

ROMANIAN ACADEMY

STOMATOLOGICAL EDUCATION JOURNAL

since 2014

2024 Volume 11 Issue 1-2

stomaeduj

A WORLD OF EDUCATIONAL RESOURCES FOR EACH PRACTICE

ROPOSTURO

ROMANIAN ASSOCIATION
OF ORAL REHABILITATION
AND POSTUROTHERAPY

FOUNDING EDITORS:
Jean-François Roulet, USA
Rolf Ewers, Austria
Marian V. Constantinescu, Romania

1-2
2024

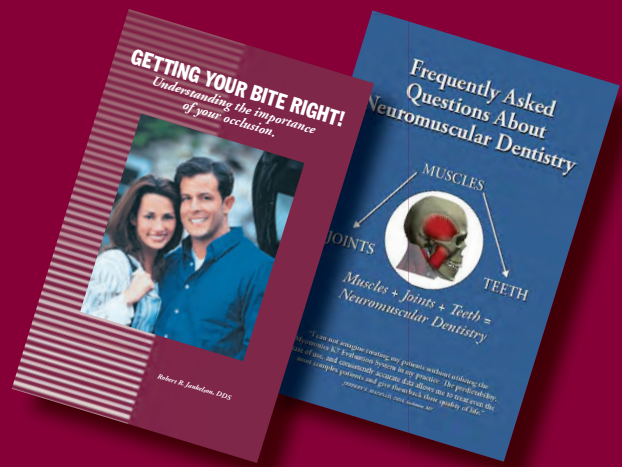
CE PROGRAM FAQs

Neuromuscular Dentistry *Powered by Myotronics*



Dentists worldwide are discovering the science and the benefits of Neuromuscular Dentistry with Myotronics technology.

Evaluate and successfully treat occlusal and restorative cases with reliable, reproducible clinical data never seen before.



Contact Myotronics to receive information on upcoming CE courses and complimentary booklets on the benefits of Neuromuscular Dentistry.
800.426.0316 or info@myotronics.com.



MYOTRONICS
Helping Build the Perfect Bite

www.myotronics.com



Patient Posture and Cervical Range of Motion recording is available exclusively on the K7x.

More and more dentists worldwide admit:

I

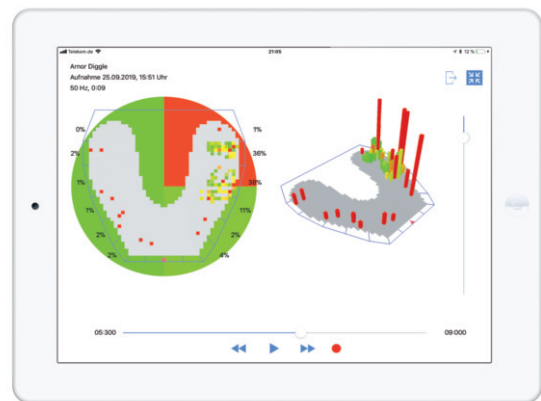


OccluSense®

Innovative device for digital occlusion control.

Take advantage of the award-winning OccluSense® system:

- 60 microns thin, flexible pressure sensors record both static and dynamic occlusion
- Data transfer to OccluSense®-iPad-App via wireless network
- Ergonomic design for intuitive handling
- Additionally, red colour coating marks the occlusal contacts on the patient's teeth



OccluSense®
by Bausch

WE MAKE OCCLUSION VISIBLE®

Dr. Jean Bausch GmbH & Co. KG | Oskar-Schindler-Str. 4 | 50769 Köln | Germany
Tel.: +49-221-709360 | Fax: +49-221-70936-66 | info@occlusense.com | www.occlusense.com
Bausch and OccluSense are trademarks of Dr. Jean Bausch GmbH & Co. KG, registered in Germany and other countries.
Apple and iPad are trademarks of Apple Inc., registered in the U.S. and other countries.

More information:
www.occlusense.com
and YouTube




Supported by:



on the basis of a decision by the German Bundestag


2024
Volume **11**
Issue **1-2**
Pages **1-94**

EDITORIAL


- 1** 10 Years of Stomatology Education Journal
Jean-François Roulet
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).edit.1](https://doi.org/10.25241/stomaedu.2024.11(1-2).edit.1)



GUEST EDITORIAL


- 3** Report from the European Regional Organization of the FDI
Simona Dianiskova
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).edit.2](https://doi.org/10.25241/stomaedu.2024.11(1-2).edit.2)



- 5** Artificial Intelligence: The New Frontier of Dentistry
Lakshman Samaranayake, Nozimjon Tuygunov
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).edit.3](https://doi.org/10.25241/stomaedu.2024.11(1-2).edit.3)




EDITORIAL

- 7** Peer Review Policy and Determined Role of Reviewers in the Editorial Process
Marian V. Constantinescu
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).edit.4](https://doi.org/10.25241/stomaedu.2024.11(1-2).edit.4)




LAUDATIO

- 11** Dr. Gregor Slavicek – Tradition or continuation of a legacy
Paula Perlea
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).letter1](https://doi.org/10.25241/stomaedu.2024.11(1-2).letter1)



NEWS

- 13** Practicing Gnathological Dentistry, 100y Anniversary of Gnathology Congress
Gregor Slavicek
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).news](https://doi.org/10.25241/stomaedu.2024.11(1-2).news)




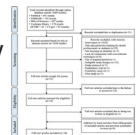
CONTINUING EDUCATION ONLINE

- 19** JADA CE Online




REVIEW ARTICLES


- 23** **DENTAL ERGONOMICS:** Evidence-based application of teledentistry: a systematic review
Tin Zar Tun, Raksanan Karawekpanyawong, Takashi Hoshino, Bandana Pathak, Hikaru Okubo,
Kaung Myat Thwin, Sachiko Takehara, Hiroshi Ogawa
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.1](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.1)




ORIGINAL ARTICLES

- 35** **DENTAL MATERIALS:** Comparative accuracy evaluation of condensing
and addition impression materials
Vlad Gabriel Vasilescu, Irini Qirici, Maria-Emilia Constantin, Marian Miculescu,
Florin-Eugen Constatinescu, Lucian Toma Ciocan
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.2](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.2)




- 42** **AESTHETIC DENTISTRY:** Evaluation of Possible Discoloration on VITA Classical Shade Tabs Used Daily Compared to New Reference Shade Tabs
 Dóra Fehér, Judit Borbély, Péter Hermann
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.3](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.3)




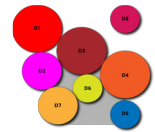
- 51** **RESTORATIVE DENTISTRY:** Study regarding the influence of various modeling agents on surface microhardness and on surface roughness of nanohybrid composite resins
 Simona Stoleriu, Gianina Iovan, Irina Nica, Galina Pancu, Andrei Georgescu, Alice Murariu, Sorin Andrian, Ionut Taraboanta
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.4](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.4)



- 58** **ORTHODONTICS AND DENTO-FACIAL ORTHOPEDICS:** Assessing Mental Foramen Position in Class I, II, and III Malocclusion by CBCT
 Abdolreza Jamilian, Ludovica Nucci, Korosh Majidi, Neda Nikkho, Rosana Farjaminejad, Vincenzo Grassia, Letizia Perillo
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.5](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.5)

Sex	Classification	Class I	Class II	Class III	Mean
Male	Upper	100%	0%	0%	100%
	Lower	100%	0%	0%	100%
	Upper	100%	0%	0%	100%
	Lower	100%	0%	0%	100%
Female	Mixed Class I/II	100%	0%	0%	100%
	Mixed Class II/III	0%	100%	0%	100%
	Mixed Class I/III	0%	0%	100%	100%
	Mixed Class II/III	0%	100%	0%	100%
Total	Mixed Class I/II	100%	0%	0%	100%
	Mixed Class II/III	0%	100%	0%	100%
	Mixed Class I/III	0%	0%	100%	100%
	Mixed Class II/III	0%	100%	0%	100%


- 65** **OCCCLUSION AND TMJ:** Systematic Approach to Oral Splints: Part 1 - Fundamental Issues
 Gregor Slavicek, Anastasia Novitskaya, Florian Slavicek
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.6](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.6)



CASE REPORT


- 73** **ORAL PATHOLOGY:** Kaposi Sarcoma disguised as pericoronitis: a deferred diagnosis due to COVID-19 pandemic
 Prashanth Konatham Haribabu, Minaal Verma, Akshay Vij, Steven R. Singer
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.7](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.7)



- 78** **ORAL SURGERY:** Large mandibular lipoma: a case report
 Mehdi Keddar, Edouard Malengrez, Cynthia Watteuw, Laurence Evrard, Firas Shall, Christophe Politis
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.8](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.8)



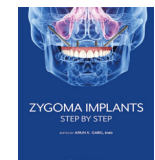
PRODUCT NEWS

- 83** Smart System to Identify Mobility in Teeth and/or Implants – InnerView LC by Perimetrics, Inc.
 Florin-Eugen Constantinescu
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).prodnews.1](https://doi.org/10.25241/stomaedu.2024.11(1-2).prodnews.1)



BOOKS REVIEW

- 85** Books review



INSTRUCTIONS FOR AUTHORS

- 92** Instructions for authors



SUBSCRIPTION

- 94** Subscription



EDITORS-IN-CHIEF



Marco Ferrari
 MD, DMD, DDS, PhD, FADM, Professor, Chairperson, Dean
 University of Siena, Siena, Italy



Constantinus Politis
 MD, DDS, MM, MHA, PhD, Full Professor and Chairperson
 University of Leuven, Leuven, Belgium



Marian-Vladimir Constantinescu
 DDS, MSc, PhD, Professor
 "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

CO-EDITORS-IN-CHIEF (AMERICAS)



James Richard Hupp
 BS, DMD, MD, JD, MBA, Professor
 Washington State University, Spokane, WA, USA



Hom-Lay Wang
 DDS, MSD, PhD, Professor
 University of Michigan, Ann Arbor, MI, USA



Mauro Marincola
 MD, DDS, Clinical Professor
 State University of Cartagena, Cartagena, Colombia



George E. Romanos
 DDS, PhD, DMD, Professor
 Stony Brook University, Stony Brook, NY, USA

CO-EDITORS-IN-CHIEF (ASIA-PACIFIC)



Lakshman Perera Samaranyake
 Hon DSc, FDSRCS (Edin), FDS RCPS (Glas), FRACDS, FRCPath (UK), BDS, DDS
 (Glas), FHKCPATH, FCDSSHK, FHKAM (Pathology), FHKAM (Dental Surgery)
 Emeritus Professor, Department of Oral Biosciences, Faculty of Dentistry
 Immediate-past Dean, University of Hong Kong, Hong Kong



Hiroshi Ogawa
 DDS, MDSc, PhD, Associate Professor
 Niigata University, Niigata, Japan



Mahesh Verma
 BDS, MDS, MBA, FAMS, FDSRCS (England), FDSRCPG (Glasgow), FDSRCS
 (Edinburgh) PhD (HC), Professor
 Maulana Azad Institute of Dental Sciences, New Delhi, India



Yongsheng Zhou
 DDS, PhD, Professor and Chair, Associate Dean
 Department of Prosthodontics, School of Stomatology (PKUSS), Peking
 University, Beijing, P.R.China

EMERITUS EDITORS-IN-CHIEF



Peter E. Dawson
 DDS, Founder Emeritus of The Dawson Academy
 Saint Petersburg, FL, USA



Adi A. Garfunkel
 DMD, PhD, Professor Emeritus
 Hadassah Hebrew University, Jerusalem, Israel



Robert Louis Ibsen
 DDS, OD, FAGD, FACD, FICD
 Founder & President DenMat Corporation, Santa Maria, CA, USA



Birte Melsen
 DDS, Dr Odont, Professor
 Aarhus University, Aarhus, Denmark



Alexandre Mersel
 DDS, PhD, Professor, Director of Studies
 Geneva Institute of Medical Dentistry (GIMD), Versoix, Switzerland

DEPUTY EDITORS-IN-CHIEF

Adrian Bejan
 Eng, PhD, J.A. Jones Distinguished Professor, Acad (AR)
 Duke University, Durham, NC, USA



Constantin Ionescu-Tărgoviste
 MD, PhD, Professor, Acad (AR)
 "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania



Gabriel Octavian Lazăr
 Phys, PhD, Professor
 "Vasile Alecsandri" University of Bacău, Bacău, România



CO-EDITORS-IN-CHIEF (EUROPE)

Simona Dianišková
 MD, MS, PhD, Associate Professor
 Orthodontic Department, Faculty of Medicine
 Slovak Medical University in Bratislava, Bratislava, Slovakia. ERO-FDI President



Mutlu Özcan
 DDS, PhD, Professor, Head Division of Dental Biomaterials
 Clinic of Reconstructive Dentistry, Center of Dental Medicine (ZZM)
 University of Zürich, Zürich, Switzerland



Letizia Perillo
 MD, MS, PhD, Professor
 Head, Dean, University of Campania Luigi Vanvitelli, Naples, Italy



Hande Şar Sancaklı
 DDS, PhD, Associate Professor
 FDI Regional CE Director Europe, Geneva-Cointrin, Switzerland



SENIOR EDITORS

Bruce Robert Donoff
 DMD, MD, Professor, Dean
 Medicine Harvard University, Boston, MA, USA



Rolf Ewers
 MD, DMD, PhD Professor and Chairman em.
 Medical University of Vienna, Vienna, Austria



Adrian Podoleanu
 Eng, PhD, Professor, FlinstP, FOSA, FSPiE, Professor
 University of Kent, Canterbury, Kent, UK



Saman Warnakulasuriya
 BDS, FDSRCS (Eng), FDSRCS (Edin), FDSRCPG (Glasg), PhD(Glasg)
 DSc, FKC, Professor
 King's College London, London, UK



EMERITUS EDITORS-IN-CHIEF

Prathip Phantumvanit
 DDS, MS, FRCDT, Professor
 Thammasat University, Bangkok, Thailand



Jacques Vanobbergen
 DDS, PhD, Professor Emeritus
 Gent University, Gent, Belgium



Rudolf Slavicek
 MD, DMD, Professor
 Medical University of Vienna, Vienna, Austria



Julian B. Woelfel
 DDS, FACD, FICD, Professor Emeritus
 College of Dentistry, The Ohio State University, Columbus, Ohio, U.S.A



David Wray
 MD (Honours), BDS, MB ChB, FDS, RCPS (Glasgow), FDS RCS (Edinburgh) F Med
 Sci Professor Emeritus, Professor, University of Glasgow, Glasgow, UK



SECTIONS EDITORS

Anmol S. Kalha, BSc, BDS, MDS, OSRE, **Editor-in-Chief**
Paula Perlea, DDS, PhD, **Co-Editor-in-Chief**

Basic Research / Dental Materials / Dental Technology
Gottfried Schmalz, DDS, PhD, Dr hc, Acad (Leopoldina),
 University of Regensburg, Regensburg, Germany -
 Editor-in-Chief

Vasile Iulian Antoniac, Eng, PhD, Habil, Vice Dean,
 University "Politehnica" of Bucharest, Bucharest, Romania
Bogdan Calenic, DDS, PhD, "Carol Davila" University of
 Medicine and Pharmacy Bucharest, Bucharest, Romania
Horia Octavian Manolea, DMD, PhD, Head, University
 of Medicine and Pharmacy of Craiova, Dolj, Romania
Annalisa Monaco, DDS, MSc, PhD, University of L'Aquila,
 L'Aquila, Italy

**Clinical Research / Oral and Dental Diagnosis / Dental
 Radiology / Evidence-Based Dentistry**
Sorin Uram-Țuculescu, DDS, PhD, Virginia Commonwealth
 University, Richmond, VA, USA - Editor-in-Chief

Amid I. Ismail, BDS, MPH, MBA, Dr PH, Dean, Temple
 University, Philadelphia, PA, USA
Fawad Javed, BDS, PhD, University of Rochester, NY, USA
Dalia Kaisarly, BDS, MDS, PhD, University of Munich,
 Munich, Germany
Chiarella Sforza, MD, PhD, University of Milan, Milan, Italy

**Community Dentistry / Oral Epidemiology / Oral Health /
 Dental Public Health / Health Promotion**
Poul Erik Petersen, DDS, Dr Odont, BA, MSc,
 WHO Senior Consultant, University of Copenhagen,
 Copenhagen, Denmark - Editor-in-Chief
Noemi Bordoni, DDS, PhD, Director, Public Health
 Research Institute, Buenos Aires, Argentina
Simona Stoleriu, DMD, PhD, "Gr. T. Popa" University of
 Medicine and Pharmacy Iași, Iași, Romania

Mihnea Ioan Nicolescu, DMD, MD, PhD, "Carol Davila"
 University of Medicine and Pharmacy Bucharest,
 Bucharest, Romania
Mihaela Răescu, DDS, PhD, "Titu Maiorescu" University,
 Bucharest, Romania

Cariology / Pedodontics / Oro-Dental Prevention
Luca Levrini, DDS, PhD, University of Insubria, Varese,
 Italy - Editor-in-Chief
Sorin Andrian, DDS, PhD, "Gr. T. Popa" University of
 Medicine and Pharmacy Iași, Iași, Romania
Dana Cristina Bodnar, DDS, PhD, "Carol Davila"
 University of Medicine and Pharmacy Bucharest,
 Bucharest, Romania
Iulia Georgievna Romanova, DMS, PhD, Odessa
 National Medical University, Odessa, Ukraine
Tamara Tserakhava, DDS, PhD, Belarusian State
 Medical University, Minsk, Belarus

Minimally Invasive Dentistry / Dental Laser

Akira Aoki, DDS, PhD, Tokyo Medical and Dental University (TMDU), Tokyo, Japan - Editor-in-Chief
Claudia C. Cotca, DDS, MPH, Washington Institute for Dentistry & Laser Surgery, Chevy Chase, MD, USA
Peter Hermann, DMD, MSc, PhD, Head, Vice-Rector, Semmelweis University Budapest, Budapest, Hungary
Sanda-Mihaela Popescu, DDS, MSc, PhD, University of Medicine and Pharmacy of Craiova, Dolj, Romania
Roman Smuder, MD, PhD, Charles University Prague, Prague, Czech Republic

Aesthetic Dentistry / Dental Photography

Douglas A. Terry, DDS, PhD, University of Texas, Houston, TX, USA - Editor-in-Chief
Lucian Toma Ciocan, DMD, PhD, Head, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Daniele Maria Gibelli, MD, PhD, University of Milan, Milan, Italy
Galip Gürel, DDS, MSc, Dentis Dental Clinic, Istanbul, Turkey
Henriette Lerner, DMD, PhD, HL Dentclinic & Academy, Baden-Baden, Germany

Endodontics and Traumatology / Dental Microscopy

Niraj Kinariwala, BDS, MDS, PhD, Karnavati University, Gandhinagar, India - Editor-in-Chief
Arnaldo Castellucci, DDS, PhD, Florence, Italy
Enrico Manca, DDS, PhD, Dental Clinic Dr. Enrico Manca, Cagliari, Italy
Paula Perlea, DDS, PhD, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Zrinka Tarle, DMD, PhD, Dean, University of Zagreb, Zagreb, Croatia

Periodontology / Oral Microbiology / Dental Hygiene

Mariano Alonso Sanz, DDS, MSD, PhD, Complutense University of Madrid, Madrid, Spain - Editor-in-Chief
Gabriela Băncescu, MD, MSc, PhD, "Carol Davila", University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Radmila R. Obradović, DDS, PhD, University of Niš, Niš, Serbia
Alina Pūrienė, BS, PhD, Dr habil, Vilnius University, Vilnius, Lithuania
Jon Byron Suzuki, DDS, PhD, MBA, Associate Dean, Temple University, Philadelphia, PA, USA

Oral Medicine / Oral Pathology

Mare Saag, DDS, PhD, University of Tartu, Tartu, Estonia - Editor-in-Chief
Asja Celebić, DDS, MSc, PhD, University of Zagreb, Zagreb, Croatia
Valeriu Fala, DM, PhD, MSc, "Nicolae Testemițanu" State University of Medicine and Pharmacy, Chișinău, Republic of Moldova
Maria Greabu, Chem, PhD, Head, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Mei-Qing Wang, DDS, PhD, Air Force Medical University (AFMU), Xi'an, Shaanxi, P.R.China

Occlusion and TMJ / Orofacial Pain / Dental Occlusion and Posture

Noshir R. Mehta, DMD, MDS, MS, Associate Dean, Tufts University, Boston, MA, USA - Editor-in-Chief
Nader Farhan Abdulhameed, BDS, MS, MSc, PhD, LECOM School of Dental Medicine, FL, USA
Rafael Benoliel, DDS, PhD, BDS, Associate Dean, The State University of New Jersey, Newark, NJ, USA
Jean-Daniel Orthlieb, DDS, PhD, Vice-Dean, Aix Marseille University, Marseille, France
Sven Erik Widmalm, DDS, Dr Odont, University of Michigan, Ann Arbor, MI, USA

Orthodontics and Dento-Facial Orthopedics

Moschos A. Papadopoulos, DDS, DMD, Chairman, Aristotle University of Thessaloniki, Thessaloniki, Greece - Editor-in-Chief
Fabrizia d'Apuzzo, DDS, MSc PhD, Research Fellow, University of Campania "Luigi Vanvitelli", Naples, Italy
Stella Chaushu, DMD, PhD, Chair, Hebrew University Hadassah Jerusalem, Jerusalem, Israel
Ecaterina Ionescu, DDS, PhD, Vice-Rector, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Abdolreza Jamilian, DDS, PhD, Tehran University of Medical Sciences, Tehran, Iran

Anesthesiology / Dentoalveolar Surgery / Maxillofacial Surgery / Oral Implantology / Emergencies at the Dentist's

Michael Frank, DDS, PhD, ERO President, German Dental Chamber, Frankfurt am Main, Germany - Editor-in-Chief
Jaafar Abduo, BDS, DclinDent, MRACDS, PhD The University of Melbourne, Victoria, Australia
Cristian Niky Cumpătă, DMD, MD, MSc, PhD, "Titu Maiorescu" University Bucharest, Bucharest, Romania
Joel Motta Junior, DMD, PhD, State University of Londrina, Londrina, Brazil
Giorgio Lombardo, MD, DDS, University of Verona, Verona, Italy

Prosthetic Dentistry / Oral Rehabilitation / Gerodontology

Veronica Mercuț, DMD, PhD, Vice-Rector, University of Medicine and Pharmacy Craiova, Dolj, Romania - Editor-in-Chief
Emilian Hutu, DDS, PhD, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Marina Meleşcanu-Imre, DDS, PhD, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Vjekoslav Jerolimov, DDS, PhD, Acad (CASA), University of Zagreb, Zagreb, Croatia
Anastassia E. Kossioni, DDS, PhD, University of Athens, Athens, Greece

Restorative Dentistry / Computerized Dental Prosthetics

François Duret, DDS, DSO, PhD, MS, MD, PhD, Acad (ANCD), University of Montpellier, Montpellier, France - Editor-in-Chief
Joannis Katsoulis, DMD, PhD, University of Bern, Bern, Switzerland
Georg B. Meyer, DMD, PhD, Dr hc, Chairman, Ernst-Moritz-Arndt University, Greifswald, Germany
Dana Ospanova, DDS, PhD, Astana Medical University, Nur-Sultan, Kazakhstan
Roberto Carlo Spreafico, MD, DMD, Busto-Arsizio, Milan, Italy

EDITORIAL ADVISORY BOARD SECTIONS

Stephen F. Rosenstiel, BDS, MSD, Prof. Em., Editor-in-Chief
Andrei Cristian Ionescu, DDS, PhD, Co-Editor-in-Chief

Basic Research / Dental Materials / Dental Technology

Ralf Janda, Chem, Dr rer nat, Habil, Heinrich-Heine-University Düsseldorf, Düsseldorf, Germany - Editor-in-Chief
Andrei Cristian Ionescu, DDS, PhD, University of Milan, Milan, Italy
Nikolay Ishkitiev, DMD, PhD, Medical University of Sofia, Sofia, Bulgaria

Clinical Research / Oral and Dental Diagnosis / Dental Radiology / Evidence-Based Dentistry

Rodolfo Isaac Miralles Lozano, MD, PhD, University of Chile, Santiago, Chile - Editor-in-Chief
Cristina Teodora Preoteasa, DMD, PhD, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Robert Sabinu Șerban, Eng, PhD, MSc, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania

Community Dentistry / Oral Epidemiology / Oral Health / Dental Public Health / Health Promotion

Amar Hassan Khamis Mohamed Omer, PhD, DEA, MSc, BSc, Mohammed Bin Rashid University of Medicine and Health Sciences, Dubai, UAE - Editor-in-Chief
Nina Mussurlieva, DDS, PhD, Medical University of Plovdiv, Plovdiv, Bulgaria
Aldo Fabián Squassi, DDS, PhD, Chair, University of Buenos Aires, Buenos Aires, Argentina

Cariology / Pedodontics / Oro-Dental Prevention

Vladimir Margvelashvili, MD, PhD, DMScI, Tbilisi State University, Tbilisi, Georgia - Editor-in-Chief
Dorjan Hysi, DDS, PhD, University of Medicine of Tirana, Tirana, Albania
Rodica Luca, DDS, PhD, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania

Minimally Invasive Dentistry / Dental Laser

Domenico Massironi, DDS, MEG – Master Educational Group, Melegnano (MI), Italy - Editor-in-Chief
Joanna Kempler, DDS, PhD, University of Maryland, Baltimore, MD, USA
Vygandas Rutkūnas, DDS, PhD, Vilnius University, Vilnius, Lithuania

Aesthetic Dentistry / Dental Photography

Bernard Touati, DDS, PhD, Paris V University, Paris, France - Editor-in-Chief
John C. Kois, DMD, MSD, Kois Center, LLC, Seattle, WA, USA
Joseph Nissan, DMD, Tel Aviv University, Tel Aviv, Israel

Periodontology / Oral Microbiology / Dental Hygiene

Anton Sculean, DMD, MS, Dr hc, University of Bern, Bern, Switzerland - Editor-in-Chief
Mario R. Cappellin, DDS, MBE, Clinica dentale Cappellin srl, Pinerolo (TO), Italy
Marian Neaguț, MD, PhD, Acad (ASM), "Carol Davila", University of Medicine and Pharmacy Bucharest, Bucharest, Romania

Oral Medicine / Oral Pathology

Ingrida Ēma, DDS, PhD, Riga Stradins University, Riga, Latvia - Editor-in-Chief
Romeo Călărășu, MD, PhD, Acad (ASM), "Carol Davila", University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Rashmi GS Phulari, BDS, MDS, Bhavnagar University, Vadodara, India

Occlusion and TMJ / Orofacial Pain / Dental Occlusion and Posture

Gregor Slavicek, DDS, PhD, Steinbeis University Berlin, Berlin, Germany - Editor-in-Chief
Luigi Maria Gallo, PhD, Dr. Ing., MEng, University of Zürich, Zürich, Switzerland
Minh Son Nguyen, DDS, PhD, Head, Danang University of Medical Technology and Pharmacy, Danang, Vietnam

Orthodontics and Dento-Facial Orthopedics

Fabio Savastano, MD, MOrth, Jaume I University, Castellón de la Plana, Castellón, Spain - Editor-in-Chief
Andreu Puigdollers-Pérez, DDS, PhD, International University of Catalunya (UIC), Barcelona, Spain
Irina Nicoleta Zetu, DDS, PhD, "Gr. T. Popa" University of Medicine and Pharmacy Iași, Iași, Romania

Anesthesiology / Dentoalveolar Surgery / Maxillofacial Surgery / Oral Implantology / Emergencies at the Dentist's

Nardi Casap-Caspi, DMD, MD, Hebrew University Hadassah Jerusalem, Jerusalem, Israel - Editor-in-Chief
Andreza Lauria de Moura, DMD, PhD, Federal University of Amazonas (FAO-UFAM), Manaus – AM, Brazil
Gianluca Martino Tartaglia, DDS, PhD, University of Milan, Milan, Italy

Prosthetic Dentistry / Oral Rehabilitation / Gerodontology

Grigorios Polyzois, DDS, Dr. Dent, MScD, National and Kapodistrian University of Athens, Athens, Greece - Editor-in-Chief
Elena Preoteasa, DDS, PhD, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania
Martina Schmid-Schwab, DDS, PhD, Medical University of Vienna, Vienna, Austria

Restorative Dentistry / Computerized Dental Prosthetics

Stephen F. Rosenstiel, BDS, MSD, Prof. Em., The Ohio State University, Columbus, USA - Editor-in-Chief
Mariam Margvelashvili-Malament, DDS, MSc, PhD, Tufts University, Boston, MA, USA
Alexandru Eugen Petre, DDS, PhD, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania

ENGLISH LANGUAGE EDITOR-IN-CHIEF

Roxana-Cristina Petcu, Faculty of Foreign Languages, University of Bucharest, Bucharest, Romania

ENGLISH LANGUAGE EDITORS

Valeria Clucerescu, Biol., Bucharest, Romania
Diana Florea, Phil, PhD, Sibiu, Romania

HONORARY STATISTICAL ADVISERS

Radu Burlacu, PhD, Bucharest, Romania
Amar Hassan Khamis Mohamed Omer, PhD, DEA

BOOKS REVIEWERS

Iulia Ciolachi, DMD, Bucharest, Romania
Florin-Eugen Constantinescu, DMD, PhD Student, Bucharest, Romania

JOURNAL MANAGER

Ioana Bălan, Maths, MSc, Bucharest, Romania
Florin-Eugen Constantinescu, DMD, PhD Student, Bucharest, Romania

PROJECT EDITOR

Irina-Adriana Beuran, DMD, PhD, Bucharest, Romania
Maria Emilia Constantin, Bucharest, Romania
Carmen Liliana Defta, Biol, PhD, Bucharest, Romania

TECHNICAL EDITORS

Gabriel Octavian Lazăr, Bucharest, Romania
Edgar Moraru, Bucharest, Romania
Johannes Friedrich Carl Rohr, Riga, Latvia

DTP / GRAPHIC & WEB DESIGNER

Mirel Toma, Bucharest, Romania



The *Stomatology Education Journal* (Stoma Edu J) is a scientific magazine of the Romanian Association of Oral Rehabilitation and Posturotherapy – ROPOSTURO, a partner of the FDI regular member, the Romanian Society of Stomatology – RSS (founded in 1923) under the aegis of The Romanian Academy.

Editor Office

Stomatology Edu Journal, 102-104 Mihai Eminescu st.
2nd District, RO-020082 Bucharest, ROMANIA
Tel/Fax: +40314327930,
e-mail: stomatology.edu@gmail.com
www.stomaeduj.com

Editors-in-Chief

Marco Ferrari, Constantinus Politis
Marian-Vladimir Constantinescu

Managing Editor

Florin-Eugen Constantinescu

ROPOSTURO

Romanian Association of Oral Rehabilitation and Posturotherapy
10, Ionel Perlea St., 1st District
RO-010209 Bucharest, Romania
Tel: +4021 314 1062; Fax: +4021 312 1357
e-mail: roposturo@gmail.com
www.roposturo.ro

Technical Editors

Gabriel Octavian Lăzar
Edgar Moraru

Project Editor

Irina-Adriana Beuran

Design Editor

Mirel Toma

Cover by

Arch. Florin Adamescu

Publisher Office

Romanian Academy Publishing House
Calea 13 Septembrie, 5th District
RO-050711 Bucharest, Romania
Tel: +40213188146
Fax: +40213182444
e-mail: edacad@ear.ro
www.ear.ro

Technical Editor

Doina Argeşanu

Editorial Assistant

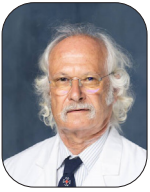
Monica Stanciu

Computer Editing

Iolanda Povară

All the original content published is the sole responsibility of the authors. All the interviewed persons are responsible for their declaration and the advertisers are responsible for the information included in their commercials.

10 Years of Stomatology Edu Journal



Jean-François ROULET
Dr. med. dent., Habil, Prof hc, Dr hc, Professor
University of Florida, Gainesville, FL, USA
Founding Editor-in-Chief
Stomatology Edu Journal

Dear Readers,

When I was asked to help to set up a new Journal with the idea to give Romanian Dentists an international platform to publish in English and allow them easy access to publications of by international researchers, I spontaneously said spontaneously "YES", because this sounded like my mentor, Hans-Rudolf Mühlemann, who did the same many years ago with *Helvetica Acta Odontologica* and some years later with *Swissdent*. However, the times had changed with worldwide accessibility to information through the internet. Furthermore, the publishing world has dramatically changed in the last 20 years. Once upon a time, respected scientific journals were strictly peer reviewed. The idea behind this is to publish solid research data. Andreas Lindhe once said: "Nothing is scientifically "shown" or "proven" before it has been published in a scientific journal with a peer review system". The result of this approach is that one can critically judge what was done, how it was done and evaluate how solid it is. This gives the reader confidence that publishing authors would disseminate their knowledge to the benefit of their readers. In this world the consumer of information (the reader, or the university) must pay for it via subscriptions in order to finance publishers for the process of publishing.

Over the years different shifts have happened: the impact factor (IF) has been created with the idea of having a quality measure of journals using the number of citations as a parameter. Later this had been used as well to measure the authors' productivity of authors, "counting" only papers published in IF-journals, for promotion or with job applications; the next step was, that IF was used for allocating research money to departments, with the result that almost all researchers wanted to publish in IF journals exclusively. When we started the *Journal of Adhesive Dentistry* in 1999, we could painfully feel this trend painfully. It was very difficult to find authors willing to contribute to a new journal without IF.

But since then, more things have happened that dramatically changed the publishing world. The view that knowledge is a common good and should be accessible to everybody got strong and stronger and is reflected in the Budapest Open Access (OA) Initiative by the Open Society Institute 2002 (www.budapestopeninitiative.org) and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities. Max Planck Society Berlin 2003 (www.openaccess.mpg.de). This has created a reversal in the business structure in the publication world. Since in this world nothing is for free, someone had to pay for the publication costs. So now it was the authors rather than the readers that had to pay for the publishing expenses. Parallel to this the requirements for promotion and qualifying for top positions, such as Department Chairs had increased, "publish or perish" became even more dominant as than in the past. When publishers saw this as a great opportunity for making money, the system got perverted. A plethora of open access journal emerged, with some excellent journals, but the majority of them did not have high quality publications in mind; high quantity submissions and thus high volume of money would better characterize this trend. better. They targeted the academic world with the promise of peer reviewed very fast publication by reducing the "review" process to extremely short periods and were not shy of any thinkable thinking able sins of the publishing process. Jeffrey Beall, a librarian at the University of Colorado was the first to note that the quality of articles published in many OA journals is low, that peer review in many OA journals is negligible or non-existent, that public access to poor-quality articles harms the public, and that the careers of young scholars who publish in poor-quality OA journals are harmed. Based on his findings the term predatory journals and a Bealls list (www.beallslist.net) were created.

Then the world was confronted with the Bohannon experiment (Bohannon J. Who's afraid of peer review? *www.Sciencemag.org*. Science 4 October 2013 Vol. 342 no. 6154 pp. 60-65. DOI: 10.1126/science.342.6154.60) Bohannon, a Harvard cancer researcher, had created 304 fake papers "The Paper took this form: Molecule X from lichen species Y inhibits the growth of cancer cell Z. To substitute those variables, I created a database of molecules, lichens, and cancer cell lines and wrote a computer program to generate hundreds of unique papers. Other than those differences, the scientific content of each paper is identical". All of them contained such grave errors that a competent peer reviewer should easily identify it as flawed and unpublishable. He created fictitious authors and institutions. Furthermore, to camouflage his good English, he had Google translate it into French and then back into English, based on a recommendation of some Harvard molecular biologists colleagues which who had mock- reviewed the paper.

John Bohannon then submitted the papers 10/week and waited for what was going to happen. I quote here Bohannon's original Science article: "By the time Science went to press, 157 of the journals had accepted the paper and 98 had rejected it. Of the remaining 49 journals, 29 seem to be derelict: websites abandoned by their creators. Editors from the other 20 had e-mailed the fictitious corresponding authors stating that the paper was still under review; those, too, are excluded from this analysis. Acceptance took 40 days on average, compared to 24 days to elicit a rejection. Of the 255 papers that underwent the entire editing process to acceptance or rejection, about 60% of the final decisions occurred with no sign of peer review. For rejections, that's good news: It means that the journal's quality control was high enough that the editor examined the paper and declined it rather than send it out for review. But for acceptances, it likely means that the paper was rubber-stamped without being read by anyone. Of the 106 journals that discernibly performed any review, 70% ultimately accepted the paper. Most reviews focused exclusively on the paper's layout, formatting, and language. This sting did not waste the time of many legitimate peer reviewers. Only 36 of the 304 submissions generated review comments recognizing any of the paper's scientific problems. And 16 of those papers were accepted by the editors despite the damning into reviews"

In 2018 there was another "Fake Science" scandal. An international group of journalists analyzed 175,000 scientific papers published by 5 of the most pseudoscientific platforms. They had successfully published nonscientific papers in the most pseudoscientific platforms and even had successfully published computer generated (SCIGN = a computer program that randomly generates academic computer science papers using context-free grammar) papers.

As an interesting side effect, they found that employees of pharma companies were using pseudoscientific platforms to publish data. (www.dw.com/en/germany-sees-sharp-rise-in-fake-science-journal-publication-report/a-44742014)

Summing up these developments in the publishing world, it is a catastrophe for science. A comment from The Guardian sums it up perfectly: "You simply don't know if the studies which are published with open access journals are good, worthless, or bad, because you cannot be sure if and what kind of editorial process or peer review process takes place there. That is the problem with the predatory journals in the end: eroding the trust in science. A slowly creeping poison. Something may look like a study but may not be worth the paper it is written on". (www.theguardian.com/technology/2018/aug/10/predatory-publishers-the-journals-who-churn-out-fake-science)

Dear Readers, in the above mentioned world Stomatology Edu Journal survived for 10 years and is still alive! Congratulations! This was possible, because the management team decided to stick to rigorous peer review, which was well structured and made transparent by using the Manuscript Manager program (andy@manuscriptmanager.com). Stomatology Edu Journal's listing with the Romanian Academy of Science necessitated a print edition. This requirement, combined with the journal's open-access policy without publication fees, introduced new financial considerations. As the journal evolved, my role transitioned from Editor to that of a supportive colleague.

I am wishing to the team that currently runs the Stomatology Edu Journal all the best for the future and I am looking forward to writing the next anniversary editorial in 10 years.

Sincerely yours,

J-F ROULET 

Founding Editor-in-Chief
Stomatology Edu Journal

Report from the European Regional Organization of the FDI



Simona DIANIŠKOVÁ
MD, MS, PhD, Associate Professor
Slovak Medical University
Bratislava, Slovakia
ERO-FDI President

Dear Ladies and Gentlemen,

I would like to report about the ERO Plenary Session and the highlights of the latest FDI Parliament and World Dental Congress in Sydney, which took place in September 2023.


The World Dental Parliament meets for a full week. Other important events are also the plenary sessions of the regional organizations of the FDI. During the European - ERO - Plenary session we adopted the following statement: "Recommendation on AI (artificial intelligence)": Corporate Dentistry has been identified as the main topic in most countries. This issue will be dealt with in detail by the Working Group on Liberal Dental Practice. A new working group on "Oral Health and General Health" will study common risk factors of oral and general diseases. We have established a new Committee on Ethics. The WG Relations between dental practitioners and universities is preparing two professional articles for publication. ERO has entered social media - please do not hesitate to submit information about your activities, to gain visibility and create more contacts.

A new ERO website is being prepared, where the e-book "Daily oral hygiene in the elderly" will be available for free download. It is mainly intended to serve nurses and other medical personnel in hospitals, hospices, and senior homes. Congratulations to Croatia, which won first place in the FDI dental practice sustainability competition!

Later in the week, The International Dental Journal was introduced by its editor Prof. Lakshaman P. Samaranayake. During his tenure, IF increased to 3.3, a 20 percent year-on-year increase. Prof. Greg Chadwick from the USA assumed the post of FDI President after outgoing Prof. Ihsane Ben Yahya. The presidential election was won by Prof. Nikolai Sharkov from Bulgaria, and he became the new President Elect of FDI.

Prof. Nikolai Sharkov will take over the post of FDI President in autumn 2025. Prof. Young Gok Park from Korea was elected as FDI Treasurer. Prof. Hiroshi Ogawa of Japan was elected to the vacant position of FDI Council member for the Asia-Pacific region. At the World Congress of Dentists in Sydney, 8600 dentists from all over the world were registered. The International Convention Center is spread over 5 floors, with many separate lecture rooms. It is connected to the multi-storey Exhibition Hall, which has makeshift lecture boxes for commercial presentations of products and devices. At least 4 sections of lectures took place in parallel.

We are looking forward to meeting many colleagues and friends at the next FDI World Dental Parliament which will be held in Istanbul, Turkey in September 2024. Before that, exciting news and reports are being expected at the ERO Plenary session in Limassol, Cyprus. Please be sure you meet us there in late April!

Simona DIANIŠKOVÁ 
ERO-FDI President

 [https://doi.org/10.25241/stomaeduj.2024.11\(1-2\).edit.2](https://doi.org/10.25241/stomaeduj.2024.11(1-2).edit.2)

DS PRIMETAPER™ EVERY DETAIL BALANCED FOR BEAUTY

With our new DS PrimeTaper implants and our intuitive digital workflows, you can take your practice to the next level. Contact your Dentsply Sirona Representative today and learn more.



Dentsply Sirona CEE Central
Office & Showroom
Str. Vulturilor 98A, 030857, București
Tel : 0774 074 094
office.romania@dentsplysirona.com
www.dentsplysirona.ro
<http://facebook.com/dentsplysirona.romania>



Artificial Intelligence: The New Frontier of Dentistry



Lakshman SAMARANAYAKE
BDS, DDS, FRCPath
FHKCPath, FCDSHK, MIBiol
Faculty of Dentistry
University of Hong Kong



Nozimjon TUYGUNOV
BSc, MDSc
Faculty of Dentistry
University of Hong Kong

Artificial intelligence (AI) holds immense promise in revolutionizing dentistry, offering a wide range of applications in educational tools, diagnostics, and treatment planning. This is a brand new frontier with exciting challenges! In this editorial we will outline the role of AI in dentistry, its potential applications, the challenges it faces, and strategies to overcome them [1].

A major nexus where AI-driven technologies can make a significant impact is dental education [2]. AI can provide personalized learning experiences and simulation-based training, enhancing the educational processes for aspiring dentists as well as for those in dental practice, to hone their skills. By leveraging AI, dental students can receive tailored instruction and practice in a virtual environment, improving their skills and knowledge. Both the theory and practice of dental pedagogy is now at a cusp of this AI revolution.

In clinical practice, AI can assist in a myriad ways. For instance, the early detection of bone loss through advanced image analysis techniques. By analysing radiographic images, AI algorithms can identify subtle changes in bone density, not decipherable by naked eye examination, enabling timely intervention and improved patient outcomes [3]. This capability is particularly valuable in the field of periodontology, where early detection of bone loss is crucial for successful therapy.

AI also shows promise in oral cancer diagnosis. By analysing digital images and histological data [4], AI algorithms can aid in the detection and classification of oral lesions. This technology can assist dentists in identifying potentially malignant or cancerous growths, leading to earlier interventions and improved prognosis for patients.

In restorative dentistry, AI can enhance diagnostic accuracy and treatment planning. AI algorithms can detect conditions such as vertical root fractures and dental caries by analysing dental images and patient data [2]. Furthermore, AI-driven approaches in prosthodontics enable the customization of dental crowns and restoration designs [5]. By leveraging AI, dentists can create highly personalized dental prosthetics that fit patients' unique anatomical features and functional requirements. This optimization of dental restorations enhances patient care and treatment outcomes.

Despite the potential of AI integration in dentistry, several challenges need to be addressed. Data availability is a significant concern, as AI algorithms require large and diverse datasets to achieve optimal performance [6]. Dentistry needs standardized and comprehensive datasets to train AI models effectively. However, in the fullness of time, with increasing data inputs, and the consequent expansion of the databases, the specificity and the sensitivity of AI diagnostics will continue to improve.

There is a slang aphorism known as "garbage in leads to garbage out", and this aphorism perfectly applies to AI technology. There are several common examples of "garbage input" that can result in poor AI performance, as follows:

I. Insufficient or biased training data: If the dataset used to train an AI model is incomplete, unrepresentative, or biased, it can lead to inaccurate or unfair results. For example, if a facial recognition system is trained primarily on data from a specific demographic, it may struggle to accurately identify individuals from underrepresented groups.

II. Noisy or corrupted data: When the input data contain errors, inconsistencies, or irrelevant information, they can adversely affect AI performance. Noisy data can confuse the model and lead to incorrect predictions or outputs.

III. Lack of diversity in training data: AI models benefit from diverse training data that encompass various demographics, backgrounds, and perspectives. Lack of diversity can limit the model's ability to generalize and perform well in real-world scenarios that involve different populations.

IV. Inadequate data preprocessing: Preprocessing is an essential step in preparing data for AI models. If data preprocessing techniques like cleaning, normalization, or feature extraction are not applied properly, they can introduce errors or distortions that impact the model's performance negatively.

V. Overfitting or underfitting: Overfitting occurs when an AI model becomes too specialized in the training data, leading to poor generalization to new, unseen data. Underfitting, on the other hand, happens when the model fails to capture the underlying patterns in the training data, resulting in suboptimal performance.

VI. Lack of context or relevant features: AI models rely on contextual information and relevant features to make accurate predictions. If important contextual cues or relevant features are missing from the input data, the model may struggle to understand the problem or produce meaningful outputs.

Addressing these issues and ensuring the quality, diversity, and representativeness of the input data is crucial for obtaining reliable and high-performing AI systems [7].

Privacy concerns also arise when implementing AI in dentistry, as patient data must be handled securely and in compliance with relevant local and regional regulations [8]. Strict data protection measures should be in place to safeguard patient confidentiality and privacy.

To overcome these challenges, several strategies can be implemented. First, fostering new perceptions of AI within the dental community is essential. Education and awareness programs can help dental professionals understand the benefits and limitations of AI, encouraging its adoption [8]. Next, setting clear objectives for AI integration and aligning them with the needs of dental practice is crucial. Identifying specific areas where AI can have the most significant impact and defining measurable goals will help guide the implementation process. Finally, cultivating a supportive work culture that encourages AI technology is also important. Dental professionals should embrace AI as a tool that enhances their practice rather than a threat for their practice and expertise. Training programs can help develop the necessary skills to utilize AI effectively.

Though investments are required to implement AI in dentistry, they should be thoughtful and targeted. Collaboration between academia, industry, and dental institutions can facilitate the development of AI technologies and their integration into dental practice. Regulatory frameworks need to be established to ensure the ethical and responsible use of AI in dentistry. Guidelines should be developed to address issues such as data privacy, algorithmic transparency, and accountability [9].

Above all, advancing AI literacy among dental professionals is crucial. Continued education and training programs should be provided to enhance the understanding of AI concepts and applications, enabling dentists to make informed decisions regarding the use of AI technologies [7].

By addressing these challenges and implementing the proposed strategies, AI has the potential to revolutionize dental care. It can improve patient outcomes, drive innovation, and transform the clinical practice of dentistry into a more efficient and effective healthcare discipline. The time to embrace this challenge is now!

REFERENCES

1. Russell SJ, Norvig P. Artificial intelligence: a modern approach. London: UK, Pearson Education; 2016. ISBN:9781292153971
[Google Scholar](#)
2. Schwendicke F, Samek W, Krois J. Artificial intelligence in dentistry: chances and challenges. *J Dent Res*. 2020;99(7):769-774. doi: 10.1177/0022034520915714.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
3. Amisha, Malik P, Pathania M, Rathaur VK. Overview of artificial intelligence in medicine. *J Family Med Prim Care*. 2019;8(7):2328-2331. doi: 10.4103/jfmpc.jfmpc_440_19.
[Full text links](#) [PubMed](#) [Google Scholar](#) [WoS](#)
4. Tobias MAS, Nogueira BP, Santana MCS, et al. Artificial intelligence for oral cancer diagnosis: What are the possibilities? *Oral Oncol*. 2022;134:106117. doi: 10.1016/j.oraloncology.2022.106117.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
5. Revilla-León M, Gómez-Polo M, Vyas S, et al. Artificial intelligence models for tooth-supported fixed and removable prosthodontics: a systematic review. *J Prosthet Dent*. 2023;129(2):276-292. doi: 10.1016/j.prosdent.2021.06.001.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
6. Khan B, Fatima H, Qureshi A, et al. Drawbacks of artificial intelligence and their potential solutions in the healthcare sector. *Biomed Mater Devices*. 2023;8:1-8. doi: 10.1007/s44174-023-00063-2
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)
7. Aldoseri A, Al-Khalifa KN, Hamouda AM. Re-thinking data strategy and integration for artificial intelligence: concepts, opportunities, and challenges. *Applied Sciences*. 2023;13(12):7082.
[CrossRef](#) [Google Scholar](#) [WoS](#)
8. Huang YK, Hsu LP, Chang YC. Artificial intelligence in clinical dentistry: the potentially negative impacts and future actions. *J Dent Sci*. 2022;17(4):1817-1818. doi: 10.1016/j.jds.2022.07.013.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
9. Rokhshad R, Ducret M, Chaurasia A, et al. Ethical considerations on artificial intelligence in dentistry: a framework and checklist. *J Dent*. 2023;135:104593. doi: 10.1016/j.jdent.2023.104593.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)

Peer Review Policy and Determined Role of Reviewers in the Editorial Process



Marian V. CONSTANTINESCU
 DDS, MSc, PhD, Professor
 Stomatology Edu Journal
 Editor-in-Chief

Dear Colleagues and Readers,

The Stomatology Education Journal (Stoma Edu J) is an Open Access (OA) journal in the field of dental medicine. It publishes established authors and is equally committed to encouraging early-career researchers and professionals to publish their works, through a rigorous double-blind peer review process. Open Access (OA) means that, as long as the original source is acknowledged and cited, readers are allowed to redistribute, reuse, and adapt the content in new works (in accordance with the selected Creative Commons License).

The meeting convened in Budapest on December 2001, by the Open Society Foundations (OSF) marked a key moment in the development of Open Access as a principle. Subsequent meetings in Bethesda in June 2003 and Berlin in October 2003 shaped the "BBB" definition of Open Access. All these declarations reiterated the ethos of Open Access and increased pressure from within the academic environment for a change in knowledge dissemination.

There are two types of Open Access: Gold Open Access, also known as Open Access Publishing, and Green Open Access, also known as Open Access Archiving.

Understanding the benefits of Open Access (OA): visibility, accessibility, quality, and global impact, Stomatology Education Journal (Stoma Edu J) has consistently adhered to these principles and demonstrated them over time in its evolution.

The Stomatology Education Journal (Stoma Edu J) is a Green Open Access (GOA) journal freely accessible on the internet; therefore, no fees for processing, peer review, or publication are required from the authors. A Green Open Access (GOA) journal means that all content is available free of charge to the user or their institution. Users are allowed to read, download, copy, distribute, print, search, or link to the full texts of the articles in this journal without seeking prior permission from the publisher or author. Our goal is to publish in the shortest possible timeframe and ensure the rapid dissemination of your work through the pages of our journal and our indexing partners.

With his rich experience as an editor, Professor Jean-François Roulet from the University of Florida recommended and supported, as Editor-in-Chief, that Stomatology Education Journal (Stoma Edu J) use the double-blind review policy for all manuscripts submitted to the journal from its inception.

The Stomatology Education Journal (Stoma Edu J) believes in the probity and rectitude of the peer review process and system, which is generated for each issue. According to this policy, both the identities of the reviewers and the identities of the authors are hidden from each other throughout the entire review process. To facilitate this process, the corresponding author is obliged to submit the "Title Page containing complete author details" and the "Manuscript without author details" as two separate files.

Once submitted, all articles undergo an initial examination by the Editors-in-Chief to determine if the articles match the aim of the journal and can be published. Subsequently, the Manuscript Manager platform administrator sends the articles to at least two independent reviewers chosen by the Editors-in-Chief. The reviewers' reports are then analyzed, and the Editor-in-Chief makes the final decision on the manuscript. The decision on the manuscript can be based on the following four options: No changes required / Minor changes / Major changes / Rejection.

Of course, the selection of a reviewer for an article constitutes a moral reward for their research and scientific site, besides putting them in contact with the latest scientific research conducted in their field of study.

Reviewers will have the privilege of being in direct contact with the latest research results of the authors, enhancing their communication skills, generating clear evidence for evaluation, and helping authors clarify and achieve their research objectives.

Peer Review is a proven system for evaluating the quality of research and how it is presented before publication. Anonymous reviewers, with vast experience in the related field, examine the received manuscripts through

the Manuscript Manager platform. The primary aim is to publish a quality article in the research field for knowledgeable readers worldwide. The peer review system judges the validity, significance, and originality of the work rather than those who performed it.

The peer review process relies on the triumvirate of three well-defined entities: Authors, Editors-in-Chief, and Reviewers.

Authors are those who research and write an original manuscript, review, or case report submitted preferably to a chosen journal. The Editors-in-Chief are those who conduct the initial and final screening of the submitted work. They are responsible for verifying the overall fit of the manuscript with the aim of the journal. Additionally, they check the format according to the author's guide, the clarity of the discussion, and the research methods used to prepare the received manuscript. Reviewers, anonymous experts in the subject, are those who provide opinions and expert advice on the quality coefficient of the manuscript. Following their evaluation, they help the Editors-in-Chief make a decision regarding the publication of the submitted manuscript.

We have a moral obligation to our readers to signal now that our editorial process has encountered some stumbling blocks in recent times. The disruptions were due, on the one hand, to the cyber-attack on the platform of the journal and the time needed by the two IT teams to recover all issues since 2014, and on the other hand, to the lack of response from invited reviewers, which significantly exceeded the peer-review process duration, delaying the regular and timely publication of the Stoma Edu J. Thus, as to the current issue, the authors of a retrospective study on "Crack Teeth and Vertical Root Fractures in Pandemic Crisis" have withdrawn their manuscript, directing it to a journal that does not practice a double-blind review policy.

At this point, analyzing the ten years of uninterrupted activity of the Stomatology Education Journal (Stoma Edu J), we owe our respectful thanks to Prof. Constantinus Politis, who, retiring from his exceptional responsibility as head of the OMF Surgery clinic at Leuven University, has also retired from his responsibility as EiC. He contributed magnificently to editorial life, both as an author but especially as an efficient and responsible editor for the last six years!


Fully adhering to the editorial management principles of the Stomatology Education Journal (Stoma Edu J) at the beginning of each year in the extraordinary working session of the Executive Board, we analyze the activity of the editors and invite new editors willing to support the journal.

This year distinguished colleagues from all over the world have graciously responded the invitation to join the Editorial Board. Thus, the position of Editor-in-Chief is held by Associate Professor William Papaioannou, DDS, MScD, PhD from the National and Kapodistrian University of Athens, Greece. The position of Co-Editor-in-Chief (Europe) is held by Professor Eitan Mijiritsky, DMD, Dipl. in Prosth., International Academic Affairs at Tel-Aviv University, Israel and President Elected & Board of Directors - European Prosthodontic Society (EPA). In the position of: Section Editor-in-Chief at Basic Research / Dental Materials / Dental Technology is Professor Julio Suay Antón, Eng, PhD, Chair at Jaume I University, Castellón de la Plana, Spain, Section Editor-in-Chief at Aesthetic Dentistry / Dental Photography is Professor Feng Liu, DDS, MSc, PhD, Deputy Director at School of Stomatology (PKUSS) Peking University, Beijing, P. R. China, Editor in the Section of Periodontology / Oral Microbiology / Dental Hygiene is Professor Gaetano Isola, DDS, DDS, PhD, University of Catania, Catania, Italy, Section Editor-in-Chief of Oral Medicine / Oral Pathology is Professor Ramya Ramadoss, MDS, PhD & Head, Associate Dean at Saveetha University, Velappanchavadi, Chennai, India, Section Editor-in-Chief at Anesthesiology / Dentoalveolar Surgery / Maxillofacial Surgery / Oral Implantology / Emergencies is Professor Kenneth Lee, BDS, MSc, MDSc at the International Academy of Advanced Dentistry - IAADent, Sydney, Australia, Section Editor-in-Chief of Restorative Dentistry / Computerized Dental Prosthetics is Dr. Ricardo Recena Orlando, DT, DDS, Medical Director, XmileStudio, Málaga, Spain.

Well known fellow dentists have joined the Editorial Advisory Board Sections, as follows: Section Editor-in-Chief of Cariology / Pedodontics / Oro-Dental Prevention, Professor Lazar Yessayan, DDS, PhD, Dean at Yerevan State Medical University, Yerevan, Armenia, Section Editor-in-Chief at Aesthetic Dentistry / Dental Photography, Professor Irfan Ahmad, BDS, BDS, FCGDent at the University of Otago, Wellington, New Zealand, Section Editor-in-Chief of Oral Medicine / Oral Pathology, Professor Ingrīda Čēma, DDS, PhD from Riga Stradins University, Riga, Latvia, Section Editor-in-Chief at Prosthetic Dentistry / Oral Rehabilitation / Gerodontology, Professor Asja Čelebić, DDS, MSc, PhD from the University of Zagreb, Zagreb, Croatia.

We graciously welcome these well-known colleagues from all over the world and hope that through their enthusiastic involvement in the editorial life, they shall revitalize the work of the entire Editorial Board in the honorable task of stepping decisively on the quotation track of the Stomatology Education Journal.

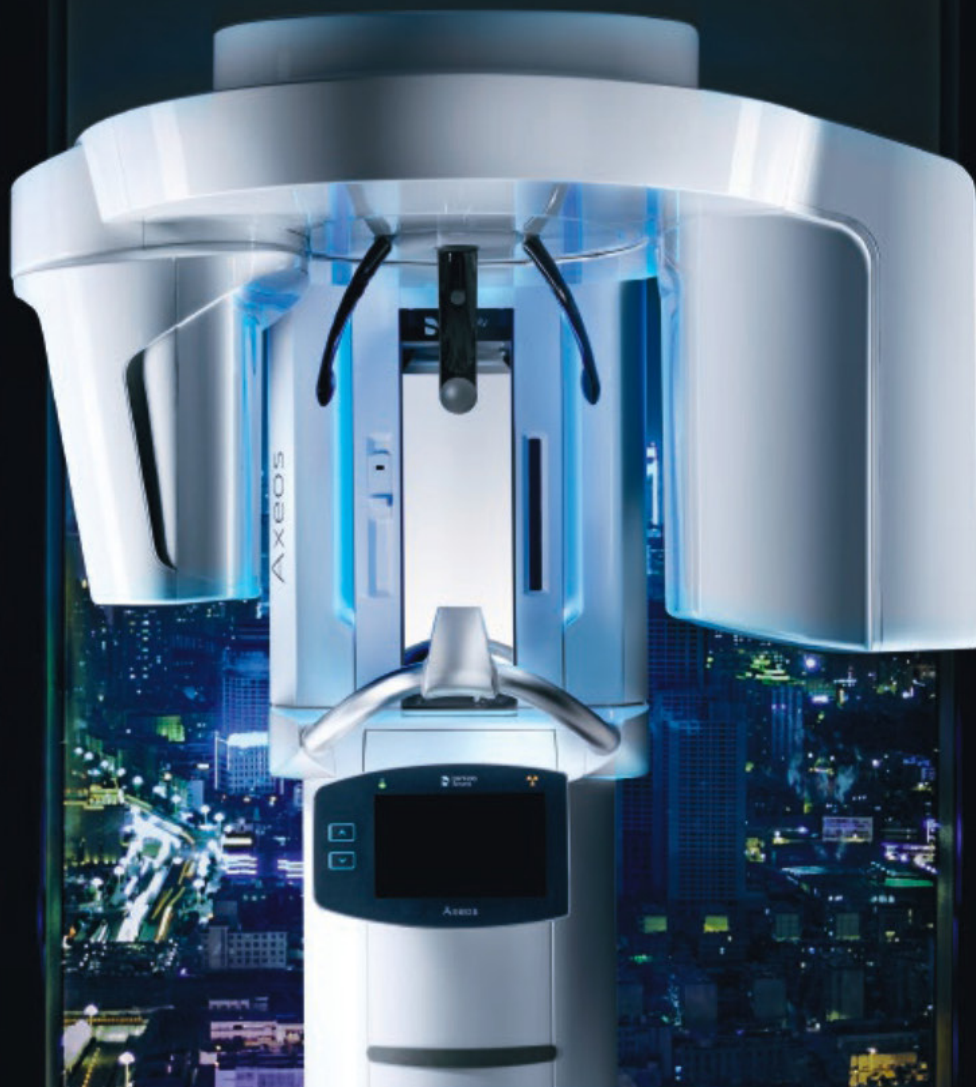
Sincerely,

M-V CONSTANTINESCU 
Stomatology Edu Journal
Editor-in-Chief

 [https://doi.org/10.25241/stomaeduj.2024.11\(1-2\).edit4](https://doi.org/10.25241/stomaeduj.2024.11(1-2).edit4)

Dentsply Sirona Imaging Solutions

Axeos. Experience the difference.



A new generation of progressive imaging is here – experience the difference with Axeos.

- 2D/3D hybrid device equipped with new technology and a broad Field of View (FoV) range, from a focused FoV ($\varnothing 5 \times 5.5$ cm) for endodontic cases up to a large FoV ($\varnothing 17 \times 13$ cm) that covers complete dentition, including both TMJs
- Seamless connectivity and individualized treatment workflow with Sidexis 4 Software
- Patient Positioning and Image Assistant (PIA) for increased patient comfort and image accuracy

Because every patient deserves a healthy, happy smile and every practice team deserves the tools to make this a reality. It's time to elevate and expand your treatment offer. It's time for Axeos.

For more information on Axeos please contact your local dealer,
Dentsply Sirona sales representative or visit

dentsplysirona.com/axeos

THE DENTAL
SOLUTIONS
COMPANY™

**Dentsply Sirona CEE Central
Office & Showroom**
Str. Vulturilor 98A, 030857, București
Tel.: 0774 074 094
office.romania@dentsplysirona.com
www.dentsplysirona.ro
<http://facebook.com/dentsplysirona.romania>

 **Dentsply
Sirona**

Dr. Gregor Slavicek :

Tradition or continuation of a legacy



Gregor Slavicek's journey into the world of gnathology and functional oral rehabilitation began as early as 1975. His early involvement in supporting his father's fundamental research project, Determinants of the Stomatognathic System, laid the foundation for his scientific works, which included integrating cephalometry into systematic clinical and instrumental diagnostics, digitizing dental structures, and linking them to axiographic data, leading to the development of sequential occlusion with dominant canine.

Gregor Slavicek's academic journey is marked by his commitment to learning and openness to diverse perspectives. He graduated as a medical doctor (MD) from the University of Vienna and specialized two years later in stomatology (DDS) at the Dental School of Vienna. His postgraduate education programs provided him with the opportunity to meet and learn from great thinkers and opinion leaders in Dentistry and Gnathology, including Charles Stuart, Arne Lauritzen, Harry Lundeen, Charly Gibbs, Bob Lee, Parker Mahan, Robert

Ricketts, Tore Hanson, and Charles Mc. Neil. His thirst for knowledge led him to Denmark, University of Aarhus, where he studied the Orthodontic Segmented Arch Technique in detail. In 2010, he furthered his academic pursuits by completing his Master's in Clinical Research at the University of Vienna.

Gregor Slavicek's influence in the field of Dentistry and Gnathology extends beyond his clinical and academic roles. He served as the Deputy Editor in Chief of the International Journal of Stomatology and Occlusion Medicine from 2008 to 2010, contributing significantly to the dissemination of knowledge and research in the field.

After a long period of clinical practice in a private setting, accompanied by teaching at the Dental School, University Vienna and the Interdisciplinary Dentistry Program at Danube University, Krems, he finally joined the Steinbeis University Berlin in 2008, where he became Director of the Steinbeis Institute on Biomedical Interdisciplinary Dentistry. He held this position until his retirement in 2021. He became Visiting Professor of 1st State Medical University in Moscow in 2013.

He was awarded the title of doctor honoris causa by the Ukrainian Dental Society (2012), became an honorable member of the Italian Gnathological Society AIG (2017), the Romanian Dental and Maxillo-Facial Prosthodontic (2019), and the Romanian Society of Stomatology (2024).

The main research interests in his scientific career are closely related to occlusion and occlusal functions: Standardization of Recording Hinge Axis Movements during chewing; Development of a Standardized Chewing Test Food; Interdisciplinary collaboration in dentistry; Evidence-Based Dentistry eviDent Collaboration with Gazi University, Ankara, Turkey, Catholic University Leuven, Belgium, Helsinki University, Finland and Steinbeis University Berlin, Germany; Visualization of Chewing Test results and BruxChecker analysis with interindividual and intraindividual analytic protocol.

In 2018, the development of a clinical chewing test led to the founding of Orehab Minds, aiming to support dental clinics by visualization of chewing and bruxing tests. As a logical consequence, after retirement from the Steinbeis University, the Orehab Academy started to support colleagues interested in contemporary Gnathology and the so-called Slavicek concept.

In 2024, he and the next Slavicek generation, Rudolf Slavicek's grandson Florian Slavicek and his wife, Anastasia Slavicek, celebrated the 100th anniversary of Gnathology. Gregor Slavicek proposed a revival of Gnathological thinking in dentistry. For some more years, he will encourage this journey with all his knowledge and empathy.

Prof. Dr. med. Dent. Dr. Habil. Paula Perlea 

President of the Romanian Society of Stomatology

Chair of the Member, Liaison and Support Committee of the FDI

Councilor of the European Regional Organization of the FDI

Councilor of the Balkan Stomatological Society

 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).letter1](https://doi.org/10.25241/stomaedu.2024.11(1-2).letter1)



Dentsply Sirona Imaging Solutions

Axeos. Experience the difference.

A new generation of progressive imaging is here – experience the difference with Axeos.

- 2D/3D hybrid device equipped with new technology and a broad Field of View (FoV) range, from a focused FoV (Ø5 x 5.5 cm) for endodontic cases up to a large FoV (Ø17 x 13 cm) that covers complete dentition, including both TMJs
- Seamless connectivity and individualized treatment workflow with Sidexis 4 Software
- Patient Positioning and Image Assistant (PIA) for increased patient comfort and image accuracy

Because every patient deserves a healthy, happy smile and every practice team deserves the tools to make this a reality. It's time to elevate and expand your treatment offer. It's time for Axeos.

For more information on Axeos please contact your local dealer, Dentsply Sirona sales representative or visit

dentsplysirona.com/axeos

THE DENTAL
SOLUTIONS
COMPANY™

Dentsply Sirona CEE Central
Office & Showroom
Str. Vulturilor 98A, 030857, Bucuresti
Tel.: 0774 074 094
office.romania@dentsplysirona.com
www.dentsplysirona.ro
<http://facebook.com/dentsplysirona.romania>

 Dentsply
Sirona

PRACTICING GNATHOLOGICAL DENTISTRY: 100Y ANNIVERSARY OF GNATHOLOGY CONGRESS

The 100th Gnathology Anniversary Congress occurred in Istanbul from 29th to 30th June 2024. Here is a summary and a review of the lecturer's conclusions. The congress was organized by Orehab Minds Academy, attracting an international audience, both on-site and online.

The Congress slogan **Who We Are and What We Can Do!** expresses the intention to demonstrate contemporary possibilities by following gnathological principles in daily dentistry. The speakers at the congress are:

- All dentists.
- Applying gnathology in their daily work.
- Interpreting gnathology is modern, future-oriented, and forward-thinking.

Gregor Slavicek, Stuttgart, Germany, opened the congress, highlighting **the Past, the Present, and the Future of Gnathology**. The term Gnathology has already been established for 100 years. Searching and finding geometrical-mathematical principles of occlusion and the stomatognathic organ starts much earlier as a pre-gnathological area. In the 1970's, there was a breakthrough due to the hinge axis recording (instead of pantographic tracings) and the introduction of a cranial reference plane. Gnathology is often called a particular discipline for a dysfunctional patient. This does not seem right. Gnathology is, in the spirit of its fathers and pioneers, the discipline dealing with occlusal functions and occlusal parameters, serving as a fundament for all dental disciplines. Gnathology is an a-disciplinary discipline, and contemporary gnathology integrates gnathological instruments and geometrical principles in oral rehabilitation. Today, practicing gnathologists focus on maintaining and optimizing oral functions (chewing, speech, bruxing) by occlusal measures in all aspects of oral rehabilitation (orthodontics, prosthodontics, restorative dentistry ...). The visualization as well as the quantitative and qualitative evaluation of chewing efficiency and bruxing activity were demonstrated by **Florian Slavicek, Vienna, Austria** in his lecture: **Objective testing of occlusal functions**. The impressive lecture delighted the audience and answered fundamental questions: How and why to visualize Occlusal Functions? Why 9 Chewing Sequences are necessary to judge Chewing Efficiency? Why are elastic Standardized Chewing Test Units required to assess the ability to chew well? How do understand Bruxing activity by analyzing the BruxChecker? How do you explain occlusal functions to the patients/parents?

A real highlight of the congress was the lecture by **Sergey Grishin, Kirov, Russian Federation**, titled **Handling the complexity of gnathological parameters in Oral Rehabilitation**. The functional parameters of occlusion and the craniomandibular system require fundamental knowledge and excellent planning and transferring skills for each patient. The vertical dimension, the therapeutic position, occlusal plane, spheric arrangement of the teeth (sagittal and transversal), and a clear sequential occlusal guidance concept with canine dominance are a matter of the consequent application of gnathological principles. The harmonization of muscles, including mimic muscles, is one of the treatment goals and a vital parameter for judging treatment efficiency. Sergey Grishin reported that patients who require oral rehabilitation are getting younger. This places a heavy burden on the responsibility of the dental team. Minimal invasive strategies are needed. Gnathological parameters such as the vertical dimension, occlusal plane, and chewing surface morphology help to be as minimal as possible. Minimal invasive dentistry is often misinterpreted if the number of teeth involved in the restorative procedures is the criterion. Minimal invasive means staying in the enamel window, removing only minimal tooth substance, and avoiding opening the dentin window. In addition, based on long-term follow-ups of clinical cases, Dr. Grishin demonstrated the practicability and usefulness of the sequential occlusal concept with canine dominance by R. Slavicek. A key message of this lecture is that thorough knowledge of all biological aspects and the ability to use the instruments properly are mandatory and require well-trained skills.

The participants gained perfect insights into TMJ Imaging, both in interpreting and integrating these data in the gnathological workflow. **Giulia Tanteri, Torino, IT, and Anastasia Slavicek, Podolsk, RF presented The temporo-mandibular joint - imaging, tracking, considering**. Dealing with the structures and functions of healthy and disturbed TMJs is part of contemporary oral rehabilitation. The use of imaging techniques (CT-Scan, MRI) is mandatory. The clinical application of the hinge axis recording techniques is crucial to understanding the impact of pathologies on mandibular dynamics and establishing a proper treatment strategy. Considering the temporo-mandibular joints is not only a task for so-called gnathologists but for all dental disciplines. Giulia Tanteri pointed out that imaging techniques have to be clearly indicated. Such techniques are to be applied, but the less, the better, considering the overall patient loads. Asking straightforward questions before the patient is sent helps radiologists to provide detailed answers. Dental practitioners should be able to recognize general medical conditions that may significantly influence TMJ conditions. **Anastasia Slavicek, Podolsk, RF**, gave a detailed synopsis of the possibility of merging Condylographic Data with Imaging techniques, especially MRI. Both techniques provide data that need to be understood: condylographic trajectories and MRI findings do not always show the same, e.g., joint effusion or ligamental status potentially mimics condylographic signals. Condylographic analysis starts with a systematic description as an integrated part of the systematic functional analysis. Advanced options

provide detailed insights regarding the coordination of the movements, the proprioceptive impairment, the rotational capacity, and the effects in occlusal dynamics, individual Posselt schemes, and individual occlusal compass. Especially in growing children and adolescents, monitoring tooth eruption and functional status is required. Especially in cases with an alteration of the regular tooth eruption in the late mixed dentition (canine before premolars), possible adverse effects on the TMJ have to be excluded.

The next lecturer from Bucharest, Romania, impressed the audience by showing the consequences of implementing knowledge, constant education, and improvement. **Marian Constantinescu, Bucharest, Romania**, can be regarded as a contemporary witness to the development of dentistry, especially Gnathology and functional-oriented Dentistry, over decades. He has seen many technologies coming and going, some still present, others not anymore. He met many opinion leaders in dentistry and is constantly exchanging ideas with experts in dentistry worldwide. He constantly strives to improve and encourage dental education in all fields and aspects. Starting with the history of dentistry in Romania, participants learned about the early international collaboration of Romanian dentistry with Fédération Dentaire Internationale (FDI), the International Prosthodontic and Gnathological Societies. He initially integrated gnathological instruments and merged muscle-oriented techniques with jaw-tracking systems. He demonstrated to the audience that professional curiosity is not a matter of age and not something for younger colleagues only, and it results in constant improvement of Gnathology. To demonstrate this, he and his son presented the lecture: **4D Digital Workflow and Planning for Personalized Prosthetic Treatment - the Practical Perspective for Daily Application in the Dental Clinic**. In recent years, there have been significant advancements in functional and digital dentistry, with the availability of multiple acquisition systems that provide more detailed information than ever before. During his lecture 4D Digital Workflow and Planning for Personalized Prosthetic Treatment - the Practical Perspective for Daily Application in the Dental Clinic, **Florin Constantinescu, Bucharest, Romania**, pointed out the incredible possibilities of digital technologies in dentistry, including the laboratory part. With the intraoral scan, facial scan, dynamic CBCT, and registration of free mandibular movements, dentists can gather the quality and quantity patient data, allowing for more precise diagnoses and treatment planning.

Integrating patients' anatomical and functional details in CAD design software has improved dramatically and brought communication between clinicians, dental laboratories, and patients to a new level. 4D technology has allowed for more predictable treatments, especially in multidisciplinary cases where a significant increase in the occlusal vertical dimension (OVD) is required to restore functional occlusion. The neuromuscular approach, which considers physiologic measurements and patient needs and requests, can be combined with this technology to provide even more precise treatment planning and deliver optimal and personalized patient care. Today, laboratory Robots can be called the descendants of the Replicator of Gibbs/Lundeen (1970 - 1980ies). Lessons learned message from **Marian and Florin Constantinescu**: Failing to Plan = Planning to Fail.

Grigory Popov from Tallinn, Estonia, provided a fascinating view of his country. His lecture **Who we are and what we can do! The clinical application of contemporary gnathology dentistry** highlighted the importance of understanding the specific situation of a country and the impact of these factors on dentistry. Estonia is a fully digitized country; patients and medical doctors accept digital dentistry quickly and easily. However, the thrust in digital processes and workflow increases the possibility of mistakes without recognition during dental processes – the uncritical application is based on the assumption that it is digital, so without failures, which may lead to a bounce-back effect. Scandinavian approaches in Estonia influence dentistry: evidence-based, holistic, and minimally invasive. Gnathology and functionally oriented dentistry have been relegated to a subordinate department at most universities. On the other hand, many dental practitioners are very strongly oriented in this direction. On the one hand, it is necessary to have certainty in diagnosis and treatment based on comprehensible parameters, and on the other hand, it is necessary because the demands and expectations of patients require it. These presentations are held under the motto of the entire meeting: WWAAWWCD! (Who We Are and What We Can Do) – and a growing group of dentists are interested in Gnathological thinking. It is still a small group, but constantly growing.

Minimal invasive restorative approaches are desirable for the patient. The prevention of dental structures is a motivator for choosing or declining a particular treatment strategy the dentist offers. **Sergey Grishin, Kirov, Russian Federation**, clarified substantial misunderstandings and misinterpretation of minimal invasiveness. Labeling an oral restoration as minimally invasive is often a fraudulent labelling. His lecture **Minimal Invasive Tooth Preparation – Occlusal Planning to Save Dental Structure** encouraged the participants to accept the increasing confrontation with the challenge of restoring caries-free teeth in young adults. The indication is often severe wear of the teeth and chewing surfaces due to bruxing. The preservation of the tooth structure requires the correct preparation techniques and knowledge of which occlusion should be implemented (backward planning). Minimally invasive techniques are a decisive factor in the attractiveness of the dental practice for patients. Key messages of his lecture: Bonding Systems: every year new products, but no real breakthrough since the 1990s; we have to know the dental anatomy; understand the difference between Minimally invasive vs. As minimal as possible; be able to work correctly with the Vertical Dimension of Occlusion to preserve tooth substance; the articulator is a tool for the Dentists! Patients start to trust the dentist due to the systematic approach: what is convincing are the treatment results, not the sales process. The following session encompasses a wide range of oral rehabilitation, challenging for both, the dental laboratory and the dental clinic. **Massimiliano Veronese, Trento, Italy**, started with his lecture, focusing on

the edentulous and partially edentulous mouth: **The challenge Oral rehabilitation: Edentulous mouth – partially edentulous mouth.** These aspects are brought together and discussed in this lecture. The dentists are in charge of delivering the treatment parameters and strategy, and the dental technician is in charge of transferring the plan to prosthodontic occlusion. Technicians follow the fundamental geometrics of the stomatognathic system and use the parameters: Lower Facial Height (LFH), Relative Condylar Inclination, Occlusal Plane inclination, Radius Curve of Spee, Sequential Occlusal Concept. The second part of this session: **The challenge Oral rehabilitation: Edentulous mouth – partially edentulous mouth – dental abrasion** by **Alexey Lyan, Almaty, Kazakhstan** focused on the caries free teeth and occlusion. For 40 years now, modern gnathology has been transforming into a practice-oriented, fundamental discipline. The focus of clinical gnathology is by no means only on dysfunctional patients. Prosthodontics, especially in the case of severely reduced residual dentition or an edentulous mouth, benefits from gnathological thinking and workflows. Collaboration between the practice and laboratory is of particular importance. These aspects are brought together and discussed in this lecture.

Without full integration of orthodontics, contemporary oral rehabilitation appears incomplete. A shared treatment plan, based on mutual understanding and support, and aligned to the same occlusal goals, is the mandatory fundament of such collaborations. **Andrey Zhuk, Moscow, Podolsk Region** discussed: **Do Orthodontists need to think gnathological? In the adult? In the child? In the adolescent?** The role of orthodontics is of great importance in many stages of a patient's life. The focus here is on harmonizing the dental parameters with the individual skeletal structure. This requires knowledge of all developmental stages of the craniomandibular system, early diagnosis of deviations from normal development, and targeted intervention. Precise coordination of the occlusion with the temporomandibular joint is also necessary when treating adults. Modern orthodontics is more than just shaping dental arches. Gnathological principles can be implemented with today's orthodontic concepts if the orthodontic technique is adjusted to the functional parameters and not vice versa. Orthodontic Clinics need algorithms for the desired goals of orthodontic treatments. It applies to all groups of patients: pediatric, adolescents, adults, and elderly. All aspects must be included, besides from the dental-occlusal the skeletal parameters, as well as progressive and bio-esthetic factors. Orthodontists are often in charge of making decisions regarding ortho-gnathic surgical approaches. The patient's chief complaint needs to be respected, but the final decision should be made only after providing complete information on all pros and cons, including the alternatives. As an orthodontist, it is crucial to understand craniofacial growth and to be familiar with the long history of growth studies, at least starting with the implant studies from Björk. As an orthodontist, ignoring the effect on the TMJ structures during the mandibular advancement strategy is not acceptable. This applies not only to sleep apnea devices, but also to skeletal class II treatment strategies. **Giorgio Fiorelli, Arezzo, Italy**, completed this session with his lecture: **Not the orthodontic method matters, but the orthodontic force system to achieve the desired tooth position.** The desired teeth positions lead to the selection of the best fitting orthodontic technique, and not a particular orthodontic method with unknown force systems should be applied. This approach, although from completely different aspects, merges strongly orthodontic and gnathological-occlusal concepts of oral rehabilitation: the desired occlusion determines the best therapeutic strategy and only then are the best fitting tools applied (orthodontics, prosthodontics, implants ...). Although starting from different ways of therapeutical thinking, the audience understood that the treatment tool (here: the orthodontic force system) is chosen because of the tooth position that has to be achieved.

Last but not least, **Ksenia Nafigna, Moscow, RF, Anastasia Novitskaya, Vienna, Austria, and Florian Slavicek, Vienna, Austria**, completed the second day of the conference with their lecture: The importance of occlusal functions during diagnostics, treatment, and follow up. A valid measurement procedure has been developed to measure, visualize, and understand the occlusal processes. The visualization helps the patient and relatives to recognize the need for detailed diagnostics. The tests are easy to implement clinically and do not involve a high financial or technical outlay. The use of the Brux Checker Analysis and the chewing function test is an effective tool for monitoring the course of treatment. An excellent functional treatment result, visualized with these tests, increases the value of the treatment enormously. Using the tests as screening, a diagnostic procedure at the start and during treatment, and subsequently, to measure long-term functional stability is a modern tool for a patient-oriented dental practice. The key messages of the engaged and competent lecturers are: Understanding occlusal Functions to motivate the patient to document the starting point; the use of Chewing Test and BruxChecker during treatment – the follow up; visualization of chewing and bruxing is an exceptional service for the patients in a dental clinic.

The participants also gained insights into the importance of a proper masticatory function: Mastication for the mind – the reduced chewing ability and increased risk of cognitive decline/dementia. **Anastasia Slavicek**, based on a systematic, comprehensive literature overview, highlighted the crucial role of maintaining a good chewing ability in the elderly population. The rhythmic muscle activity during chewing is key to understanding this causal correlation. She proposed that oral rehabilitation, based on gnathological principles, could be a strategic approach to delay the onset of cognitive decline. This underscores the significant positive impact that gnathologists can have on the patients' well-being (physical and psychical), leading to an improved quality of life for patients and relatives, reduced costs for comprehensive care, and, to some extent, relieving the burden on the health care system.

The conference went by too fast; just after the opening remarks, it was time to conclude with **Closing remarks – 100y Anniversary of Gnathology.** **Gregor Slavicek, Stuttgart, Germany**, completes the

meeting. Gnathology has a long history. On the one hand, a constant improvement of our knowledge results from research, science, and development. New technologies are boosting the instruments and making clinical applications easier and simpler.

On the other hand, fundamental principles have been established for over 100 years and have yet to be discarded. However, modern technologies and the search for simplified processes must not lead to the sacrifice and negation of fundamental knowledge. If a fundamental gnathological parameter is declared invalid, then a robust alternative must be presented - and this must be scientifically proven. Pure technical feasibility in the digital world is not yet proof of coherence. The manufacturers of these systems must provide this proof. If this proof is not provided, the responsibility lies with the user. Technical developments and the improvement of knowledge are the tasks of the entire dental community. However, blind faith in technological progress is very risky and carried out on the backs or in the patients' mouths. In 2024, it is time to look both back and forward. Traditional gnathology, in its purely technical approach, needs to be updated. Limiting gnathology to dysfunction has proven to be ineffective. Modern gnathology is an interdisciplinary approach with prophylactic, diagnostic, therapeutic, and communicative tasks between the disciplines. Modern gnathology is a medical discipline that advances the term occlusal medicine.

The progress made in gnathology, especially the extraordinary exchange of gnathological thoughts during the two days, has left a sense of optimism and hope for the future of the field. All have been inspired by the possibility to apply gnathological principles merged with modern technologies and treatment strategies, interpreted with the knowledge of 2024. Looking back to the long history of Gnathology allows progress towards the future. Applied Gnathology does not require a yes or no decision, it supports all aspects of dentistry as an a-disciplinary discipline

We are thrilled to announce the next edition of the conference, which will take place on **5th – 6th December 2025**. The topic, **"It's the occlusion, stupid!"** promises to be another engaging and enlightening event. We look forward to your participation in the 2nd International Meeting of Clinical Expert Consortium Gnathology and Occlusal Functions.

The Orehab Academy Congress - 101y Anniversary of Gnathology


Save the Date! Don't miss this event.

**"It's the economy, stupid" is a phrase by James Carville, a political advisor for US Government, in 1992.*

The Orehab Academy Congress -101y Anniversary of Gnathology

Save the Date! Don't miss this event.

** "It's the economy, stupid" is a phrase by James Carville, a political advisor for US Government, in 1992.*

Gregor SLAVICEK 
MD, DDS, MSc, CEO, Head
Orehab Minds GmbH
DE-70567 Stuttgart, Germany

 [https://doi.org/10.25241/stomaeduj.2024.11\(1-2\).News](https://doi.org/10.25241/stomaeduj.2024.11(1-2).News)



Made by You

Dentsply Sirona CEE Central
Office & Showroom
Str. Vulturilor 98A, 030857, Bucuresti
Tel.: 0774 074 094
office.romania@dentsplysirona.com
www.dentsplysirona.ro
<http://facebook.com/dentsplysirona.romania>

Open a world of confident smiles with Primescan's uniquely accurate approach to dentistry. Primescan as unique as your patients, the first intraoral scanner to be validated for Atlantis suprastructures.



Scanned with Primescan



THE BEST DENTISTRY LINE IN THE WORLD



cod. 9768



cod. 8007

DEMONSTRATIVE LINE

MODELS FOR DEMONSTRATING ORAL REHABILITATION TECHNIQUES AND IMPLANTS FOR PATIENTS OR STUDENTS.

THEY ARE EXCELLENT SALES TOOLS THAT ALLOW YOU TO EXPLAIN TREATMENTS IN A CLEAR AND DIDACTIC WAY.

TRAINING LINE

DEVELOPED WITH INTERNAL AND EXTERNAL ANATOMICAL CHARACTERISTICS AND MECHANICAL PROPERTIES VERY CLOSE TO NATURAL BONE. THEY ARE IDEAL FOR HANDS ON AND TRAINING IN IMPLANT SURGICAL PRACTICES. THEY CAN BE DRILLED, CUT AND HAVE SOFT TISSUE SIMULATION THAT ALLOWS INCISION AND SUTURE.

THE ENTIRE TRAINING LINE CAN BE RADIOPAQUE.



cod. 11588



cod. 30PCF-CP3



From The Journal of the American Dental Association



JADA ONLINE CE EXAMS

<http://jada.ada.org/ce/home>

<http://jada.ada.org/ceworksheets>

July 2024

A RETROSPECTIVE CLINICAL STUDY TO COMPARE THE ABILITY OF CONE-BEAM COMPUTED TOMOGRAPHIC IMAGES AND PERIAPICAL RADIOGRAPHS TO REVEAL CRACKED TEETH, SPLIT TEETH, AND TEETH WITH VERTICAL ROOT FRACTURES

María Soledad Mareque-Bueno, DDS · Venkateshbabu Nagendrababu, PhD · Paul M.H. Dummer, PhD · Manuel Ruíz-Piñón, PhD · Teresa Arias-Moliz, PhD · David Uroz-Torres, PhD · Sara Garrido-Parada, DDS · Benjamín Martín-Biedma, PhD · Pablo Castelo-Baz, PhD

J Am Dent Assoc. July 2024; Volume 155, Issue 7p614-623

Doi: 10.1016/j.adaj.2024.04.009

[https://jada.ada.org/article/S0002-8177\(24\)00212-5/fulltext](https://jada.ada.org/article/S0002-8177(24)00212-5/fulltext)

<https://engage.ada.org/courses/456/view>

<https://engage.ada.org/page/faq>

This article has an accompanying online continuing education activity available at:

[https://jada.ada.org/article/S0002-8177\(24\)00242-3/abstract](https://jada.ada.org/article/S0002-8177(24)00242-3/abstract)

PMID: 34952683

DOI: <https://doi.org/10.1016/j.adaj.2024.04.009>

Copyright © 2020 American Dental Association. Published by Elsevier Inc.

All rights reserved.



AH Plus® Bioceramic Sealer

Ready, SET, Go!



 Dentsply
Sirona

Dentsply Sirona CEE Central
Office & Showroom
Str. Vulturilor 98A, 030857, Bucuresti
Tel.: 0774 074 094
office.romania@dentsplysirona.com
www.dentsplysirona.ro
<http://facebook.com/dentsplysirona.romania>

It is all about passion.

Bioactivity of bioceramic sealers is important but you need more to ensure a stable seal. The apical seal is only completed after the sealer sets predictably. Our sealer sets apart from others because it offers a 60% faster set time, has a high washout resistance and is 25% more radiopaque compared to current market leaders. Set your new standard with AH Plus® Bioceramic Sealer.

dentsplysirona.com/bioceramic-sealer #EndoPassion

PART OF A





From The Journal of the American Dental Association



JADA ONLINE CE EXAMS

<http://jada.ada.org/ce/home>

<http://jada.ada.org/ceworksheets>

August 2024

**POSTOPERATIVE PAIN AFTER ENDODONTIC TREATMENT USING 8.25% VS 2.5% SODIUM HYPOCHLORITE
IN NECROTIC MANDIBULAR MOLARS WITH APICAL PERIODONTITIS**

Filipe Colombo Vitali, PhD · Pablo Silveira Santos, PhD · Lucas da Fonseca Roberti Garcia, PhD · Cleonice da Silveira Teixeira, PhD

J Am Dent Assoc. Volume 155, Issue 8p657-666.e2

Doi: 10.1016/j.adaj.2024.04.011

[https://jada.ada.org/article/S0002-8177\(24\)00242-3/fulltext](https://jada.ada.org/article/S0002-8177(24)00242-3/fulltext)

<https://engage.ada.org/courses/460/view>

<https://engage.ada.org/page/faq>

This article has an accompanying online continuing education activity available at:

[https://jada.ada.org/article/S0002-8177\(24\)00242-3/abstract](https://jada.ada.org/article/S0002-8177(24)00242-3/abstract)

PMID: 34952683

DOI: <https://doi.org/10.1016/j.adaj.2024.04.011>

Copyright © 2020 American Dental Association. Published by Elsevier Inc.

All rights reserved.



Dentsply Sirona Imaging Solutions

Axeos. Experience the difference.



A new generation of progressive imaging is here – experience the difference with Axeos.

- 2D/3D hybrid device equipped with new technology and a broad Field of View (FoV) range, from a focused FoV ($\varnothing 5 \times 5.5$ cm) for endodontic cases up to a large FoV ($\varnothing 17 \times 13$ cm) that covers complete dentition, including both TMJs
- Seamless connectivity and individualized treatment workflow with Sidexis 4 Software
- Patient Positioning and Image Assistant (PIA) for increased patient comfort and image accuracy

Because every patient deserves a healthy, happy smile and every practice team deserves the tools to make this a reality. It's time to elevate and expand your treatment offer. It's time for Axeos.

For more information on Axeos please contact your local dealer, Dentsply Sirona sales representative or visit

dentsplysirona.com/axeos

THE DENTAL
SOLUTIONS
COMPANY™

Dentsply Sirona CEE Central
Office & Showroom
Str. Vulturilor 98A, 030857, București
Tel.: 0774 074 094
office.romania@dentsplysirona.com
www.dentsplysirona.ro
<http://facebook.com/dentsplysirona.romania>

 Dentsply
Sirona

EVIDENCE-BASED APPLICATION OF TELEDENTISTRY: A SYSTEMATIC REVIEW

Tin Zar Tun^{1,2a} , Raksanan Karawekpanyawong^{3b} , Takashi Hoshino^{1c} , Bandana Pathak^{2d} , Hikaru Okubo^{1e} ,
 Kaung Myat Thwin^{1f} , Sachiko Takehara^{1g} , Hiroshi Ogawa^{1h*} 

¹Department of Oral Health Science, Graduate School of Medical and Dental Sciences, Faculty of Dentistry, Niigata University, Niigata, Japan

²Department of Pediatric Dentistry, University of Dental Medicine, Yangon, Myanmar

³Department of Community Dentistry, Faculty of Dentistry, Mahidol University, Thailand

^aMDS, Lecturer; e-mail: tina2jpn@gmail.com; ORCIDiD: <https://orcid.org/0000-0003-3429-8047>

^bDDS, PhD, Lecturer; e-mail: raksanan.kar@mahidol.edu; ORCIDiD: <https://orcid.org/0000-0002-7540-5497>

^cDDS, PhD, Assistant Professor; e-mail: takashi-hoshino@dent.niigata-u.ac.jp; ORCIDiD: <https://orcid.org/0000-0003-1450-5942>

^dDDS, Graduate Student; e-mail: bandanapathak51@gmail.com; ORCIDiD: <https://orcid.org/0009-0002-5449-3210>

^eDDS, Graduate Student; e-mail: hikaru@dent.niigata-u.ac.jp; ORCIDiD: <https://orcid.org/0000-0001-7852-9578>

^fDDS, PhD, Assistant Professor; e-mail: kaung@dent.niigata-u.ac.jp; ORCIDiD: <https://orcid.org/0000-0003-0350-7977>

^gDDS, PhD, Associate Professor; e-mail: takeh@dent.niigata-u.ac.jp; ORCIDiD: <https://orcid.org/0000-0002-3039-7104>

^hDDS, PhD, Professor, and Head; e-mail: ogahpre@dent.niigata-u.ac.jp; ORCIDiD: <https://orcid.org/0000-0003-1070-2172>

ABSTRACT

 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.1](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.1)

Background Teledentistry has emerged as a potential alternative to in-person dentistry, offering new possibilities for oral healthcare delivery and prompting need for a comprehensive evaluation of its efficacy and global applicability.

Objective To determine most common fields of teledentistry application, evaluate its effectiveness compared to in-person dentistry, and analyze its utilization in various countries based on the economic context.

Data source This systematic review conducted a literature search from five electronic databases: PubMed, Embase, Web of Science, Clinical Trials.gov, and the International Clinical Trials Registry Platform.

Study selection Evidence-based studies published in English (2011-2021), using teledentistry.

Data extraction Primary outcome: teledentistry usability. Secondary focus: utilization across economic strata. Methodological quality was assessed using the Down and Black checklist.

Data synthesis Of 34 reviewed studies, 18 favored a combined approach, 6 found comparable efficacies, 9 favored teledentistry, and 1 preferred in-person dentistry for anxiety management. Effectiveness was evident across economic settings (22 high-income, 6 upper-middle-income, 6 lower-middle-income nations). Teledentistry showed efficacy in oral health promotion and interprofessional consultation. We found that orthodontics is the most common specialty in teledentistry. Generally, teledentistry showed positive outcomes in patient education and behavior modification across various dental specialties. The adoption of teledentistry adoption might depend on economic status, highlighting the need for further research and implementation strategies in low-income countries to address global oral health disparities. This review demonstrates teledentistry's effectiveness as a versatile tool across diverse economic settings, emphasizing the need for focused research in low-income regions to bridge the global oral healthcare divide.

KEYWORDS

Dentistry; Teledentistry; Oral Health; Mobile Applications; Evidence-Based.

1. INTRODUCTION

The COVID-19 pandemic precipitated an unprecedented crisis in healthcare systems globally, with oral health services particularly affected due to the inherent risks associated with conventional dental practices. The generation of potentially virus-laden aerosols and droplets during face-to-face dental interventions posed significant challenges to the continuity of care, even with stringent infection control protocols [1,2].

To address these challenges, the implementation of health promotion strategies became even more crucial. One of these is Mobile Oral Health (mOralHealth), which primarily focuses on enhancing oral health through knowledge dissemination, skill development, and community-based healthcare access [3]. These interventions helped sustain oral health services during the pandemic by providing alternative ways to deliver care, thus reducing the risk of virus transmission while ensuring patients continued to receive necessary dental support.

 **OPEN ACCESS** This is an Open Access article under the CC BY-NC 4.0 license.

Peer-Reviewed Article

Citation: Wun TZ, Karawekpanyawong R, Hoshino T, Pathak B, Okubo H, Thwin KM, Takehara S, Ogawa H. Evidence-based application of teledentistry: a systematic review. *Stoma Edu J.* 2024;11(1-2):23-34.

Received: July 22, 2024; **Revised:** July 27, 2024; **Accepted:** August 15, 2024; **Published:** September 03, 2024.

***Corresponding author:** Prof. Hiroshi Ogawa, PhD and Head, Division of Preventive Dentistry, Graduate School of Medical and Dental Sciences, Niigata University. 2-5274, Gakkocho-Dori, Chuo-Ku, Niigata, Japan 951-8514 **Tel/Fax:** +81-25-227-2858 **E-mail:** ogahpre@dent.niigata-u.ac.jp

Copyright: © 2022 the Editorial Council for the Stomatology Edu Journal.

One oral health intervention is teledentistry, which addresses remote diagnosis and treatment planning via communication technologies [4]. The World Health Organization (WHO) and the American Dental Association (ADA) define teledentistry as providing health services using electronic information, imaging, and communication technologies to deliver and support oral healthcare services such as dentist-patient communication, and inter-professional communication among general dental practitioners, dental specialists, and medical professionals from other disciplines [5], particularly in situations where geographical proximity is a critical factor [6]. ADA further delineates teledentistry into four primary modalities: synchronous (live video), asynchronous (store and forward), remote patient monitoring (RPM), and health education (mHealth) [7]. The wide array of teledentistry interventions includes diagnosis (tele-diagnosis), consultation (tele-consultation), treatment (tele-treatment), and dental information dissemination and education (tele-education) through interactive audiovisual aids and data communication systems [8]. Although there is empirical evidence suggesting that teledentistry can effectively complement in-person management [9], with diverse applications ranging from patient education on oral health and hygiene improvement, particularly in orthodontic patients [10-12], to enhancing specific dental hygiene practices through various digital platforms [13-17], there is a significant gap in the literature regarding the applicability of teledentistry concerning various countries' economic status. Low-income countries may find it challenging to implement such teledentistry interventions, considering factors such as dental clinic availability and geographical accessibility.

Research has shown that conventional dental treatment integrated with digital support has demonstrated the potential for improving diagnostic accuracy, treatment efficacy, and prognostic outcomes [18-21]. However, comprehensive research evaluating the effectiveness of teledentistry encompassing diagnosis, consultation, and treatment compared to in-person dentistry across various dental specialties remains limited. Therefore, the effectiveness of teledentistry compared to in-person dentistry in the fields of dentistry was evaluated in this systematic review.

2. METHODS

This study employs a systematic review methodology to determine the most common fields of teledentistry application, evaluate its effectiveness compared to in-person dentistry, and analyze its utilization in various countries across diverse economic contexts. The research protocol adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines and is registered with the International Prospective Register of Systematic Reviews (Registration Number CRD 42022259600) [22].

2.1. Search strategy and focused questions

A comprehensive literature search was conducted across five electronic databases: PubMed, Embase, Web of Science, ClinicalTrials.gov, and the International Clinical Trials Registry Platform. Supplementary hand searches were performed to ensure comprehensive coverage. Detailed information is provided in supplementary Table 1. The following three questions were formulated using the PICO approach to assess whether teledentistry is

Table 1. Characteristics of the Included Studies.

No.	Authors/ Year of Publication (Country)	Study Population	Target age groups (Number of Subjects)	Tele-dentistry Intervention(s)	Form of Tele-communication/ Devices	Comparison Group	Main Outcomes	(∂ , ∇ , b, ϵ , \surd) results
Orthodontic Dentistry								b
1	Jejurikar et al., 2014 (India)	patients (full fixed appliances in both arches)	Young adults: 13-19 years (n=50)	Weekly text message reminders after OHI, once a week for 4 months	Remote patient monitoring (RPM)	Only OHI	Plaque index (PI), white spot lesions (WSL)	
2	Eppright et al., 2014 (USA)	patients (active treatment with full fixed appliances in both arches)	Young adults: 11-19 years (n=42)	One parent or guardian of each patient received a text message and the patient received oral hygiene instruction.	Mobile health (mHealth)	Only Oral hygiene instruction	Bleeding index (BI), Modified Gingival Index (MGI), and Plaque Index (PI)	∂ b
3	Bowen et al., 2015 (USA)	patients (fixed maxillary edgewise appliances)	Young adults: 10-18 years (n=50)	Audiovisual presentation on oral hygiene care followed by 2-3 text messages per week for 4 weeks, then 1 text message per week for 8 weeks.	Asynchronous (store and forward)	Only audiovisual presentation about oral hygiene care	Planimetry-based evaluation of plaque values evaluation (Digimizer software)	b
4	Al-Silwadi et al. 2015 (United Kingdom)	patients (scheduled to receive fixed orthodontic appliance)	Others: \geq 13 years (n=60)	Following the distribution of oral health education and leaflets on oral health and fixed appliance care, an email was sent inviting participants to view a video providing the same information.	Other	Only oral health education, leaflets on oral health and care of fixed appliances	Knowledge of dental and appliance care	

5	Abdaljawwad, 2016 (Iraq)	patients (fixed orthodontic appliances)	Young adults: 17-23 years (n=34)	After OHI, text messages twice a week for 4 weeks and once a week for 8 weeks.	Asynchronous (store and forward)	Only OHI	Bleeding Index (BI), Modified Gingival Index (MGI), Plaque Index (PI)	b
6	Cozzani et al., 2016 (Italy)	patients (begin fixed orthodontic treatment)	Others: mean age: 13.5 ± 1.7 years (n=84)	1. after the OHI, a reinforced text message 2. phone call 5-7 hours after initial bonding	Mobile health (mHealth)	Only OHI	Oral Hygiene Index, by Silness and Loe's Modified Index, Plaque Index (PI)	b
7	Zotti et al., 2016 (Italy)	patients (full fixed appliances in both arches)	Others: mean age: control group 13.6 years, study group 14.1 years (n=80)	OHI by taking video tutorials in WhatsApp chat rooms and sharing selfies as part of the "Brush Game."	Asynchronous (store and forward)	Only OHI	Plaque index (PI), gingival index (GI), white spot (WS), caries presence	b
8	Li et al., 2016 (China)	patients (begin fixed appliance and single-phase orthodontic treatment)	Young adults: 12-21 years (n=244)	Signed up for a WeChat account and received twice-weekly behavioral reminders and 2-3 educational messages per week throughout the treatment period.	Mobile health (mHealth)	Only orthodontic strategy and pretreatment education as in the WeChat group	Length of treatment Failure to keep appointments, tardiness Bracket bond failure Orthodontic PI, modified gingivitis index	∅
9	Iqbal et al., 2017 (Pakistan)	patients (full-fixed orthodontic appliances)	Young adults: 15-25 years (n=100)	Weekly text message reminders after OHI for 60 days	Asynchronous (store and forward)	Only OHI	Bleeding Index (BI), Modified Gingival Index (MGI), Plaque Index (PI)	b
10	Alkadhhi et al., 2017 (Saudi Arabia)	patients (fixed orthodontic appliances)	Others: ≥ 12 years (n=44)	Mobile application for video oral hygiene instruction and proactive reminders three times a day for one month.	Mobile health (mHealth)	Only OHI during visits	Plaque and Gingival indices (PI and GI)	∅
11	Kumar et al., 2018 (India)	patients (fixed orthodontic appliances)	Young adults: 13-19 years (n=60)	Weekly text message reminders after OHI for 3 months	Asynchronous (store and forward)	Only OHI	Plaque index (PI) and WSL status	b
12	Deleuse et al., 2020 (Belgium)	patients (full-fixed orthodontic appliances)	Young Adults: 12-18 years (n=38)	Interactive oscillating/rotating electric toothbrush connected to a brushing assistance app	Mobile health (mHealth)	Only oscillating/rotating electric toothbrush	Plaque index (PI), gingival index (GI), white spot lesion (WSL)	∇
13	Scheerman et al., 2020 (Netherlands)	patients (fixed orthodontic appliances)	Others: mean age: study group 13.2±1.01 years, control group 13.5±0.97 years (n=121)	Use the "White Teeth" mobile application to reinforce plaque control daily for 12 weeks.	Mobile health (mHealth)	OHI and oral health education when dental visits	Plaque index (PI) and Bleeding on marginal probing index (BOMP)	b
14	Al-Moghrabi et al., 2020 (UK)	participants (scheduled for removable retention with thermoplastic retainer (TPR))	Young adults: 12-21 years (n=84)	Use "My Retainers", a mobile application that reminds users to wear orthodontic retainers	Mobile health (mHealth)	Reminder of retainer wear chart	Stability, plaque level, bleeding during probing and depth of probing, level of patient experience and knowledge regarding retainers	∇
15	Farhadifard et al., 2020 (Iran)	patients (started their fixed orthodontic treatment)	Others: mean age: study group 18.7 ± 3.87 years, control group: 19.27 ± 3.65 years (n=120)	In addition to conventional oral hygiene instruction, the team educated the patients to use a smartphone app (Brush DJ) that includes timers and daily reminders to assist in improving oral hygiene.	Mobile health (mHealth)	Conventional oral hygiene instruction	Plaque Index (PI) and Gingival Index (GI)	∅
16	Sangalli et al., 2021 (Hong Kong)	patients (scheduled to start an orthodontic treatment)	Others: mean age: study group 24.9±10.9 years, control group: 6.3±3.2 years (n=30)	A scan box and cheek retractor (Dental Monitoring@) were provided and the patient was instructed to perform a monthly intraoral scan.	Remote patient monitoring (RPM)	Only in-person toothbrushing instruction	Plaque Index (PI), Gingival Index (GI), and White Spot Lesions (WSL)	b
Preventive Dentistry								
17	Jadhav et al., 2016 (India)	social work colleges (two different)	Young adults: 18-20 years (n=400)	OHI and oral health education followed by oral health education text messages sent twice a week for 3 months	Mobile health (mHealth)	Only OHI and oral health education	Oral Hygiene Index and Gingival Index (GI)	b

18	Williams et al., 2018 (USA)	participants (mild to moderate periodontitis)	Adults: 21-80 years (n=60)	View oral hygiene instruction, brushing and flossing presentations on computer	Asynchronous (store and forward)	Only OHI with visual aids	Plaque score (PS) and bleeding index (BL)	∇
19	Marchetti et al., 2018 (Brazil)	students (technical high school)	Young adults: 14-19 years (n=263)	1. Verbal oral health education and reinforced messages via mobile app for 30 days. 2. oral health education video and reinforced messages via mobile app for 30 days. 3. oral health education video only	Mobile health (mHealth)	Only verbal oral health education	Knowledge Score (KS), simplified oral hygiene index (OHI-S), Gingival Bleeding Index (GBI)	b
20	Araújo et al., 2019 (Portugal)	patients (> 20 teeth, and bleeding on marginal probing index over 0.5)	Others: mean age: control group 13.6 years, study group 14.1 years	OHI using intraoral camera during the visit and/or text messages between visits	Asynchronous (store and forward)	Only OHI	Bleeding on marginal probing (BOPM), dental hygiene, behavior change	b
21	Scheerman et al., 2020 (Iran)	students (public high school)	Others: high school students, 12-17 years, with and without their mothers (n=791)	1. use of the Dental Health telegram channel for patients to receive oral hygiene education via text message or video 2. use of the Telegram channel for mothers to receive oral health education and instructions for teaching and monitoring their children's oral health.	Combination	Without intervention	Psychosocial variables, toothbrushing behavior, Visual Plaque Index (VPI), Community Periodontal Index (CPI)	√
22	Vpk et al., 2020 (India)	patients (cerebral palsy)	Children: 4-12 years (n=53)	Video based oral health education following OHI	Mobile health (mHealth)	Only OHI	Oral hygiene status, including the simplified oral hygiene index (OHI-S), plaque index (PI), and gingival index (GI)	b
23	Shida et al., 2020 (Japan)	participants (Kyoto University)	Others: ≥18 years, mean age: control group 25.0 years, study group 26.0 years (n=112)	After the video based OHI, a real-time visualization brushing instruction device (GUMPLAY) linked to a mobile application was used for 4 weeks.	Mobile health (mHealth)	After the OHI by video, brush with the same device without connecting it to the application.	Plaque control record (PCR) score	∇
24	Marchetti et al., 2020 (Brazil)	students (high school)	Young adults: 14-19 years (n=291)	Video-based dental flossing and counseling to communicate oral hygiene knowledge twice a day for 30 days (VD + smartphone app, VD without app)	Mobile health (mHealth)	Dental floss and oral counseling (OR+ app, OR without app)	Simplified oral hygiene index (OHI-S) and gingival bleeding index (GBI)	∂
25	Lee et al., 2021 (Korea)	adults (enrolled at a senior college and senior welfare center)	Others: ≥65 years (n=73)	1. Receive lecture-type oral health education using PowerPoint slides (non-app use group) 2. Receive oral health education using a smartphone application developed in this study.	Mobile health (mHealth)	Without intervention	Oral health knowledge score, O'Leary index, and tongue coating	∇
Pediatric Dentistry								
26	Plonka et al., 2013 (Australia)	children (areas of low socioeconomic status)	Others: Infants within two months of birth and caregivers (n=246)	Home visits and phone calls	Other	Without intervention	Prevalence of Early Childhood Caries (ECC)	∂
27	Hashemian et al., 2015 (USA)	Mothers (bringing a child aged 5 years or younger for dental care)	Others: 18-56 years	Along with the usual care printed materials, they received text messages regarding oral health information.	Mobile health (mHealth)	Only the usual print materials	Oral health knowledge and oral health behaviors (including improving oral health behaviors for their children)	b

28	Iskander, M., et al., 2016 (USA)	adult (accompanied a child to the dental appointment)	Adults 36-45 years (n=89)	Oral health education with "Dental Trauma mobile healthcare" application (permanent tooth avulsion scenario)	Mobile health (mHealth)	Oral health education with "Save Your Tooth" poster (assuming primary tooth injury)	Knowledge of permanent tooth avulsion	∂
29	Zotti et al., 2019 (Italy)	patients (3 private dental practices)	Others: 4-7 years with one of their parents (n=100)	Use the OHI motivational mobile apps "Time2Brush" and "Brusheez-The Little Monsters Toothbrush Timer" for children over and under five, respectively.	Mobile health (mHealth)	Only OHI	Plaque Index (PI), presence of caries, localization of carious lesions	b
30	Alkilzy et al., 2019 (Germany)	children (an almost complete deciduous dentition)	Children: mean age: 5.1 ± 0.6 years (n=49)	OHI adds toothbrush mobile application	Mobile health (mHealth)	Only OHI	Plaque and papillary bleeding indices (QHI, PBI)	b
Oral and Maxillofacial Surgery								
31	Salazar-Fernandez et al., 2012 (Spain)	patients (TMDs)	Children: 1-5 years (n=1052)	Digital TMJ and panoramic radiographic consultation via intranet e-mail	Asynchronous (store and forward)	Conventional consultation system at the hospitals	Clinical effectiveness, consultation costs, and patient satisfaction	∇
32	Wang et al., 2019 (Taiwan)	patients (admitted at a general hospital for curative oral cancer surgery)	Adults: 30-82 years (n=60)	A 12-week intervention program (warm compresses, masticatory muscle massage, and jaw exercises) three times a day, with additional telephone support after discharge.	Other	Only 12-week intervention program	Maximum Interincisal Opening (MIO)	b
33	Takeuchi-Sato et al., 2019 (Japan)	patients (TMDs)	Others: mean age: 30.7 ± 8.7 years, (n=30)	Cognitive Behavioral Therapy (CBT), email recording and reminder system, sticky note reminders	Mobile health (mHealth)	Brief oral instructions to avoid non-functional tooth contact (n-FTC) during the day	Pain-free opening aid	∂
34	Omezli et al., 2020 (Turkey)	patients (scheduled to undergo impacted lower third molar removal)	Others: mean age: study group 22.93 ± 5.83 years, control group 23.12 ± 4.99 years (n=113)	Third molar surgery video	Other	Third molar surgery verbal information	Anxiety	ç

∂ Teledentistry is more favorable than the conventional method, ∇ Teledentistry is not different from the conventional method, b Teledentistry along with conventional methods is more effective than conventional ones alone, ç Teledentistry is less favorable than the conventional method, √ others (Teledentistry was effective to deliver oral health education among high-school students, especially with the involvement of their mothers), OHI – Oral Health Instruction

more effective than in-person dentistry in contemporary dental fields:

1. In which dentistry fields is teledentistry most utilized?
2. How does the effectiveness of teledentistry compare to in-person dentistry in terms of patient education, behavior modification, professional communication, and cost-effectiveness?
3. In which countries is teledentistry more frequently utilized based on economic context?

2.2. Eligibility Criteria

The study included evidence-based research published in English between January 2011 and December 2021, focusing on teledentistry interventions. Eligible studies involved participants of all ages and sexes who received teledentistry services, with conventional dental treatment or oral health instruction as the control or comparison group. Primary outcomes assessed teledentistry's usability through clinical indices, behavioral modifications, Knowledge Attitude Practice (KAP) metrics, or cost-effectiveness analyses, while a secondary outcome explored teledentistry utilization concerning coun-

tries' economic status. Studies were excluded if they lacked comparison with conventional methods, were not original research, or were not written in English.

2.3. Study selection, and data extraction

Two independent reviewers (TH and BP) conducted the literature review and screened titles and abstracts to identify studies that met the inclusion and exclusion criteria. They compiled lists of selected studies for each research question, which were then compared. By discussing each source, they reached a definitive consensus on which studies to include for each question. Any discrepancies during the screening and selection processes were resolved through discussions between the two reviewers. If disagreements persisted, additional reviewers (RK and TZ) were consulted to reach a consensus. Once consensus was reached, the full texts of the selected literature were collected and independently assessed by the same reviewers. Only studies with sufficient data were included in the analysis, with discrepancies resolved through discussion. The reviewers extracted data using a standardized form, collecting general information such as authors, title,

year of publication, journal name, study aims, design, level of evidence, relation to COVID-19, number of participants, countries of research, study setting, dental specialty, type, and mode of teledentistry intervention, comparison with in-person dentistry, and outcomes. Outcome information was extracted from the included studies.

2.4. Quality Assessment

Two reviewers independently assessed the quality and risk of bias in the data extraction process, following the guidelines from a modified version of the Downs and Black checklist [23]. The quality of each including randomized controlled trials (RCTs), and non-randomized controlled trials (NRCTs) was evaluated. This instrument evaluates the risk of bias across 27 items in five sub-scales (Table 3). This instrument is based on the following components that define study quality and evaluate the risk of bias: reporting, external validity, internal validity (bias and confounding (selection bias)), and power.

The bias was rated on a 4-point scale (No risk 0, partial risk 1, clear risk 2, UTD unable to determine) for each domain, depending on the reviewers. The studies were categorized into four quality levels based on their scores [24] (Table 4). The risk of bias was summarized by considering the assessments for each domain and synthesizing them into an overall judgment of the study: (excellent 26-28; Good 20-25; Fair 15 -19 or poor less than or equal to 14). Further disagreements were resolved through discussion with input from other reviewers (RK and TZ).

2.5. Data synthesis and management

Data synthesis and management were facilitated through Microsoft Excel. The citation management tool Endnote X9 (Clarivate Analytics, New York, United States) was used for reference management.

2.6. Reporting

The PRISMA flowchart and checklist were utilized to ensure transparent and comprehensive reporting of the literature search and review process.

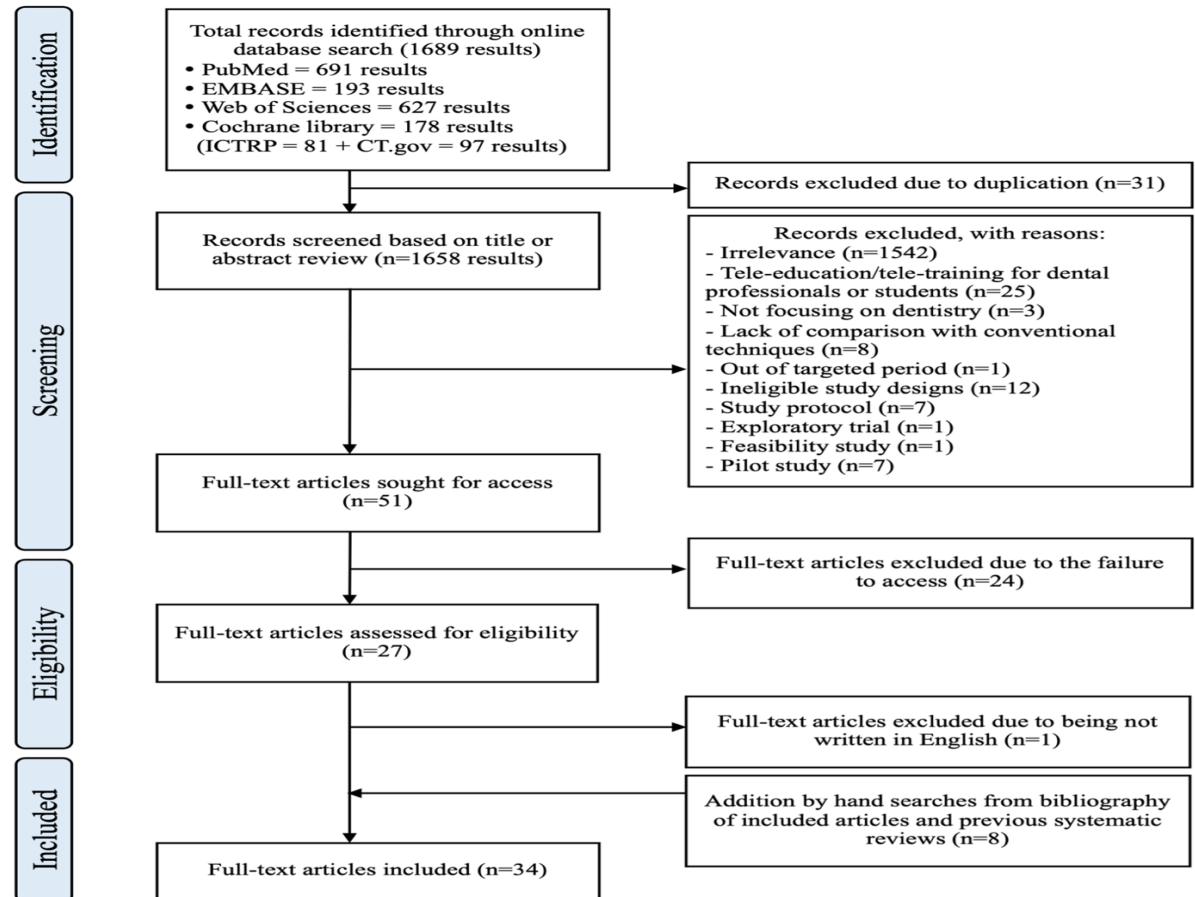


Figure 1. PRISMA flowchart: This diagram illustrates the methodological procedure used to incorporate publications in the systematic review of teledentistry (2011–2021).

3. RESULTS

3.1. Characteristics of the included articles

This systematic review analyzed 34 studies, comprising 31 randomized controlled trials and three nonrandomized controlled trials [5,15,25]. The literature search across multiple databases yielded 1,689 initial results, with 34 articles meeting the inclusion criteria after rigorous screening (Figure 1). The excluded studies are detailed in the supplementary materials (Table 2).

The included studies demonstrated the significant utility of teledentistry at individual level, primarily in oral health education, behavioral modification, and reinforcement. Most studies were conducted in educational settings (high schools and dental colleges) and healthcare facilities. One study specifically examined professional communication [5] while several incorporated follow-up reminder systems. Notably, no studies provided evidence of tele-treatment implementation. The primary outcome measures utilized were clinical indices, often in combination with knowledge assessments,

Table 2. Different outcomes measure of included studies.

Outcome measures	Orthodontic Dentistry	Preventive Dentistry	Pediatric Dentistry	Oral and Maxillofacial Surgery	Total number of studies
Clinical Indices	13	5	3	3	24
KAP	1	0	1	0	2
Clinical Indices & KAP	1	2	0	0	3
Clinical Indices and behavior modification	1	2	0	0	3
Behavior modifications and KAP	0	0	1	0	1
Cost and satisfaction	0	0	0	1	1

KAP refers to the knowledge, attitude, and practice of the participants. Detailed outcome measures are reported in Table 1.

behavioral modifications, Knowledge-Attitude-Practice (KAP) evaluations, and cost-effectiveness analyses.

3.2. Quality assessment results

An evaluation of 34 teledentistry studies using the Downs and Black checklist revealed varied quality levels (Table 4). While nearly half (47.1%) of the studies were rated as good quality, about one-fifth (20.5%) were considered poor, and none achieved excellent quality.

Most of the articles demonstrated high standards in reporting quality. However, specific methodological

concerns were identified in two studies: one lacked external validity [10], potentially limiting the generalizability of its findings, while another one exhibited a high risk of internal validity [26], which may affect the reliability of its results.

Notably, over two-thirds of the studies had sufficient statistical power to detect treatment effects, indicating appropriate sample sizes and analyses to support their conclusions. This assessment provides a crucial context for interpreting teledentistry research, highlighting strengths and weaknesses. It offers valuable insights into the overall quality of evidence.

Table 4. Quality assessment result of included studies.

Article No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	
Reporting	8	7	6	9	6	9	8	5	9	6	6	10	7	5	9	6	6	9	10	9	7	10	8	9	10	9	10	10	8	10	10	8	9	10	
external validity	1	3	1	1	1	1	2	1	2	1	1	2	1	1	2	1	1	1	1	1	2	2	0	2	2	1	2	2	1	2	2	3	1		
internal validity - bias	3	1	4	5	5	3	4	7	6	4	5	6	5	5	4	5	6	6	4	7	7	4	4	6	6	7	6	6	6	5	5	5	3		
internal validity - confounding (selection bias)	1	3	1	3	3	5	2	0	4	2	2	4	0	1	4	1	2	5	4	3	3	5	5	4	6	6	3	5	4	4	5	4	4	2	
Power	0	1	0	0	1	1	1	0	1	1	0	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	
Overall Score	13	15	12	18	16	20	16	10	23	16	13	22	15	12	21	12	14	22	21	18	19	25	20	18	25	23	22	24	20	22	23	20	22	17	
Quality	*	**	*	**	**	‡	**	*	‡	**	*	‡	**	*	‡	*	*	‡	‡	**	**	‡	**	**	‡	‡	‡	‡	‡	‡	‡	‡	‡	‡	**

‡ Good quality, ** Fair quality, * Poor quality, [excellent (26–28); good (20–25); fair (15–19); and poor (≤14)]

3.3. Teledentistry usage according to fields of dentistry

According to the current review, teledentistry interventions can be broadly categorized into three groups: customized applications for oral health education, in-office education with remote reinforcement measures, and supervision tools connecting specialists with general dentists to minimize referrals. Table 2 provides a comprehensive distribution of study outcomes across various dental specialties.

The studies included covered various dental specialties, with orthodontics (15 studies) being the most represented [10-14,17,20,25,27-34], followed by preventive dentistry (8 studies) [15,18,21,35-40], pediatric dentistry (5 studies) [26,41-44], and oral and maxillofacial surgery (5 studies) [5,19,45, 46]. Each specialty employed diverse objectives, methodologies, and outcome measures to assess teledentistry's efficacy compared to in-person dentistry. Studies predominantly emphasized three key areas: clinical indices, oral health knowledge and behaviors, and overall clinical effectiveness.

3.3.1. Orthodontic Dentistry

Most studies indicate that a combined approach of teledentistry and in-person dental practices can enhance oral health outcomes for orthodontic treatment. Digital health technologies, including mobile applications, SMS notifications, telephone communications, and specialized software, have proven effective for patient appointment reminders and engagement. A significant number of orthodontic studies (nine in total) advocate for this integrated approach to improve the oral health of orthodontic patients. While four studies demonstrated that teledentistry outperformed in-person dentistry in enhancing oral hygiene, two studies found no significant difference between the two approaches. Regarding outcome measures, clinical indices such as plaque index, gingival index, and bleeding on probing are predominantly used according to the study. Many studies utilized clinical indices and assessments of patient knowledge or evaluations of behavioral modifications. It is worth noting that one study employed a Knowledge, Attitude, and Practice (KAP) assessment as an outcome measure. The methodologies and findings underscore the evolving nature of teledentistry applications in orthodontic care.

3.3.2. Preventive Dentistry

This systematic review reveals that preventive dentistry is the second most prevalent field for teledentistry applications. Integrating teledentistry with in-person dental practices shows considerable promise. While some research suggests that both are comparably effective, other studies argue that teledentistry demonstrates superior outcomes. Notably, teledentistry has shown efficacy in disseminating oral health education within high school settings.

Similar to the studies in orthodontics, clinical indices are predominantly utilized as primary outcome measures. However, a more comprehensive approach is often adopted, combining these clinical indices with assessments of patient knowledge or evaluations of behavioral modifications. This provides a more holistic understanding of teledentistry's impact on preventive dental care, encompassing both clinical outcomes and patient-centered factors.

3.3.3. Pediatric Dentistry

Three studies advocate for an integrated approach that combines teledentistry with conventional methods. However, two additional studies propose that teledentistry alone may offer superior outcomes in pediatric dental care.

Regarding the outcome measures, most pediatric dentistry studies rely on clinical indices as their primary evaluation tool. This approach aligns with the broader trend observed across dental specialties. Notably, two studies employ alternative assessment methods: one focuses on behavioral modification outcomes, while another utilizes the Knowledge, Attitude, and Practice (KAP) assessment.

3.3.4. Oral and Maxillofacial Surgery

Research in this area offers varied recommendations, reflecting the complex nature of surgical interventions. Some studies advocate for an integrated approach, combining teledentistry with in-person dentistry. Others propose that teledentistry alone can be sufficient. Conversely, some research supports in-person dentistry, particularly for oral health education in surgical contexts.

The most common primary outcome measures are clinical indices. However, one notable study examines cost-effectiveness and patient satisfaction, which offers valuable insights into the economic and patient-centered aspects of teledentistry in surgical settings, providing a more comprehensive evaluation of its potential benefits and challenges.

3.4. Effectiveness of teledentistry compared to in-person dentistry

The analysis reveals that mobile health technologies emerged as the predominant communication method, closely followed by asynchronous techniques for remote patient monitoring. Interestingly, one study [17] combined both asynchronous and synchronous (real-time or live interaction) approaches, though it is worth noting that no research employed synchronous techniques exclusively.

The application of teledentistry varied across the literature reviewed. While most studies implemented teledentistry as a complementary tool for oral hygiene instruction, education, and behavioral reminders, three studies explored its potential in different contexts. Specifically, these studies utilized teledentistry as an adjunct to physical exercises [19], professional consultation [5], and behavioral therapy [45].

3.5. Teledentistry usage according to income economy

The current review examined teledentistry adoption across 21 nations, as illustrated in Table 3, and reveals a distinct pattern of implementation correlated with the economic status. High-income countries demonstrate a well-established integration of teledentistry services into their healthcare systems. The review also identifies an emerging trend in upper-middle and lower-middle-income countries, where teledentistry utilization is gaining momentum and showing significant growth. However, there were no data on teledentistry utilization available from low-income countries in the current review.

Table 3. Distribution of the Number of studies based on the Countries' economic status.

No.	Country	Income Economy*	Number of Studies
1	Belgium	High	1
2	Germany	High	1
3	Italy	High	3
4	Japan	High	2
5	Netherlands	High	1
6	Portugal	High	1
7	Saudi Arabia	High	1
8	Spain	High	1
9	Taiwan	High	1
10	UK	High	2
11	USA	High	3
12	Australia	High	1
13	Korea	High	1
14	Hong Kong	High	1
15	Brazil	Upper-middle	2
16	China	Upper-middle	1
17	Iraq	Upper-middle	1
18	Turkey	Upper-middle	1
19	India	Lower-middle	5
20	Iran	Lower-middle	1
21	Pakistan	Lower-middle	1

*Countries' income economy according to the World Bank is described in Supplementary file (S4 Table)

4. DISCUSSION

This systematic review reveals the potential of teledentistry to complement and, in some cases, better in-person dentistry in terms of efficacy and accessibility, particularly in oral health education, behavioral modification, and reinforcement. However, it is not yet being utilized for tele-treatment. Orthodontics employed teledentistry most commonly, followed by preventive dentistry, pediatric dentistry, and oral

and maxillofacial surgery. Most studies found that integrating teledentistry with in-person dentistry improved patient outcomes. Mobile health technologies and asynchronous communication emerged as the most common teledentistry approaches. While the quality of the studies was good, some lacked robust design. Teledentistry shows promise in enhancing dental care, especially when used alongside in-person dentistry. High-income nations have well-established teledentistry services, while middle-income countries are increasingly adopting these technologies. However, there was a lack of data on teledentistry in low-income countries.

4.1. Field of Teledentistry

Teledentistry has demonstrated applications across dental specialties, with orthodontics emerging as the primary field of utilization. Research shows that integrating teledentistry with traditional practices significantly enhances oral health outcomes. Digital health technologies, including mobile applications and SMS notifications, have effectively improved patient engagement and appointment management.

Teledentistry has proven particularly effective in disseminating oral health education in high school settings. Across specialties, clinical indices serve as the primary outcome measures, often complemented by assessments of patient knowledge, behavioral changes, and unique evaluations such as Knowledge, Attitude, and Practice (KAP) assessments and cost-effectiveness analyses. This comprehensive approach provides a more holistic understanding of teledentistry's impact, highlighting its potential to revolutionize dental care across various specialties.

While existing studies have predominantly focused on teledentistry's role in health education and behavior modification, it is high time to broaden the research scope. Future investigations should explore its potential in professional consultations and diagnostic processes, areas that remain underexplored but offer significant potential for enhancing remote dental care delivery.

4.2. Effectiveness of Teledentistry

Teledentistry was found to be effective in improving patient education and behavior modification across various dental specialties. It also has the potential to enhance professional communication and may offer cost-effective solutions in certain scenarios. However, the effectiveness can vary depending on the specific application and dental specialty, highlighting the need for continued research and evaluation in this evolving field.

4.2.1. Patient Education

Teledentistry has shown significant promise in enhancing patient education across various dental specialties. In orthodontics and preventive dentistry, digital health technologies such as mobile applications and SMS notifications have proven effective in disseminating oral health information [9,47]. Notably, teledentistry has demonstrated efficacy in providing oral health education within high school settings [41]. The use of these technologies allows for consistent and accessible educational content, potentially improving patients' understanding of their oral health needs and treatment processes.

4.2.2. Behavior modification

The implementation of teledentistry has shown positive results in modifying patient behaviors. Several studies incorporated assessments of behavioral modifications as outcome measures, suggesting that teledentistry interventions can effectively encourage better oral hygiene practices with positive behavioral modifications [19]. For instance, in orthodontics, mobile applications and reminders have been associated with improved oral hygiene among patients with fixed appliances. This indicates that teledentistry can be a valuable tool for reinforcing positive oral health behaviors between in-person visits.

4.2.3. Professional communication

Teledentistry has shown potential implications for professional communication. Teledentistry is recognized as a supervision tool connecting specialists with general dentists to minimize referrals [9,47]. This suggests that teledentistry can facilitate improved communication and collaboration between dental professionals, potentially leading to more efficient patient care and reduced unnecessary referrals [17]. In fields like oral and maxillofacial surgery, where some studies supported an integrated approach, teledentistry likely plays a role in enhancing communication between surgeons and other dental professionals involved in patient care.

4.2.4. Cost-effectiveness

There is limited direct information on cost-effectiveness, however, cost-effectiveness alongside patient satisfaction was also assessed. This might suggest that cost-effectiveness is an important consideration in teledentistry implementation. We can infer that teledentistry may offer cost-effective solutions in certain scenarios, such as reducing the need for in-person visits for routine check-ups or follow-ups, particularly in orthodontics and preventive dentistry. However, more research specifically focused on the economic aspects of teledentistry across different specialties would be beneficial.

4.3. Economic context

Teledentistry offers substantial economic benefits for the dental healthcare sector, providing potential cost and time savings compared to traditional in-person dentistry. This allows the management of more patients in less time [47], facilitating quick consultations and referrals [3], which translates into economic benefits for both dental practices and patients [3].

The adoption of teledentistry is progressing globally, but its integration varies considerably based on a country's economic resources and healthcare infrastructure. This variation highlights teledentistry's potential to bridge healthcare gaps across diverse economic landscapes. However, the review uncovered a significant data gap regarding teledentistry implementation in low-income countries, raising important questions about global health equity.

This disparity underscores the need for further research and exploration of opportunities for teledentistry expansion in resource-limited settings. By addressing these gaps, teledentistry could play a crucial role in improving access to dental care and reducing healthcare disparities worldwide.

Teledentistry offers significant advantages on an individual level, reducing out-of-pocket expenses and minimizing time off work. However, its implementation necessitates initial investments in technology—such as intraoral cameras, imaging systems, and reliable internet connections and training for healthcare professionals [48-50]. While these upfront costs are substantial, they may yield long-term economic benefits through improved efficiency and expanded reach, particularly in serving underserved populations.

Integrating teledentistry with broader healthcare systems could further enhance economic efficiencies by reducing redundancies and improving coordinated care. The COVID-19 pandemic has highlighted teledentistry's potential to provide economic resilience during health crises [51,52]. Although specific figures are not provided, the study suggests that teledentistry has the potential for positive economic impacts through cost savings, improved efficiency, and better resource allocation in dental care delivery [5].

Achieving these economic benefits, however, requires addressing implementation challenges and carefully balancing initial investments against long-term gains. As teledentistry continues to evolve, its economic impact on both individual patients and healthcare systems at large promises to be significant, potentially reshaping the landscape of dental care delivery.

4.4. Evaluation of the risk of bias and limitations of this systematic review

The quality assessment of the studies suggests that while the field has a solid foundation of research, there's significant room for improvement in research methodologies. Most studies excelled in reporting standards and statistical power, indicating strong documentation practices and appropriate sample sizes. However, specific methodological concerns were identified in some studies, particularly regarding external and internal validity. These issues potentially limit the generalizability and reliability of certain findings.

Despite these challenges, it provides valuable insights into teledentistry, offering a foundation for future research. It highlights both strengths (good reporting, sufficient statistical power in many studies) and weaknesses (lack of excellent-quality studies, some methodological issues) in the current literature.

REFERENCES

- Peng X, Xu X, Li Y, et al. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci*. 2020 Mar 3;12(1):9. doi: 10.1038/s41368-020-0075-9. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Wax RS, Christian MD. Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients. *Can J Anaesth*. 2020 May;67(5):568-576. doi: 10.1007/s12630-020-01591-x. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
- World Health Organization, *Report of the Global mOralHealth Report*. Workshop: 10-12 October 2018. 2019:1-27. <https://iris.who.int/handle/10665/326149>.
- Ramesh N, Pankaj A, Archana JS, et al. Teledentistry: knowledge and attitudes among dentists in Udaipur, India. *Oral Health Dent Manag*. 2013 Sep;12(3):138-144. [PubMed](#) [Google Scholar](#)
- Salazar-Fernandez CI, Herce J, Garcia-Palma A, et al. Telemedicine as an effective tool for the management of temporomandibular joint disorders. *J Oral Maxillofac Surg*. 2012 Feb;70(2):295-301. doi: 10.1016/j.joms.2011.03.053. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- WHO Global Observatory for eHealth. Telemedicine: opportunities and developments in Member States: report on the second global survey on eHealth. *World Health Organization*. 2010:1-93. <https://iris.who.int/handle/10665/44497>

While this analysis provides valuable insights into the current state of teledentistry research across various dental specialties, there are limitations to consider, including the lack of consideration for specialty areas of dentistry, or specified dental treatment, limited consideration for teledentistry approach and the exclusion of non-English literature. To advance the field, future studies should focus on enhancing methodological rigor, aiming for excellent quality to strengthen the evidence base and improve the applicability of teledentistry research findings. Future research should explore the use of teledentistry in specific dental fields, encourage its application in targeted treatment areas, and maintain a focus on oral hygiene control as a top priority. Furthermore, studies with more robust designs, larger sample sizes, and longer follow-up periods should be conducted to strengthen the evidence base for teledentistry.

5. CONCLUSION

Teledentistry shows promise across dental specialties, particularly in orthodontics, for patient education and behavior modification. It offers potential cost and time savings but faces implementation challenges. Adoption of teledentistry varies by each country's income level. Integration with traditional in-person care is beneficial. Future research should focus on long-term outcomes, patient satisfaction, and economic impacts globally.

CONFLICT OF INTEREST

Author declare that there is no conflict of interests.

AUTHOR CONTRIBUTIONS

The study framework was conceived and designed by **RK** and **HO** (Hiroshi Ogawa). **TH** and **BP** conducted a thorough search for scientific literature and evaluated the risk of bias, under the guidance of **RK** and the assistance of **TZ**. The interpretation of the results was performed by **RK**, **TH**, **TZ**, and **HO** (Hikaru Okubo). The manuscript was written primarily by **TZ**, with **TH**'s contributions. All authors provided constructive feedback and contributed to the development of the research, data synthesis, and manuscript preparation.

ACKNOWLEDGMENTS

Special thanks are extended to all the colleagues and staff from the Division of Preventive Dentistry, Niigata University, and Mahidol University.

- American Dental Association*. D9995 and D9996 – ADA Guide to Understanding and Documenting Teledentistry Event. January 1, 2023 Available from: [v4_d9995andd9996_adaguidetounderstandinganddocumentingteledentistryevents_2023jan.pdf](https://www.ada.org/en/about/governance/current-policies/ada-policy-on-teledentistry)
- American Dental Association*. ADA Policy on Teledentistry. 2021; Available from: <https://www.ada.org/en/about/governance/current-policies/ada-policy-on-teledentistry>.
- Estai M, Kanagasigam Y, Tennant M, Bunt S. A systematic review of the research evidence for the benefits of teledentistry. *J Telemed Telecare*. 2018 Apr;24(3):147-156. doi: 10.1177/1357633X16689433. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Deleuse M, Meiffren C, Bruwier A, et al. Smartphone application-assisted oral hygiene of orthodontic patients: a multicentre randomized controlled trial in adolescents. *Eur J Orthod*. 2020 Dec 2;42(6):605-611. doi: 10.1093/ejo/cjz105. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Kumar GS, Kashyap A, Raghav S, et al. Role of text message reminder on oral hygiene maintenance of orthodontic patients. *J Contemp Dent Pract*. 2018 Jan 1;19(1):98-101. doi: 10.5005/jp-journals-10024-2219. [PubMed](#) [Google Scholar](#) [Scopus](#)
- Li X, Xu ZR, Tang N, et al. Effect of intervention using a messaging app on compliance and duration of treatment in orthodontic patients. *Clin Oral Investig*. 2016 Nov;20(8):1849-1859. doi:

Evidence-based application of teledentistry: a systematic review

10.1007/s00784-015-1662-6.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 13. Iqbal J, Awan R, Parvez MA, et al. Effectiveness of text message instructions on oral hygiene for orthodontic patients. *Pakistan Oral & Dental Journal*. 2017;37(2):278-282.
[Google Scholar](#)
 14. Alkadh OH, Zahid MN, Almanea RS, et al. The effect of using mobile applications for improving oral hygiene in patients with orthodontic fixed appliances: a randomised controlled trial. *J Orthod*. 2017 Sep;44(3):157-163. doi: 10.1080/14653125.2017.1346746.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 15. Jadhav HC, Dodamani AS, Karibasappa GN, et al. Effect of reinforcement of oral health education message through short messaging service in mobile phones: a quasi-experimental trial. *Int J Telemed Appl*. 2016;2016:7293516. doi: 10.1155/2016/7293516.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 16. Wang Y, Peng J, Li Y, et al. Association between tooth loss and risk of oesophageal cancer: a dose-response meta-analysis. *Springerplus*. 2016 Jul 8;5(1):1020. doi: 10.1186/s40064-016-2711-6.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 17. Zotti F, Dalessandri D, Salgarello S, et al. Usefulness of an app in improving oral hygiene compliance in adolescent orthodontic patients. *Angle Orthod*. 2016 Jan;86(1):101-107. doi: 10.2319/010915-19.1.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 18. Marchetti G, Fraiz FC, Nascimento WMD, et al. Improving adolescents' periodontal health: evaluation of a mobile oral health App associated with conventional educational methods: a cluster randomized trial. *Int J Paediatr Dent*. 2018 Jul;28(4):410-419. doi: 10.1111/ipd.12371.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 19. Wang TJ, Su JH, Leung KW, et al. Effects of a mouth-opening intervention with remote support on adherence, the maximum interincisal opening, and mandibular function of postoperative oral cancer patients: A randomized clinical trial. *Eur J Oncol Nurs*. 2019 Jun;40:111-119. doi: 10.1016/j.ejon.2019.04.001. Erratum in: *Eur J Oncol Nurs*. 2019 Aug;41:195. doi: 10.1016/j.ejon.2019.06.009.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 20. Scheerman JFM, van Meijel B, van Empelen P, et al. The effect of using a mobile application ("White Teeth") on improving oral hygiene: a randomized controlled trial. *Int J Dent Hyg*. 2020 Feb;18(1):73-83. doi: 10.1111/idh.12415.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
 21. Vpk V, Mohanty VR, Balappanavar AY, et al. Effectiveness of different parenting interventions on oral hygiene of cerebral palsy children: a randomized controlled trial. *Spec Care Dentist*. 2020 Jul;40(4):335-343. doi: 10.1111/scd.12481.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 22. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021 Mar 29;372:n71. doi: 10.1136/bmj.n71.
[Full text links](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 23. Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health*. 1998 Jun;52(6):377-84. doi: 10.1136/jech.52.6.377.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 24. Hooper P, Putai JW, Strong G, Russell-Minda E. Age-related macular degeneration and low-vision rehabilitation: a systematic review. *Can J Ophthalmol*. 2008 Apr;43(2):180-7. doi: 10.3129/i08-001.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
 25. Sangalli L, Savoldi F, Dalessandri D, et al. Effects of remote digital monitoring on oral hygiene of orthodontic patients: a prospective study. *BMC Oral Health*. 2021 Sep 7;21(1):435. doi: 10.1186/s12903-021-01793-9.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 26. Plonka KA, Pukallus ML, Barnett A, et al. A controlled, longitudinal study of home visits compared to telephone contacts to prevent early childhood caries. *Int J Paediatr Dent*. 2013 Jan;23(1):23-31. doi: 10.1111/j.1365-263X.2011.01219.x.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 27. Jejurikar H, Nene S, Kalia A, et al. Does text messaging reminder help in the orthodontic compliance of patients to maintain their oral hygiene. *Oral Hyg Health*. 2014;2(5):152.
[CrossRef](#) [Google Scholar](#)
 28. Bowen TB, Rinchuse DJ, Zullo T, DeMaria ME. The influence of text messaging on oral hygiene effectiveness. *Angle Orthod*. 2015 Jul;85(4):543-548. doi: 10.2319/071514-495.1.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 29. Al-Silwadi FM, Gill DS, Petrie A, Cunningham SJ. Effect of social media in improving knowledge among patients having fixed appliance orthodontic treatment: a single-center randomized controlled trial. *Am J Orthod Dentofacial Orthop*. 2015 Aug;148(2):231-237. doi: 10.1016/j.jado.2015.03.029.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 30. Abdaljawwad AA. The influence of text message reminders on oral hygiene compliance in orthodontic patients. *Iraqi Dental Journal*. 2016;38(1):58-62.
[CrossRef](#) [Google Scholar](#)
 31. Cozzani M, Ragazzini G, Delucchi A, et al. Oral hygiene compliance in orthodontic patients: a randomized controlled study on the effects of a post-treatment communication. *Prog Orthod*. 2016 Dec;17(1):41. doi: 10.1186/s40510-016-0154-9.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 32. Al-Moghrabi D, Pandis N, McLaughlin K, et al. Evaluation of the effectiveness of a tailored mobile application in increasing the duration of wear of thermoplastic retainers: a randomized controlled trial. *Eur J Orthod*. 2020 Nov 3;42(5):571-579. doi: 10.1093/ejo/cjz088.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 33. Farhadifard H, Soheilifar S, Farhadian M, et al. Orthodontic patients' oral hygiene compliance by utilizing a smartphone application (Brush DJ): a randomized clinical trial. *BDJ Open*. 2020 Nov 20;6(1):24. doi: 10.1038/s41405-020-00050-5.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
 34. Eppright M, Shroff B, Best AM, et al. Influence of active reminders on oral hygiene compliance in orthodontic patients. *Angle Orthod*. 2014 Mar;84(2):208-13. doi: 10.2319/062813-481.1.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 35. Araújo MR, Alvarez MJ, Godinho CA, Roberto MS. An eight-month randomized controlled trial on the use of intra-oral cameras and text messages for gingivitis control among adults. *Int J Dent Hyg*. 2019 Aug;17(3):202-213. doi: 10.1111/idh.12391.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 36. Williams KA, Mithani S, Sadeghi G, Palomo L. Effectiveness of oral hygiene instructions given in computer-assisted format versus a self-care instructor. *Dent J (Basel)*. 2018 Jan 10;6(1):2. doi: 10.3390/dj6010002.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 37. Scheerman JFM, Hamilton K, Sharif MO, et al. A theory-based intervention delivered by an online social media platform to promote oral health among Iranian adolescents: a cluster randomized controlled trial. *Psychol Health*. 2020 Apr;35(4):449-466. doi: 10.1080/08870446.2019.1673895.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 38. Shida H, Okabayashi S, Yoshioka M, et al. Effectiveness of a digital device providing real-time visualized tooth brushing instructions: a randomized controlled trial. *PLoS One*. 2020 Jun 25;15(6):e0235194. doi: 10.1371/journal.pone.0235194.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 39. Marchetti G, Assunção LRDS, Soares GMS, Fraiz FC. Are information technologies capable of stimulating the use of dental floss by adolescents? A cluster randomized clinical trial. *Oral Health Prev Dent*. 2020 Jul 4;18(3):427-432. doi: 10.3290/j.ohpd.a44684.
[Full text links](#) [PubMed](#) [Google Scholar](#)
 40. Lee KH, Choi YY, Jung ES. Effectiveness of an oral health education programme using a mobile application for older adults: a randomised clinical trial. *Gerodontology*. 2023 Mar;40(1):47-55. doi: 10.1111/ger.12616.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 41. Zotti F, Pietrobelli A, Malchiodi L, et al. Apps for oral hygiene in children 4 to 7 years: fun and effectiveness. *J Clin Exp Dent*. 2019 Sep 1;11(9):e795-e801. doi: 10.4317/jced.55686.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 42. Alkilzy M, Midani R, Höfer M, Splieth C. Improving toothbrushing with a smartphone app: results of a randomized controlled trial. *Caries Res*. 2019;53(6):628-635. doi: 10.1159/000499868.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 43. Iskander M, Lou J, Wells M, Scarbecz M. A poster and a mobile healthcare application as information tools for dental trauma management. *Dent Traumatol*. 2016 Dec;32(6):457-463. doi: 10.1111/edt.12278.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 44. Hashemian TS, Kritiz-Silverstein D, Baker R. Text2Floss: the feasibility and acceptability of a text messaging intervention to improve oral health behavior and knowledge. *J Public Health Dent*. 2015 Winter;75(1):34-41. doi: 10.1111/jphd.12068.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
 45. Takeuchi-Sato T, Ono Y, Funato M, et al. Efficacy of an email-based recording and reminding system for limiting daytime non-functional tooth contact in patients with temporomandibular disorders: a randomized controlled trial. *J Oral Rehabil*. 2020

Feb;47(2):158-163. doi: 10.1111/joor.12875. [Full text links](#) [Cross-Ref](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)

46. Omezli MM, Torul D, Kahveci K. Does watching videos increase the perioperative anxiety in patients undergoing third molar surgery? A randomized trial. *J Oral Maxillofac Surg*. 2020 Feb;78(2):216.e1-216.e9. doi: 10.1016/j.joms.2019.09.027. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)

47. Aquilanti L, Santarelli A, Mascitti M, et al. Dental care access and the elderly: what is the role of teledentistry? A systematic review. *Int J Environ Res Public Health*. 2020 Dec 4;17(23):9053. doi: 10.3390/ijerph17239053. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)

48. Shirolkar R, Ruparelia KP, More C, Ruparelia P. Teledentistry: An art and science of healing. *Journal of Indian Academy of Oral Medicine and Radiology*. 2011;23(2):108-111. [CrossRef](#) [Google Scholar](#) [Scopus](#)

49. Flores APDC, Lazaro SA, Molina-Bastos CG, et al. Teledentistry in the diagnosis of oral lesions: a systematic review of the literature. *J Am Med Inform Assoc*. 2020 Jul 1;27(7):1166-1172. doi: 10.1093/jamia/ocaa069. PMID: 32568392; PMCID: PMC7647318. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)

50. Tella AJ, Olanloye OM, Ibiyemi O. Potential of teledentistry in the delivery of oral health services in developing countries. *Ann Ib Postgrad Med*. 2019 Dec;17(2):115-123. [Full text links](#) [PubMed](#) [Google Scholar](#)

51. Ghai S. Teledentistry during COVID-19 pandemic. *Diabetes Metab Syndr*. 2020 Sep-Oct;14(5):933-935. doi: 10.1016/j.dsx.2020.06.029. [Full text links](#) [PubMed](#) [Google Scholar](#) [WoS](#)

52. Niknam F, Sharifian R, Bashiri A, et al. Tele-dentistry, its trends, scope, and future framework in oral medicine; a scoping review during January 1999 to December 2021. *Arch Public Health*. 2023 Jun 14;81(1):104. doi: 10.1186/s13690-023-01128-w. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)

Tin Zar TUN

MDS, Lecturer
 Department of Oral Health Science
 Graduate School of Medical and Dental Sciences
 Faculty of Dentistry
 Niigata University, Niigata, Japan
 Department of Pediatric Dentistry
 University of Dental Medicine
 Yangon, Myanmar



CV

Tin Zar Tun, born on April 2, 1988, in Myanmar, is a dedicated doctoral student at Niigata University, Japan, focusing on Preventive Dentistry in the Graduate School of Medical and Dental Sciences. She has a robust research portfolio, co-authoring significant publications, including a systematic review on school-based oral health programs in PLOS ONE and a study on the 8020 Campaign's impact in Japan in the International Journal of Environmental Research and Public Health. Her work on teledentistry in oral health services has gained FDI's recognition. Recently, she investigated risks related to early childhood caries and the effectiveness of fluoride varnish in preventing dental issues. Currently, her research focuses on the oral function of older adults in Japan, contributing valuable insights to the field.

Questions

1. What are common technologies used in teledentistry?

- a. Live video consulting;
- b. Email correspondence;
- c. Remote monitoring devices;
- d. Faxing patient records.

2. Which of the following can be considered a benefit of teledentistry?

- a. Increased travel time for patients;
- b. Improved access to dental care for remote areas;
- c. Reduced need for in-person visits;
- d. Limited appointment availability.

3. What type of services can be provided through teledentistry?

- a. Orthodontic consultations;
- b. Post-operative follow-ups;
- c. Major surgical procedures;
- d. Dental cleanings.

4. In teledentistry, what is essential for patient-provider interactions?

- a. Confidentiality and data privacy;
- b. High-speed internet only;
- c. Mandatory in-person visits;
- d. Physical tools like dental mirrors.

COMPARATIVE EVALUATION OF ACCURACY/ACCURACY OF ELASTOMERIC CONDENSATION AND ADDITION IMPRESSIONING MATERIALS

Vlad Gabriel Vasilescu^{1a}, Irini Qirici^{2b}, Maria-Emilia Constantin^{1c*}, Marian Miculescu^{3d}, Florin-Eugen Constatinescu^{4e}, Lucian-Toma Ciocan^{1f}

¹ Faculty of Dentistry, "Carol Davila" Medicine and Pharmacy University, 37, Dionisie Lupu Str., District 2, 020021 Bucharest, Romania

² Faculty of Medical Engineering, University "Politehnica" of Bucharest, 1-7, Gheorghe Polizu Str., Corp F, District 1, 011061 Bucharest, Romania

³ Faculty of Material Science and Engineering, University "Politehnica" of Bucharest, 313, Splaiul Independentei, corp JA 104-106, District 6, 060042 Bucharest, Romania

⁴ Doctoral School, Faculty of Dentistry, "Carol Davila" University of Medicine and Pharmacy, 37, Dionisie Lupu Str., District 2, 020021 Bucharest, Romania

^a DDS, PhD, Assistant Professor; e-mail: vlad.vasilescu@umfcd.ro; ORCIDiD: <https://orcid.org/0000-0001-6251-833X>

^b BioEng, PhD; e-mail: iriniqirici@yahoo.com

^c student; e-mail: maria-emilia.constantin0720@stud.umfcd.ro; ORCIDiD: <https://orcid.org/0009-0004-6242-4615>

^d Eng, PhD, Professor; e-mail: marian.miculescu@upb.ro; ORCIDiD: <https://orcid.org/0000-0002-2723-6713>

^e DDS, MSc.Neur.Orth; e-mail: florin-eugen.constantinescu@drd.umfcd.ro; ORCIDiD: <https://orcid.org/0000-0002-9425-0291>

^f DMD, MD, PhD, Associate Professor; e-mail: lucian.ciocan@umfcd.ro; ORCIDiD: <https://orcid.org/0000-0002-0329-5102>

ABSTRACT

 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.2](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.2)

Introduction The scientific selection of dental materials in modern dentistry requires the evaluation of their characteristics based on physical, chemical, and mechanical tests, in order to assess their typical properties. Comparative analysis of material characteristics for the right option in a specific application has demonstrated over time a close link between the clinical success of materials and certain of their properties.

Methodology The purpose of the study is to evaluate the basic characteristics, namely fidelity and dimensional stability, of some elastomeric addition and condensation materials. The experimental samples made of siloxane polyvinyl with different fluidity (medium and high) were placed in a fidelity test device (test block, mold), according to SR EN 4823:2002 standard, two samples of each, one being condensation and the other addition.

Results The study of the adaptation mode and the characteristics regarding the impressing accuracy was carried out by three methods of analysis, namely: stereomicroscopy, photolithography and digital scanning. Stereomicroscopy showed that the material adapted well to the mold surface, but showed irregularities. Photolithography indicated that the material has good fidelity, even if some of the samples are less accurate, and digital scanning reinforces the idea that the materials used in this study show good fidelity.

Conclusion The results obtained are satisfactory for the experimental samples of addition and condensation polyvinyl siloxane, all the more so as their fluidity is higher and the comparative analysis of the results has provided conclusive information on the properties suitable for accurate impressing.

KEYWORDS

Dental Impression; Fidelity Accuracy; Dimensional Accuracy; Addition and Condensation Polyvinyl Siloxane.

1. INTRODUCTION

The selection of impression materials in dentistry is based on their characteristics [1,2,3,4,5,6,7,8] and mainly takes into account the impressing techniques used [9,10,11] and the particularities of the prosthetic field. Among these characteristics, of particular practical importance are: fidelity or accuracy with which impression materials manage to reproduce the finest details of the prosthetic field, plasticity, defined by the ability of the material to be deformed and modeled under the action

of minimal pressure, recording all morphological details of the prosthetic field without deforming its reliefs, dimensional stability, or a characteristic of the material that ensures the faithful preservation of the negative image of the prosthetic field from the moment of disinsertion of the imprint from the oral cavity until after the final grip of the material, the time of socket, or the characteristic that must satisfy the clinical requirements according to the particularities of each impressing technique [12,13,14,15,16], compatibility with model materials.



OPEN ACCESS This is an Open Access article under the CC BY-NC 4.0 license.

Peer-Reviewed Article

Citation: Vasilescu VG, Qirici I, Constantin ME, et al. Comparative accuracy evaluation of condensing and addition impression materials. *Stoma Edu J.* 2024;11(1-2):35-41.

Received: December 17, 2023; **Revised:** March 03, 2024; **Accepted:** March 25, 2024; **Published:** March 29, 2024.

***Corresponding author:** Maria-Emilia Constantin, Prosthetics Technology Department, Faculty of Dentistry, "Carol Davila" University of Medicine and Pharmacy, 4-6, Eforiei Str., 4th Floor, Off. 31, District 5, 050037 Bucharest, Romania; **Phone** +40724-902 400, **Fax** +4021-313 53 77;

e-mail: mariaconstantin1810@gmail.com

Copyright: © 2022 the Editorial Council for the Stomatology Edu Journal.

Fidelity and dimensional stability are two essential physical characteristics characterizing the performance of synthetic elastomers as impression materials [17,18,19] as a result of remarkable advances in synthetic polymer chemistry. These characteristics express the ability of silicone and polyetheric impression materials to reproduce the surface details of dental preparations in a very precise way and to maintain these details over a period of time sufficient to allow precise patterns to be cast under optimal conditions. Factors affecting the fidelity and dimensional stability of elastomeric impression materials [20,21] include changes that occur during polymerization, such as volumetric reductions, loss of alcoholic groups, which cause contractions and, last but not least, temperature, disinfectants and impressing techniques. Synthetic elastomers (polysulfides, polysiloxane polyethers), according to international norms (ISO) are classified as follows: type I - putty (Putty); type II - with increased viscosity for preliminary impressions (Heavy bodied); type III - medium viscosity for a wide range of impressions (Regular); type IV- low viscosity (fluids) for syringe injection techniques (Light bodied).

Silicone elastomers (silicones) are compounds containing organic groups, one or more of which are covalently bonded to a silicon atom [22,23,24]. Silicones are sold in three viscosity variants (high, medium and low), each in a two-component system (base and catalyst). The base is packaged in tubes (silicones of medium and fluid consistency) or in cartons (those with chituous consistency), and the catalyst (activator) in vials, when in liquid form, or in tubes when presented as a paste. Silicone elastomers used for impressing are obtained either by polycondensation reactions or by polyaddition reactions [25,26]. The addition silicones are composed of base paste (polyvinylsiloxane) and accelerator paste (polyxyloxane with terminal vinyl group, organometallic catalyst – chloroplatinic acid). Condensation silicones are composed of base paste (polydimethylsiloxane, inert inorganic mass that ensures the necessary viscosity and rigidity consists of pyrolytic silica and titanium dioxide (plasticizer)) and accelerator paste (tin octoate, ethyl orthosilicate, sometimes chromium oxide or palladium metal particles with the role of capturing hydrogen that is not beneficial to the footprint surface). Siloxane polyvinyl materials are an improvement in condensation silicones. Both are based on polydimethyl siloxane polymer, but their plug processes are distinct due to the presence of different terminal groups. In the basic substance, a polymer containing silane terminal groups called polymethyl hydrogen siloxane copolymer is present, which has a low molecular weight. Vinyl polydimethyl siloxane is present in the accelerator substance, although it comprises vinyl terminal groups, and this polymer has a moderately low molecular weight. As a homogeneous metallic complex catalyst, chloroplatinic acid is also a component of the accelerator material. When silane and vinyl groups are combined, an addition process takes place. The properties of siloxane polyvinyl vary greatly in terms of viscosity, working and grip time, breaking energy, elastic recovery and deformation, dimensional stability, creep conformity, radiopacity, etc. [27]. It is common when fluid silicone, with low viscosity, is used in the second time in impressing techniques, after using chituous material. Each material

has its own advantages and disadvantages, and its choice is made based on factors such as accuracy, ease of use and patient comfort [28]. They must demonstrate excellent detail reproduction, good tear resistance, be biocompatible and non-toxic, etc. The evaluation of basic characteristics such as fidelity and dimensional stability, but also the comparative analysis of the results obtained when evaluating them by the three study methods, demonstrates the possibility of successful use of elastomeric addition and condensation materials [30, 37, 38, 39].

2. MATERIALS AND METHODS

The material used in the experiments is polyvinyl siloxane of different fluidities. For each high and medium fluidity, two samples were obtained, one condensation and the other addition.

2.1. Preparation of test samples

a) The medium fluidity condensation polyvinyl siloxane sample is prepared from Zhermack Zetaplus chituous silicone and Zhermack catalyst, indurent (induced) gel. The two components were thoroughly mixed to remove air bubbles (mixing time about 30 seconds) until a homogeneous, grey mixture was obtained (Fig. 1a).

b) The medium fluidity addition polyvinyl siloxane sample was prepared from Zhermack elite HD+ chituous silicone and a Zhermack elite HD+ catalyst by manually mixing the two components to eliminate air bubbles for about 30 seconds. A homogeneous yellow-orange material was obtained (Fig. 1b).



Figure 1a. Siloxane polyvinyl samples: a. condensation with medium fluidity.

Figure 1b. Siloxane polyvinyl samples: b. addition with medium fluidity.

c) The high fluidity condensation polyvinyl siloxane sample was prepared from Lascod silicone Silaxyl Light body = fluid consciousness, together with a universal catalyst, Coltene Speedex activator. Mixing these two materials was done on waxed paper, by mixing vigorously with a spatula and pressing on waxed paper to remove air bubbles. The mixing time is approximately 30 seconds until a homogeneous blue material is obtained (Fig. 2a).

d) The high-fluidity addition polyvinyl siloxane sample was prepared from a Zhermack elite HD+ super light body consistency. A pink sample of suitable consistency (neither hard nor soft) was obtained (Fig. 2b).

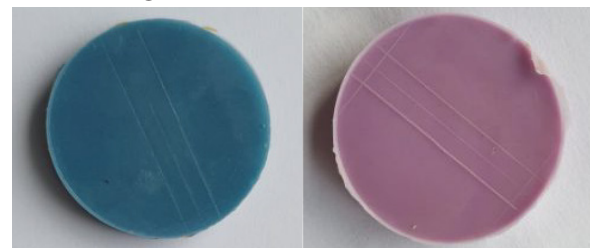


Figure 2a. Siloxane polyvinyl samples: a. High fluidity condensation.

Figure 2b. Siloxane polyvinyl samples: b. high fluidity addition.

The four samples of different colors, respectively of the four impression materials, were placed in a fidelity testing device (a stainless steel test block) in accordance with SR EN 4823:2002 standard, (Fig. 3) for the evaluation of elastomeric impression materials.



Figure 3. The three components of the test piece.

The preparation of the samples consists in preparing the paste from the studied impression material, placing it in the mold (standard) and evenly distributing throughout the mold mass to eliminate gaps and air bubbles. After about 3-5 minutes the sample is subjected to analysis.

2.2. Methods for analysing experimental samples

The study of adaptation mode and impressing accuracy characteristics was carried out by three methods of analysis: stereomicroscopy, photolithography and digital scanning.

2.2.1. Stereomicroscopy analysis

For this experimental study, the Nikon SMZ1270 stereomicroscope was used with a wide range of accessories (trinocular tubes and diascopic lighting holders with thin LEDs), which has a number of advantages, such as zoom ratio, the highest in its class, and high-resolution viewing of 640LP/mm.

2.2.2. Analysis by photolithography

Photolithography has the ability to manipulate the geometry of features with very good precision and can produce patterns with very small characteristics, down to several tens of nanometers.

2.2.3. Analysis by digital CAD/CAM scanning

The study used PlanScan Lab's PlanScan Lab scanner. Gypsum patterns and impressions can be scanned quickly and accurately using this desktop scanner, with a wide range of applications including full arch bridges, implant bars and crowns.

3. RESULTS

The results regarding the fidelity and dimensional stability were obtained, recorded and studied, expressed by the dimensions (widths and length) of the three parallel grooves on the standard (mold) and on the experimental samples. The results of the stereomicroscopy analysis are shown in the images below, which shows the average of the width values of the three parallel grooves on the five samples. The trenches have different widths, trench 1 is the thickest, trench 2 is medium width and trench 3 is the thinnest.

Table 1. Average furrow width measurements from five different areas.

The width of the grooves	Standard	Zhermack Zetaplus putty (gray)	Zhermack elite HD+ putty (yellow)	Lascod Silaxil light body (blue)	Zhermack elite HD+ light body (violet)
Groove 1	187.80µm	1.60mm	1.21 mm	181.34µm	2.30 mm
Groove 2	182.63µm	167.13µm	656.36µm	149.47µm	2.09 mm
Groove 3	169.71µm	103.81µm	161.96µm	123.62µm	1.39 mm

3.1. Results of stereomicroscopy analysis

Also with the help of the stereomicroscope, the length of the trench was measured on each sample, the measurement results are shown in the images below (Fig. 4ab-5ab) and in Table 2.

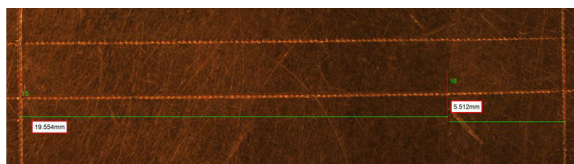


Figure 4a. Ditch length a. on metal piece.

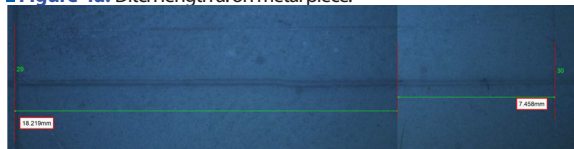


Figure 4b. Ditch length b. on Zhermack zetaplus putty sample.

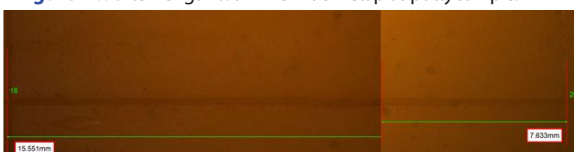


Figure 5a. Ditch length a. on Zhermack elite HD+ putty sample.



Figure 5b. Ditch length b. on the Lascod Silaxil light body sample.

Table 2. The three components of the test piece.

Groove depth	Mold	Gray sample	Yellow sample	Blue sample	Sample purple
Value	24.895 mm	24.844 mm	25.114 mm	24.834 mm	24.849 mm

3.2. Results of photolithography analysis

The images below (Fig. 6a-6b) present the experimental results for each sample in which two profiles were recorded, one representing the length of the sample, and the other the depths of the three grooves. For this analysis, in addition to photolithography, advanced metrology (Metrology 4.0 Analysis 9.1.9957) was used to study surface roundness and to measure important structural factors such as size, depth, geometry and surface quality.

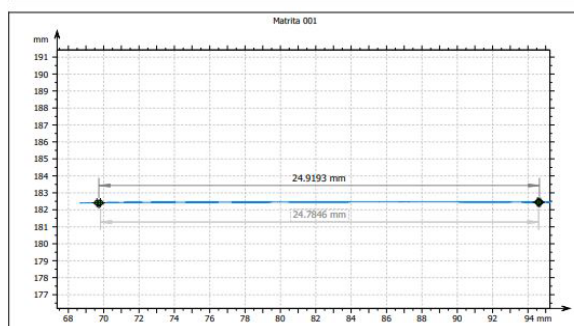
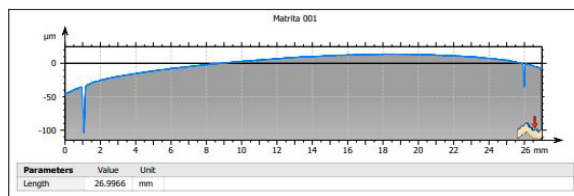


Figure 6a. Profile 1 / mold length.

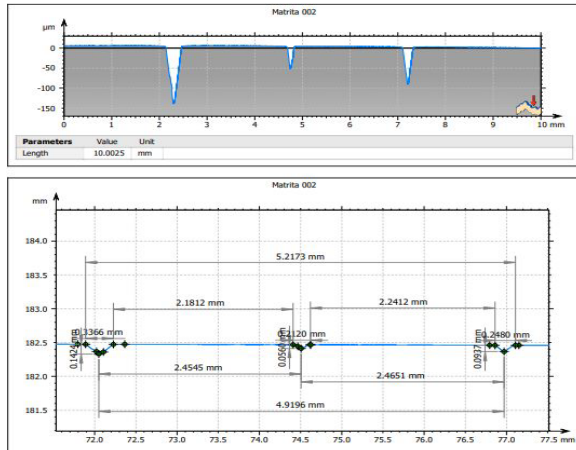


Figure 6b. Profile 2 / depths of mold grooves.

3.3. Analysis results from digital scanning

The images below (Fig. 7a-7b) show the results of the analysis from the digital scan. These images show the samples in 3D CAD/CAM plane, but also the measurements made for the length of the trench. The samples were placed on the scanner stand, scanned, and then converted into 3D images. Table 6 shows the lengths for each of the 5 samples.

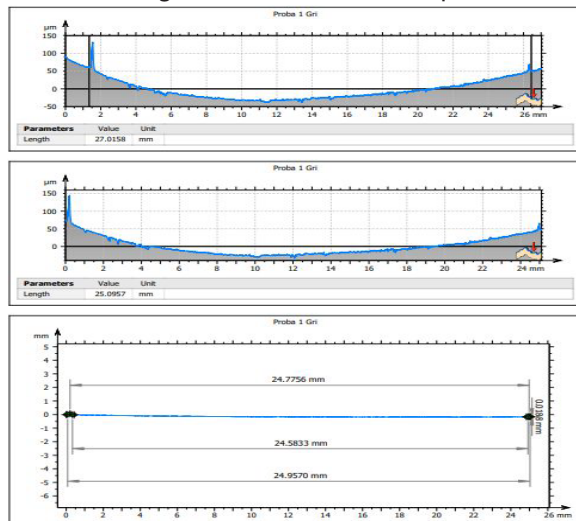


Figure 10. Profile 1 / sample length of medium fluidity condensation polyvinyl siloxane (grey material).

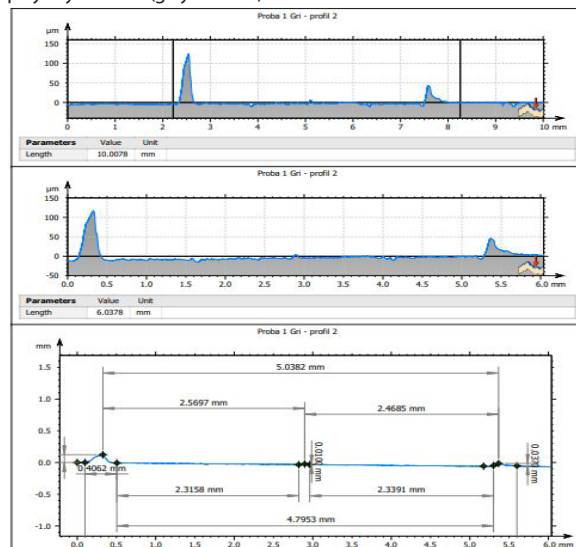


Figure 11. Profile 2 / depth of grooves of medium fluidity condensation polyvinyl siloxane sample (grey material).

Table 6. The groove length values from the scan of the five samples.

Groove depth	Mold	Gray sample	Yellow sample	Blue sample	Sample purple
Groove 1	0.3366 mm	0.4062 mm	0.3700 mm	0.3791 mm	0.3803 mm
Groove 2	0.2120 mm	0.1404 mm	0.2080 mm	0.0001 mm	0.1858 mm
Groove 3	0.2480 mm	0.1890 mm	0.2970 mm	0.3297 mm	0.2344 mm

4. DISCUSSION

The stereomicroscopic analysis highlighted the impressing characteristics of the experimental samples by evaluating the size values (width and length) of the three parallel grooves on the five experimental samples and the differences recorded from those on the block (standard) test. From the measured width values/table 1 it follows that the three parallel grooves (1, 2 and 3) are uneven, starting with the first groove where there is a large difference between the samples and the block test. More accurate results in width with the standard were obtained in the sample of addition polyvinyl siloxane with medium fluidity (yellow). Trench length measurements (Tab. 2) show very accurate values between samples. The medium fluidity addition polyvinyl siloxane sample has a slightly lower value, and the high fluidity condensation polyvinyl siloxane sample (blue) has values close to the block test length. Compared to the other samples, high fluidity condensation polyvinyl siloxane has the values closest to standard. Having greater fluidity means that it also has a large grip contraction, which leads to high dimensional stability, but distortions can occur if the plug contraction is greater than it should be. When assessing the shrinkage of the socket, it is observed how much the material has entered the trench (fidelity) and how much it has contracted between the edges (stability).

The photolithography analysis that records the profiles of the experimental samples assessing the length and depth of the three grooves revealed that the samples have the same diameter as the mold (profile 1), with very small differences between them, of 0.003-0.100 mm (Tab. 3). Trench length measurements show similar values for all of them, namely 25 mm. Compared to the trench length in the mold, which is 24.9193 mm, samples show that the material is adapted to the mold, i.e. it contracted well between the edges of the mold. Profile 2 shows the depths of the trenches, measured values on the standard sample and on the experimental samples. The values in the mold range from 0.1424 mm (trench 1) and 0.0937 (trench 3) to 0.0560 mm (trench 2), but it is noticeable that the material did not insinuate itself very well in all cases (Tab. 4).

Table 3. Groove length values on the five samples.

The width of the grooves	Standard	Zhermack Zetaplus putty (gray)	Zhermack elite HD+ putty (yellow)	Lascod Silaxil light body (blue)	Zhermack elite HD+ light body (violet)
Value 1	25.066 mm	25.677 mm	23.184 mm	25.109 mm	25.218 mm

Table 4. These are the groove depth values for the five samples.

Length of the groove	Groove depth	Mold	Gray sample	Yellow sample	Blue sample	
Value		24.9193 mm	25.0957 mm	25.3846 mm	25.3893 mm	25.5502 mm

Knowing that impression materials usually evince shrinkage of the socket, with this method of analysis, one can see how much the material has entered the trench (fidelity), but also how much it has contracted between the edges (stability).

It is visible, both from the graphs and from the tabulated values, that the fluidity of the material influenced its adaptation, trench 2 being almost invisible, and in the case of the addition polyvinyl siloxane sample with medium fluidity (yellow) the material did not even enter the trench. On the high fluidity addition polyvinyl siloxane sample (violet) all trench depths are observed, the measurement values being even closer to those in the mold. If we consider the widths of the grooves, the mold shows the following values: 0.3366 mm (1), 0.2120 mm (2), 0.2480 (3), and the samples have different values from each other, but are close to those measured in the mold (Tab. 5).

Table 5. Groove width values on the five samples.

Groove depth	Mold	Gray sample	Yellow sample	Blue sample	Sample purple
Groove 1	0.1424 mm	0.1200 mm	0.1280 mm	0.1170 mm	0.1711 mm
Groove 2	0.0560 mm	0.0100 mm	0.0260 mm	0.0098 mm	0.0230 mm
Groove 3	0.0937 mm	0.0370 mm	0.0611 mm	0.0624 mm	0.0780 mm

Here, too, the experimental sample of addition polyvinyl siloxane with high fluidity is the one with values much closer to the mold. We can also appreciate that the medium fluidity condensation polyvinyl siloxane sample (gray sample) did not adapt very well to the mold, and the high fluidity addition polyvinyl siloxane sample (purple sample) has better fidelity.

The digital scanning analysis method confirms the previous results and highlights once again that these materials have adapted well with the respective mold. The differences between the values are very small. Only the medium-fluidity addition polyvinyl siloxane sample has a longer length than the other samples. What is important, however, is that the shape of the grooves in the samples is similar to the mold (scan images). This means that the materials have good stability and entered the trench very well, the sample closest to the mold was the purple sample, made of addition polyvinyl siloxane with wrinkled fluidity.

REFERENCES

- Connor RA, Dorfman J, Ring ME, Kamen S. *Dentistry*. Encyclopedia Britannica, December 28, 2023. Available from: <https://www.britannica.com/science/dentistry>.
- Ratner BD, Hoffman AS, Schoen FJ, Lemons JE. *Biomaterials Science: An Introduction to Materials in Medicine*. Third Edition, Elsevier Academic Press: New York, NY, USA; 2013. [Full text links Google Scholar](#)
- Martinez V. Introduction to dental materials. Accessed: Jun. 12, 2023. [Online]. Available from: https://www.academia.edu/50756970/Introduction_to_Dental_Materials
- Sakaguchi RL, Powers JM. *Craig's Restorative Dental Materials-E-Book*. Elsevier Health Sciences; 2011. [Full text links Google Scholar](#)
- Cleveland Clinic. Dental impressions: definition, purpose & procedure [Online]. Accessed Apr. 21, 2023. Available from: <https://my.clevelandclinic.org/health/diagnostics/22671-dental-impressions>
- Gupta R, Brizuela M. *Dental Impression Materials*. 2023 Mar 19. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024.

5. CONCLUSION

The precision with which the impression material records tissue details will determine the quality and how well the restoration or final prosthesis fits. This accuracy of the impression material depends both on its properties and on the techniques for obtaining the impression.

The study meets the proposed objective, which is to evaluate the basic characteristics, namely fidelity and dimensional stability of elastomeric addition and condensation materials with different fluidity. Experimental research is aimed at studying the impressing accuracy of polyvinyl siloxane as an impression material. The comparative analysis of the experimental results on how to adapt and the accuracy of impressing by the three study methods (stereomicroscopy, photolithography and digital scanning) highlighted the following important aspects with practical utility:

- photolithography is the method of analysis that has the best accuracy;
 - elastomeric imprint materials with high fluidity reproduce details better compared to those with increased consistency;
 - regardless of consistency (fluid or viscous) addition silicones are more dimensionally stable than condensation silicones;
 - the highest fidelity (accuracy of reproduction of details) was demonstrated in experiments by addition silicone (Elite HD superlight body), probably also due to the high fluidity found during application;
- The results of the study shall also provide useful information on methods of study and analysis in establishing the essential characteristics of basic impression materials in order to obtain an accurate impression.

AUTHOR CONTRIBUTIONS

All authors have read and agreed to the published version of the manuscript.

FUNDING

This research received no external funding.

DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy reasons.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interests.

- Bhakta S, Vere J, Calder I, et al. Impressions in implant dentistry. *Br Dent J*. 2011 Oct 21;211(8):361-367. doi: 10.1038/sj.bdj.2011.862. [Full text links CrossRef PubMed Google Scholar WoS](#)
- The difference between impression materials [Online]. Accessed Jun. 13, 2023. Available from: <https://www.dental-nursenetwork.com/news/dental-nursing-library/1073-the-difference-between-impression-materials.html>
- Shillingburg HT Jr, Hatch RA, Keenan MP, et al. Impression materials and techniques used for cast restorations in eight states. *J Am Dent Assoc*. 1980 May;100(5):696-699. doi: 10.14219/jada.archive.1980.0228. [Full text links CrossRef PubMed Google Scholar Scopus](#)
- Morgano SM, Milot P, Ducharme P, et al. Ability of various impression materials to produce duplicate dies from successive impressions. *J Prosthet Dent*. 1995 Apr;73(4):333-340. doi: 10.1016/s0022-3913(05)80327-0. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
- Chee W, Jivraj S. Impression techniques for implant dentistry. *Br Dent J*. 2006 Oct 7;201(7):429-432. doi: 10.1038/sj.bdj.4814118. [Full text links PubMed Google Scholar](#)

12. Conventional Impression-Taking | Thommen Medical [Online]. Accessed May 27, 2023. Available from: <https://www.thommenmedical.com/us-en/dental-professionals/products/impression-taking/conventional-impression-taking>
13. Hamalian TA, Nasr E, Chidiac JJ. Impression materials in fixed prosthodontics: influence of choice on clinical procedure. *J Prosthodont.* 2011;20(2):153-160. doi: 10.1111/j.1532-849X.2010.00673.x. Epub 2011 Feb 1. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
14. Digital impressions or conventional impressions - What's better? [Online]. Accessed May 27, 2023. Available from: <https://www.cayster.com/blog/digital-impressions-or-conventional-impressions-whats-better>
15. Birnbaum NS, Aaronson HB. Dental impressions using 3D digital scanners: virtual becomes reality. *Compend Contin Educ Dent.* 2008;29(8):494, 496, 498-505. [PubMed Google Scholar Scopus](#)
16. Traditional vs. Digital impressions [Online]. Accessed Apr. 21, 2023. Available from: <https://prodentusa.com/traditional-vs-digital-impression-trays/>
17. VR Sastri, Vinny R. Plastics in medical devices: properties, requirements, and applications. William Andrew, eBook ISBN: 9780323851275, 2021. [Google Scholar](#)
18. Tolidis K, Tortopidis D, Gerasimou P, et al. Comparison of elastomeric impression materials' thixotropic behavior. *Eur J Prosthodont Restor Dent.* 2013;21(2):75-78. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
19. Mandikos MN. Polyvinyl siloxane impression materials: an update on clinical use. *Aust Dent J.* 1998;43(6):428-434. doi: 10.1111/j.1834-7819.1998.tb00204.x. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
20. Gomez-Polo M, Celemin A, del Rio J, et al. Influence of technique and pouring time on dimensional stability of polyvinyl siloxane and polyether impressions. *Int J Prosthodont.* 2012;25(4):353-356. [PubMed Google Scholar Scopus WoS](#)
21. Ho W, Lin Seow L, Musawi A. Viscosity effects of polyvinyl siloxane impression materials on the accuracy of the stone die produced. *J Clin Transl Res.* 2018;4(1):70-74. [Full text links CrossRef PubMed Google Scholar Scopus](#)
22. Mojsiewicz-Pieńkowska K, Jamrógiewicz M, Szymkowska K, et al. Direct human contact with siloxanes (silicones) - safety or risk part 1. Characteristics of siloxanes (silicones). *Front Pharmacol.* 2016;7:132. doi: 10.3389/fphar.2016.00132. [Full text links CrossRef PubMed Google Scholar WoS](#)
23. Silicone: a guide to production, uses and benefits – SIMTEC [Online]. Accessed Jun. 13, 2023. Available from: <https://www.simtec-silicone.com/blogs/how-is-silicone-produced/>
24. The many uses of dental impression silicone [Online]. Accessed Apr. 21, 2023. Available from: <https://magazine.zhermack.com/en/laboratory-en/many-uses-of-dental-impression-silicone/>
25. Bilir H, Ayguzen C. Comparison of digital and conventional impression methods by preclinical students: efficiency and future expectations. *J Int Soc Prev Community Dent.* 2020;10(4):402-409. doi: 10.4103/jispcd.JISPCD_330_18. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
26. Condensation and addition silicon impression material [Online]. Accessed Jun. 13, 2023. Available from: <https://www.juniordentist.com/silicone-impression-material.html>
27. Naumovski B, Kapushevska B. Dimensional stability and accuracy of silicone - based impression materials using different impression techniques - a literature review. *Pril (Makedon Akad Nauk Umet Odd Med Nauki).* 2017;38(2):131-138. doi: 10.1515/prilozi-2017-0031. [Full text links CrossRef PubMed Google Scholar](#)
28. Zare M, Ghomi ER, Venkatraman PD, et al. Silicone-based biomaterials for biomedical applications: antimicrobial strategies and 3D printing technologies. *Journal of Applied Polymer Science.* 2021;138(38):50969. [CrossRef Google Scholar Scopus WoS](#)
29. Razmjoo H, Abdi E, Atashkadi S, et al. Comparative study of two silicone hydrogel contact lenses used as bandage contact lenses after photorefractive keratectomy. *Int J Prev Med.* 2012;3(10):718-722. [Full text links PubMed Google Scholar Scopus WoS](#)
30. Derrien G, Le Menn G. Evaluation of detail reproduction for three die materials by using scanning electron microscopy and two-dimensional profilometry. *J Prosthet Dent.* 1995;74(1):1-7. doi: 10.1016/s0022-3913(05)80221-5. [Full text links PubMed Google Scholar Scopus](#)
31. Lin YM. Digitalisation in dentistry: development and practices. The digitization of business in China: exploring the transformation from manufacturing to a digital service hub. 2018:199-217.
32. Punj A, Fisselier F. Digital dentistry for complete dentures a review of digital dentistry versus conventional approaches to complete dentures. *Decid Dent.* 26 (2020): 12-20. [Google Scholar](#)
33. Unkovskiy A, Wahl E, Huettig F, et al. Multimaterial 3D printing of a definitive silicone auricular prosthesis: an improved technique. *J Prosthet Dent.* 2021;125(6):946-950. doi: 10.1016/j.prosdent.2020.02.021. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
34. Konofaos P, Ver Halen JP. Nerve repair by means of tubulization: past, present, future. *J Reconstr Microsurg.* 2013;29(3):149-164. doi: 10.1055/s-0032-1333316. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
35. Bray A. Essentials of physical medicine and rehabilitation: musculoskeletal disorders, pain, and rehabilitation. *Occup Med (Lond).* 2017;67(1):80-81. doi: 10.1093/occmed/kqw129. [Full text links PubMed Scopus](#)
36. Indurent gel – bio link medical surgical equipment & instruments trading [Online]. Accessed Jun. 22, 2023. Available from: <https://biolinkdubai.com/products/indurent-gel>
37. StereoMicroscope_2CE-ENBH-1.
38. What is a stereo microscope and how does it work? [Online]. Accessed Jun. 06, 2023. Available from: <https://www.microscope-detective.com/stereo-microscope.html>
39. Qirici I. Dissertation Diploma, Faculty of Medical Engineering, Politehnica University of Bucharest, 2023a

Vlad Gabriel VASILESCU

DDS, PhD, Assistant Professor
 Prosthetics Technology Department
 Faculty of Dentistry
 "Carol Davila" University of Medicine and Pharmacy
 Bucharest, Romania



CV

Vlad Gabriel Vasilescu is a graduate of the "Carol Davila" University of Medicine and Pharmacy. He presents numerous courses completed over the years as well as published works. He specializes in implantology and has submitted research work on the most suitable materials. Vlad Gabriel Vasilescu started his career as a university assistant at the "Carol Davila" University of Medicine and Pharmacy, and in the meantime, he has also completed his doctoral studies.

Questions

1. What is the correct order ?

- a. Putty, heavy-bodied, regular, and light-bodied;
- b. Heavy-bodied, putty, regular and light-bodied;
- c. Light-bodied, putty, regular and heavy-bodied;
- d. Regular, putty, heavy-bodied, light-bodied.

2. What is the difference between Polyvinyl siloxane materials and condensation silicones?

- a. None, they are the same;
- b. Condensation silicone contains vinyl;
- c. They differ in the terminal ends;
- d. Polyvinyl siloxane materials have a condensation reaction.

3. What are the factors by which we choose an impression material?

- a. Money and mental state;
- b. The choice is made based on factors such as accuracy, ease of use, and patient comfort;
- c. The material with the highest polymerization contraction is chosen;
- d. The choice is made strictly based on the patient's preferences.

4. What materials were used in the study?

- a. Alginate and reversible hydrocolloids;
- b. Thermoplastic materials;
- c. Condensation silicones;
- d. Polyvinyl siloxane with different fluidity.

ACADEMY OF DENTAL MATERIALS



ADM
2025

SAVE THE DATE:
OCT 1-4, 2025

THE WESTIN
PLAYA BONITA

PANAMA

CONNECTIONS IN DENTAL BIOMATERIALS



WWW.ADMCONFERENCE.COM

<https://admconference.com/>

EVALUATION OF POSSIBLE DISCOLORATION ON VITA CLASSICAL SHADE TABS USED DAILY COMPARED TO NEW REFERENCE SHADE TABS

Dóra Fehér^{1a*}, Judit Borbély^{1b}, Péter Hermann^{1c}

¹Department of Prosthodontics, Faculty of Dentistry, Semmelweis University, Szentkirályi utca 47, Budapest, 1088-Hungary

^aDMD, Assistant Lecturer; e-mail: dori.bpg@gmail.com; ORCIDiD: <https://orcid.org/0000-0002-3268-2478>

^bDMD, PhD, Associate Professor; e-mail: borbely.judit@semmelweis.hu; ORCIDiD: <https://orcid.org/0000-0003-3064-8724>

^cDMD, PhD, Professor and Head; e-mail: hermann.peter@semmelweis.hu; ORCIDiD: <https://orcid.org/0000-0002-9148-0139>

ABSTRACT

[https://doi.org/10.25241/stomaedu.2024.11\(1-2.art.3](https://doi.org/10.25241/stomaedu.2024.11(1-2.art.3)

Introduction Visual shade selection is still a very popular way of shade selection. This method is subjective with uncertain factors like the material of the conventional shade tab and restoration is different, the companies put different colored materials on the market under the same shade tab code. Besides these aggravating factors, the shade tabs can go under discoloration over time causing further difficulty in proper shade determination. This study aims to evaluate the extent of discoloration of the regularly used shade tabs by students in the Department of Prosthodontics.

Methodology Six shades (A1, A2, A3, C2, C3, D2) were selected from nine regularly used VITA Classical shade guides (54 shade tabs in total) and compared visually and digitally (VITA Easyshade V spectrophotometer) to a corresponding brand-new reference guide. During the digital comparison $L^*a^*b^*$ values were recorded and the color difference ($\Delta E00$) was calculated with the CIEDE2000 formula.

Results 38 out of the 54 shade tabs were above the perceptibility threshold (0.8 $\Delta E00$) and visual color changes were noticed as well. Unacceptable color differences (above 1.8 $\Delta E00$) were found in 19 cases. Only 16 shade tabs did not show visible and clinically relevant measurable discoloration.

Conclusion Conventional shade tabs are worn off and go through discoloration over time. In this study, 70.4 % of the regularly used shade tabs went through noticeable discoloration. It is recommended to keep one new shade guide to verify the color of the regularly used shade tabs in the dental office.

KEYWORDS

Prosthodontics; Dental aesthetic; Color; Spectrophotometry; Discoloration.

1. INTRODUCTION

The success of dental aesthetic rehabilitation depends on the correct tooth shade selection. The color of the restoration is an important factor in patient satisfaction [1,2]. In most cases, the tooth shade determination is still carried out visually with shade tabs. The restoration materials are rapidly developing, new materials appear on the market every year until the most frequently used shade guides were put on the market before the noughties. (Fig. 1) The VITA Classical shade guide (VC) (before VITA Lumin Vacuum, VITA Zahnfabrik, Bad Säckingen, Germany) in 1956, the Chromoscop (Ivoclar-Vivadent, Amherst, NY) in 1990, and the VITA 3D Master (VITA Zahnfabrik, Bad Säckingen, Germany) in 1998 appeared on the market [2-4]. The material, translucency, and thickness of the restorations and the conventional shade guides are not always the same. Furthermore, the different companies carry out different shades under the same shade tab code [5]. Besides these aggravating factors that might lead to

unsuccess in shade determination, the shade tabs are disinfected daily to prevent cross contamination which can lead to discoloration and worsen the outcome of the shade determination as well [6,7].



Figure 1. New VITA Classical and 3D Master shade guides (left), old VITA Classical shade guides (right).

This present study aims to compare the color parameters of VC shade tabs in daily use at the Department of Prosthodontics, Semmelweis University with brand-new, reference VC shade tabs to detect color changes due to the effect of daily use which might lead to inaccuracy in shade determination.

OPEN ACCESS This is an Open Access article under the CC BY-NC 4.0 license.
Peer-Reviewed Article

Citation: Fehér D, Borbély J, Hermann P. Evaluation of possible discoloration on VITA classical shade tabs used daily compared to new reference shade tabs. *Stoma Edu J.* 2024;11(1-2):42-50.

Received: February 14, 2024; **Revised:** February 25, 2024; **Accepted:** July 18, 2024; **Published:** August 08, 2024.

***Corresponding author:** Dr. Dóra Fehér, DMD, PhD, Department of Prosthodontics, Faculty of Dentistry, Semmelweis University, Szentkirályi utca 47, Budapest, 1088, Hungary, **Tel.:** +3614591500/59315; **Fax:** +3614591500; e-mail: dori.bpg@gmail.com

Copyright: © 2022 the Editorial Council for the Stomatology Edu Journal.

2. MATERIALS AND METHODS

Selection of the shade tabs:

Nine layered ceramic VC shade guide (VITA Zahnfabrik, Bad Säckingen, Germany) was selected randomly from the practice rooms of the Department of Prosthodontics, Semmelweis University, the shade tabs are used by students (manufactured 1 guide in 2010, 4 guides in 2012 1 guide in 2013, and 3 guides in 2015 and all of them are original and produced by VITA Zahnfabrik). The reference was a brand-new VC shade guide provided by the manufacturer and manufactured in 2021. Based on a previous study the A1, A2, A3, C2, C3, and D2 are the most frequent natural tooth shades [8]. In this present study, these six shades were evaluated. (Fig. 2)



Figure 2. The six evaluated shade from VITA Classical shade tab.

Visual shade selection:

To provide standard lighting Smile Lite lamp (Smile Line, Switzerland) was used for visual shade determination. The Smile Lite lamp simulated the optimal 5500 K illumination for the correct tooth shade selection [9]. (Fig. 3)



Figure 3. Smile lite lamp (5500 K).

The visual shade selection was evaluated on the fact of the color difference between the used and the reference shade tabs but the degree of the color difference was not recorded. The observers, two dental students and one dentist who is an expert in dental shade selection went through the Ichihara test before the visual shade selection. (Fig. 4)

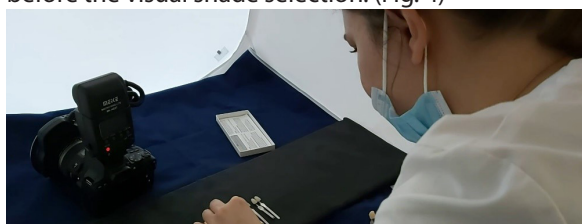


Figure 4. Visual comparison of the used and reference shade tabs.

Digital shade determination:

For digital comparison, a VITA Easyshade V spectrophotometer (VITA Zahnfabrik, Bad Säckingen, Germany) was used. The standardization of the lighting conditions was essential because the spectrophotometer measured the reflected light for this the shade tabs were evaluated in a dark box, through a little hole the same size as the tip of the spectrophotometer. To provide a standard position the shade tab holder was used. In the holder, the shade tab was positioned centrally with the help of a custom-made deep-drawn foil case (positioning foil). The holder with the positioning foil was placed in the dark box under the hole. (Fig. 5) To standardize the position of the spectrophotometer an acrylic stand was made to hold the device.



Figure 5. Positioning the shade tabs.

One point measurement was made on every shade tab after calibration based on the instructions of the manufacturer. Every shade tab was measured three times. The spectrophotometer measures L*a*b* values. (Fig. 6) The L*a*b* values were recorded in an Excel file.



Figure 6. The VITA Easyshade V spectrophotometer measures L*a*b* values.

Calculating the color difference:

The ΔE shows the color difference between the used and the corresponding reference shade tabs. The color difference (ΔE_{00}) was calculated with the CIEDE2000 formula. [10]

$$\Delta E_{00} \sqrt{\left(\frac{\Delta L'}{k_L S_L}\right)^2 + \left(\frac{\Delta C'}{k_C S_C}\right)^2 + \left(\frac{\Delta H'}{k_H S_H}\right)^2 + R_T \left(\frac{\Delta C'}{k_C S_C}\right) \left(\frac{\Delta H'}{k_H S_H}\right)}$$

Where $\Delta L'$, $\Delta C'$, and $\Delta H'$ are the differences in lightness, chroma, and hue. ΔR is an interactive term between hue and chroma differences. The weighting functions for the lightness, chroma, and hue components, respectively shown by S_L , S_C , S_H . The k_L , k_C and k_H parametric factors are correction

terms for experimental conditions. In the present study $kL=kC=kH=1$. [11,12] Based on a previous study wherein the Semmelweis University participated in the color difference was not noticeable to half of the observers between 0 and 0.8 ΔE_{00} [13]. Between 0.8 and 1.8 ΔE_{00} half of the observers noticed the color difference, but it was considered acceptable, but above 1.8 ΔE_{00} the color difference was unacceptable. Correspondingly, in this present study, the perceptibility threshold (PT50:50%) is defined in 0.8 ΔE_{00} and the acceptability threshold (AT50:50%) is in 1.8 ΔE_{00} simultaneously. Based on the AT50:50% and PT50:50% the color difference of the shade tabs were divided into three groups: invisible, acceptable, and unacceptable color differences. (Fig. 7)

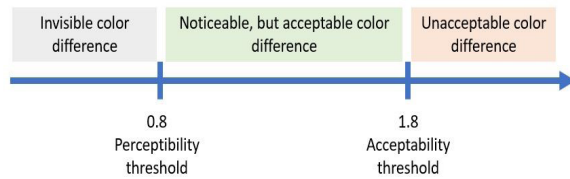


Figure 7. The shade tabs are divided into three groups based on the perceptibility and acceptability thresholds.

3. RESULTS

The ΔE_{00} was calculated based on the $L^*a^*b^*$ values. (Table 1)

Table 1. Measured $L^*a^*b^*$ and calculated ΔE values in the case of all shades and samples.

Sample 1	L	a	b	ΔE
A1	83.4	-0.3	14.2	0.8067
	83.4	-0.3	14.2	0.8090
	83.4	-0.3	14.2	0.8924
			Average:	0.8360
A2	81.3	1.8	19.2	1.5699
	81.5	1.8	19.4	1.7837
	81.6	1.8	19.4	1.9317
			Average:	1.7618
A3	76.6	2.1	19.1	3.2300
	76.5	2.1	19.3	2.9667
	76.5	2.1	19.4	3.0437
			Average:	3.0802
C2	73.7	1.3	17.7	0.4014
	73.7	1.3	17.7	0.4000
	73.6	1.3	17.6	0.4582
			Average:	0.4199
C3	70.3	2.4	19.2	1.6633
	70.5	2.4	19.2	1.7519
	70.4	2.4	19.2	1.6076
			Average:	1.6743
D2	77.2	-0.4	12.1	1.1648
	77.3	-0.3	12.2	1.0154
	77.3	-0.3	12.3	1.3272
			Average:	1.1691

Sample 2	L	a	b	ΔE
A1	82.7	-0.2	14.6	0.4355
	82.5	-0.2	14.5	0.2686
	82.6	-0.2	14.4	0.4900
			Average:	0.3981
A2	79	1.7	14.2	0.1855
	78.9	1.7	14.2	0.2097
	78.9	1.7	14.2	0.1506
			Average:	0.1819
A3	83.4	1.2	14.2	0.4972
	83.4	1.2	14.2	0.3595
	83.4	1.2	14.2	0.4335
			Average:	0.4301
C2	83.4	1.6	14.2	0.3174
	83.4	1.6	14.2	0.4588
	83.4	1.6	14.2	0.2975
			Average:	0.3579
C3	83.4	2.5	14.2	0.6130
	83.4	2.5	14.2	0.5185
	83.4	2.5	14.2	0.3258
			Average:	0.4857
D2	83.4	-0.2	14.2	0.4058
	83.4	-0.2	14.2	0.3830
	83.4	-0.3	14.2	0.7483
			Average:	0.5124

Sample 3	L	a	b	ΔE
A1	85.5	-0.2	15.7	2.3754
	85.5	-0.2	15.7	2.3530
	85.5	-0.2	15.8	2.5210
			Average:	2.4165
A2	81	1.9	19.2	1.3592
	81.1	1.8	19.1	1.4678
	81	1.8	19.1	1.4945
			Average:	1.4405
A3	77.2	2.5	20	2.8037
	77.1	2.5	20	2.6280
	77.2	2.4	20	2.6294
			Average:	2.6870
C2	75.3	2	19.9	1.6174
	75.2	2	19.9	1.4395
	75.4	2	19.9	1.6441
			Average:	1.5670
C3	71.2	2.2	19.5	2.4059
	71.4	2.2	19.4	2.5026
	71.6	2.1	19.3	2.5557
			Average:	2.4881

D2	76.7	-0.3	13	0.8542
	76.6	-0.2	13.1	0.7166
	76.8	-0.3	12.9	1.0045
			Average:	0.8584

Sample 4	L	a	b	ΔE
A1	85	-0.3	15.4	2.0014
	84.4	-0.3	15.5	1.6376
	84.5	-0.3	15.5	1.8471
			Average:	1.8287

A2	80.9	1.8	19.2	1.3214
	80.9	1.8	19.1	1.3467
	80.9	1.8	19.1	1.4346
			Average:	1.3676

A3	78	1.5	23	1.2772
	78	1.5	23	1.0736
	78	1.4	23	1.1257
			Average:	1.1588

C2	74.2	1.8	18.9	0.6477
	74.5	1.7	18.7	0.5899
	74.5	1.7	18.7	0.7283
			Average:	0.6536

C3	70.6	2.4	20	2.0451
	70.4	2.5	20	1.2750
	70.4	2.5	20.1	1.2535
			Average:	1.2557

D2	76.5	0.1	14.1	1.2385
	76.7	0.1	14	1.2750
	76.4	0.1	14.1	1.2535
			Average:	1.2557

Sample 5	L	a	b	ΔE
A1	84.6	-0.7	14.3	1.6811
	84.5	-0.8	14.1	1.6676
	84.5	-0.8	14.2	1.6853
			Average:	1.6780

A2	82.6	1.2	22.8	3.4936
	82.6	1.2	22.8	3.5478
	82.4	1.1	22.7	3.5342
			Average:	3.5252

A3	79.4	1.3	23.2	0.2823
	79.5	1.3	23.2	0.1972
	79.5	1.3	23.5	0.2548
			Average:	0.2447

C2	73.1	1.4	18.5	0.5001
	73.4	1.4	18.5	0.5287
	73.2	1.4	18.7	0.4785
			Average:	0.5024

C3	70.6	2.5	20.6	2.1944
	70.8	2.6	20.7	2.3054
	71	2.6	20.7	2.3658
			Average:	2.2885

D2	76.4	-0.3	13.1	0.7190
	76.3	-0.3	13.1	0.5973
	76.4	-0.3	13	0.7673
			Average:	0.6946

Sample 6	L	a	b	ΔE
A1	85.1	-0.3	15.4	2.0628
	85.1	-0.3	15.4	2.0423
	85.1	-0.3	15.4	2.1757
			Average:	2.0963

A2	80.7	1.8	19.2	1.2010
	80.8	1.8	19.2	1.3153
	80.7	1.8	19.2	1.3469
			Average:	1.2877

A3	77	2.2	18.9	3.1564
	77.2	2.3	19.4	2.6884
	77	2.2	19	2.9957
			Average:	2.9468

C2	73.7	1.7	18.9	0.4481
	73.8	1.7	19.4	0.6065
	73.7	1.8	19	0.5242
			Average:	0.5263

C3	70.3	2.3	19.6	1.7691
	70.2	2.4	19.9	1.7182
	70.2	2.4	19.9	1.6544
			Average:	1.7139

D2	76.5	-0.3	12.8	0.6811
	76.4	-0.2	13.2	0.6761
	76.5	-0.3	12.8	0.7901
			Average:	0.7158

Sample 7	L	a	b	ΔE
A1	84	-0.4	15	1.3043
	84.2	-0.3	15.2	1.4443
	83.9	-0.4	15	1.3509
			Average:	1.3665

A2	82.2	1.6	19.4	2.1999
	82.3	1.8	19.7	2.3416
	82.1	1.7	19.4	2.2419
			Average:	2.2611

A3	76.6	2.2	19.5	3.1270
	76.3	2.4	20	2.9797
	76.4	2.4	20	3.0293
			Average:	3.0453

C2	76	1.5	19.3	1.8827
	75.8	1.6	19.4	1.5868
	76	1.5	19.4	1.8821
			Average:	1.7839
C3	70.5	2.2	19.6	1.9351
	70.7	2.2	19.6	2.0242
	70.5	2.3	19.9	1.8697
			Average:	1.9430
D2	75.9	-0.4	12.9	0.5190
	75.7	-0.4	12.8	0.4322
	75.9	-0.3	13.1	0.5414
			Average:	0.4957

Sample 8	L	a	b	ΔE
A1	85.6	0.1	16.2	2.6028
	85.6	0.1	16.4	2.6278
	85.5	0	16	2.6098
			Average:	2.6135
A2	80.3	1.6	18.4	0.8195
	80.4	1.7	18.4	0.8772
	80.4	1.6	18.3	0.9546
			Average:	0.8838
A3	77.9	1.4	22.8	1.3436
	78.3	1.4	23.2	0.8669
	78.1	1.4	23	1.0554
			Average:	1.0886
C2	74.3	1.6	18.8	0.6449
	74.5	1.6	18.9	0.6638
	74.3	1.7	18.9	0.6470
			Average:	0.6519
C3	71.4	2.3	19.4	2.5128
	71.2	2.4	19.5	2.3079
	71.4	2.2	19.2	2.3714
			Average:	2.3973

D2	77	-0.2	12.3	0.9468
	77	-0.2	12.3	0.7907
	77	-0.2	12.3	1.0962
			Average:	0.9446

Sample 9	L	a	b	ΔE
A1	88.6	-0.9	17.3	4.6140
	88.6	-0.9	17.3	4.5907
	88.6	-0.9	17.4	4.7307
			Average:	4.6451
A2	83.1	0.8	18.6	2.9254
	83	0.8	18.7	2.8458
	83.1	0.7	18.3	2.9927
			Average:	2.9213
A3	77.9	1.6	23	1.3655
	77.9	1.6	23	1.1637
	77.8	1.6	23	1.2975
			Average:	1.2756
C2	73.1	1.6	18.7	0.4976
	73.4	1.6	18.6	0.4972
	73.2	1.6	18.7	0.4051
			Average:	0.4666
C3	73.1	2.3	20.7	3.9351
	73.1	2.3	20.9	3.9202
	73.1	2.3	20.9	3.8479
			Average:	3.9011
D2	78.6	-0.1	13.8	2.2484
	78.5	-0.1	13.8	2.0854
	78.5	-0.1	13.8	2.2939
			Average:	2.2092

Only 16 shade tabs were under the 0.8 ΔE values. 38 shade tabs were above 0.8 ΔE and 19 of the 38 exceeded the 1.8 ΔE values. (Table 2)

Table 2. The number of shade tabs above 0.8 ΔE₀₀ (PT_{50:50%}) and 1.8 ΔE₀₀ (AT_{50:50%}) in the case of six shades.

	A1 9 Samples	A2 9 Samples	A3 9 Samples	C2 9 Samples	C3 9 Samples	D2 9 Samples	All 54 Samples
Under 0.8 ΔE	8	8	7	2	8	5	38
Above 1.8 ΔE	5	3	4	0	6	1	19

The most deviations were found in the case of A1, A2, and C3, eight out of nine shade tabs were above the PT50:50% in all of these cases. In the case of C3 six shade tabs were also above the AT50:50%, in the case of A1 and A2 five and three shade tabs were found unacceptable (above AT50:50%) color difference. Categorization and Fisher's exact test equivalent to the Chi-square test were done. The test showed that in the combined groups A1, A2, and C3 significantly ($p=0.00056$) worse outcome was noticeable than other shades in total. The three examined categories were combined on the basis that they have the lowest proportion of ΔE_{00} results indicating invisible color difference. (Figs. 8,9)

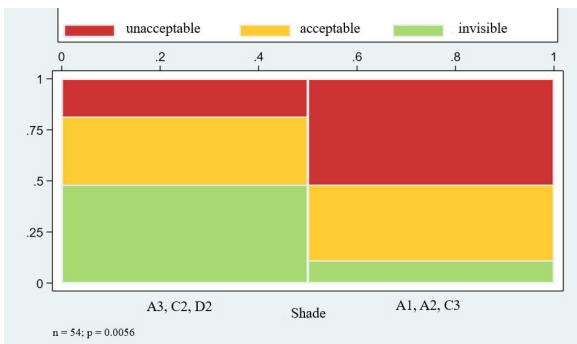


Figure 8. Distribution of ΔE_{00} categories defined based on the perceptibility and acceptability thresholds in groups formed based on shades and combined according to the similarity of the distribution. Fisher's exact test.

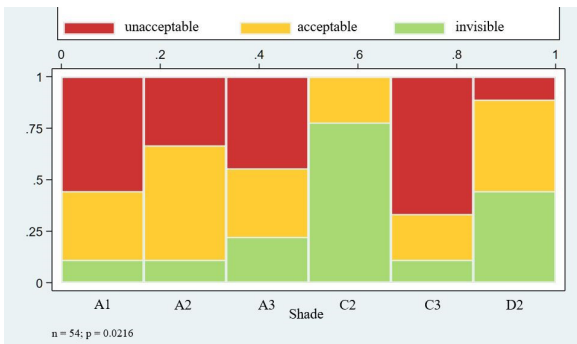


Figure 9. Distribution of ΔE_{00} categories defined based on the perceptibility and acceptability thresholds in groups formed based on shades. Fisher's exact test.

The ΔE_{00} of nine samples compared to the reference in every six shades are shown in Fig. 10. The perceptibility and acceptability thresholds are marked with an orange line. During the visual comparison, the observers found visible color differences in 38 cases.

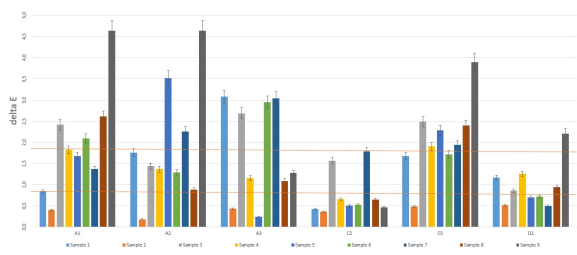


Figure 10. The ΔE_{00} values of the shade tabs compared to the reference separated to shades. The orange line shows the perceptibility (0.8 ΔE) and acceptability thresholds (1.8 ΔE).

4. DISCUSSION

Evaluation of the method of visual shade selection is a popular topic in dentistry. The most commonly used shade guide for visual shade selection is still the VC shade guide which contains 16 shades [14-16]. In dental practices to prevent cross-contamination the shade guides are disinfected regularly, [17] which can lead to changes in the shade [6,18]. Al Amri et al. evaluated the effects of the disinfectant liquid on VITA Lumin shade tabs with VITA Easyshade. In their study, 80% of the randomly selected shade tabs showed higher ΔE values than the perceptibility threshold [19]. In another previous study the effect of three disinfectants - Cavicide, Asepticare TB, and Sporicidin – was evaluated with a VITA Easyshade spectrophotometer on VC shade tabs [17]. The study evaluated two years of usage and based on the results the shade tabs did not undergo color changes in this period. Arrejaie et al simulated the effects of one, two and three years of disinfection with three different disinfectants on VITA Toothguide 3D Master shade guides. The measurements were carried out with A 7000A Colour Eye (X-rite, Grand Rapid, MI, USA) spectrophotometer [20].

Clinically significant color change was not described even after the three-year simulation, but the number of simulated disinfectant cycles was less than in other similar articles Hombesh et al evaluated the survivability of VITA 3D Master shade guides. The measurements were carried out with a spectrophotometer and two years were simulated. The test group was treated with isopropyl alcohol (70%), for the control group distilled water was used. A significant color difference was found between the control and the test group but without any clinical significance [6]. Alshetri et al treated the VC shade tabs with a disinfectant containing 70% ethanol and isopropyl alcohol. The potential color difference after the disinfection was evaluated digitally (Shade Eye NCC colorimeter) and visually [18]. Discoloration on the shade tabs was found in the case of 17.8% after two years of simulation, after three years it was raised to 28.9%. Pohjola et al found increased L^* (lightness) and c^* (chroma) values after two and three years of simulated disinfection with Cavicide disinfectant [21]. Alsethri and Pohjola both recommend keeping one reference shade guide in the dental office to check the color of the frequently used shade guides regularly [18,21]. In this present study the potential discoloration of the shade tabs - used by students in the Department of Prosthodontics, Semmelweis University - was evaluated due to everyday usage. During the visual comparison a visible color difference was found on 38 shade tabs. The color difference was not commensurable, but the transparency of the edges was less visible on the used shade tabs compared to the new reference. (Fig. 11,12) Regarding the C2 shade tabs the best result was observed because discoloration was only found in two cases. (Fig. 13)



Figure 11. D2 shade tabs. Reference shade tab on the left side. Discolored shade tabs on the middle and on the right side. For the upper pictures a cross polarization filter was used to remove glare.

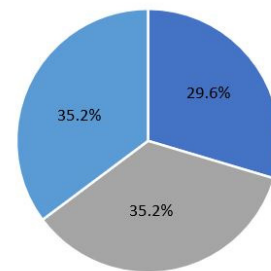


Figure 12. The color difference is visible with the naked eye. The discolored shade tabs on the right side and the reference shade tabs on the left side. For the upper pictures a cross polarization filter was used to remove glare.



Figure 13. C2 shade tabs reached the best results, in this photo discoloration was not visible. For the upper pictures a cross polarization filter was used to remove glare.

During the spectrophotometric digital measurement, 38 out of 54 shade tabs showed higher values than 0.8 ΔE_{00} (perceptibility threshold) and belonged to the visible color difference group. The most frequent shade tabs were A1, A2, and C3 shade tabs in the visible color difference group. This can be attributed to the more frequent use of the mentioned shades and the increased number of disinfection cycles. The ΔE_{00} was above 1.8 in the case of 19 shade tabs, so 35.2% of the tested tabs belonged to the unacceptable color difference group. These tabs were considered clinically useless due to the unacceptable discoloration. The most frequent shades in the unacceptable color difference group were the A1 and C3. Only 29.6% of the tested shade tabs did not show noticeable color differences during the digital comparison. (Fig. 14)



■ Invisible color difference ■ Acceptable color difference ■ Unacceptable difference

Figure 14. Percentage distribution of invisible, acceptable and unacceptable color differences among the tested shade tabs.

CONCLUSION

35.2 % of the tested VC shade tabs underwent unacceptable color changes. The present study demonstrated that the shade tabs were worn out, and discolored over time. The discoloration was even detected visually. The color changes might affect the color of the final restoration and lead to esthetic failures. The shade tabs used daily need to be checked regularly and have to be replaced if discoloration is detected.

AUTHOR CONTRIBUTIONS

DF: Conceptualization, Methodology, Investigation, Writing-Original draft, Visualization, Project Administration **JB:** Conceptualization, Methodology, Writing-Review and Editing, Supervision **PH:** Conceptualization, Writing-Review and Editing, Supervision

CONFLICT OF INTEREST

Authors declare that there is no conflict of interests.

ACKNOWLEDGMENTS

The authors want to thank Dr. László Kardos for the statistical evaluation.

REFERENCES

1. Tin-Oo MM, Sadtqi N, Hassan N. Factors influencing patient satisfaction with dental appearance and treatments they desire to improve aesthetics. *BMC Oral Health*. 2011 Feb 23;11:6. doi: 10.1186/1472-6831-11-6.
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
2. Kinra MS, Goyal M, Handa A, et al. Shade Selection for Fixed Partial Dentures. *Kasmera*. 2015;09(01):15-25.
3. Sulaiman AO, Adebayo GE. Most frequently selected shade for advance restoration delivered in a tertiary hospital facility in South Western Nigeria. *Ann Ib Postgrad Med*. 2019;17(2):157-161.
[Full text links CrossRef PubMed Google Scholar](#)
4. Zenthöfer A, Wiesberg S, Hildenbrandt A, et al. Selecting VITA classical shades with the VITA 3D-master shade guide. *Int J Prosthodont*. 2014;27(4):376-382. doi: 10.11607/ijp.3770.
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
5. Alnusayri MO, Sghaireen MG, Mathew M, et al. Shade selection in esthetic dentistry: a review. *Cureus*. 2022;14(3):e23331. doi: 10.7759/cureus.23331.
[Full text links CrossRef PubMed Google Scholar WoS](#)
6. Hombesh MN, Praveen B, Sinha HV, et al. Two years survival of VITA 3D master shade matching guides after disinfection with isopropyl alcohol: an in vitro study. *J Conserv Dent*. 2019;22(3):275-280. doi: 10.4103/JCDJCD_573_18.
[Full text links CrossRef PubMed Google Scholar Scopus](#)
7. KHodarahmi E, Salari M, Azizi A, Lawaf S. Discoloration of Vita classical shade guide by glutaraldehyde disinfectant. *J Res Dent Maxillofac Sci* 2021;6(1):4-13. doi: jrdms.dentaliau.ac.ir/article-1-293-en.html
[Google Scholar Scopus](#)
8. Elamin HO, Abubakr NH, Ibrahim YE. Identifying the tooth shade in group of patients using Vita Easyshade. *Eur J Dent*. 2015;9(2):213-217. doi: 10.4103/1305-7456.156828.
[Full text links CrossRef PubMed Google Scholar Scopus](#)
9. Clary JA, Ontiveros JC, Cron SG, Paravina RD. Influence of light source, polarization, education, and training on shade matching quality. *J Prosthet Dent*. 2016;116(1):91-97. doi: 10.1016/j.prodent.2015.12.008.
[Full text links CrossRef PubMed Google Scholar Scopus](#)
10. Mokrzycki WS, Tatol M. Colour difference $\Delta E - a$ survey. *Mach Graph Vis*. 2011;20(4):383-411.
[Google Scholar](#)
11. Luo M, Cui G, Rigg B. The development of the CIE 2000 colour-difference formula: CIEDE2000. *Color Research & Application*. 2001;26(5):340-350. doi: 10.1002/col.1049
[CrossRef Google Scholar Scopus WoS](#)
12. ISO/TR 28642: Dentistry - Guidance on color measurement. Vernier, CH: ISO; 2016.
13. Paravina RD, Ghinea R, Herrera LJ, et al. Color difference thresholds in dentistry. *J Esthet Restor Dent*. 2015;27 Suppl 1:S1-9. doi: 10.1111/jerd.12149.
[Full text links CrossRef PubMed Google Scholar](#)
14. Hassel AJ, Zenthöfer A, Corcodel N, et al. Determination of VITA Classical shades with the 3D-Master shade guide. *Acta Odontol Scand*. 2013;71(3-4):721-726. doi: 10.3109/00016357.2012.715197.
[CrossRef PubMed Google Scholar Scopus WoS](#)
15. Iglie C, Weyhrauch M, Wentaschek S, et al. Dental color matching: a comparison between visual and instrumental methods. *Dent Mater J*. 2016;35(1):63-69. doi: 10.4012/dmj.2015-006.
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
16. Paravina RD. Performance assessment of dental shade guides. *J Dent*. 2009;37 Suppl 1:e15-20. doi: 10.1016/j.jdent.2009.02.005.
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
17. Huang PY, Masri R, Romberg E, Driscoll CF. The effect of various disinfectants on dental shade guides. *J Prosthet Dent*. 2014;112(3):613-617. doi: 10.1016/j.prodent.2014.04.006.
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
18. Alshethri SE. Evaluation of color changes in the Vitapan Classical Shade Guide after disinfection. *Oper Dent*. 2014;39(3):317-324. doi: 10.2341/13-125-L.
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
19. Alamri MD. The effect of disinfecting solutions on the color of porcelain shade guides. *Egypt Dent J*. 2008 Apr;54(2):1057-1066.
[Google Scholar](#)
20. ArRejaie AS. The effect of chemical disinfectants on the color of a porcelain shade guide. *Int J Health Sci (Qassim)*. 2014;8(3):299-304. doi: 10.12816/0023982.
[Full text links CrossRef PubMed WoS](#)
21. Pohjola RM, Hackman ST, Browning WD. Evaluation of a standard shade guide for color change after disinfection. *Quintessence Int*. 2007;38(8):671-676.
[Full text links PubMed Google Scholar Scopus WoS](#)

CV

Dr. Dóra Fehér is a PhD student and became a prosthodontist specialist in 2022. She has been working in the Department of Prosthodontics, at the Semmelweis University since 2019. Her PhD is about the possibilities of shade reproduction and investigates the shade matching of the shade tabs and restorative materials and the color stability and discoloration of conventional shade guides. Its aim is to provide patients with the best aesthetic outcome by reproducing the correct shade and translucency with modern ceramic materials. Besides her research activities, she teaches prosthodontics at the university for dental students and participates in the education of post-graduation students, dental assistants, and dental technicians as well.

Dóra FEHÉR

DMD, PhD
 Department of Prosthodontics
 Faculty of Dentistry
 Semmelweis University
 Budapest, Hungary



Questions

1. What are the most commonly used shade guides?

- a. Vita Classical and Vita 3D Master;
- b. Vita Classical and Ivoclar Universal A-D shade guide;
- c. Vita 3D Master and Vita Bleachguide 3D Master;
- d. None of the above.

2. The visual shade selection is:

- a. Objective;
- b. Not used anymore;
- c. Subjective;
- d. Always very precise.

3. What is the color temperature of the Smile Lite lamp?

- a. 1000 K;
- b. 65000 K;
- c. 10000 K;
- d. 5500 K.

4. Please select the true statement:

- a. The Vita Easyshade V spectrophotometer measures the reflected light;
- b. For visual shade selection, the standardized light conditions are not important;
- c. The VITA Easyshade spectrophotometer is not able to measure color parameters like L^*a^*b or L^*c^*h ;
- d. The color difference is measurable with the Vita Easyshade spectrophotometer.

assimilate
by medvarsity

CPD Credit
Points Awaited
by Dubai Health Authority

**Aesthetic Dentistry Medical
Congress Dubai 2025**

The art and science behind the smile

Save the date

25th & 26th APRIL, 2025
JW Marriott Marina , Dubai

REGISTER NOW www.assimilate.one

STUDY REGARDING THE INFLUENCE OF VARIOUS MODELING AGENTS ON SURFACE MICROHARDNESS ROUGHNESS OF NANOHYBRID COMPOSITE RESINS

Simona Stoleriu^{1a*}, Gianina Iovan^{1b}, Irina Nica^{1c}, Galina Panca^{1d}, Andrei Georgescu^{1e}, Alice Murariu^{2f*}, Sorin Andrian^{1g}, Ionuț Tărăboanță^{1h}

¹Department of Odontology, Periodontology and Fixed Prosthodontics, "Grigore T. Popa" University of Medicine and Pharmacy, Iasi, Romania

²Department of Surgery, Faculty of Dental Medicine, "Grigore T. Popa" University of Medicine and Pharmacy, Iasi, Romania

^aDMD, PhD, Associate Professor; e-mail: simona.stoleriu@umfiasi.ro; ORCID-ID: <https://orcid.org/0000-0001-5427-6027>

^bDMD, PhD, Professor; e-mail: gianina.iovan@umfiasi.ro; ORCID-ID: <https://orcid.org/0000-0001-7255-4406>

^cDMD, PhD, Lecturer; e-mail: irina.nica@umfiasi.ro; ORCID-ID: <https://orcid.org/0000-0003-1189-0785>

^dDMD, PhD, Lecturer; e-mail: galina.panca@umfiasi.ro; ORCID-ID: <https://orcid.org/0000-0001-5427-6027>

^eDMD, PhD, Professor assistant; e-mail: andrei.georgescu@umfiasi.ro; ORCID-ID: <https://orcid.org/0000-0001-7407-844X>

^fDMD, PhD, Professor; e-mail: alice.murariu@umfiasi.ro; ORCID-ID: <https://orcid.org/0000-0003-4526-3878>

^gDMD, PhD, Professor; e-mail: sorin.andrian@umfiasi.ro; ORCID-ID: <https://orcid.org/0000-0002-9271-6123>

^hDMD, PhD, Professor assistant; e-mail: ionut.taraboanta@umfiasi.ro; ORCID-ID: <https://orcid.org/0000-0001-5452-916X>

ABSTRACT

[https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.4](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.4)

Objective The purpose of this study was to investigate the effects of different modeling agents on surface hardness and on surface roughness of some conventional nanohybrid composite resins.

Methodology Samples of two nanohybrid composite resins: Essentia - group I (n=40) and Neo Spectra ST HV - group II (n=40) were included in this study. Three modeling agents were applied on top of the last composite layer before light curing: Modeling Liquid - subgroup 2 (n=10), 7th generation of bonding system-G-Bond - subgroup 3 (n=10), and a universal bonding system G-Premio Bond - subgroup 4 (n=10). In subgroup 1 (n=10) no modeling agent was applied. Half of the samples in subgroups 1, 2, 3 and 4 from each group were subjected to surface hardness determination using a digital electronic hardness tester (Vickers Hardness Number (VHN) mean value was reported) and half of them to surface roughness evaluation by Atomic Force Microscopy (AFM) analysis (AFM analysis) (root mean square parameter (Rq) was reported).

Results In group I and II statistically significant results were obtained when comparing the surface microhardness in subgroups 2, 3 and 4 with subgroup 1, the microhardness in subgroups 2 and 3 and in subgroup 2 and 4 (Wilcoxon test, p<0.05). In both groups, no statistically significant differences were obtained when comparing the mean Rq values among all subgroups (ANOVA and post hoc Bonferroni tests, p<0.05). The difference on the left side was insignificant (0.81, p=0.9933). The total volume removed did not differ significantly between the two methods (p=0.88851) or on the side (p=0.7582).

Conclusion All evaluated modeling agents decreased the surface microhardness of the tested nanohybrid composite resins. None of the modeling agents influenced the surface roughness of the composites.

KEYWORDS


Atomic Force Microscopy (AFM); Composite Resins; Microhardness; Modeling Agents; Roughness.

1. INTRODUCTION

Due to technological progress in material science composite resins have become the most commonly used direct restorative materials both on anterior and posterior area of the arches [1]. The main advantages are represented by their use in minimally invasive techniques, esthetic aspect, good mechanical properties, good handling properties (some composite resins having easy transportation, insertion and modeling characteristics) [2]. Rebuilding tooth anatomy is a mandatory step when restoring a tooth and due to the viscosity of resin monomers sometimes it is difficult to shape the

composite in order to fit the natural anatomical aspect of the tooth.

To prevent the adhesiveness of the composite to the instruments used for transportation, insertion or modeling, different resin monomers or substances were used to lubricate the tools or the brushes. In time practitioners started to use alcohol, acetone and isopropyl acid to control the handling and modeling characteristics of the composites, but they were considered inappropriate for the purpose. Alcohol used as a modeling agent can have detrimental effects on the resin matrix and can decrease the mechanical properties of composites [3]. Some producers introduced wetting agents

 OPEN ACCESS This is an Open Access article under the CC BY-NC 4.0 license.

Peer-Reviewed Article

Citation: Stoleriu S, Iovan G, Nica I, Panca G, Georgescu A, Murariu A, Andrian S, Tărăboanță I. Study regarding the influence of various modeling agents on surface microhardness and on surface roughness of nanohybrid composite resins. *Stoma Edu J.* 2024;11(1-2):51-57.

Received: March 21, 2024; **Revised:** April 21, 2024; **Accepted:** May 02, 2024; **Published:** May 15, 2024.

***Corresponding author:** Simona Stoleriu; Address: Universității Street No.16, Iași, Romania; **Tel.:** +40-745-106-066; e-mail: simona.stoleriu@e-mail.com

com; Alice Murariu; Address: Universității Street No.16, Iași, Romania; **Tel.:** +40-745-106-066; e-mail: alice.murariu@umfiasi.ro.

Copyright: © 2022 the Editorial Council for the Stomatology Edu Journal.

(modeling liquids) for better handling. The lubricants can be applied in the layering process of composite application to minimize adhesiveness by wiping the instrument with modeling agents [4,5]. This approach facilitated the improvement of handling and insertion, but also simplified the modeling process of composite resins and improved the surface characteristics by smoothing the surface [6].

Most of the modeling agents are resin-based materials that include little or no filler [7]. Modeling liquids generally contain methacrylates such as urethane dimethacrylate (UDMA), bisphenol A-glycidyl methacrylate (Bis-GMA), and triethylene glycol dimethacrylate (TEGDMA). They are also composed of hydrophobic non-solvated resins and they have low or no organic fillers [8]. Chemical, structural and mechanical alterations have been reported in composite materials after being modeled with the instrument lubricated with modeling agent even when the chemical composition of the agent was similar to that of the composite resin [9]. As an alternative to modeling liquids dental clinicians have used bonding systems to improve composite handling properties, even if this use is not included in the manufacturers' specifications. Some studies have pointed that these techniques can negatively affect the physical properties and surface characteristics of composite resins [10-12]. Significantly higher decrease of composite surface micro-hardness was reported when a non-solvated adhesive (the 3rd step of etch and rinse bonding system) [10] or the self-etch primer (the 1st liquid of the 2-step self-etch bonding system) [11] were used as lubricants. On the contrary, other studies concluded that some modeling agents can preserve the surface hardness [13]. Only a few articles reported data regarding the influence of modeling agents on composite surface roughness and these data are controversial. Some of the studies pointed that the modeling liquid, the universal bonding agent or the 2nd step of a self-etch bonding system have no effect on the surface roughness of the investigated composite resins [10,11]. On the other hand, in other studies the application of a modeling liquid determined an increased surface roughness of the composite resins [13].

The purpose of this study was to investigate the effects of various agents (modeling substances or adhesive systems) on the surface hardness and surface roughness of some conventional nanohybrid composite resins.

The null hypotheses were:

1. the use of different modeling agents has no effect on the surface microhardness of nanohybrid composite resins;
2. the use of different modeling agents has no effect on the surface roughness of nanohybrid composite resins.

2. METHODS AND MATERIALS

Study design is presented in Fig. 1. roughly in the canine location (Fig. 1).

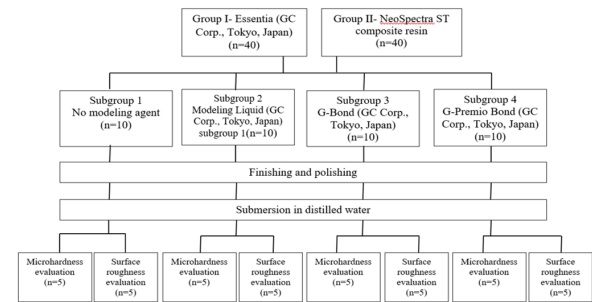


Figure 1. Study design.

2.1. Sample preparation

Two nanohybrid composite resins were included in this study: Essentia - group I (GC Corp., Tokyo, Japan) (light enamel shade) and Neo Spectra ST HV- group II (Dentsly Sirona, Konstanz, Germany) (A1 shade). Forty samples of each material were obtained by condensing the resin into the plastic cylinders 6 mm in diameter and 4 mm in height. The molds were placed on a glass plate in contact with a transparent matrix to ensure a smooth surface of the sample. Two layers of each material were inserted, each layer being individually cured for 40 seconds using a LED lamp (Woodpecker Med. Instrument, Guilin, China) with the intensity of 1.200 mW/cm².

Before light-curing the last layer, three different modeling agents were applied on the surface of 30 samples from each group using a brush. Modeling Liquid (GC Corp., Tokyo, Japan) was applied on 10 samples from each group (subgroup 2), G-Bond bonding system (GC Corp., Tokyo, Japan) on 10 samples (subgroup 3) and universal bonding system G-Premio Bond (GC Corp., Tokyo, Japan) were applied in self-etch technique on 10 samples (subgroup 4). Different brushes were used for each modeling agent and for a specific type of agent the brush was replaced by a new one after 10 applications. The same quantity of the liquid (one drop) was placed in a plastic box, the brush was submersed one time in the liquid and the excess was removed by touching a paper towel with the brush. For the rest of 10 samples in each group no modeling agent or bonding system was applied before light-curing the last layer of composite resin (subgroup 1).

Details related to the chemical composition of the two composite resins and modeling agents are presented in Table 1.

Table 1. Chemical composition of the tested materials.

	Material type	Composition	The manufacturing company
Essentia	Nanohybrid composite resin	Matrix: UDMA, Bis-MEPP, Bis-EMA, Bis-GMA, TEGDMA Filler: prepolymerized silicon particles, barium glass (81% by weight and 65% by volume)	GC Corp., Tokyo, Japan
Neo Spectra ST HV	Nanohybrid composite resin	Matrix: Methacrylate modified polysiloxane (organically modified ceramic), Bis-EMA, TEGDMA Filler: prepolymerized spherical particles (15 µm) and 0.6 µm barium glass and 0.6 µm ytterbium fluoride particles, silicon dioxide nanoparticles (10 nm), (77–79% by weight and 59–61% by volume)	Dentsly Sirona, Konstanz, Germany
Modeling Liquid	Modeling agent	UDMA, 2-HEMA, TEGDME	GC Corp., To-kyo, Japan
G-Bond	adhesive system (7 th generation)	Phosphoric acid ester monomers, 4-MET monomer, nanoparticles	GC Corp., To-kyo, Japan
G-Premio Bond	Universal adhesive system	4-MET, MDP and MDTP	GC Corp., To-kyo, Japan
UDMA- urethane dimethacrylate; Bis-MEPP- bisphenol-A ethoxylate dimethacrylate; Bis-EMA- ethoxylated bisphenol-A dimethacrylate; Bis-GMA-bisphenolglycidyl methacrylate; TEGDMA- triethylene glycol dimethacrylate; UDMA- urethane dimethacrylate; 2-HEMA- 2 hydroxyethyl methacrylate, TEGDME- trimethylene glycol dimethyl ether; 4-MET- 4-[2-(methacryloyloxy)ethoxycarbonyl]phthalic acid;MDP- 10-Methacryloyloxydecyl dihydrogen phosphate; MDTP- 4,4',4''- [(methanetriyl)tris (benzene-4,1-diyl)] tris (oxy)] triphthalonitrile.			

The samples were then removed from the plastic mold, the lower surfaces were marked and the upper surfaces of the samples were finished with medium, fine and extra fine abrasive discs (Sof-Lex™, 3M ESPE) under water cooling, for 20 seconds for each grit. The samples were then submerged for 24 hours in a container with distilled water. Half of the samples in subgroups 1, 2, 3 and 4 from each group were subsequently subjected to surface hardness determination and half of them to surface roughness evaluation.

2.2. Determination of surface microhardness

On the unmarked surfaces of the samples Vickers hardness was determined using a digital electronic hardness tester (Micro-Vickers Hardness System CV-400 DMTM, CV Instruments Namicon). CV-400 micro/macrohardness tester is a solid and accurate hardness tester used on an industrial and laboratory scale. It is equipped with an automatic Vickers indentation head and a special indentation measurement and evaluation software. In this study a load of 200 g with a 10-second dwell time was applied on Vickers hardness head, according to the International Organization for Standardization (ISO) 6507/ASTM E 384 standards. For each sample 2 indentations were made, the distance between the indentations being of 1 mm. The surface hardness was determined by measuring the indentation diagonal and was expressed as Vickers Hardness Number (VHN). The final surface hardness of a sample was calculated as the average value of the two determinations.

2.2. Determination of surface microroughness

Half of the samples in each group were analyzed for surface roughness using atomic force microscopy (SOLVER PRO-M scanning probe microscope, NTMDT, Russia). The measurements were performed in air environment and in static force operating mode. 2D and 3D images were obtained on sample area of 20 × 20 µm. On 3D images the surface roughness was reported as the root mean square roughness

parameter (Rq). Two hundred fifty-six linear scans were performed on each section and the final Rq value of the sample was reported as the mean value of all scans.

2.3. Statistical analyses

The data were analyzed using IBM SPSS Statistics 28.0.1 program (SPSS Inc., Chicago, IL, USA). The effects of modeling agents on hardness were analyzed using the Wilcoxon test (at p<0.05 significance level) and the effects on surface roughness using ANOVA and post hoc Bonferroni tests (at p<0.05 significance level).

3. RESULTS

The mean values and standard deviation of surface microhardness (VHN) in groups and subgroups are presented in Table 2.

Table 2. Mean VHN values and standard deviations of surface microhardness (VHN) in groups and subgroups.

	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 4
Group I	68.04 ± 0.45	63.58 ± 0.77	54.25 ± 1.34*	56.02 ± 0.48*
Group II	66.05 ± 0.67	58.23 ± 0.70	44.93 ± 0.99*	46.05 ± 0.60*

* represent no statistical differences among the subgroups in group (p>0.05)

In group I and II statistically significant results were obtained when comparing the surface microhardness values of the samples in subgroups 2, 3 and 4 with subgroup 1 of the samples in subgroups 2 and subgroup 3 and of subgroup 2 with subgroup 4 (Table 2).

3.2. Surface roughness evaluation

3D and 2D aspects of some samples in group I subgroups 1-4 and group II subgroups 1-4 are presented in Figs. 2, 3, respectively.

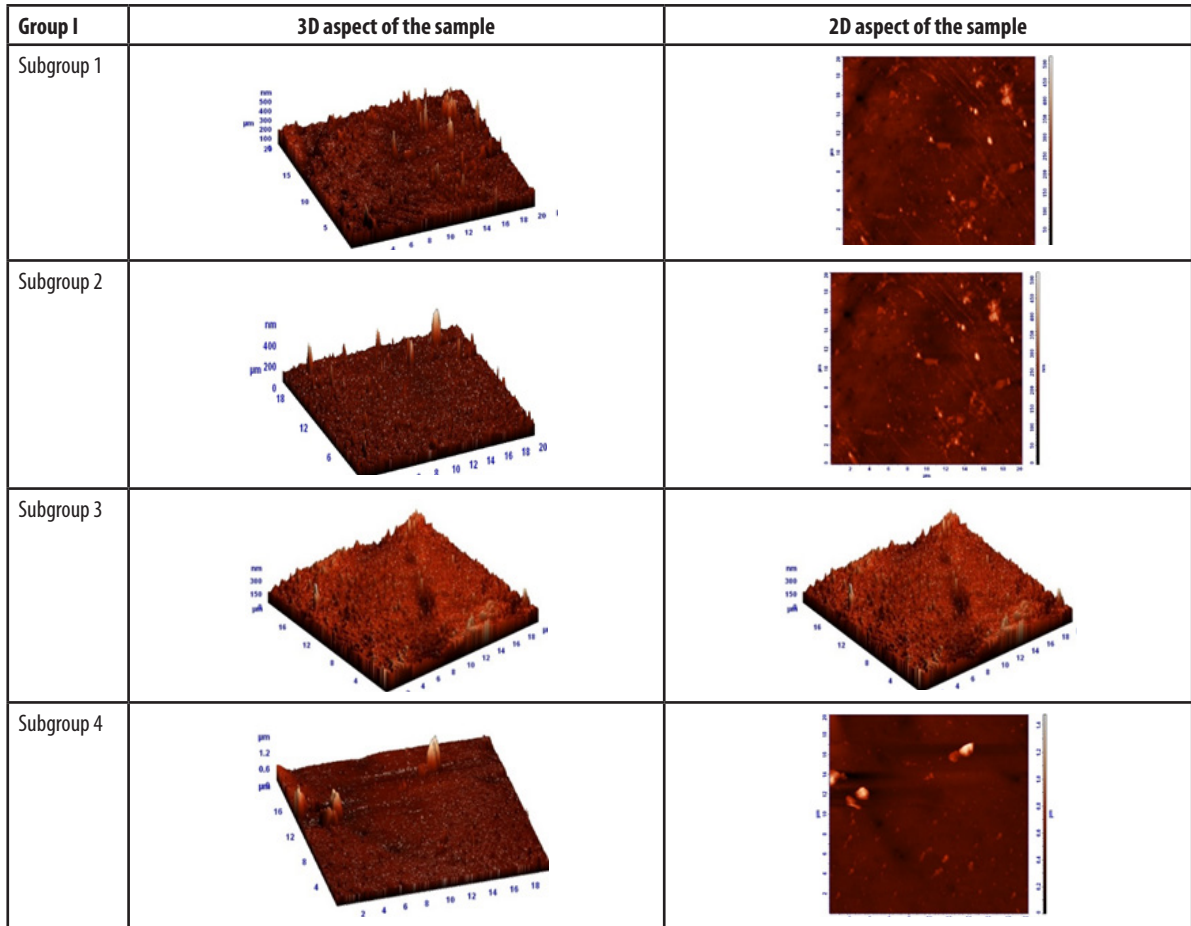


Figure 2. 3D and 2D aspect of Essentia samples when using no modeling agent (subgroup 1), Modeling Liquid (subgroup 2), G-Bond (subgroup 3), G-Premio Bond (subgroup 3)..

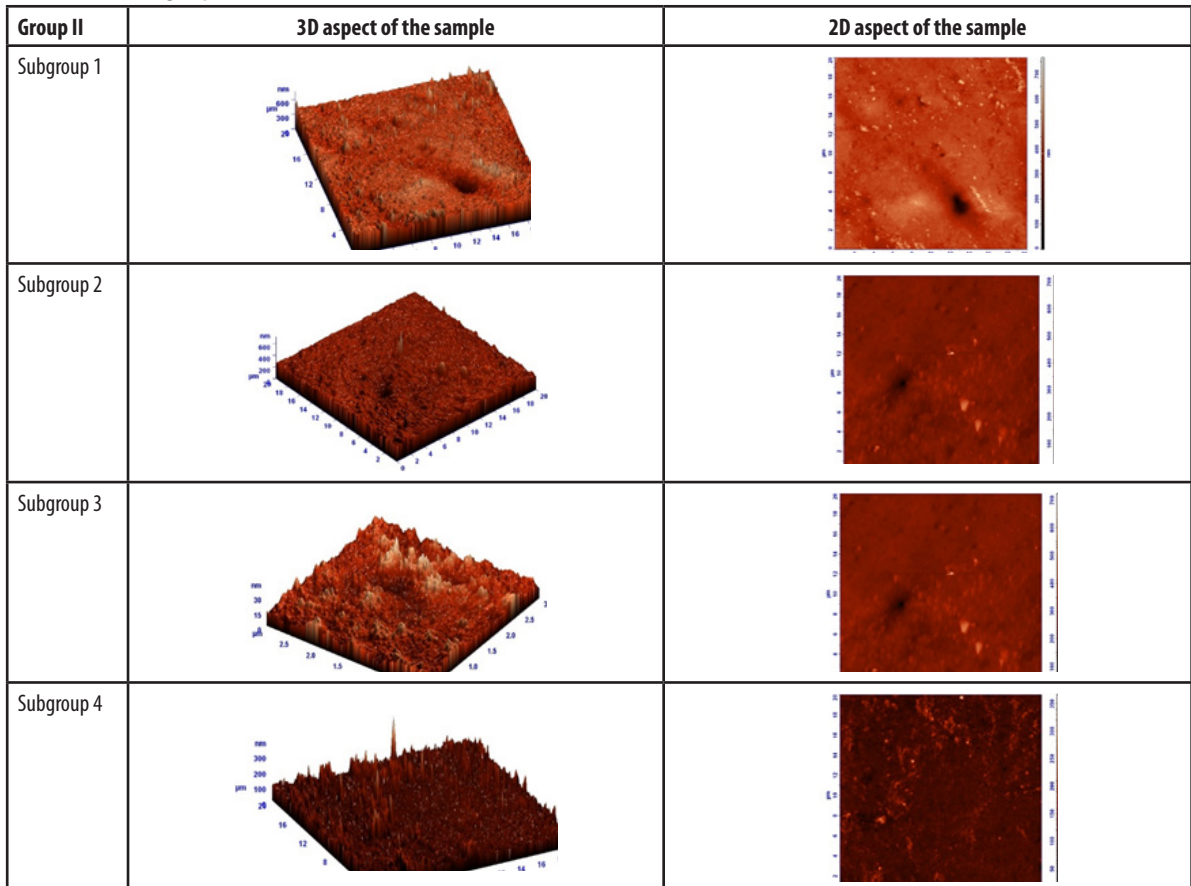


Figure 3. 3D and 2D aspect of NeoSpectra ST samples when using no modeling agent (subgroup 1), Modeling Liquid (subgroup 2), G-Bond (subgroup 3), G-Premio Bond (subgroup 3).

The mean Rq values and standard deviation in subgroups 1-4 of groups I and II are presented in table 3. In both groups, no statistically significant differences were obtained when comparing the surface roughness among subgroups 1, 2, 3 and 4.

Table 3.

	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 4
Group I	0.051±0.003	0.067±0.002	0.055±0.003	0.064±0.003
Group II	0.052±0.002	0.064±0.003	0.057±0.004	0.065±0.002

4. DISCUSSION

The first null hypothesis of the study was rejected, all the agents used for modeling the composite resin decreasing the composite surface hardness. This might be determined by the filler content in the final composite layer after using modeling agents [7]. All modeling agents have a low filler percentage, so their application on the last composite layer lead to a resin-rich layer formation on the surface [14]. As a result, lower VHN values are obtained after modeling agent application. Generally, this external layer having high resin content is removed by the finishing procedure. Although all the samples in this study were finished, VHN values were still lower in the groups where modeling agents were used when comparing to the control group (Table 2). Even if the external resin-rich layer was removed by finishing, it seems that wetting agents can diffuse in the deeper layers of the material, changing their chemical composition and hardness [15]. Another explanation for decreasing the surface hardness as a result of modeling agents application is the presence of 2-HEMA molecule in the composition of the Modeling Liquid, a hydrophilic monomer which can cause water absorption due to a hydroxyl and carbonyl group [16]. Therefore, as it was reported even in previous studies, HEMA can reduce the hardness of composite resin [17].

The 2021 study conducted by Ezgi T. Bayraktar also focused on the effects of modeling agents on mechanical properties of composites when using modeling agents on composite top layer [8]. Their study reported the reduction of surface microhardness as a result of modeling agents application in the last material layer, similar to the results of the present study. Also, Tuncer et al. evaluated the effects of a modeling agent (Modeling Resin, Bisco, IL, USA) on the surface microhardness of different composite resins and they reported decreased surface microhardness when using a modeling agent for two of the tested composite resin [7].

In our study the group in which the Modeling Liquid was used recorded highest hardness value when comparing to the 7th generation of adhesive system and to the universal bonding system. That aspect might be correlated to the presence of UDMA molecule in the composition. This molecule consists of two urethane bonds and a flexible aliphatic core and forms double hydrogen bonds [18]. It has been

reported that resins containing UDMA have superior polymerization rates and a high degree of conversion [18]. Consequently, the degree of conversion and polymerization rate can affect the surface hardness of the samples. However, Tuncer et al. pointed that differences in microhardness between different composites may not be attributed to the degree of conversion [7]. Also Kutuk et al tested Modeling Liquid and two universal adhesive agents (G-Premio Bond, GC Corp.; OptiBond XTR, KavoKerr, Orange, CA, United States) as modeling agents in combination with nanohybrid composite resins [11]. The study found the lowest microhardness values when OptiBond XTR was used. Contradictory to the findings of this study, in our research the 7th generation of bonding agent determined lower microhardness of the tested materials when comparing to the Modeling Liquid group and control group and the same effect as the universal bonding resin.

The composite resins hardness is also determined by the characteristics of filler particles and their interaction with the polymers [19,20]. It was reported that nanofilled composite resins exhibit improved hardness and abrasion resistance when comparing to other categories of composite resins [21]. That was the reason for including nanohybrid composites as testing materials in our study. The low-viscosity agents used to improve composites handling characteristics act by reducing the surface tension [22], but also by filling the defects in the material by diffusing through the pores resulted during layering procedure, making the material more resistant to degradation [5,23]. The final layer of restorative material has a decisive effect on aesthetics, color stability, and surface roughness [24]. Smooth and well-polished surfaces decrease plaque retention and consequently lower the risk of secondary caries and staining. In our study, the roughness values of both tested composite resins were lower than the plaque accumulation threshold of 20 µm [25]. Adequate finished and polished surfaces are mandatory to achieve long-lasting clinical restorations. Composites having nanoparticles present high polishability when using tools containing Al₂O₃ or diamond particles [26,27]. In our study, the specimens were polished using Sof-Lex aluminum oxide discs to achieve optimal surface smoothness. Following the polishing procedure, in our study the samples were submersed in distilled water for 24 hours to remove unreacted monomers and to allow post-polymerization process. It has been suggested that some liquid agents can be used to achieve smooth composite resin surface [28,29]. However, it has been proved to be very difficult to obtain a regular surface when using liquid resins [30]. All tested modeling agents in the present study had no effect on surface roughness of composite resins (Tab. 3), so the second null hypothesis was accepted].

5. CONCLUSION

Within the limitations of this study, all evaluated modeling agents decreased the surface microhardness of the tested nanohybrid composite resins. None of the modeling agents influenced the surface roughness of the composites. Further clinical studies should be performed for more accurate understanding of the effects of modeling agents on the mechanical properties and surface condition of composite resins.

REFERENCES

- Rosa WL, Piva E, Silva AF. Bond strength of universal adhesives: a systematic review and meta-analysis. *J Dent.* 2015;43(7):765-776. doi: 10.1016/j.jdent.2015.04.003.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Nahsan FP, Mondelli RF, Franco EB, et al. Clinical strategies for esthetic excellence in anterior tooth restorations: understanding color and composite resin selection. *J Appl Oral Sci.* 2012;20(2):151-156. doi: 10.1590/s1678-77572012000200005.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Sneed WD, Draughn RA. Effect of alcohol on the strength of a composite resin. *Oper Dent.* 1980;5(2):47-48.
[PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Dunn WJ, Strong TC. Effect of alcohol and unfilled resin in the incremental buildup of resin composite. *Quintessence Int.* 2007;38(1):e20-26.
[Full text links](#) [PubMed](#) [Google Scholar](#)
- Barcellos DC, Pucci CR, Torres CR, Goto EH, Inocencio AC. Effects of resin monomers used in restorative dental modeling on the cohesive strength of composite resin. *J Adhes Dent.* 2008;10(5):351-354.
[Full text links](#) [PubMed](#) [Google Scholar](#)
- Perdigão J, Gomes G. Effect of instrument lubricant on the cohesive strength of a hybrid resin composite. *Quintessence Int.* 2006;37(8):621-625.
[Full text links](#) [CrossRef](#) [PubMed](#) [WoS](#)
- Tuncer S, Demirci M, Tiryaki M, Unlü N, Uysal Ö. The effect of a modeling resin and thermocycling on the surface hardness, roughness, and color of different resin composites. *J Esthet Restor Dent.* 2013;25(6):404-419. doi: 10.1111/jerd.12063.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)
- Bayraktar ET, Atali PY, Korkut B, et al. Effect of modeling resins on microhardness of resin composites. *Eur J Dent.* 2021 Jul;15(3):481-487. doi: 10.1055/s-0041-1725577.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)
- Ellakwa A, Cho N, Lee IB. The effect of resin matrix composition on the polymerization shrinkage and rheological properties of experimental dental composites. *Dent Mater.* 2007;23(10):1229-1235. doi: 10.1016/j.dental.2006.11.004.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- de Paula FC, Valentin Rde S, Borges BC, et al. Effect of instrument lubricants on the surface degree of conversion and crosslinking density of nanocomposites. *J Esthet Restor Dent.* 2016;28(2):85-91. doi: 10.1111/jerd.12182.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Kutuk ZB, Erden E, Aksahin DL, Durak ZE, Dulda AC. Influence of modeling agents on the surface properties of an esthetic nano-hybrid composite. *Restor Dent Endod.* 2020;45(2):e13. doi: 10.5395/rde.2020.45.e13.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)
- Pereira PL, Pereira R, Silva BG, et al. Effect of wetting agent coverage on the surface properties of resin composite submitted to brushing and staining cycles. *J Clin Exp Dent.* 2021;13(8):e795-e801. doi: 10.4317/jced.58311.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)
- Perea-Lowery L, Tolvanen M, Vallittu PK. Evaluation of the effect of monomer systems on the softening of a composite resin. *Int J Prosthodont.* 2019;32(1):101-103. doi: 10.11607/ijp.5692.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
- Nayyer M, Zahid S, Hassan SH, et al. Comparative abrasive wear resistance and surface analysis of dental resin-based materials. *Eur J Dent.* 2018;12(1):57-66. doi: 10.4103/ejd.ejd_380_17.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)
- Koc-Vural U, Baltacioglu I, Altinci P. Color stability of bulk-fill and incremental-fill resin-based composites polished with aluminum-oxide impregnated disks. *Restor Dent Endod.* 2017;42(2):118-124. doi: 10.5395/rde.2017.42.2.118.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)
- Pratap B, Gupta RK, Bhardwaj B, Nag M. Resin based restorative dental materials: characteristics and future perspectives. *Jpn Dent Sci Rev.* 2019;55(1):126-138. doi: 10.1016/j.jdsr.2019.09.004.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Chou KF, Han CC, Lee S. Water transport in 2-hydroxyethyl methacrylate copolymer irradiated by γ rays in air and related phenomena. *J Polym Sci Pol Part B: Polym Phys.* 2000;38(5):659-671.
[CrossRef](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Barszczewska-Rybark IM. Structure-property relationships in dimethacrylate networks based on Bis-GMA, UDMA and TEGDMA. *Dent Mater.* 2009;25(9):1082-1089. doi: 10.1016/j.dental.2009.01.106.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Kundie F, Azhari CH, Muchtar A, et al. Effects of filler size on the mechanical properties of polymer-filled dental composites: a review of recent developments. *J Physiol Sci.* 2018;29(1):141-165.
[Google Scholar](#) [Scopus](#) [WoS](#)
- Prentice LH, Tyas MJ, Burrow MF. The effect of ytterbium fluoride and barium sulphate nanoparticles on the reactivity and strength of a glass-ionomer cement. *Dent Mater.* 2006;22(8):746-751. doi: 10.1016/j.dental.2005.11.001.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Klapdohr S, Moszner N. New inorganic components for dental filling composites. *Monatsh Chem/Chemical Monthly.* 2005;136(1):21-45. doi: 10.1007/s00706-004-0254-y
[CrossRef](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Araujo FS, Barros MCR, Santana MLC, et al. Effects of adhesive used as modeling liquid on the stability of the color and opacity of composites. *J Esthet Restor Dent.* 2018;30(5):427-433. doi: 10.1111/jerd.12378.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Munchow EA, Sedrez-Porto JA, Piva E, Pereira-Cenci T, Cenci MS. Use of dental adhesives as modeler liquid of resin composites. *Dent Mater.* 2016 Apr;32(4):570-577. doi: 10.1016/j.dental.2016.01.002.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Liebermann A, Spintzyk S, Reymus M, Schweizer E, Stawarczyk B. Nine prophylactic polishing pastes: impact on discoloration, gloss, and surface properties of a CAD/CAM resin composite. *Clin Oral Investig.* 2019 Jan;23(1):327-335. doi: 10.1007/s00784-018-2440-z.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#)
- Bollen CM, Papaioanno W, Van Eldere J, et al. The influence of abutment surface roughness on plaque accumulation and peri-implant mucositis. *Clin Oral Implants Res.* 1996;7(3):201-211. doi: 10.1034/j.1600-0501.1996.070302.x.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Sahbaz C, Bahsi E, Ince B, Bakir EP, Cellik O. Effect of the different finishing and polishing procedures on the surface roughness of three different posterior composite resins. *Scanning.* 2016;38(5):448-454. doi: 10.1002/sca.21295.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Andrian S, Iovan G, Pancu G, et al. Study regarding the surface state of composite resins after finishing and polishing using different systems. *Mater Plast.* 2017;54(4):689-693.
[CrossRef](#) [Google Scholar](#) [Scopus](#) [WoS](#)
- Perez Cdos R, Hirata RJ, da Silva AH, Sampaio EM, de Miranda MS. Effect of a glaze/composite sealant on the 3-D surface roughness of esthetic restorative materials. *Oper Dent.* 2009;34(6):674-680. doi: 10.2341/08-014-L.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#)
- Lowe RA. Using BisCover surface sealant/polish on direct and indirect composite and bisacrylic provisional restorations. *Compend Contin Educ Dent.* 2004;25(5):400-401.
[PubMed](#) [Google Scholar](#) [Scopus](#)
- Bertrand MF, Leforestier E, Muller M, Lupi-Pégurier L, Bolla M. Effect of surface penetrating sealant on surface texture and microhardness of composite resins. *J Biomed Mater Res.* 2000;53(6):658-663. doi: 10.1002/1097-4636(2000)53:6<658:aid-jbm7>3.0.co;2-o.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#)

AUTHOR CONTRIBUTIONS

SS, GP, GI: concept; **SS, IN, AM:** protocol; **SS, IT, AG:** data gathering and analysis; **SS, GP:** data interpretation; **SA, GI:** revising the manuscript.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interests.

Simona STOLERIU

DMD, PhD, Associate Professor
Department of Odontology Periodontology and Fixed Prosthodontics
"Grigore T. Popa" University of Medicine and Pharmacy
Iasi, Romania

**CV**

Simona Stoleriu is an educationist, researcher, and specialist in cariology and operative dentistry. Since 2018 she is associate professor on the Faculty of Dental Medicine, "Grigore T. Popa" University of Medicine and Pharmacy Iasi, Romania in 2018. She received PhD in Medical Dentistry in 2009 and she became senior specialist in General Dentistry in 2006. The research activity focused on early diagnosis of dental caries, non-operative and restorative treatment of caries lesion, diagnosis and treatment of wear lesions, the behavior of restorative materials in oral environment, factors which can influence the surface condition and mechanical properties of direct restorative materials, and remineralization of dental hard tissues. She was also being invited as a speaker on many national and international congresses and he received 10 awards for the scientific activity.

Questions**1. Different tools have been developed to improve the fit and the configuration of composite resins:**

- a. Titanium coated instruments;
- b. Aluminum coated instruments;
- c. Resin knives;
- d. Brushes.

2. Practitioners have used multiple lubricants in layering process of composite application to minimize adhesiveness of the material to the instrument:

- a. Acetone;
- b. Glycerine;
- c. Modeling liquid;
- d. Bonding system.

3. The followings are true regarding the conclusions of the present study:

- a. Modeling liquid had no effect on surface hardness;
- b. The use of 7th generation of adhesive system increased surface roughness of composite resin;
- c. The use of universal bonding system had no effect on surface roughness of composite resin;
- d. Modeling liquid increased composite surface roughness.

4. Some studies have pointed that adhesive agent used on the extern layer of the restoration may lead to:

- a. Changes of composite color;
- b. Changes of composite physical properties;
- c. Changes of composite chemical properties;
- d. Increased viscosity of the composite resin.

ASSESSING MENTAL FORAMEN POSITION IN CLASS I, II, AND III MALOCCLUSION BY CBCT

Abdolreza Jamilian^{1,2a*}, Ludovica Nucci^{3b}, Korosh Majidi^{2c}, Neda Nikkho^{1d},
 Rosana Farjaminejad^{4e}, Vincenzo Grassia^{3f}, Letizia Perillo^{3g}

¹Orthodontic Department, Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran

²City of London Dental School, University of Bolton, London, UK

³Multidisciplinary Department of Medical-Surgical and Dental Specialties, University of Campania Luigi Vanvitelli, Naples, Italy

⁴Department of Health Services Research and Management, School of Health & Psychological Sciences, City University of London, UK

^aDDS, MSc, OMFS, Professor, Module leader; ORCIDiD: <https://orcid.org/0000-0002-8841-0447>; e-mail: info@jamilian.net

^bDDS, MSc, OMFS, PhD; ORCIDiD: <https://orcid.org/0000-0002-7174-7596>; e-mail: Ludortho@gmail.com

^cDDS, MSc, MFDS RCS, LDS RCS, Dip Dent Sci, Lecturer; ORCIDiD: <https://orcid.org/0009-0008-4074-2662>; e-mail: korosh@ortics.london

^dDDS, MSc; ORCIDiD: <https://orcid.org/0009-0002-9215-1182>; e-mail: ajamilian@yahoo.com

^eDDS, Research Intern; ORCIDiD: <https://orcid.org/0009-0006-7795-0444>; e-mail: Rosana.Farjaminejad@city.ac.uk

^fDDS, MSc, Assistant Professor; ORCIDiD: <https://orcid.org/0000-0002-6671-2380>; e-mail: grassiavincenzo@libero.it

^gDDS, MSc, PhD, Professor; ORCIDiD: <https://orcid.org/0000-0001-6175-7363>; e-mail: letiziaperillo@gmail.com

ABSTRACT

 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.5](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.5)

Background The present study aimed to determine the position of the mental foramen (MF) in CBCT images in Class I, II, and III malocclusions with different growth patterns.

Methods In this study, 150 CBCT with Class I, II, and III malocclusions were selected. Each sagittal malocclusion had 50 samples, with 25 participants with vertical growth and 25 with horizontal growth patterns. MF Shape and Position relative to the Nearest Tooth were evaluated. MF Length, height, Distance from MF to Inferior Border, Distance from MF to Bone Crest, and Mental Canal Angle were measured. A one-way analysis of variance and chi-square test evaluated the data.

Results No significant differences were observed in the shape of MF among different types of malocclusion in sagittal and type of growth pattern. Significant differences in the location of MF were observed in terms of growth pattern $P=0/0028$. However, there were no significant changes in the location of MF in sagittal malocclusions.

Conclusion Greater distance between the mental foramen (MF) and the inferior border of the mandible was observed in the Class II vertical growth pattern compared to Class I and Class II vertical growers.

KEYWORDS

Malocclusion; Mandibular Canal; Mental Foramen; Cone-Beam Computed Tomography.

1. INTRODUCTION

The mental foramen (MF) is a bilateral opening on the mandible's anterior surface; determining its position, shape, and size is important in dental treatments such as local anesthesia and surgical procedures. By focusing the injection around the MF, dental procedures in the mandibular area can be performed with optimal pain control and patient comfort [1]. MF is a crucial anatomical landmark used for various methods, including administering local anesthesia, placing implants, inserting miniscrew or miniplate, performing peri-apical surgeries, and carrying out osteotomies in the MF region [2]. Neurosensory disturbances affecting the chin and lower lip are commonly encountered as unintended complications during implant placements and

miniscrew and mini plate placement. These complications often arise from a failure to properly identify and protect the structures of the mental foramen [3]. Multiple studies have documented both temporary and permanent sensory disturbances in the peri-oral soft tissues following the placement of mandibular implants [4-6]. In the existing literature, there is a lack of knowledge regarding the position of the mandibular foramen in different skeletal malocclusion. This research gap emphasizes the need for further investigation into the MF position in sagittal and vertical deformities. Understanding the specific characteristics and variations in MF position based on different skeletal malocclusion is crucial for appropriate treatment planning and developing practical techniques. It also contributes to a more personalised and practical approach to orthodontics,

 **OPEN ACCESS** This is an Open Access article under the CC BY-NC 4.0 license.

Peer-Reviewed Article

Citation: Jamilian A, Nucci L, Majidi K, Nikkho N, Farjaminejad R, Grassia V, Letizia Perillo L. Assessing Mental Foramen Position in Class I, II, and III Malocclusion by CBCT. *Stoma Edu J.* 2024;11(1-2):58-64.

Received: February 09, 2024; **Revised:** March 27, 2024; **Accepted:** April 15, 2024; **Published:** May 14, 2024.

***Corresponding author:** Prof. Dr. Abdolreza Jamilian, No 14, Pesiyan St., Vali Asr St., Tehran 1986944768, Iran **Tel.:** 0098 21 22011892;

Fax: 0098 21 22022215; e-mail: info@jamilian.net

Copyright: © 2022 the Editorial Council for the Stomatology Edu Journal.

ensuring optimal outcomes for patients with malocclusion. This research would contribute to the existing literature by better understanding the MF position of different sagittal and vertical skeletal malocclusion. Moreover, Knowing the location of the mental foramen in each malocclusion is crucial during the insertion of mini plates and mini-screws. High-resolution Cone-Beam Computed Tomography (CBCT) is considered the most promising and accurate technology currently available for precisely determining the position of the mental foramen quantitatively [7]. By examining CBCT images, researchers could assess the MF position and analyse any correlations between its location and different malocclusion classes.

This observational study aimed to determine and compare the size and location of the MF by using the CBCT in class I, II, and III malocclusions in horizontal and vertical growth pattern samples.

2. METHODS AND MATERIALS

In this study, a comprehensive analysis was conducted on CBCT obtained from the archives of the Department of Oral and Maxillofacial Radiology at the Faculty of Dentistry, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran. The survey was performed according to the guidelines of the Declaration of Helsinki. All human research was conducted by the ethical standards of the committee responsible for human experimentation (institutional and national) and with the Helsinki Declaration of 1975, revised in 2013. 150 CBCT Images, aged between 18 and 35, were collected with Class I, II, and III malocclusions with vertical and horizontal growth patterns in each sagittal malocclusion. Using the Analysis Power ANOVA one-way considering $\alpha=0.05$ and $\beta=0.2$, the minimum required sample size for each of the six subgroups under investigation is determined to be 25 samples. Therefore, 150 individuals (25 with vertical growth patterns and 25 with horizontal growth patterns in each class I, II, and III malocclusion group). Each individual has two mental foramina; therefore, considering 150 samples, 300 foramina were examined. All the patients had no specific oral diseases, surgical history, previous orthodontic treatment, previous history of trauma, and facial and neck anomalies.

Ethical approval was obtained from the IAU Local Research Ethics Committees (Number: IR.IAU.DENTAL, REC;1400.187). The skeletal malocclusion types were grouped as Class 1, Class 2 and Class 3 according to Steiner's ANB angle and wits appraisal based on lateral cephalometric radiographs (Point A: the deepest anterior point on the buccal face of the maxilla body, Point N: Nasion, Point B: the deepest anterior point on the buccal face of the mandibular body, ANB angle: the angle formed by the NA and NB planes and wits appraisal: which was measured

drawing perpendiculars from points A and B on the maxilla and mandible, respectively, onto the occlusal plane).

Class 1: $ANB^\circ = 0^\circ$ to 4° ; $0 < Wits < -1$

Class 2: $ANB^\circ > 4^\circ$; $0 < Wits$

Class 3: $ANB^\circ < 0^\circ$; $Wits < -1$

Samples in each class I, II, and III groups were divided into subgroups according to vertical and horizontal growth. In the horizontal growth pattern, the SN-Gn-Go angle is less than 32 degrees ($32 > SN-Gn-Go$). In the vertical growth pattern, the Go-Gn-SN angle is greater than 32 degrees ($Go-Gn-SN > 32$).

There were 100 images of individuals with Class I malocclusion, with 25 individuals having a vertical growth pattern and 25 having a horizontal growth pattern. For Class II malocclusion, there were 50 images, with 25 individuals having a vertical growth pattern and 25 individuals having a horizontal growth pattern. Similarly, there were 50 images for Class III malocclusion, with 25 individuals with a vertical growth pattern and 25 with a horizontal growth pattern. Using CBCT images, measurements were performed on both the left and right sides. MF Shape and MF Position relative to the Nearest Tooth were evaluated. MF Length, Height, Distance from MF to Inferior Border, Distance from MF to Bone Crest, and Mental Canal Angle were measured.

The measurements were recorded as follows:

- Mental Foramen Shape: In CBCT images, the shape of the mental foramen was categorised as oval or round.
- Mental Foramen Position relative to the Nearest Tooth: In CBCT images, the position of the mental foramen was recorded in one of four locations: below the first premolars, below the second premolars, between the first and second premolars, and between the second premolars and first molars.
- Mental Foramen Length: The widest part of the mental foramen in millimetres.
- Mental Foramen Height: The tallest height of the mental foramen in millimetres.
- Distance to Inferior Border: The distance from the lowest point of the foramen to the inferior border of the mandible in millimetres.
- Distance to Bone Crest: The distance from the highest point of the foramen to the bone crest in millimetres.
- Mental Canal Angle with Buccal Surface of Mandible: The angle between the longitudinal axis of the mental canal and the superior part of the buccal cortical bone, measured in degrees.

To assess the reliability of the measurements in the study, 20 CBCT images were randomly selected, and the measurements were repeated after one week. The results of the intraclass correlation coefficient (ICC) test showed no statistically significant difference between the two measurement sessions ($ICC = 0.756$)

The data were analysed using the statistical software SPSS (version 25.0). The mean and standard deviation

of MF Length, Height, Distance from MF to Inferior Border, Distance from MF to Bone Crest, and Mental Canal Angle were measured for each Class I, II, and III malocclusions, as well as based on horizontal and vertical growth patterns. The calculations and results regarding different malocclusions were evaluated using a one-way analysis of variance (ANOVA). The frequency of the MF shape and its position relative to the nearest tooth were analysed using the chi-square test. To assess the reliability of research measurements, 20 CBCT scans were randomly selected, and the measurements were repeated after two weeks. The coefficient correlation intraclass (ICC) test results showed a non-significant statistical difference (ICC = 0.756) between the two measurement occasions.

3. RESULTS

Of 300 images, 144 cases (48.0%) were related to women, and 156 patients (52.0%) were related to men. The average age of the samples was 26.91 years, with a standard deviation of 5.33 years.

The chi-square test showed no significant differences in the shape of MF between the horizontal and vertical growth patterns. However, significant differences were observed in the position of MF among different growth patterns ($p=0.028$), where the position between the first and second premolars was greater in the vertical growth pattern, and the position below the second premolar was greater in the horizontal growth pattern. (Table 1) The chi-square test also showed that no significant differences were found in the shape and position of MF among different types of malocclusion in CBCT images. (Table2)

Table 1. The abundance of shape and position of MF based on horizontal and vertical growth pattern.

Growth pattern		Vertical	Horizontal	P value
Shape	Circular	(%56/7) 85	(%48/0) 72	0/1
	Oval	(%43/3) 65	(%52/0) 78	
Position	Below is the first premolar	(%2/7) 4	(%0/7) 1	0/028
	Below the second premolar	(%42/7) 64	(%55/3) 83	
	Between premolars	(%54/0) 81	(%41/3) 62	
	Below are the first premolar and first molar	(%0/7) 1	(%2/7)4	

Table 2. The abundance of shape and position of MF based on sagittal malocclusion.

Growth pattern		Class I	Class II	Class III	P Value
Shape	Circular	(%57) 57	(%52) 52	(%48) 48	0/4
	Oval	(%43/) 43	(%48) 48	(%52) 52	
Position	Below is the first premolar	(%2) 2	(%2) 2	(%1) 1	0/5
	Below the second premolar	(%41) 41	(%54) 54	(%52) 52	
	Between premolars	(%56) 56	(%42) 42	(%45) 45	
	Below are the first premolar and first molar	(%1) 1	(%2) 2	(%2) 2	

One-way ANOVA test revealed significant differences in the length and height of MF, distance to the mandibular border, and distance to the bone crest among different types of malocclusion ($p < 0.001$). However, the angle of the mental canal did not show significant differences among different types of malocclusion. Based on these findings, the length and height of MF were greater in patients with Class I malocclusion compared to the other two groups, the distance to the mandibular border was greater in individuals with Class II malocclusion, and the distance to the bone crest was greater in individuals with Class I malocclusion. (Table 3)

Table 3. The variables' mean and standard deviation based on the malocclusion type.

	Class I	Class II	Class III	P Value
Mental Foramen Length	5/32±0/88	2/98±0/66	2/70±0/61	<001
Mental Foramen Height	5/56±0/78	2/90±0/73	2/66±0/61	<001
Distance to Inferior Border	10/74±0/57	14/76±1/43	10/44±0/90	<001
Distance to Bone Crest	14/15±2/33	10/06±1/28	11/05±1/55	<001
Mental Canal Angle	42±14	46±16	44±12	0/1

As seen in Table 4, the Student's t-test showed no significant differences in the length and height of the MF between the two growth patterns. However, the distance from MF to the inferior border ($p<0.001$), distance to the crest of the bone ($p<0.001$), and mental canal angle ($p=0.008$) were significantly greater in individuals with a vertical growth pattern compared to those with a horizontal growth pattern.

Table 4. The mean and standard deviation of the variables based on the growth pattern.

	Vertical	Horizontal	P Value
Mental Foramen Length	3/71±1/24	3/62±1/52	0/6
Mental Foramen Height	3/80±1/42	3/61±1/56	0/3
Distance to Inferior Border	12/46±2/60	11/50±1/65	<001
Distance to Bone Crest	12/85±2/58	10/67±1/84	<001
Mental Canal Angle	48±14	44±14	<008

Tables 5 and 6 present the mean and standard deviation of the variables under investigation based on the classification of malocclusion types in CBCT images of individuals aged 18-35 with vertical and horizontal growth patterns, respectively. According to the results of the ANOVA test, in individuals with horizontal and vertical growth patterns, significant differences were observed in terms of the length and height of the MF, distance to the inferior border, and distance to the crest of the bone in different types of malocclusion (all $p < 0.001$).

Table 5. The mean and standard deviation of the variables based on the type of malocclusion in the vertical growth pattern.

	Class I	Class II	Class III	P Value
Mental Foramen Length	5/13±0/79	3/21±0/69	2/80±0/64	<001
Mental Foramen Height	5/52±0/82	3/17±0/69	2/72±0/63	<001
Distance to Inferior Border	10/82±0/59	15/96±0/63	10/59±1/0	<001
Distance to Bone Crest	16/27±0/76	16/27±0/76	16/27±0/76	<001
Mental Canal Angle	48±16	49±14	47±13	0/7

Table 6. The mean and standard deviation of the variables based on the type of malocclusion in the horizontal growth pattern.

	Class I	Class II	Class III	P Value
Mental Foramen Length	5/51±0/93	2/74±0/55	2/61±0/58	<001
Mental Foramen Height	5/60±0/75	2/63±0/67	2/60±0/58	<001
Distance to Inferior Border	10/66±0/54	13/56±0/89	10/28±0/78	<001
Distance to Bone Crest	12/03±1/11	8/94±0/66	11/02±1/89	<001
Mental Canal Angle	48±11	43±17	41±11	0/03

The MF distance to the mandible's inferior border was 15/96± 0/63 in class II vertical growth pattern, higher than in class I and II vertical growers. Also, the same distance was 13/56± 0/89, more significant than in class I and II horizontal growers.

4. DISCUSSION

In this study, CBCT images of individuals with Class I, II, and III malocclusion were selected. The images' sagittal dimension measured the MF's length, height, and shape. In the coronal dimension, the distance from the MF to the crest of the bone, the distance from the MF to the inferior border of the bone, and the mental canal's angle with the mandible's occlusal plane were measured. In the axial dimension, the position of the MF relative to the nearest tooth was assessed. According to the research findings, the size of the variables was significantly greater in males than in females. Furthermore, the position and shape of the MF were consistent across different malocclusions. Still, the length, height, distance

to the inferior border, and distance to the crest of the bone showed differences among malocclusion types.

The mental foramen is one of the critical anatomical landmarks of the mandible that has received significant attention. Some studies have evaluated its position, shape, and distance from other anatomical landmarks and adjacent tooth roots. From a clinical perspective, local anesthesia during dental treatments and the safety of surgical procedures in this area are influenced by the clinician's knowledge of the mental foramen's position. The mental foramen also plays a role in interpreting anatomical landmarks in forensic medicine. In the present study, the mental foramen (MF) position was observed below the second premolar in 49.0% of cases and between the first and second premolars in 47.7% of cases. Significant differences were also noted in terms of the patients' growth patterns, where the position between the first and second premolars was more critical in the vertical growth pattern compared to the horizontal growth pattern, and the part below the second premolar was more significant in the horizontal growth pattern compared to the vertical growth pattern. On the other hand, no significant differences were found in the position of MF among patients with Class I, Class II, and Class III malocclusions.

According to the present study's findings, the shape of MF was round in 52.3% of cases and oval in 47.7%. On the other hand, no significant differences were observed in the shape of MF based on the growth pattern or in the three groups of malocclusions. However, in the vertical growth pattern group, the frequency of round-shaped MF was slightly higher in individuals with Class III malocclusion compared to other malocclusions, and the frequency of oval-shaped MF was somewhat higher in individuals with Class II malocclusion compared to other malocclusions. In the horizontal growth pattern group, the frequency of round-shaped MF was higher in individuals with Class I malocclusion, and the frequency of oval-shaped MF was higher in individuals with Class III malocclusion compared to other malocclusions.

In this study, no significant differences were found in terms of the length and height of MF between vertical and horizontal growth patterns. However, the distance from MF to the inferior border (mean of 12.46 mm versus 11.50 mm) and from MF to the crest of the bone (mean of 12.25 mm versus 10.67 mm) differed significantly between vertical and horizontal growth patterns. Additionally, the angle of the mental canal (mean of 42 degrees versus 44 degrees) was significantly greater in individuals with vertical growth compared to those with horizontal growth. Overall, in the combined images of both groups, the distance from MF to the inferior border was approximately 11.92 mm, and the distance from MF to the crest of the bone was approximately 11.76 mm.

Some studies have observed that mental foramen (MF) is most commonly located between the mandible's first and second premolar teeth [8, 9]. Al-Mahalawy et al. [1] conducted a study that demonstrated the most common position of the mental foramen (MF) to be below the apex of the second premolar in both male and female patients. Similarly, Aoun et al. reported that MF was predominantly in line with the second mandibular premolar on both sides. [10] On the other hand, MF in the Indian population, North American Caucasian population, and Nigerian adults were primarily located between the roots of the first and second premolars [9,11-13]. It is well-documented that the position of the mental foramen (MF) can vary among different racial and ethnic groups. Studies in dental anthropology and craniofacial research have highlighted these variations. Factors such as craniofacial morphology, genetic factors, and evolutionary differences contribute to the differences observed in the position of MF across populations [1].

Based on the shape of the mental foramen, Verma et al. found that most of the MF was round, followed by an oval in the Indian population. [9] Conversely, Sheikhi et al. [14] found that the oval shape of the mental foramen was twice as familiar as the round shape; the findings of Sheikhi et al. were by Gershenson et al. [15]. Some results of the previous study were not used in the present study because of the difference in the race and group of the population selected. Most previous studies have been conducted using two-dimensional imaging techniques, such as panoramic images, rather than 3-D imaging techniques, like cone-beam computed tomography (CBCT)

5. CONCLUSION

The results of the current study aimed at determining the position of MF in CBCT images in Class I, Class II, and Class III malocclusions with different growth patterns are as follows:

- No significant differences were found in the shape of MF among different types of malocclusions.
- There were no significant changes in MF's location in sagittal malocclusions.

REFERENCES

1. Al-Mahalawy H, Al-Aithan H, Al-Kari B, et al. Determination of the position of mental foramen and frequency of anterior loop in Saudi population. A retrospective CBCT study. *Saudi Dent J.* 2017;29(1):29-35. doi: 10.1016/j.sdentj.2017.01.001. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
2. Greenstein G, Tarnow D. The mental foramen and nerve: clinical and anatomical factors related to dental implant placement: a literature review. *J Periodontol.* 2006;77(12):1933-1943. doi: 10.1902/jop.2006.060197. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
3. Chen JC, Lin LM, Geist JR, et al. A retrospective comparison of the location and diameter of the inferior alveolar canal at the mental foramen and length of the anterior loop between American and Taiwanese cohorts using CBCT. *Surg Radiol Anat.* 2013;35(1):11-18. doi: 10.1007/s00276-012-0986-z. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)

- The position of MF was located below the second premolars in 55.3% of cases in horizontal growth patterns and between the first and second premolars in 54.0% of vertical cases, with significant differences observed based on the growth pattern ($p = 0.028$).
- The length and height of MF were more significant in individuals with Class I malocclusion in comparison with class II and III ($p < 0.001$). The distance from MF to the inferior border was more significant in individuals with Class II malocclusion in regards to other sagittal malocclusions ($p < 0.001$), and the distance from MF to the crest of the bone was more significant in individuals with Class I malocclusion in comparison with class II and III malocclusion ($p < 0.001$).
- No significant differences were found in the length and height of MF based on the growth patterns. However, the distance from MF to the inferior border ($p < 0.001$), the distance from MF to the crest of the bone ($p < 0.001$), and the angle of the mental canal in vertical growth patterns were more significant than in horizontal growth patterns ($p = 0.002$).
- The distance of MF to the inferior border of the mandible was more significant in class II vertical growth patterns about class I and class II vertical growers. The same distance in class II horizontal growers was higher than in class I and II horizontal growers.

AUTHOR CONTRIBUTIONS

AJ was the major contributor to writing the manuscript, study design, and corresponding author. **LN** was responsible for statistical consulting and editing the final draft. **KM** was responsible for radiological consultant and data generation. **NN** was involved in data gathering and methodology. **RF** was responsible for the literature review and drafting, and **VG** and **LP** were responsible for the literature review, data interpretation, and critical revisions. All the authors have read and approved the final version of the manuscript.

COMPETING INTERESTS

The authors declare that they have no competing interests in this study.

SOURCE OF FUNDING

This research received no external funding.

4. Field J, Spencer R, Johnson I, Cure R. Professional standards in dental education. *Br Dent J.* 2020;228(11):875-881. doi: 10.1038/s41415-020-1640-5. [Full text links CrossRef PubMed Google Scholar WoS](#)
5. Walton JN. Altered sensation associated with implants in the anterior mandible: a prospective study. *J Prosthet Dent.* 2000;83(4):443-449. doi: 10.1016/s0022-3913(00)70039-4. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
6. Bartling R, Freeman K, Kraut RA. The incidence of altered sensation of the mental nerve after mandibular implant placement. *J Oral Maxillofac Surg.* 1999;57(12):1408-1412. doi: 10.1016/s0278-2391(99)90720-6. [Full text links CrossRef PubMed Google Scholar Scopus WoS](#)

7. Wismeijer D, Van Waas MA, Vermeeren JI, et al. Patient satisfaction with implant-supported mandibular overdentures. A comparison of three treatment strategies with ITI-dental implants. *Int J Oral Maxillofac Surg*. 1997;26(4):263-267. doi: 10.1016/s0901-5027(97)80864-8.
[PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
8. Cure RJ. Experiences of the challenges of undertaking an orthodontic needs assessment within the National Health Service in England. *J Orthod*. 2019;46(2):143-147. doi: 10.1177/1465312519842877.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
9. Aminoshariae A, Su A, Kulild JC. Determination of the location of the mental foramen: a critical review. *J Endod*. 2014;40(4):471-475. doi: 10.1016/j.joen.2013.12.009.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
10. Currie CC, Meechan JG, Whitworth JM, et al. Determination of the mental foramen position in dental radiographs in 18-30 year olds. *Dentomaxillofac Radiol*. 2016;45(1):20150195. doi: 10.1259/dmfr.20150195.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
11. Verma P, Bansal N, Khosa R, et al. Correlation of radiographic mental foramen position and occlusion in three different Indian populations. *West Indian Med J*. 2015;64(3):269-274. doi: 10.7727/wimj.2014.143.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)
12. Aoun G, El-Outa A, Kafrouny N, Berberi A. Assessment of the mental foramen location in a sample of fully dentate lebanese adults using cone-beam computed tomography technology. *Acta Inform Med*. 2017;25(4):259-262. doi: 10.5455/aim.2017.25.259-262.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#)
13. Moiseiwitsch JR. Position of the mental foramen in a North American, white population. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1998;85(4):457-460. doi: 10.1016/s1079-2104(98)90074-9.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
14. Fishel D, Buchner A, Hershkowitz A, Kaffe I. Roentgenologic study of the mental foramen. *Oral Surg Oral Med Oral Pathol*. 1976;41(5):682-686. doi: 10.1016/0030-4220(76)90325-x.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#)
15. Olasoji HO, Tahir A, Ekanem AU, Abubakar AA. Radiographic and anatomic locations of mental foramen in northern Nigerian adults. *Niger Postgrad Med J*. 2004;11(3):230-233.
[CrossRef](#) [PubMed](#) [Google Scholar](#)
16. Sheikhi M, Karbasi Kheir M, Hekmatian E. Cone-beam computed tomography evaluation of mental foramen variations: a preliminary study. *Radiol Res Pract*. 2015;2015:124635. doi: 10.1155/2015/124635.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
17. Gershenson A, Nathan H, Luchansky E. Mental foramen and mental nerve: changes with age. *Acta Anat (Basel)*. 1986;126(1):21-28. doi: 10.1159/000146181.
[CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
18. Yeşilyurt H, Aydınllıglu A, Kavaklı A, et al. Local differences of the position of the mental foramen. *Folia Morphol (Warsz)*. 2008;67(1):32-35.
[PubMed](#) [Google Scholar](#) [Scopus](#)
19. Weiss R 2nd, Read-Fuller A. Cone beam computed tomography in oral and maxillofacial surgery: an evidence-based review. *Dent J (Basel)*. 2019 May 2;7(2):52. doi: 10.3390/dj7020052.
[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)

Abdolreza JAMILIAN

SDDS, MSc, Fellow OSCS, Module leader
 Orthodontic Department, Faculty of Dentistry
 Tehran Medical Sciences, Islamic Azad University
 Tehran, Iran
 City of London Dental School
 University of Bolton
 London, UK



CV

Professor Abdolreza Jamilian is a researcher and specialist in the field of Orthodontics. He received his D.D.S. (1991), MSc in Orthodontics (1998), and Fellowship of Orthognathic Surgery & Craniofacial Syndromes (2010) from the Shahid Beheshti University in Tehran, Iran. He obtained his European Board of Orthodontics certification in 2013. Now, he is a Module leader at the City of London Dental School, University of Bolton, London, UK, and a professor at the Islamic Azad University in Tehran. He has lectured at several international congresses and has been a consultant for various journals. He has published over 200 original, peer-reviewed research and review articles, 15 book chapters, and more than 300 scientific communications. He holds 3 patents in the United States Patent and Trademark Office.

Questions

1. Which one is correct?

- a. The shape of the Mental Foramen is round in 52.3% of cases and oval in 47.7%;
- b. The shape of the Mental Foramen was oval in 52.3% of cases and round in 47.7%;
- c. The shape of the Mental Foramen was oval in 45% of cases and round in 35%;
- d. The shape of the Mental Foramen was oval in 35% of cases and round in %.

2. The position of Mental foramen in the Indian population, North American Caucasian population, and Nigerian adults were primarily located :

- a. Between the roots of the first and second premolars;
- b. Between the roots of the first and second molars;
- c. Between the roots of the canine and first premolars;
- d. Below the canine.

3. Which factors contribute to the differences observed in the position of MF across populations?

- a. Craniofacial morphology;
- b. Genetic factors;
- c. Evolutionary differences ;
- d. All of them.

4. Which one is correct?

- a. In the present study, the mental foramen position was observed below the second premolar in 49.0% of cases and between the first and second premolars in 47.7% of cases.;
- b. In the present study, the mental foramen position was observed below the second premolar in 60.0% of cases and between the first and second premolars in 40.% of cases;
- c. In the present study, the mental foramen position was observed below the second premolar in 40.0% of cases and between the first and second premolars in 60.% of cases;
- d. None of them.



<https://congress.eoseurope.org/>

SYSTEMATIC APPROACH TO ORAL SPLINTS – AN OPINION PAPER: PART 1 – FUNDAMENTAL ISSUES

Gregor Slavicek^{1a*}, Anastasia Novitskaya^{1,2b}, Florian Slavicek^{1c}

¹Orehab Minds GmbH, DE-70567 Stuttgart, Germany

²Dental Clinic Smiletime, RU-14106 Podolsk, Moscow Region, Russia

^aMD, DDS, MSc, CEO and Head; e-mail: g.slavicek@orehab-minds.com; ORCIDiD: <https://orcid.org/0000-0003-2454-4048>

^bDDS, CEO; e-mail: anastasia.novitskaya@gmail.com; ORCIDiD: <https://orcid.org/0000-0003-3446-3866>

^cBSc; e-mail: f.slavicek@orehab-minds.com; ORCIDiD: <https://orcid.org/0000-0003-4245-7829>

ABSTRACT

[https://doi.org/10.25241/stomaedu.2024.11\(1-2\).art.6](https://doi.org/10.25241/stomaedu.2024.11(1-2).art.6)

Background Oral Splints are controversially discussed in dentistry. Although scientific findings cannot yet provide a definitive statement on efficacy and mechanism of action, dentists apply occlusal splints in large numbers.

Objectives This series of articles aims to bring together the discrepancy between findings from studies and clinical reality. In addition, the contradictory terminology will be discussed.

Conclusion The practicing dentist and his interdisciplinary team strive to provide the best possible treatment for the patient. The treatments focus on the long-term effect, using a causal therapeutic approach. Occlusal splints can be used in different situations. This requires the indication to be defined precisely, the parameters of the splint to be tailored to the individual patient, and a realistic picture, including a realistic prognosis regarding the expected effect, to be developed together with the patient.

KEYWORDS

Cranio-mandibular Disorder; Occlusal Splints; Positioning Splints; Re-Capturing Splints; Stabilization Splints.

1. INTRODUCTION

Oral Splints are controversially seen in dentistry. Practicing dentists use this therapeutic option frequently and regularly [1,2]. Academic opinion leaders reject the use of oral splints, citing the paucity of studies that show little evidence for these forms of therapy [3]. A constantly increasing number of over-the-counter devices (OTC) and similar commercially available devices indicate that consumers, affected persons, and unsatisfied patients demand these products a lot [4]. A wide range of other treatment methods, some of which are part of so-called conventional medicine but others that go far beyond it, make it difficult to form a clear opinion and define the best way to relieve affected patients [5,6].

Dental treatments aim to improve the patient's situation in the long term. Often, the patient requires intervention from the dental team because of a symptom such as pain. The approach is either causal or symptomatic. Causal therapy is preferable in many respects. Dentists must take these situations seriously and are in charge of developing the best possible treatment. Any treatment requires an open mind without premature and preconceived diagnoses. An unbiased diagnosis needs systematic examinations and neutral conclusions. Weighing

up the facts and the patient's preferences can now be combined with the scientific evidence. The most suitable therapy will be implemented after weighing the risk-benefit profile. The dental team must consider scientific information (the evidence) and match all parameters while developing a treatment plan. However, if the evidence for a particular therapy (e.g., occlusal splints) is weak (low), the conclusion must not be to rule out this treatment method. The dentist's expertise and the patient's autonomous freedom of choice are equally important factors in evidence-based medicine [7]. (Fig. 1)

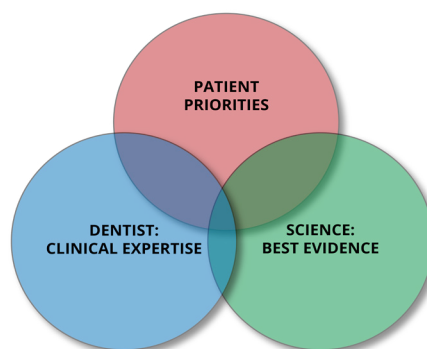


Figure 1. Evidence-based medicine (EBM). Scientific evidence is an important, but not the only element in decision making. Only the combination between the clinical expertise of the dental team and the patient's priorities allows the establishment of the best treatment strategy.

 **OPEN ACCESS** This is an Open Access article under the CC BY-NC 4.0 license.
Peer-Reviewed Article

Citation: Slavicek G, Novitskaya A, Slavicek F. Systematic Approach to Oral Splints – an opinion paper Part 1: Fundamental Issues. *Stoma Edu J.* 2024;11(1-2):65-71.

Received: April 01, 2024; **Revised:** April 30, 2024; **Accepted:** May 02, 2024; **Published:** May 04, 2024.

***Corresponding author:** Professor Gregor Slavicek, MD, DDS, MSc, CEO and Head; Orehab Minds GmbH, Address: Zettachring 2, DE-70567 Stuttgart, Germany; **Tel./Fax:** +49-7307-24922-11; e-mail: g.slavicek@orehab-minds.com

Copyright: © 2022 the Editorial Council for the Stomatology Edu Journal.

Evidence-based medicine is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. Low evidence should not be interpreted as a rejection of a therapy. Rejection implies the risk of harming a patient by withholding a possible helpful therapeutic regime. [8] Rejection requires evidence as well. A paradigm shift is methodically and ethically sound if a clear alternative exists and the evidence demonstrates the superiority of the alternative [9-11].

This series of three articles discusses the discrepancy between scientific evidence and clinical expertise regarding occlusal splints (oral devices). If the main differences in the view on occlusal splints (scientific vs. practical) are understood, an improved application of occlusal splints, merging evidence with expertise and patients' characteristics to improve the patient's quality of life.

2. CONFUSING TERMINOLOGY

In medicine and dentistry, "splint" refers to measures to connect, stabilize, and fix two or more parts together to enable or improve the healing process. A rigid or flexible device maintains the corrected position of displaced parts to keep these parts in place. Such splinting devices usually restrict motions or immobilize joints. Splinting in dentistry refers to connecting two or more teeth, forming a rigid unit to reduce the mobility of the single tooth [12].

In (muscle) physiology, a prolonged muscle contraction that inhibits or prevents movement of a body part is called muscle splinting, an involuntary contraction of a muscle (total or partially) to avoid particular movements causing severe pain sensations. The location of the pain to be avoided by the splinting is not necessarily located directly in the muscle but in joints, joint capsules, ligaments, and tendons. Resistance to passive stretch of the muscle with partial muscle relaxation at rest is typical for such situations, also called protective muscle contraction [13-15].

Today, the term splint is still used, although the main idea of occlusal splints is not to connect and to fix two parts. Occlusal splints are removable intraoral devices covering the occlusal surfaces and affecting the relationship of the mandible to the maxillae. Blocking mandibular movements and limiting TMJ movements are not intended by prescribing occlusal splints; here, the term splint should not be interpreted in a sense, as mentioned earlier, of fixing two or more moveable parts [16].

The use of occlusal splints may include, but is not limited to, occlusal stabilization, initial therapy prior to extensive intervention, or prevention of wear of the dentition or damage to brittle restorative dental materials. Such occlusal appliances (occlusal splints) are designed in manifold variations. A unique and characteristic feature of occlusal splints is the artificial occlusion, allowing reversible alterations of dental structures and the interaction of upper and lower

teeth. Oral splints allow alterations of mandibular position, vertical dimension, and joint position without irreversible changes in dental structures [16]. The terms occlusal splints, occlusal appliances, and occlusal splints are generally used as synonyms. The term night guard is misleading and should be used only for particular indications, which is usually the parafunctional activity of the patient. Such devices are used during sleep to avoid the adverse side effects of bruxing and clenching. Night guard implies that these devices should be used during sleep (during the night) only. Today, awake bruxism also requires attention, and such protection guards are also helpful during the awake state. Bruxism was (and sometimes still is) seen as a harmful movement disorder. [Sleep medicine] On the other hand, the positive effects of these (physiological) occlusal functions are described: breathing suspension and increased salivation [17, 18], hormonal regulation, and stress relief [19]. The visualization of the tooth contacts, occurring due to grinding or pressing teeth in an awake or asleep state, helps the patient to understand these unconscious occlusal functions and supports the dental team in integrating this information into the diagnostic findings (not only "bruxing yes or no" but also which teeth, which segments of the dental arches are involved, correlated to other findings such as periodontal breakdown, chipping, class V lesions, pain and alterations of mandibular movements). [18] Sleep bruxism is not only an issue for the adult. Clinical attention should be placed on children and adolescents to support the development of the stomatognathic system and occlusal functions. [20].

3. UNCLEAR INTENTIONS OF ORAL SPLINTS

A general description for oral splints can best be described as follows: Occlusal splints are removable devices, usually made of hard acrylic, covering the occlusal and incisal surfaces of all teeth in one dental arch and influencing the relationship of the upper and lower jaw. The labels (names) for such devices that emerged over the last decades (1950 till now) are not uniform and often conflicting and, therefore, confusing. Unclear synonyms potentially provoke misunderstandings, leading to problems with the indication and application [21,22].

The following (incomplete) list intends to illustrate this problem, particularly from the perspective of the reader of specialist articles and publications:

- Positioning:
- What should be positioned?
- From which position (start) to which position (desired)?
- Repositioning:
- What should be repositioned?
- From which position (start) to which position (desired)?
- Positioning and Repositioning:
- Are there differences in the intention and in the design of the splint?

- Are there differences in the meaning?
- Stabilization:
- What has to be stabilized?
- Why does something has to be stabilized?
- What was the reason for becoming unstable?
- Are there particular and clinically relevant differences between Stabilization and Positioning?
- Is the stabilization an active (via splint elements) or a passive (via muscle coordination and relaxation) operation?

Names (labels) of splints refer to typical design features (e.g., mandibular advancement splint), may refer to the proposed effect (mandibular stabilization splint), or refer to particular diagnostic findings (disc (re-) positioning splint). Are these devices different to justify different names, or is it one type of splint, and further subdivisions do not lead to more clarity but create more misunderstandings? On the other hand, if this labeling makes sense and is helpful in clinical decision-making, are such differentiators recognizable in the evidence-based conclusions?

Four terms are often used concerning occlusal splints and may be considered to refer to fundamental intentions when using such oral devices.

* Stabilization usually refers to stabilizing the mandible. Occlusal structures (relief and particular elements) of the splint occlusal surface are used to implement the stabilization effect. A harmonization and improved coordination of the muscles of the chewing organ is a possible mechanism for stabilization or a positive effect of the achieved mandibular stability. The term stabilization splint is frequently used in clinical trials [23,24].

* Relaxation usually refers to relaxation of the neuromuscular system. The relaxation effect of oral splints (stabilization, Positioning) is often not explicitly mentioned but can probably be read between the lines. Relaxation techniques seem to be the domain of non-splint therapeutical regimes. However, the effects of stabilization splints and applied relaxation techniques are not different; both show similar effectiveness in treating pain [25]. However, if the patient receives two or more therapies, and different disciplines are involved, the outcome of the therapy should be better compared to the outcome of a single therapy. (Fig. 2)

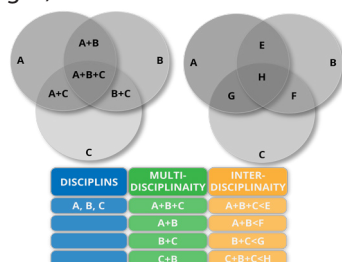


Figure 2. Multi- and Interdisciplinary treatments. In a multidisciplinary approach, the collaboration of disciplines leads to the sum of the effects of the disciplines. In an interdisciplinary collaboration, the concerted approach leads to an increased therapeutic effect. [adapted from: Slavicek G., Interdisciplinary - A Historical Reflection 2012, Int.J.Humanities&Social Science Vol.2/20].

* Oral devices for short-term masticatory muscle relaxation can be summarized in one group with only partial occlusal contacts (often frontal teeth, but also premolars). Jig, anterior bite plate, and interceptor are familiar names.

* Positioning refers to Mandibular Position. An active positioning requires the fabrication of the splint in the programmed articulator. A passive positioning: the CMS System dominates over occlusion. The terms active and passive are here used from the dentist's perspective: active implies decision and construction elements, and passive means the dentist allows the stomatognathic system to position the mandible as soon as the splint separates the existing occlusion.

* Re-capturing refers to the articular disc in cases with partial or total anterior disc dislocation with reduction. A re-capturing occlusal device aims to bring the articular disc back into its physiological position in relation to the condyle. A re-capturing splint is applied to move the articular disc from partial or total displacement back to the physiological position in relation to the condyle. The terms Disc-Repositioning and Disc Re-Capturing are used synonymously. What is known today as internal derangement of TMJ structures has been described by W. Farrar in 1978: the condyle-disc relationship is temporarily (anterior Disc Displacement with Reduction aDDwR) or permanently (anterior Disc Displacement without Reduction aDDwoR) disturbed. In both situations, the articular disc is anteriorly positioned in relation to the condyle, with possible lateral or median shifts. The anterior dislocation of the disc remains during the opening movement in aDDwoR, with the condyle-disc relationship restored during the opening in aDDwR. The reduction of the disc and the luxation of the disc are often accompanied by joint noises, usually described as clicking noises. Clinically, the term reciprocal click is used to summarize the opening and closing sounds. Mandibular movements can be affected quantitatively and qualitatively; the mandibular range of motion (MROM) may be reduced for opening, protrusion, and laterotrusion, deviation, and deflections during mandibular movements can be described as well. The aDDwoR and reduced opening capacity are summarized as acute (often accompanied by joint pain) and chronic (often without joint pain, but with muscle pain, stiffness, or fatigue) locked joint (mouth) phenomena [26,27].

Most occlusal devices used in clinical studies can be allocated to one of the above-mentioned terms.

The length of the plates in the mandible was used as an indicator for the advancement of the lower jaw. A BSSO with plate lengths of 8 mm or less was considered as a small advancement (574 patients), while plate lengths of more than 8 mm were considered as a big advancement (573 patients). In the patient group with a small advancement 31 patients needed plate removal, 41 patients in the big advancement group (P=.221). Of the 1147 patients

with a lower jaw osteotomy, 86 patients had a rotation of the mandible. Patients with a rotation of the lower jaw had more plates removed than patients with a symmetrical osteotomy ($P=0.10$).

According to the patient files 47 out of 1252 patients smoked (3.8%). Only 2 of these 47 patients had plates removed (2.6%, $P=0.965$). Smoking was more frequent among female patients (70.2%), versus 29.8% for male patients.

4. THE ORIGIN OF MANY OF TODAY'S COMMON NAMES FOR OCCLUSAL SPLINTS

The first systematic use and description of occlusal devices dates back to Ramfjord and Ash in the 1950s [28,29]. At that time, stabilization and splinting teeth were strategies in periodontal treatment.

The splinting was not performed with occlusal devices but as temporary splints using bonding techniques. Stabilization refers, in this context, to reducing tooth mobility. An additional option for treating periodontal patients and reducing occlusal loads on mobile teeth was called bite-planes. Occlusal trauma and periodontal stress due to bruxism were primary indications, intending to stabilize mobile teeth and prevent tooth migration. Positive effects of such devices on temporomandibular joint discomfort and muscle pain were observed (positive adverse events) and were subsequently used therapeutically. Before orthodontic re-positioning of migrated teeth, bite planes were used if permanent splinting was impossible. Ramfjord and Ash described maxillary bite-planes with flat occlusal surfaces, centric stops for all opposing teeth, and anterior and canine guidance for posterior Disclusion in lateral and protrusive mandibular movements. "This appliance will decrease the occlusal load for single teeth and also decrease the total muscle activity" [28]. The terms splinting, stabilization, positioning and repositioning have emerged already, but they are based on different meanings and intentions.

Knowledge of the original texts by Ramfjord and Ash helps a lot to understand the nomenclature of occlusal splints in use today: to splint – to reduce occlusal forces affecting single teeth; to stabilize – reduce tooth mobility; to reposition – orthodontic movement of migrated teeth back to their original position. These terms are still in use, but the meaning and the target structures have significantly changed. Occlusal Splints are used to reduce and distribute occlusal forces better; Occlusal Splints are used to stabilize the mandible by alternating mandibular-maxillary relationship and to allow the neuromuscular system to reduce activity and to harmonize mandibular statics and dynamics; Occlusal Splints are used to (re-) position the mandible and to improve TMJ position, including the condyle-disc relation [29].

Today, the term stabilization splint is frequently used. A splint is used to stabilize (but not immobilize) the chewing organ or parts of it if occlusion does not

perform stabilization. [GPT-9] In the 1980s, the term stabilization splint became popular and refers to splints fabricated in semi-adjusted articulators to stabilize the mandible. Often, such splint designs are called Michigan splints. Upper and lower teeth are separated by a flat occlusal surface with centric contacts and anterior guiding elements (laterotrusive and protrusive). Indication for stabilization of the mandible is an unstable lower jaw due to occlusal deficits of an individual. Occlusal structures are not able to stabilize the mandible. Today, the term "stabilization" with an occlusal splint implies the following intentions in the specialist literature: to develop a stable status, to maintain the stable status, to protect other parts of the stomatognathic system due to instability of the mandible, to secure and to reinforce elements of the craniomandibular system. The Michigan type and similar splint designs are often applied in splint studies. Systematic reviews show that no clear evidence exists to support the provision of splints for the various subtypes of TMD or bruxism. However, the conclusions drawn from such meta-analysis are based on the studies, which used substantial differences in three crucial factors: 1) diagnoses, 2) splint type, and 3) outcome measurement/reporting [3].

A common indication and inclusion criteria in clinical trials is pain, referring to the (R)DC/TMD criteria [30]. Pain is an unspecific symptom. Craniomandibular disorder (CMD) is a collective term that summarizes signs and symptoms. Pain often goes along with dysfunction. The treatment needs of CMD patients are controversially discussed. Causal or symptomatic approaches are possible. Pathomechanism, especially the role of occlusion and occlusal function as a cause for CMD, is the subject of ongoing debate [11,14, 31]. J.B. Costen described the effect of occlusal alterations, loss of vertical dimension of occlusion, and reduction of lower facial height in 1934 [32]. The description of this clinical picture, known today as Costen's syndrome, is a predecessor to today's CMD interpretation. Pain alone or combined with other signs and symptoms is often used as an inclusion criterion in (randomized) clinical trials of occlusal splints versus other therapeutic regimens [22]. The results are inconclusive and do not allow a final conclusion as to whether splints are superior to other forms of therapy [34]. Pain, dysfunction, and bruxism are often combined in these studies, which makes it difficult to quantify the effects [35-37].

5. CONCLUSION

Rejection of (potentially helpful) splint therapy for individual patients due to a lack of scientific evidence carries the risk of withholding effective therapies and prolonging or worsening the patient's situation. Experimentation and trial and error approaches are contraindicated. A superficial diagnosis, often focused only on one symptom (pain or dysfunction), leads to

symptomatic applications of oral devices that perform equally or even worse in direct comparison with other methods.

A causal approach is required in contemporary dentistry. However, the causality of occlusion in the development and emergence of masticatory organ dysfunctions, cranial Mandibular Dysfunctions, and Myoarthropathy is still controversially discussed. There are two completely contradictory points of view for and against occlusal causality; the dentist has to make the decision based on systematic clinical and instrumental functional analysis. The goal of a splint therapy is a causal approach. Here, special attention has to be made to multifaceted problems of the patient. If the patient's situations does not allow a clear assignment to a particular discipline, or the diagnostic findings clearly show that more facets need to be considered, a one-splint therapy is very apt to fail. Patients with various problem should not fall between two stools (disciplines). (Fig. 3)

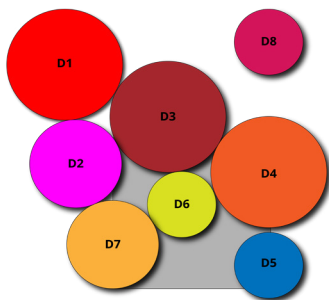


Figure 3. Interdisciplinary dentistry. The allocation of a patient to a special discipline is sometimes difficult, especially if the patient's problems affect several disciplines (indicated by the light grey area). This can complicate the coordination of diagnostic and therapeutic tasks. [adapted from: Slavicek G., Interdisciplinary - A Historical Reflection 2012, Int.J.Humanities&Social Science Vol.2/20].

Application of occlusal splints for individual patients is effective and efficient in treating patients in daily dental practice, not only to reduce or eliminate symptoms, but also to serve as basis for oral rehabilitation [37]. However, the scientific evidence of these positive effects still needs to be completed. From the authors' point of view, the following factors contribute significantly to this:

- * one type of splint for (almost) all indications
- * general splint parameters for each patient, without considering the individual patient's skeletal class and skeletal pattern
- * only limited information regarding instructions for the patient who and when to use the appliance
- * almost no information regarding follow-up (short-term check-up) and how to monitor the course of the treatment
- * no information if the occlusal splint has to be adapted and equilibrated
- * expectations are formulated in a very general manner (pain reduction)

The complexity of the stomatognathic system requires special attention. Successful therapeutical regimes require a clear and systematic clinical sequence of dental diagnostics followed by an initial splint therapy [37,38] A classical gnathological triangle demonstrates the interaction between occlusion, TMJ and neuromuscular system (Fig. 4).

Nevertheless, the complexity of the masticatory organ is not reflected in this conclusive graphic. If the masticatory organ is understood as a cybernetic system, more complex interactions can be derived.

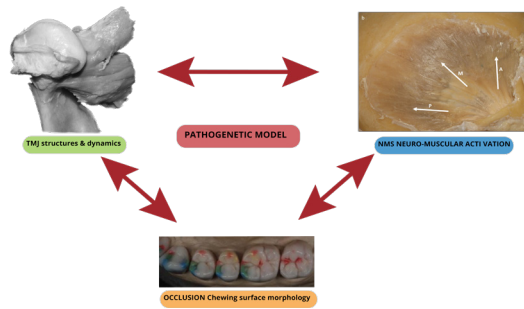


Figure 4. Mutual influences. The mutual positive and negative influences of the temporomandibular joint, musculature and occlusion are clearly recognizable and comprehensible in a pathogenetic model. However, linear relationships are simplifying and not capturing the fundamental complexity.

The role of occlusion in this system is recognized less by separated independent factors (interference) and more by dynamic occlusal function (chewing, swallowing, speaking, grinding, clenching) (Fig. 5). Searching for similarities between the occlusal splints leads to two elements, both closely related to occlusion: the existing occlusion is (reversibly) changed, and the vertical dimension of the occlusion is increased. The craniomandibular system can stabilize, position, and relax without constantly conflicting with the existing occlusion. Splints usually lead to a new lower jaw position.

The existing occlusion remains unchanged. The subsequent oral rehabilitation task is to adapt the occlusion to optimally support this new lower jaw position and guarantee the long-term effect (Fig. 6).

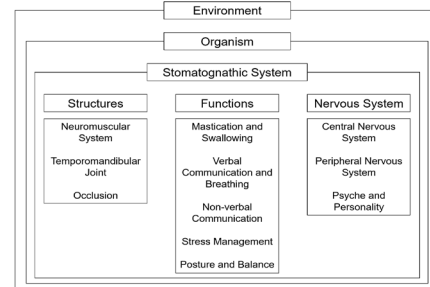


Figure 5. Cybernetic system. If the masticatory organ is viewed as an integrated part of the organism, the relationships of structures, occlusal functions and central/peripheral nervous system can be visualized. Psyche and personality are elements that cannot be ignored. [adapted from: Slavicek R. The Masticatory Organ, ISBN 3950126112, 9783950126112].

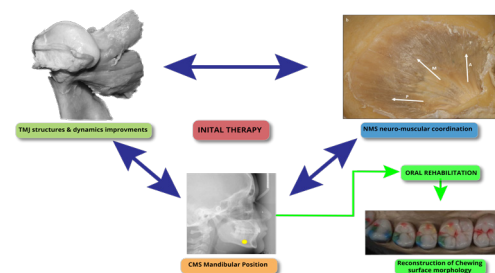


Figure 6. General splint effects. Most occlusal splints act via the occlusion, which is reversibly altered, including an increase in the vertical dimension of the occlusion. These alterations of occlusion allow the neuromuscular system to relax, harmonize better, and carry out the mandibular movements more cohesively. The jaw joint can assume a centered position without being placed in an unfavorable position by the occlusion.

The beneficial effects of occlusal splints can be significantly increased by considering individual factors. Clinical application is based on adapting the splint in many ways to the individual patient's situation. These aspects are discussed and explained in part 2 and part 3 of this article series.

REFERENCES

1. Ommerborn MA, Kollmann C, Handschel J, et al. A survey on German dentists regarding the management of craniomandibular disorders. *Clin Oral Investig*. 2010;14(2):137-144. <https://doi.org/10.1007/s00784-009-0282-4>
[Full text links PubMed Google Scholar Scopus WoS](#)
2. Pierce CJ, Weyant RJ, Block HM, et al. Dental splint prescription patterns: a survey. *J Am Dent Assoc*. 1995;126(2):248-254. <https://doi.org/10.14219/jada.archive.1995.0153>
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
3. Riley P, Glennly AM, Worthington HV, et al. Oral splints for temporomandibular disorder or bruxism: a systematic review. *Br Dent J*. 2020 Feb;228(3):191-197. <https://doi.org/10.1038/s41415-020-1250-2>
[Full text links PubMed Google Scholar](#)
4. Wassell RW, Verhees L, Lawrence K, et al. Over-the-counter (OTC) bruxism splints available on the Internet. *Br Dent J*. 2014;216(11):E24. doi: 10.1038/sj.bdj.2014.452. <https://doi.org/10.1038/sj.bdj.2014.452>
[Full text links CrossRef PubMed Google Scholar WoS](#)
5. Gerstner G, Yao W, Siripurapu K, et al. Over-the-counter bite splints: a randomized controlled trial of compliance and efficacy. *Clin Exp Dent Res*. 2020;6(6):626-641. <https://doi.org/10.1002/cre2.315>
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
6. Song YL, Yap AU. Outcomes of therapeutic TMD interventions on oral health related quality of life: a qualitative systematic review. *Quintessence Int*. 2018;49(6):487-496. <https://doi.org/10.3290/j.qi.a.40340>
[Full text links PubMed Google Scholar Scopus WoS](#)
7. Sackett DL, Rosenberg WM, Gray JA, et al. Evidence based medicine: what it is and what it isn't. *BMJ*. 1996;312(7023):71-72. <https://doi.org/10.1136/bmj.312.7023.71>
[Full text links PubMed Google Scholar](#)
8. Penston J. Patients' preferences shed light on the murky world of guideline-based medicine. *J Eval Clin Pract*. 2007;13(1):154-159. <https://doi.org/10.1111/j.1365-2753.2006.00701.x>
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
9. Kuhn TS. The structure of scientific revolutions. Vol. 962. Chicago: University of Chicago Press; 1997. ISBN 9780226458113
10. Ash MM. Paradigmatic shifts in occlusion and temporomandibular disorders. *J Oral Rehabil*. 2001;28(1):1-13. <https://doi.org/10.1046/j.1365-2842.2001.00658.x>
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
11. Widmalm SE. Use and abuse of bite splints. *Compend Contin Educ Dent*. 1999;20(3):249-254, 256, 258-259; quiz 260. PMID: 11692335.
[PubMed Google Scholar Scopus](#)
12. von Arx T, Filippi A, Lussi A. Comparison of a new dental trauma splint device (TTS) with three commonly used splinting techniques. *Dent Traumatol*. 2001;17(6):266-274. <https://doi.org/10.1034/j.1600-9657.2001.170605.x>
[Full text links CrossRef PubMed Google Scholar WoS](#)
13. Machado LP, Nery Cde G, Leles CR, et al. The prevalence of clinical diagnostic groups in patients with temporomandibular disorders. *Cranio*. 2009;27(3):194-199. <https://doi.org/10.1179/crn.2009.029>
[Full text links CrossRef PubMed Google Scholar WoS](#)
14. Okeson JP. Management of temporomandibular disorders and occlusion. 4th ed. Maryland Heights, MO: Mosby; 1997:180-182
15. Moreno-Hay I, Okeson JP. Does altering the occlusal vertical dimension produce temporomandibular disorders? A literature review. *J Oral Rehabil*. 2015;42(11):875-882. <https://doi.org/10.1111/joor.12326>
[Full text links CrossRef PubMed Google Scholar](#)
16. The Glossary of Prosthodontic Terms: Ninth Edition. *J Prosthet Dent*. 2017;117(5S):e1-e105. doi: 10.1016/j.prosdent.2016.12.001
[Full text links PubMed](#)
17. Lobbezoo F, Ahlberg J, Raphael KG, et al. International consensus on the assessment of bruxism: Report of a work in progress. *J Oral Rehabil*. 2018;45(11):837-844. doi: 10.1111/joor.12663
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)

AUTHOR CONTRIBUTIONS

All authors contributed to the concept, writing, analysis, interpretation and critical revision of the manuscript.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interests.

18. Slavicek G, Grimmer D, Novitskaya A, et al. On the track of bruxism: quantitative, qualitative and intraindividual analyses of the BruxChecker® in daily clinical routine. *Stoma Edu J*. 2021;8(3):163-171. [https://doi.org/10.25241/stomaedu.2020.8\(3\).art.2](https://doi.org/10.25241/stomaedu.2020.8(3).art.2)
[Google Scholar](#)
19. Sato S, Slavicek R. The masticatory organ and stress management. *Int J Stomatol Occlusion Med*. 2008;(1):51-57. doi:10.1007/S12548-008-0010-8
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
20. Casazza E, Giraudeau A, Payet A, et al. Management of idiopathic sleep bruxism in children and adolescents: A systematic review of the literature. *Arch Pediatr*. 2022;29(1):12-20. <https://doi.org/10.1016/j.arcped.2021.11.014>
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
21. Dao TTT, Lavigne GJ, Charbonneau A, et al. The efficacy of oral splints in the treatment of myofascial pain of the jaw muscles: a controlled clinical trial. *Pain*. 1994;56(1):85-94. [https://doi.org/10.1016/0304-3959\(94\)90153-8](https://doi.org/10.1016/0304-3959(94)90153-8)
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
22. Ramer E. Controversies in temporomandibular joint disorder. *Dent Clin North Am*. 1990;34(1):125-133. [https://doi.org/10.1016/S0011-8532\(22\)01169-7](https://doi.org/10.1016/S0011-8532(22)01169-7)
[CrossRef Google Scholar](#)
23. Al-Ani Z, Gray RJ, Davies SJ, et al. Stabilization splint therapy for the treatment of temporomandibular myofascial pain: a systematic review. *J Dent Educ*. 2005;69(11):1242-1250. <https://doi.org/10.1002/j.0022-0337.2005.69.11.tb04023.x>
[Full text links CrossRef PubMed Google Scholar Scopus](#)
24. Türp JC, Komine F, Hugger A. Efficacy of stabilization splints for the management of patients with masticatory muscle pain: a qualitative systematic review. *Clin Oral Investig*. 2004;8(4):179-195. <https://doi.org/10.1007/s00784-004-0265-4>
[Full text links CrossRef PubMed Google Scholar Scopus](#)
25. Huhtela OS, Koivisto N, Hägg V, et al. Effectiveness of applied relaxation method vs splint in treatment of temporomandibular disorders in Finnish students. *J Oral Rehabil*. 2020 Feb;47(2):123-131. <https://doi.org/10.1111/joor.12884>
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
26. Farrar WB. Characteristics of the condylar path in internal derangements of the TMJ. *J Prosthet Dent*. 1978;39(3):319-323. [https://doi.org/10.1016/S0022-3913\(78\)80103-6](https://doi.org/10.1016/S0022-3913(78)80103-6)
[Full text links CrossRef PubMed Google Scholar Scopus](#)
27. Farrar WB. Craniomandibular practice: the state of the art; definition and diagnosis. *J Craniomandibular Pract*. 1982;1(1):4-12. <https://doi.org/10.1080/07345410.1982.11677813>
[CrossRef PubMed Google Scholar Scopus](#)
28. DuPont JS Jr, Brown CE. Occlusal splints from the beginning to the present. *Cranio*. 2006 Apr;24(2):141-145. doi: 10.1179/crn.2006.022
[Full text links PubMed Google Scholar Scopus WoS](#)
29. Ramfjord SP, Ash MM Jr. Significance of occlusion in the etiology and treatment of early, moderate, and advanced periodontitis. *J Periodontol*. 1981;52(9):511-517. doi: 10.1902/jop.1981.52.9.511.
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
30. Pihlstrom BL. Sigurd Ramfjord and Major Ash, Jr.: periodontology and occlusion at Michigan. *J Dent Res*. 1997;76(11):1716-1719. <https://doi.org/10.1177/00220345970760110101>
[Full text links CrossRef PubMed Google Scholar Scopus WoS](#)
31. Schiffman E, Ohrbach R, Truelove E, et al. Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) for Clinical and Research Applications: recommendations of the International RDC/TMD Consortium Network® and Orofacial Pain Special Interest Group†. *J Oral Facial Pain Headache*. 2014;28(1):6-27. doi: 10.11607/jop.1151
[Full text links CrossRef PubMed Google Scholar](#)
32. Slavicek G. The influence of occlusion on masticatory efficiency considering relevant influencing factors *Stoma Edu J* 2020;7(3):197-207 [https://doi.org/10.25241/stomaedu.2020.7\(3\).art.6](https://doi.org/10.25241/stomaedu.2020.7(3).art.6)
[Google Scholar](#)

33. Costen JB. A syndrome of ear and sinus symptoms dependent upon disturbed function of the temporomandibular joint. 1934. *Ann Otol Rhinol Laryngol.* 1997;106(10 Pt 1):805-819. doi: 10.1177/000348949710601002.

[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)

34. Conti PC, dos Santos CN, Kogawa EM, et al. The treatment of painful temporomandibular joint clicking with oral splints: a randomized clinical trial. *J Am Dent Assoc.* 2006;137(8):1108-1114. <https://doi.org/10.14219/jada.archive.2006.0349>

[Full text links](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)

35. Ebrahim S, Montoya L, Busse JW, et al. The effectiveness of splint therapy in patients with temporomandibular disorders: a systematic review and meta-analysis. *J Am Dent Assoc.* 2012;143(8):847-857. <https://doi.org/10.14219/jada.archive.2012.0289>

[Full text links](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)

36. Hardy RS, Bonsor SJ. The efficacy of occlusal splints in the treatment of bruxism: a systematic review. *J Dent.* 2021;108:103621. <https://doi.org/10.1016/j.jdent.2021.103621>

[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)

Gregor SLAVICEK

MD, DDS, MSc, CEO, Head
 Orehab Minds GmbH
 DE-70567 Stuttgart, Germany



CV

Dr. Slavicek is an MD, specialized in Dentistry. He is currently Director of the Steinbeis Transfer Institute Biomedical Interdisciplinary Dentistry, Steinbeis University of Berlin. Since 2019, he has been CEO of Orehab Minds GmbH in Stuttgart, Germany. He graduated from the University of Vienna (medicine and dentistry), also specializing in Clinical Research at the same university (Master of Science). He attended additional postgraduate orthodontic training at the University of Aarhus (Denmark), with Prof. B. Melsen, and postgraduate gnathological training at University of Florida (USA), with Prof. H. Lundeen and Prof. C. Gibbs. He is an honorary member of the Italian Gnathological Society. He was awarded an honorary professorship by the Ukrainian Dental Society. He was visiting professor at the first medical state University in Moscow Sechenov (2014-2018).

Questions

1. Systematic reviews report the level of evidence for splints studies for the various subtypes of TMD or bruxism as follows:

- a. Strong;
- b. Low;
- c. Confirmed;
- d. Superior to alternative treatments.

2. Data from meta-analysis on occlusal splints often are unclear regarding the following parameters:

- a. Diagnosis;
- b. Splint type and outcome measure;
- c. Diagnosis, Splint type and outcome measure;
- d. Outcome measure.

3. Typical Splint types do not refer to one of the following items:

- a. Posteriorizing;
- b. Stabilization;
- c. Positioning;
- d. Anterior repositioning.

4. Which statement is incorrect regarding the term re-capturing?

- a. Re-Capturing refers to the articular disc;
- b. Re-Capturing refers to aDDwR;
- c. Farrar description of the pathomechanism of the reciprocal click with a recapturing and a luxation of the articular disc;
- d. Re-Capturing refers to the re-establishing the vertical dimension of occlusion.



Made by You

Dentsply Sirona CEE Central
Office & Showroom
Str. Vulturilor 98A, 030857, București
Tel.: 0774 074 084
office.romania@dentsplysirona.com
www.dentsplysirona.ro
<http://facebook.com/dentsplysirona.romania>

Open a world of confident smiles with Primescan's uniquely open approach to dentistry. Primescan as connected as your patients, now validated for any major lab software out there.



Scanned with Primescan

KAPOSI SARCOMA DISGUISED AS PERICORONITIS: A DEFERRED DIAGNOSIS DUE TO COVID-19 PANDEMIC

Prashanth Konatham Haribabu^{1a*}, Minaal Verma^{2b}, Akshay Vij^{3c}, Steven R. Singer^{4d}

¹Specialty Care Unit - Oral & Maxillofacial Surgery, Missouri School of Dentistry & Oral Health, A.T. Still University of Health Sciences, Saint Louis, USA

²Dental Materials Section, Department of Prosthodontics & Endodontics, School of Dental Medicine, Southern Illinois University, Alton, USA

³Specialty Care Unit - Esthetic & Digital Dentistry, Missouri School of Dentistry & Oral Health A.T. Still University of Health Sciences, Saint Louis, USA

⁴Division of Oral & Maxillofacial Radiology, Department of Diagnostic Sciences, Rutgers School of Dental Medicine, Rutgers, The State University of New Jersey, Newark, USA

^aDDS, BDS, MDS, MSD, FICD, Associate Professor and Director; e-mail: prashanthharibabu@atsu.edu; ORCIDiD: <https://orcid.org/0000-0002-0470-1467>

^bDDS, BDS, MDS, FICD, Assistant Professor and Head; e-mail: mverma@siue.edu; ORCIDiD: <https://orcid.org/0009-0006-2390-4223>

^cBDS, ACT, FAGD, FICD, Associate Professor and Director; e-mail: akshayvij@atsu.edu; ORCIDiD: <https://orcid.org/0000-0002-6342-8755>

^dDDS, Professor and Chair, Interim Director; e-mail: steven.singer@rutgers.edu; ORCIDiD: <https://orcid.org/0000-0003-2549-955X>

ABSTRACT

 [https://doi.org/10.25241/stomaeduj.2024.11\(1-2\).art.7](https://doi.org/10.25241/stomaeduj.2024.11(1-2).art.7)

Aim The current case report describes an uncommon presentation and subsequent diagnosis of Kaposi sarcoma caused by acquired immunodeficiency syndrome (AIDS).

Summary The COVID-19 pandemic led to global disruptions in healthcare services, sometimes resulting in postponed diagnoses of infectious diseases. Kaposi sarcoma (KS) is a malignant soft-tissue neoplasm commonly associated with human immunodeficiency virus (HIV) and AIDS, but it also occurs in other immune-compromised individuals. The oral manifestations of KS play a crucial role in its early diagnosis and may be a predictor of disease progression from HIV to AIDS. The current case report describes an unusual case involving a young male who presented to a dental clinic with persistent postoperative pain and delayed wound healing following extraction of his lower third molar. Clinical examination indicated a proliferative mucosal lesion with reddish-purple coloration in the vicinity of the surgical site that extended to the left retromolar pad, and cone-beam computed tomography scans showed marked osseous changes. Histopathological analysis confirmed a diagnosis of AIDS-related KS and an additional diagnosis of metastatic pulmonary KS.

Key learning points

1. The COVID-19 pandemic caused numerous disruptions in healthcare systems and services, which led to delayed healthcare visits.
2. Kaposi sarcoma is a malignant soft-tissue neoplasm commonly associated with HIV and AIDS.
3. Kaposi sarcoma may also occur in other immune-compromised individuals.
4. The oral manifestations of KS may play a crucial role in diagnosis of AIDS.
5. Kaposi sarcoma may present in uncommon ways, such as persistent postoperative pain and delayed wound healing.


KEYWORDS

Kaposi Sarcoma; Postoperative Pain; Delayed Wound Healing; Human Immunodeficiency Virus; Acquired Immune Deficiency Syndrome.

1. INTRODUCTION

Sarcomas are a rare mesenchymal cancer that grows in different types of connective tissue [1]. Kaposi sarcoma (KS) is one type of sarcoma that develops from the cells lining lymphatic or blood vessels [1]. It is classified as an intermediate neoplasm because it lacks the conventional features of a true malignancy [2]. Caused by human herpes virus-8 (HHV-8), KS is present in 1%–5% of the general population globally, but its seroprevalence is greater (20%–77%) among men who have sex with other men, particularly those diagnosed with human immunodeficiency virus (HIV)

and acquired immunodeficiency syndrome (AIDS) [3]. Because HHV-8 is considered an opportunistic infection, it is often transmitted between individuals through saliva, sexual activity, blood, or organ transplant. However, it can also remain latent until the individual experiences an immunosuppression reaction, at which point the virus becomes associated with additional pathologies, such as KS or lymphomas. Therefore, it is crucial to understand these transmission routes and latency mechanisms for effective prevention and management strategies in susceptible populations.

 **OPEN ACCESS** This is an Open Access article under the CC BY-NC 4.0 license.

Peer-Reviewed Article

Citation: Haribabu PK, Verma M, Vij A, Singer SR. Kaposi Sarcoma disguised as pericoronitis: a deferred diagnosis due to COVID-19 pandemic. *Stoma Edu J.* 2024;11(1-2):73-77

Received: July 23, 2024; **Revised:** August 06, 2024; **Accepted:** August 15, 2024; **Published:** August 29, 2024.

***Corresponding author:** Assoc. Prof. Prashanth K. Haribabu, DDS, BDS, MDS, MSD, FICD, Director, Specialty Care Unit – Oral & Maxillofacial Surgery, Missouri School of Dentistry & Oral Health, A.T. Still University of Health Sciences, 1500 Park Ave, Saint Louis, MO 63104, USA; **Tel.:** 660.626.2121;

Fax: 660.626.2121; e-mail: prashanthharibabu@atsu.edu

Copyright: © 2022 the Editorial Council for the Stomatology Edu Journal.

Oral KS occurs in approximately 22% of individuals diagnosed with HIV and is typically the first sign of undiagnosed HIV infection [4]. The most common sites of occurrence in the oral cavity are the hard palate, gingiva, and dorsum of the tongue [5,6]. Clinically, oral KS can present as solitary, multifocal, or multicentric macular patches, plaques, or nodules of varying dimension; colors can range from deep red to purplish blue [7,8]. Multifocal lesions may also coalesce into solitary exophytic masses. Oral KS can cause local tissue destruction, pain, spontaneous bleeding, masticatory difficulty, and interference with the wearing of oral prostheses. Although severe alveolar bone destruction and unexplained tooth mobility with underlying oral KS has been documented [9], oral KS presenting as a source of persistent dentoalveolar pain is uncommon. Therefore, the aim of the current case report was to describe an uncommon presentation and subsequent diagnosis of KS caused by AIDS.

2. CASE PRESENTATION

A 29-year-old White male presented to our Oral & Maxillofacial Surgery clinic with pain with accompanying intraoral swelling that emanated from the region around his lower left third molar. The only relevant medical history that the patient divulged is that he had been previously diagnosed with HIV but had not followed with his physician for management and treatment. Patient did not provide any previous medical records or blood work. Clinical examination revealed erythematous, hyperplastic soft tissue partially covering the lower left third molar (tooth #17) and tenderness on palpation. A diagnosis of acute pericoronitis was established based on the clinical and radiological findings. Due to the acute nature of this event, a clinical decision to proceed with treatment was made. The tooth was considered to be not salvageable and was extracted. The socket was subsequently curetted to remove remnants of granulation tissue. The residual pericoronar tissue was rather prominent and noticeable.

The patient was instructed to return for evaluation of the surgical site if his pain persisted or there was no resolution of the redundant pericoronar tissue. However, the patient did not follow up as instructed, likely because of the COVID-19 pandemic. His treatment coincided with increased public health restrictions designed to mitigate the effects of the pandemic, which meant that follow-up oral care services were severely limited.

Four months later, the patient returned to the clinic with complaints of bleeding and constant, low-grade pain emanating from the surgical site. He reported that the bleeding started two weeks before and that his pain had intensified (5 of 10 on a numeric pain scale), leading him to seek care. At the time of this visit, his HIV disease was poorly controlled (CD4+ < 200 cells/mm³, viral load = 67,229 copies/mL), and he had stopped taking the highly active antiretroviral therapy over the past few months. He reported generalized weakness, insomnia, poor appetite, and weight loss during the past month.

Extraoral examination was significant for a non-tender, nonmobile left submandibular lymph node that measured approximately 1 × 1 cm. Intraoral examination revealed a 3 × 3 cm bluish-purple proliferative lesion that originated from the extraction socket site of tooth #17, extended to the left retromolar pad, and involved the lingual gingiva and buccal vestibule (Fig. 1).



Figure 1. Irregular proliferative lesion at the healing surgical site of tooth #17 that extended toward the lingual and buccal gingiva and toward the faucial pillars of the oropharynx.

A less intense, reddish-purple mucosal discoloration was also visible in the left maxillary tuberosity (Fig. 2).

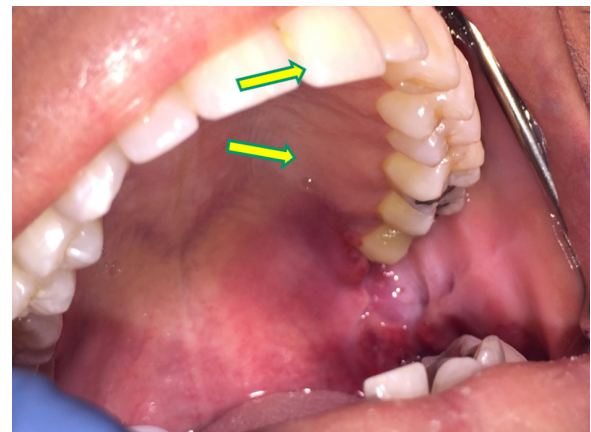


Figure 2. Reddish-purple hyperplastic discoloration (arrows) that extended superiorly around the attached palatal gingiva of tooth #16.

Palpation of the clinical sites elicited intense pain, which the patient indicated was the primary reason he returned for follow-up (Fig. 3).

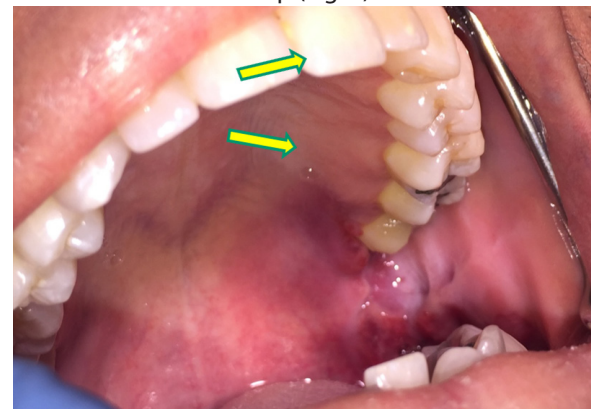


Figure 3. Reddish-purple coloration of palatal gingiva at tooth #16 and near the left maxillary tuberosity.

At this visit, a panoramic radiograph was obtained and indicated a well-healed extraction socket for tooth #17 and intact cortical borders of the mandible (Fig. 4). The shadow of a dome-shaped soft tissue growth of approximately 9-mm wide × 3-mm high at the crest of the ridge posterior to tooth #18 was evident and likely represented the lesion.



Figure 4. Panoramic radiograph showing intact cortical alveolar borders in the healed extraction socket (region of tooth #17), but marked alveolar bone loss around tooth #16.

Next, an incisional biopsy of the lesion growing from the extraction site of tooth #17 was performed. Histopathological examination with hematoxylin-eosin confirmed the presence of AIDS-associated oral KS. Low resolution (Fig. 5) and medium resolution (Fig. 6) photomicrographs showed a polypoid lesion composed of vascular connective tissue and pleomorphic spindle cells compressing the extravasations of erythrocytes.

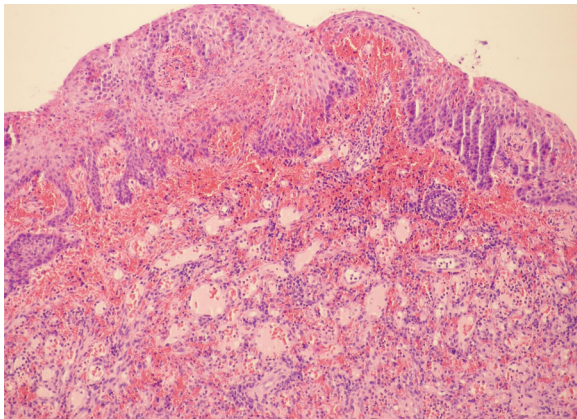


Figure 5. Low resolution histopathological photomicrograph showing a polypoid lesion composed of vascular connective tissue partially covered by stratified squamous (hematoxylin-eosin, magnification ×40).

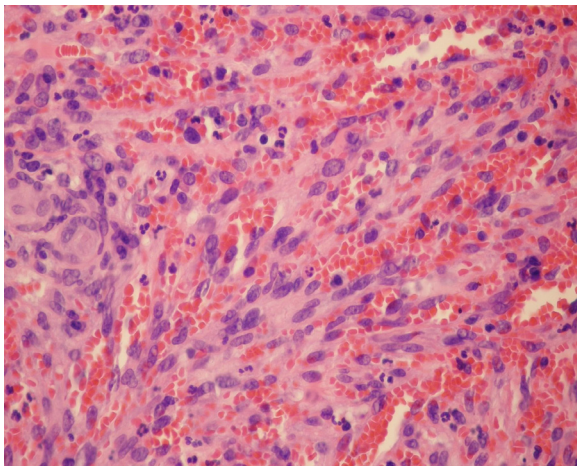


Figure 6. Medium resolution histopathological photomicrograph showing poorly differentiated vascular slits and fascicles of pleomorphic spindle cells compressing the extravasated erythrocytes (hematoxylin-eosin, magnification ×40).

Advanced imaging was then performed to determine whether there was any osseous change in the site of the lesion. Large volume cone-beam computed tomography scans revealed an irregularly shaped osseous defect in the left posterior mandible that extended from the ramus anteriorly to the second molar area (Fig. 7). Although the buccal cortical plate was intact, the lingual cortical plate and the alveolar crest showed signs of resorption. There was a furcation defect in tooth #18 and loss of the lamina dura, which likely represented the most anterior extent of the lesion. The lesion extended inferiorly to the level of the inferior alveolar nerve canal, perforating the cortical shelf of that canal (Fig. 8). Infiltration of the inferior alveolar nerve canal explained the patient's reported episodes of sharp pain in conjunction with persistent low-grade pain.



Figure 7. Cone-beam computed tomography scan showing irregularly shaped osseous defect in the left posterior mandible that extended from the ramus anteriorly to the second molar area.



Figure 8. Large volume cone-beam computed tomography scan slices showing an irregular alveolar defect on the lingual cortex of the mandible that extended inferiorly to the level of the inferior alveolar nerve canal.

The patient was informed of the diagnosis and promptly referred to his infectious disease specialist for further evaluation and management. Diagnostic workup confirmed the presence of pulmonary KS, and he was again started on highly active antiretroviral therapy that helped resolve the oral and systemic manifestations of KS throughout his body.

3. DISCUSSION

Manifestation of oral KS as pericoronitis or in conjunction with pain often serves as a warning sign

for any form of injury sustained by the human body. In the current case report, persistent postextraction pain was the main reason the patient pursued follow-up evaluation. Although oral KS can occur at any intraoral site, it has a predilection for the hard palate and gingiva. Cases of oral KS resembling pericoronitis or local soft tissue inflammation with constant low-intensity pain have been rare. For patients living with HIV, unrelieved pain has been reported as a major problem. For example, patients with CD4+ T cell counts less than 200/mm³ often have pain as a common, persistent symptom [10]. Given the outcomes of the current case, clinicians should consider HIV, AIDS, and their associated manifestations, such as oral KS, as potential sources of persistent postoperative pain. Therefore, clinicians should routinely examine oral soft tissues for potential pathology in immunosuppressed patients. Certainly, the detection of oral KS in this case led to the discovery of pulmonary involvement and was critical for effective and successful treatment of the patient.

The disruption of healthcare services during and after the COVID-19 pandemic had a major effect on patient care and increased the number of complications for oral infectious diseases. Several studies reported that COVID-19 accelerated the incidence of KS in extraoral areas, especially the skin of the extremities. This increase was associated with reactivation of the HHV-8 virus, which was likely due to exposure to the SARS-CoV-2 virus. This type of surge in carcinomas was also observed in other oral malignancies that were not caused by HIV [28].

REFERENCES

1. Feller L, Wood NH, Lemmer J. HIV-associated Kaposi sarcoma: pathogenic mechanisms. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2007 Oct;104(4):521-529. doi: 10.1016/j.tripleo.2006.08.015. [CrossRef Full text links PubMed Google Scholar Scopus WoS](#)
2. Fletcher CD. The evolving classification of soft tissue tumours - an update based on the new 2013 WHO classification. *Histopathology.* 2014 Jan;64(1):2-11. doi: 10.1111/his.12267. [CrossRef Full text links PubMed Google Scholar Scopus WoS](#)
3. Kedes DH, Operskalski E, Busch M, et al. The seroepidemiology of human herpesvirus 8 (Kaposi's sarcoma-associated herpesvirus): distribution of infection in KS risk groups and evidence for sexual transmission. *Nat Med.* 1996 Aug;2(8):918-924. doi: 10.1038/nm0896-918. Erratum in: *Nat Med* 1996 Sep;2(9):1041. [CrossRef Full text links PubMed Google Scholar Scopus WoS](#)
4. Mohanna S, Bravo F, Ferrufino JC, et al. Classic Kaposi's sarcoma presenting in the oral cavity of two HIV-negative Quechua patients. *Med Oral Patol Oral Cir Bucal.* 2007 Sep 1;12(5):E365-E368. [Full text links PubMed Google Scholar Scopus](#)
5. Papagatsia Z, Jones J, Morgan P, Tappuni AR. Oral Kaposi sarcoma: a case of immune reconstitution inflammatory syndrome. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2009 Jul;108(1):70-75. doi: 10.1016/j.tripleo.2009.02.035. [Full text links PubMed Google Scholar Scopus WoS](#)
6. Lager I, Altini M, Coleman H, Ali H. Oral Kaposi's sarcoma: a clinicopathologic study from South Africa. *Oral Surg Oral Med Oral*

4. CONCLUSIONS

Manifestations of KS in the oral cavity can be an early sign of additional pathology in immunosuppressed individuals. Therefore, dental practitioners should purposefully investigate the origin of preoperative and postoperative intraoral pain in patients with HIV disease and effectively communicate any findings to medical providers to expedite systemic care of these patients. During the current post-pandemic period, dental practitioners should include an additional layer of screening during standard patient examinations for early detection of oral malignancies, such as oral KS.

AUTHOR CONTRIBUTIONS

PKH, SRS contributed to the concept, protocol, case documentation, data gathering and interpretation and making critical edits to the manuscript. **AV, MV** contributed to the protocol, case documentation, data gathering and interpretation and making critical edits to the manuscript.

ACKNOWLEDGMENTS

We would like to acknowledge and thank Late Dr. Harold V. Cohen, DDS – Professor of Diagnostic Sciences, Rutgers School of Dental Medicine, Newark NJ for his expertise and counsel towards interprofessional care involving infectious diseases medical and dental care.

1. *Pathol Oral Radiol Endod.* 2003 Dec;96(6):701-710. doi: 10.1016/s1079-2104(03)00370-6. [CrossRef Full text links PubMed Google Scholar Scopus WoS](#)
7. Speicher DJ, Wanzala P, D'Lima M, et al. Diagnostic challenges of oral and cutaneous Kaposi's sarcoma in resource-constrained settings. *J Oral Pathol Med.* 2015 Nov;44(10):842-849. doi: 10.1111/jop.12315. [CrossRef Full text links PubMed Google Scholar Scopus WoS](#)
8. Richter F, Hill GJ, Schwartz RA. Professor Kaposi's original concepts of Kaposi's sarcoma. *J Cancer Educ.* 1995 Summer;10(2):113-116. doi: 10.1080/08858199509528344. [PubMed Google Scholar Scopus](#)
9. Pantanowitz L, Dezube BJ. Kaposi sarcoma in unusual locations. *BMC Cancer.* 2008 Jul 7;8:190. doi: 10.1186/1471-2407-8-190. [CrossRef Full text links Free PMC Article PubMed Google Scholar WoS](#)
10. Aouizerat BE, Miaskowski CA, Gay C, et al. Risk factors and symptoms associated with pain in HIV-infected adults. *J Assoc Nurses AIDS Care.* 2010 Mar-Apr;21(2):125-133. doi: 10.1016/j.jana.2009.10.003. [CrossRef Full text links Free PMC Article PubMed Google Scholar Scopus WoS](#)

Prashanth Konatham HARIBABU

DDS, BDS, MDS, MSD, FICD
 Associate Professor and Director

Specialty Care Unit – Oral & Maxillofacial Surgery Missouri School of Dentistry & Oral Health
 A.T. Still University of Health Sciences
 Saint Louis, MO 63104, USA



CV

Dr. Prashanth K. Haribabu, DDS, MDS, MSD, is the Director of Oral and Maxillofacial Surgery and Assistant Professor at A.T. Still University-Missouri School of Dentistry & Oral Health (ATSU-MOSDOH). A dedicated educator, he emphasizes continuous learning to maintain excellence in patient care and train future healthcare providers. Dr. Haribabu also chaired a scientific surgical session and was awarded the prestigious Master Implant Fellow Certification by the World Congress of Oral Implantology (WCOI).

Questions

1. What is the primary cause of Kaposi Sarcoma (KS)?

- a. Human Papillomavirus (HPV);
- b. Epstein-Barr Virus (EBV);
- c. Human Herpesvirus-8 (HHV-8);
- d. Cytomegalovirus (CMV).

2. What was the initial diagnosis for the 29-year-old male in the case report?

- a. Kaposi Sarcoma;
- b. Acute Pericoronitis;
- c. Osteomyelitis,
- d. Oral Lichen Planus.

3. What delayed the follow-up care of the patient in the case report?

- a. Personal negligence,
- b. Financial constraints,
- c. The COVID-19 pandemic,
- d. Lack of transportation.

4. What was a significant clinical finding during the patient's follow-up visit?

- a. A painless intraoral lesion,
- b. A bluish-purple proliferative lesion,
- c. Normal healing of the extraction site,
- d. Discoloration limited to the hard palate.

International Association of Oral and Maxillofacial Surgeons

JOIN US FOR ICOMS IN:
Singapore

MAY 22-25, 2025
 MARINA BAY SANDS

ABSTRACT SUBMISSIONS:
 AVAILABLE VIA
WWW.IAOMS.ORG

ICOMS2025
 SINGAPORE

<https://icoms.iaoms.org/>

Large Mandibular Lipoma: A Case Report

Mehdi Keddar^{1a*}, Edouard Malengrez^{1b}, Cynthia Watteuw^{1c}, Laurence Evrard^{1d},
 Firas Shall^{1e}, Christophe Politis^{1f}

¹Department of Stomatology and Maxillofacial Surgery, The Brussels University Hospital (H.U.B), Université Libre de Bruxelles 1070-Brussels, Belgium

^aDaMD, DDS; e-mail: mehdi.keddar@hotmail.com; ORCIDiD: <https://orcid.org/0009-0005-1715-8968>

^bMedical student; e-mail: edouard.malengrez@ulb.be

^cMD, DDS; e-mail: cynthiawatteuw@gmail.com

^dMD, DDS, PhD, Director; e-mail: laurence.evrard@ulb.be; ORCIDiD: <https://orcid.org/0000-0001-5581-4093>

^eMD, DDS; e-mail: firasshall@gmail.com; ORCIDiD: <https://orcid.org/0000-0003-3061-2625>

^fMD, DDS; e-mail: christophe.politis@gmail.com; ORCIDiD: <https://orcid.org/0000-0002-1076-1327>

ABSTRACT

[https://doi.org/10.25241/stomaeduj.2024.11\(1-2\).art.8](https://doi.org/10.25241/stomaeduj.2024.11(1-2).art.8)

This case report describes an intraoral lipoma in a 29-year-old female, a rare occurrence given the significant size of the lesion, which exceeded the common threshold of 2.5 cm for intraoral lipomas. Typically manifesting in areas such as the buccal mucosa and tongue, the lipoma in this case was located on the buccal mucosa, underscoring the variability in presentation sites. Surgical excision, the standard approach for such tumors, was the chosen treatment, with a successful outcome and no recurrence. This case report adds to the limited body of literature on intraoral lipomas, highlights the potential for atypical presentations in size, and emphasizes the effectiveness of surgical management.

KEYWORDS

Maxillofacial Surgery; Intraoral Lipoma; Lipoma Management; Oral Pathology; Soft Tissue Tumor.

1. INTRODUCTION

Lipomas are the most common benign mesenchymal tumors occurring in humans and are predominantly composed of mature adipocytes. Lipomas mainly occur in various parts of the body, such as the trunk and proximal regions of the extremities, but are uncommon in the oral cavity. These entities represent a mere 1–5% of all benign oral tumors [1], but they present unique diagnostic and therapeutic challenges. Lipomas in the oral cavity do not exhibit a predilection for any specific location, and occurrences have been reported in areas such as the tongue, buccal mucosa, and floor of the mouth. They tend to occur in patients between the ages of 40 and 60, with the average age of occurrence being approximately 52 years, although they can appear at any age.

Histologically, oral lipomas present in a spectrum of subtypes, including but not limited to simple lipomas, fibrolipomas, spindle cell lipomas, intramuscular or infiltrating lipomas, and angiolipomas. Each subtype exhibits distinct histopathological features, whose identification is critical for accurate diagnosis and appropriate management.

Clinically, oral lipomas often present as asymptomatic, slow-growing masses that may be overlooked or misdiagnosed due to their subtlety and benign nature. This report describes a case involving an adult female patient who underwent successful surgical removal of an intraoral lipoma.

2. CASE PRESENTATION

A 29-year-old woman presented at the Oral and Maxillofacial Surgery Department at HUBruxelles Erasme with a history of intermittent left cheek swelling for several years (Fig. 1).



Figure 1. Preoperative intraoral view.

She was first admitted without appointment, as she described a sudden onset of cheek swelling that could be compatible with cellulitis. The patient had no notable medical history or medication usage to report but disclosed that she smoked approximately 10 cigarettes daily. The patient's oral hygiene was found to be excellent, no cavities were observed, and no pain was elicited during dental percussion. Moreover, an orthopantomogram revealed no significant lesions. Blood work showed no elevation in white blood cells, C-reactive protein (CRP), or other relevant markers of infectious or allergic origin. A

OPEN ACCESS This is an Open Access article under the CC BY-NC 4.0 license.
Peer-Reviewed Article

Citation: Keddar M, et al. Politis C. Large Mandibular Lipoma: A Case Report. *Stoma Edu J.* 2024;11(1-2):78-81.

Received: February 18, 2024; **Revised:** March 18, 2024; **Accepted:** April 01, 2024; **Published:** May 03, 2024.

***Corresponding author:** Dr. Mehdi Keddar, MD, DDS, Department of Stomatology and Maxillofacial Surgery, The Brussels University Hospital (H.U.B), Université Libre de Bruxelles, Route de Lennik 808, 1070, Brussels, Belgium; **Tel. /Fax:** +32 (0) 2 555 55 55; e-mail: mehdi.keddar@hotmail.com

Copyright: © 2022 the Editorial Council for the Stomatology Edu Journal.

cervical ultrasound revealed a 37-mm mass in the left cheek, initially suggestive of a lipoma (Fig. 2).

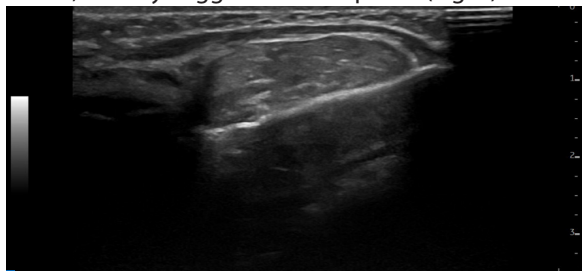


Figure 2. Ultrasonographic image depicting a well-defined hypoechoic mass consistent with a lipoma.

This diagnosis was later confirmed by an MRI, which delineated a lesion with fat signal characteristics (hyperintense in T1 and T2, hypointense in T2 with fat saturation, and T1 post-gadolinium with fat saturation), consistent with a lipoma that measured 37 x 13 x 17 mm (length x anteroposterior x craniocaudal). The lipoma was located along the external aspect of the left horizontal mandibular branch (Fig. 3).

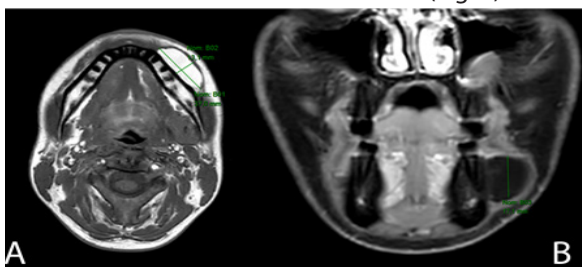


Figure 3. MRI scans with A) axial and B) coronal views (T2 fat-saturated), illustrating a homogenous, high-signal intensity mass on T1-weighted images characteristic of a lipoma's fat content

The decision was made to perform an excisional biopsy and excision of the lesion (Fig. 4). The procedure was performed under general anesthesia due to significant anxiety on the part of the patient. An electrocautery unit was used to make an incision along the vestibular sulcus from tooth 33 to 36, which immediately exposed the lipoma. Careful dissection was undertaken to preserve the mandibular nerve, with meticulous attention to hemostasis. The wound was then closed with simple interrupted sutures using 3-0 Vicryl (polyglactin 910).



Figure 4. Operative view after superficial excision showing the mass in situ, B) isolation and exposure of the lipoma, C) post-excision site showing the surgical bed, and D) sutured closure of the surgical site.

The follow-up after 14 days showed an uneventful wound healing process; however, there was a transient hypoesthesia of the mandibular nerve, which resolved completely after one month.

3. DISCUSSION

This case report regarding an intraoral lipoma in an adult female patient underscores the clinical rarity and diagnostic subtleties of these tumors in the oral cavity. Lipomas, which typically occur in other areas of the body, manifest distinctively when they occur in the oral region. This patient's presentation with a non-tender, soft mass and the subsequent imaging and histopathological findings are characteristic of intraoral lipomas and align with reports in the literature [2]. However, this particular lipoma was significantly larger than average, as intraoral lipomas rarely exceed 2.5 cm in diameter [3].

Regarding the localization of intraoral lipomas, the buccal mucosa is the most common site, followed by the tongue; together, these two sites account for 50% of intraoral lipomas. Other notable locations include the lip, palate and floor of the mouth, vestibule, retromolar area, and gingiva [4].

Approximately 5% of lipomas can manifest in multiple forms and are associated with conditions such as neurofibromatosis or familial adenomatous polyposis syndrome [4,5]. However, cases of intraoral lipomas appear to be exclusive and solitary in nature [6].

A notable aspect of this case is the patient's lack of significant medical history, with the exception of tobacco use. Tobacco consumption has not been conclusively linked to the development of intraoral lipomas, which suggests that the occurrence of these tumors could be independent of tobacco use. The exact cause of lipomas is still not fully understood, and the occurrence of lipomas appears to be influenced by multiple factors with no direct correlation to habits such as tobacco consumption. Some researchers have proposed that lipoma formation might be triggered by recurrent minor trauma that potentially stimulates the growth of fatty tissue. However, a definitive link between such trauma and the occurrence of a lipoma remains elusive. Other studies have suggested that these tumors may originate from embryonic multipotential cells, which are dormant until hormonal changes during adolescence activate their differentiation into mature adipose tissue, leading to the gradual emergence of a lipoma [6].

Diverse subtypes of lipomas have been described. In the reported case, the histopathological analysis established a classic lipoma, the most common variant of intraoral lipomas, accounting for between 45% and 50% of all intraoral lipomas (Fig. 5). It has been suggested that oral lipomas are more common in males, while oral fibrolipomas are more frequent in females; however, there is no clear evidence to support these suggestions [7], [6]. Our patient presented with a simple lipoma.



Figure 5. Excised lipoma.

Surgical excision remains the treatment of choice, and there is a less than 1% recurrence rate [6]. Steroid injections in the center of the lipoma have been suggested in the literature as an alternative treatment to reduce the size of tumors of less than 2.54 cm in diameter. Because they cause local fat atrophy, these injections have been associated with few complications [8]. However, the patient described in this report was not a suitable candidate for this treatment. The hypoesthesia, which resolved within a month, is a relatively uncommon but possible postoperative complication related to the location of the lesion. Comprehensive radiographical evaluation is crucial for both the diagnostic process and the surgical planning.

REFERENCES

1. Kumaraswamy SV, Madan N, Keerthi R, Shakti S. Lipomas of oral cavity: case reports with review of literature. *J Maxillofac Oral Surg.* 2009 Dec;8(4):394-397. doi: 10.1007/s12663-009-0096-6. Epub 2010 Apr 24. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [Scopus](#) [WoS](#)
2. Furlong MA, Fanburg-Smith JC, Childers EL. Lipoma of the oral and maxillofacial region: Site and subclassification of 125 cases. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2004 Oct;98(4):441-450. doi: 10.1016/j.tripleo.2004.02.071. [Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)
3. Azzouz Y, Abidi S, Zidane FZ, Chbicheb S. An unusual intraoral lipoma: case report and review of the literature. *Pan Afr Med J.* 2022 Apr 26;41:336. doi: 10.11604/pamj.2022.41.336.34808. [Full text links](#) [PubMed](#) [Google Scholar](#)
4. Egido-Moreno S, Lozano-Porras AB, Mishra S, et al. Intraoral lipomas: Review of literature and report of two clinical cases. *J Clin*

4. 5 KEY LEARNING POINTS

1. Intraoral lipomas can present beyond typical size ranges, highlighting the need for clinical awareness in differential diagnosis of soft tissue masses, especially for non-tender, slow-growing lesions.
2. Imaging, particularly ultrasound and MRI, is essential for the preliminary identification and characterization of intraoral lipomas.
3. Surgical excision is highly effective for intraoral lipomas, with minimal recurrence and manageable postoperative complications.
4. Histological examination is critical to differentiate between the subtypes of oral lipomas, guiding accurate diagnosis and management.
5. The etiology of intraoral lipomas remains uncertain, underscoring the need for further research into potential lifestyle and genetic factors.

AUTHOR CONTRIBUTIONS

MK, CW, FS Patient management. **MK, EM** Drafting of the article. **LE** Revision of the article. **CP** Revision and final approval of the article.

ACKNOWLEDGMENTS

We extend our deepest gratitude to the patient who consented to the publication of this case, enabling us to share valuable insights with the medical community. Our thanks also go to the entire team at the Stomatology and Maxillofacial Surgery Department at HU Bruxelles Erasme for their exceptional care and dedication in managing this case. Special appreciation is directed towards the radiology department for their expertise and assistance in the diagnostic process, which was pivotal for the successful treatment outcome.

Exp Dent. 2016 Dec 1;8(5):e597-e603. doi: 10.4317/jced.52926.

[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)

5. de Visscher JG. Lipomas and fibrolipomas of the oral cavity. *J Maxillofac Surg.* 1982 Jan 1;10:177-181. doi:10.1016/S0301-0503(82)80036-2

[CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)

6. Fregnani ER, Pires FR, Falzoni R, Lopes MA, Vargas PA. Lipomas of the oral cavity: clinical findings, histological classification and proliferative activity of 46 cases. *Int J Oral Maxillofac Surg.* 2003 Feb 1;32(1):49-53. doi:10.1054/ijom.2002.0317

[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#) [WoS](#)

7. Salam GA. Lipoma excision. *Am Fam Physician.* 2002 Mar 1;65(5):901-905. PMID: 11898962.

[Full text links](#) [CrossRef](#) [PubMed](#) [Google Scholar](#)

Mehdi KEDDAR

MD, DDS

Department of Stomatology and Maxillofacial Surgery

The Brussels University Hospital (H.U.B)

Université Libre de Bruxelles

1070, Brussels, Belgium



CV

Dr. Mehdi Keddar was a doctoral student at the Université Catholique de Louvain (2011-2019) where he obtained his MD title (Doctor of Medicine). He obtained his DDS title (Doctor of Dental Surgery) after a three-year period of studies (2019-2022) at the Université Libre de Bruxelles. Since 2019 he has been a Resident in Training at the Université Libre de Bruxelles (Stomatology and Maxillo-Facial Residency).

Questions

1. What is the most common location for intraoral lipomas?

- a. Palate;
- b. Buccal mucosa;
- c. Tongue;
- d. Floor of the mouth.

2. Which imaging technique is NOT typically used for the diagnosis of intraoral lipomas?

- a. Ultrasound;
- b. MRI;
- c. CT Scan;
- d. PET Scan.

3. What is the age range most commonly associated with the occurrence of intraoral lipomas?

- a. 20-30 years;
- b. 40-60 years;
- c. 10-20 years;
- d. 30-40 years.

4. Which of the following is NOT a subtype of oral lipomas mentioned in the report?

- a. Simple lipomas;
- b. Fibrolipomas;
- c. Spindle cell lipomas;
- d. Osteolipomas.



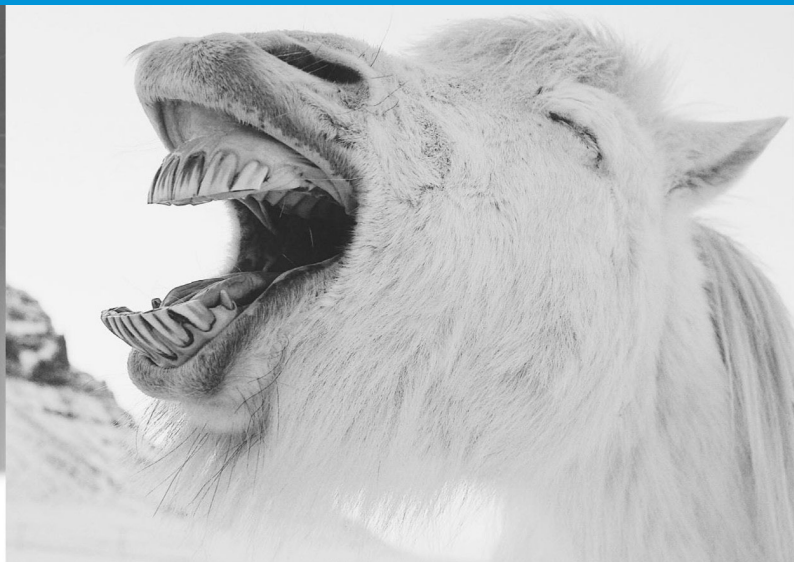
EUROPEAN LECTURE SERIES VII (SEPT 2024-25)
**USE OF COMPUTER-ASSISTED TOOLS
IN ORTHOGNATHIC SURGERY**

8th MAY, 2025
MEETING ROOM OPEN 19.45 CET - LECTURE 20.00 CET
WATCH LIVE

[CLICK HERE](#)

Speaker:
Hakan Tüz, Türkiye





Because every bite is different.



Bausch
WE MAKE OCCLUSION VISIBLE

Dr. Jean Bausch GmbH & Co. KG | Oskar-Schindler-Str. 4 | D-50769 Cologne | Germany
Phone: +49-221-70936-0 | info@bauschdental.de | www.bauschdental.de

SMART SYSTEM TO IDENTIFY MOBILITY IN TEETH AND/OR IMPLANTS – INNERVIEW LC BY PERIMETRICS, INC.

Everybody knows that cracks occur less frequently in non-restored teeth, and much more frequently in teeth that have undergone a dental procedure.

In non-restored teeth, there are no internal micromovements, while there are in damaged teeth, being caused by failed restorations or by various coronal cracks (oblique, vertical or horizontal) and root cracks, impossible to diagnose visually or noninvasively.

Perimetrics, Inc. based on machine learning, deep learning and finite element analysis realizes an electromagnetically actuated system of non-invasive quantitative percussion diagnosis (QPD) to identify mobility in teeth and/or implants.

The InnerView LC system is indicated to accurately measure the damping characteristics of the periodontium and its associated fixed structures (teeth and/or implants).

The system offers the results in real time with an easy-to-read report on the screen, namely:

- Describes the state of tooth or implant restoration,
- Provides the percentage calculation of the diagnosis and the calculation basis of the probable cause of the damage,
- Immediate recommended action is indicated,
- Empowers the clinician to provide an adequate treatment plan,
- Eliminates the learning curve, as the results are calculated in real time, with a diagnostic report that is easy to read by the patient.



InnerView LC system
<https://www.perimetrics.ai/>

The InnerView LC system is made up of:

- Wireless handpiece provided with a single-use tip with Smart Chip technology,
- Low-profile base station, designed to sit on the operator’s table,
- Software,
- A USB cable providing a connection from the base station to a computer.

The working methodology tests the cushioning capacity and, consequently, the mobility of the teeth and dental implants by lightly percussing their buccal surface. The percussion data generated by the handpiece is wirelessly transferred to the base station and forwarded to the computer via the USB connection.

This system provides a number of benefits for both patient and clinician:

Patient benefits:

- Confidence in the diagnosis
- Early detection
- Non-invasive, painless and without radiation
- Fast, 2 seconds per tooth
- Inexpensive
- Patient Portal Application

Clinician benefits:

- Empowerment with a suitable treatment plan
- The practice of “wellness”
- Significant new income
- Increased credibility
- Digital diagnosis (Dental insurance code - D0600)

Against this backdrop, the InnerView LC system can be recommended due to its diagnostic capabilities and easy use by the dental professional for each individual patient, becoming a new standard of care.

Florin - Eugen Constantinescu
 DMD, PhD Student
 Editorial Director, Product News

[https://doi.org/10.25241/stomaedu.2024.11\(1-2\).prodnews.1](https://doi.org/10.25241/stomaedu.2024.11(1-2).prodnews.1)



Made by You

Dentsply Sirona CEE Central
Office & Showroom
Str. Vulturilor 98A, 030857, Bucuresti
Tel.: 0774 074 094
office.romania@dentsplysirona.com
www.dentsplysirona.ro
<http://facebook.com/dentsplysirona.romania>

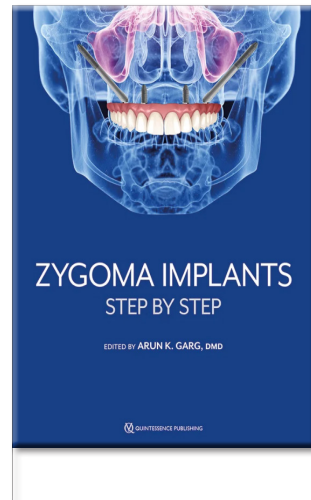
Open a world of confident smiles with Primescan's high performance and fast approach to dentistry. Primescan as high performing as your patients, now twice as fast than before.



Scanned with Primescan

Zygoma Implants - Step by Step

Editor: Arun K. Garg
 Publisher: Quintessence Publishing, USA
 Language: English
 ISBN: 978-1-64724-157-5
 Edition: 1/e
 Publish Year: 2023
 Pages: 216, Illustrated
 Price: €148.00



Marian V. Constantinescu
 DDS, MSc, PhD
 Holistic Dental & Medical Institute
 of Bucharest - ROPOSTURO
 Bucharest, Romania
 e-mail: roposturo@gmail.com

Zygoma implants are today the standard care to treat patients with severe bone atrophy of the maxillary that cannot be rehabilitated with surgical bone augmentation and/or conventional or tilted implant placement. The reported survival rate of 95% to 98% during 3 to 12 years of follow-up confirmed the long-term stability and predictability of zygoma implants.

Dr. Arun K. Garg, full-time professor of surgery in the Division of Oral and Maxillofacial Surgery at the University of Miami Leonard M. Miller School of Medicine, as editor, selected the 16 contributors based on their decades of clinical knowledge and experience with zygoma implants. Each has contributed to the rapid progress made over the past two decades in restoring function and aesthetics to patients with severe bone atrophy of the maxillary, a long-neglected patient population.

Quintessence Publishing, world leader in dental literature, supports experienced implantologists to gain a comprehensive understanding of the various surgical and prosthetic protocols practiced worldwide today with the publication of a new book by Dr. Arun K. Garg titled *Zygoma Implants - Step by Step*.

The book has 12 chapters. After a presentation of the anatomy and pathophysiology of maxillary bone atrophy, the ZAGA concept is described, as a multifaceted approach to zygoma implant rehabilitation and zygoma implants, rationale, indications, and overview. Next, the reader is introduced to the step-by-step surgical protocol of zygoma implants, oral rehabilitation with pterygoid implants from two zygoma implants in combination with conventional or tilted implants to quadruple zygoma implants, multiple zygoma implants and zygoma minimally invasive technique with piezoelectric instrumentation.

Prosthetic restoration is presented through the step-by-step prosthetic protocol for zygoma implants, illustration of classic cases of prosthetic restoration of zygoma implants and through zygoma implants in the patient with cancer or maxillofacial trauma.

Zygoma Implants - Step by Step by Dr. Arun K. Garg and the other 16 contributors from different countries, represents the most innovative and advanced knowledge and techniques available on this topic. To help the readers, it contains ample drawings and case illustrations, giving the necessary knowledge to perform oral rehabilitation with zygoma implants procedures in their own offices.

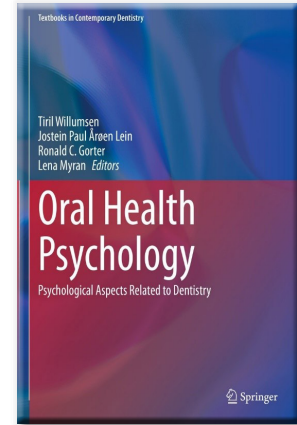
 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).bookreview.1](https://doi.org/10.25241/stomaedu.2024.11(1-2).bookreview.1)

The Books Review is drafted in the reviewer's sole wording and illustrates his opinions

Marian V. Constantinescu
DDS, MSc, PhD
Holistic Dental & Medical Institute
of Bucharest - ROPOSTURO
Bucharest, Romania
e-mail: roposturo@gmail.com

Oral Health Psychology

Psychological Aspects Related to Dentistry
Editors: Tiril Willumsen, Jostein Paul Årøen Lein,
Ronald C. Gorter, Lena Myran
Publisher: Springer Nature, Switzerland
Language: English
ISBN: 978-3-031-04247-8
Edition: 1/e
Publish Year: 2022
Pages: 352, Illustrated
Price: €106.99



In 2021, the World Health Organization (WHO) issued a resolution to provide better oral care, to make oral care accessible to all, to establish a key indicator of overall health, well-being and quality of life. WHO recommends a shift from the traditional curative approach to a preventive approach that includes promoting oral health in the family, schools and workplaces as well as timely, comprehensive and inclusive care in the primary health care system.

Oral Health Psychology is a book which defines oral health psychology as a collection of scientific, pedagogical and professional contributions from psychology to promoting and maintaining oral health, while placing oral health as an integral part of general health and well-being.

The book has 22 chapters divided in five parts. The first part, Basic Oral Health Psychology, approaches the link between basic oral health related to psychology, the importance of trauma, pain, the importance of a safe relationship with dental patients, oral health literacy, communication in dentistry, behavior change for oral health and autonomy support and improving oral health.

The second part, Children, first comments on positive encounters for children to prevent dental anxiety from the perspective of theory and practice, and then on family violence and child maltreatment.

Dental Anxiety is the third part where we are presented with understanding development and persistence of dental anxiety, psychological prevention and management of dental anxiety, administered CBT for dental anxiety and injection phobia. The fourth part, Patients with Complex Reactions and Co-morbidity, introduces persons with mental disorders as dental patients, how to deal with gagging, child sexual abuse and oral health challenges, providing dental care to torture survivors and the psychosocial impacts of orofacial features with examples from orthognathic surgery.

The last part, Professionalism, makes an eloquent plea on dental professionalism and professional behavior in practice and education, work stress, burnout risk, and engagement in dental practice and working in partnership for better oral health care.

This book is the result of the international collaboration of prestigious authors from various countries and continents and is an indispensable guide both for current and future dentists, as well as for other professionals in the field of oral health. The book *Oral Health Psychology* contributes both to better oral health for patients of all ages, and to improving collaboration between dental professionals, their patients and patient caregivers, ensuring increased job satisfaction and reducing the risk of burnout among dental staff.

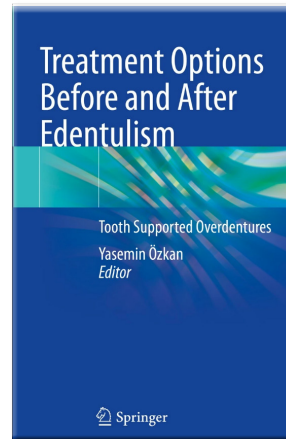
 [https://doi.org/10.25241/stomaeduj.2024.11\(1-2\).bookreview.2](https://doi.org/10.25241/stomaeduj.2024.11(1-2).bookreview.2)

The Books Review is drafted in the reviewer's sole wording and illustrates his opinions

Treatment Options Before and After Edentulism

Tooth Supported Overdentures

Editor: Yasemin Özkan
Publisher: Springer Nature, Switzerland
Language: English
ISBN: 978-3-031-37581-1
Edition: 1/e
Publish Year: 2023
Pages: 421, Illustrated
Price: €149.79



Sanda Mihaela Popescu
DMD, PhD, Professor
Faculty of Dentistry
University of Medicine and Pharmacy Craiova
Craiova, Dolj, Romania
e-mail: sanda.popescu@umfcv.ro

Treatment Options Before and After Edentulism, a book edited by Yasemin Özkan, addresses an often overlooked but highly significant topic in dentistry: how to manage the transition from partial to complete edentulism in patients who are not candidates for fixed implant-supported prostheses—whether due to medical, anatomical, or financial constraints.

The book focuses on tooth-supported overdentures, also known as attachment-retained overdentures. It details the various types of attachments used in these restorations, including ball or locator attachments, bar attachments, telescopic attachments, and magnetic attachments. The authors explain the principles behind each system, outline the clinical indications and contraindications, and provide guidance for appropriate case selection.

Structured into nine chapters, the book offers a comprehensive approach:

- The first two chapters cover the fundamental principles of attachment-retained overdentures and review all the prosthetic systems suitable for such cases.
- The next four chapters explore each type of attachment system in detail. Each is richly illustrated with clinical images that highlight specific indications and techniques.
- The final three chapters are devoted to essential clinical protocols: case assessment to determine the appropriate type of restoration, tooth preparation procedures for attachment placement, and post-treatment maintenance—all critical steps for ensuring long-term success and restoration longevity.

By addressing a subject rarely covered in dental literature, *Treatment Options Before and After Edentulism* fills an important gap. The book is especially valuable for prosthodontists, but it also serves as a practical guide for general dentists who frequently encounter such challenging cases in daily practice.

 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).bookreview.3](https://doi.org/10.25241/stomaedu.2024.11(1-2).bookreview.3)

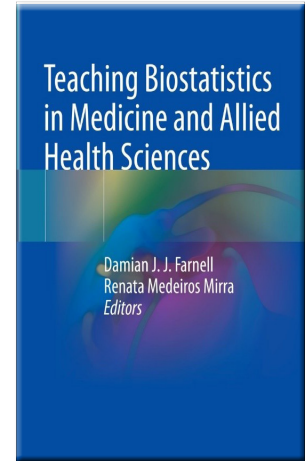
The Books Review is drafted in the reviewer's sole wording and illustrates his opinions

Cristina Teodora Preoteasa

DMD, PhD, Assistant Professor
Faculty of Dentistry
Department of Scientific Research Methodology
and Ergonomics
Faculty of Dental Medicine, "Carol Davila"
University of Medicine and Pharmacy,
Bucharest, Romania
e-mail: cristina.preoteasa@umfcd.ro

Teaching Biostatistics in Medicine and Allied Health Sciences

Editors: Damian J. J. Farnell, Renata Medeiros Mirra
Publisher: Springer Nature, Switzerland
Language: English
ISBN: 978-3-031-26009-4
Edition: 1/e
Publish Year: 2023
Pages: 219, Illustrated
Price: €128.39



Biostatistics is crucial for the medical professionals, being important for understanding information presented in the scientific literature, and for implementing the concept of evidence-based medicine. *Teaching Biostatistics in Medicine and Allied Health Sciences* is a book which focuses on teaching biostatistics in medicine and allied health sciences, highlighting its trends and challenges, and giving suggestions on how to improve the methods used in order to obtain good learning outcomes e.g., an adequate level of understanding of the basics of statistical concepts; acquiring knowledge needed for the correct understanding of research results; raising interest on the topic and giving confidence to students that they can understand and use biostatistics.

As the authors highlight, teaching biostatistics in medicine and dentistry in higher education shows great variability. Discussion on what and how biostatistics courses should be taught is under way. therefore, book presents the perspective of both teaching staff and students, which is a highly recommended approach as the two parts are frequently different in many regards.

In this book, teaching of some aspects frequently discussed during the courses of biostatistics, needed for understanding research results, is assessed e.g., on the topics of null hypothesis, p-values and confidence intervals. The authors highlight that such topics are frequently perceived by students as being important to be known, but also rather hard to understand. Therefore, these courses should take into account the students' level of understanding. Simplifying the information presented, especially in beginner courses, may be recommended in order to promote conceptual understanding of biostatistics and provide a foundation on which students can develop by individual learning.

As the authors highlight, one important challenge that comes with teaching statistics is related to delivering it to people who frequently do not have advanced training in mathematics, by teaching staff that rather often do have training in this regard. A misconception that is frequently encountered among students is that understanding biostatistics cannot be done without advanced medical training, and it should be resolved after the statistical course taught. Important suggestions on how teaching staff can overcome this obstacle are given in this book. Opinion on the level of mathematical training that should be used is also given, and the importance of focusing on statistical thinking more than on formula and calculation is highlighted.

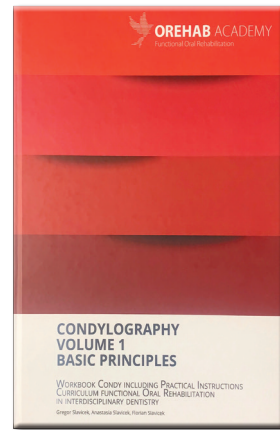
In conclusion, *Teaching Biostatistics in Medicine and Allied Health Sciences* provides a comprehensive perspective on teaching biostatistics to medical and dental students, and provides knowledge useful for the teaching staff in order to obtain adequate learning outcomes.

 [https://doi.org/10.25241/stomaedu.2024.11\(1-2\).bookreview.4](https://doi.org/10.25241/stomaedu.2024.11(1-2).bookreview.4)

The Books Review is drafted in the reviewer's sole wording and illustrates his opinions

Basic Principles of Condylography - Volume 1

Workbook Condyl including Practical Instructions
 Curriculum Functional Oral Rehabilitation in Interdisciplinary Dentistry
 Authors: Gregor Slavicek, Anastasia Slavicek, Florian Slavicek
 Publisher: Orehab Minds GmbH, Germany
 Language: English
 ISBN: 978-3-9825923-1-2
 Edition: 1/e
 Publish Year: 2023
 Pages: 388, Illustrated
 Price: €550



Marian V. Constantinescu
 DDS, MSc, PhD
 Holistic Dental & Medical Institute
 of Bucharest - ROPOSTURO
 Bucharest, Romania
 e-mail: roposturo@gmail.com

The temporomandibular joint (TMJ) and mandibular movements are fundamental for essential oral functions such as biting, chewing, swallowing, and speaking—directly influencing quality of life. According to the American Academy of Orofacial Pain, approximately 75% of the U.S. population experiences temporomandibular disorders (TMDs) at some point, with 5–10% requiring clinical intervention. These conditions generate an annual financial burden exceeding \$2 billion for the U.S. healthcare system.

In dentistry, precise measurement of TMJ movement is critical for evaluating mandibular function, diagnosing dysfunctions, guiding occlusal therapy (e.g., splint design), assessing implant and prosthesis performance, and monitoring outcomes after TMJ surgery. Among the techniques available, condylography stands out as a non-invasive method that records and analyzes TMJ function, producing digital data and tracings used for articulator programming and treatment planning.

Basic Principles of Condylography – Volume 1, authored by Prof. Gregor Slavicek and colleagues, offers the first systematic manual and workbook dedicated to condylography. The content is structured into five chapters, providing both foundational knowledge and clinical application. The book is based on the occlusal and functional concepts of Prof. Rudolf Slavicek and emphasizes the transfer of condylographic data to the functional determinants of occlusion.

- **Chapter 1: The Fundamentals of Condylography** highlights how TMJ parameters influence oral rehabilitation, including mandibular movements, hinge axis orientation, and clinical functional analysis.
- **Chapter 2: Functional Anatomy and Biomechanics of the TMJ** explores joint classifications, the anatomy of the TMJ, masticatory muscles, craniomandibular dysfunction, and the diagnostic value of condylography.
- **Chapter 3: Recording of Hinge-Axis Movements** explains the principles and standard protocols for accurate data capture, covering system geometry and recording standardization.
- **Chapter 4: Fundamentals of Condylographic Analysis** presents systematic methods for interpreting tracings, focusing on patterns, joint sounds, and relevant clinical signals.
- **Chapter 5: Condylographic Terminology** compiles key concepts and descriptors such as movement quantity, quality, excursion patterns, asymmetry, and specific findings.

This volume serves as an essential reference for clinicians and dental students alike, promoting precise communication and interdisciplinary collaboration in the diagnosis and management of TMJ-related conditions.

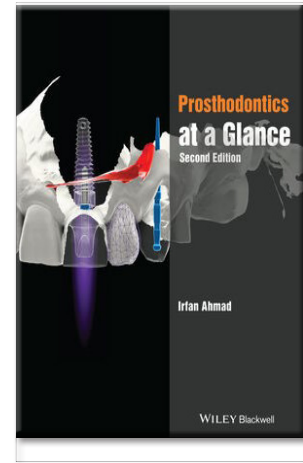
 [https://doi.org/10.25241/stomaeduj.2024.11\(1-2\).bookreview.5](https://doi.org/10.25241/stomaeduj.2024.11(1-2).bookreview.5)

The Books Review is drafted in the reviewer's sole wording and illustrates his opinions

Marian V. Constantinescu
DDS, MSc, PhD
Holistic Dental & Medical Institute
of Bucharest - ROPOSTURO
Bucharest, Romania
e-mail: roposturo@gmail.com

Prosthodontics at a Glance

Author: Irfan Ahmad
Publisher: Wiley-Blackwell, UK
Language: English
ISBN: 978-1-119-74972-1
Edition: 2/e
Publish Year: 2022
Pages: 240, Illustrated
Price: €64.95



Dr. Irfan Ahmad graduated from the University of Liverpool in 1984 with final honors in surgery. He brings over 30 years of experience in private clinical practice, with a strong focus on implantology, advanced esthetics, prosthodontics, and restorative dentistry. His academic contributions include more than 200 publications across various dental specialties, authorship of seven dental textbooks, and contributions to several works by internationally renowned clinicians.

He is a member of several prestigious professional academies and a founding member of the International Academy of Adhesive Dentistry (IAAD). He also serves as an honorary professor at the Ukrainian Medical Dental Academy, a reviewer for the British Dental Journal, and is part of the editorial and review board of the Journal of Cosmetic Dentistry.

Prosthodontics at a Glance is an essential guide for dental students and practitioners interested in oral rehabilitation. The second edition features 18 concise chapters covering all key areas of prosthetic dentistry - from diagnosis and treatment planning to periodontal and endodontic considerations, posts and cores, tooth preparation, dental implants, occlusion, restorations, esthetics, and more.

This updated edition incorporates the latest scientific developments and techniques in prosthodontics. It introduces new chapters on digital dentistry, bioactive materials, artificial intelligence, tissue engineering, stem cells, ethical aspects of elective procedures, dental lasers, and CAD/CAM technologies used in both clinical and laboratory settings.

The book is designed for ease of use, with each chapter being short and focused, accompanied by clear diagrams and concise explanations. It now includes expanded content on 3D printing, intraoral scanning, digital workflows, diagnostic tools, smile design, shade selection, and facial esthetic enhancements using dermal fillers.

Richly illustrated with color diagrams and clinical photographs, *Prosthodontics at a Glance*, Second Edition is an invaluable resource for students preparing for exams and for dental professionals seeking a practical reference. It serves as an excellent introductory and revision text throughout dental education and into clinical practice.

 [https://doi.org/10.25241/stomaeduj.2024.11\(1-2\).bookreview.6](https://doi.org/10.25241/stomaeduj.2024.11(1-2).bookreview.6)

The Books Review is drafted in the reviewer's sole wording and illustrates his opinions



DAC Universal S

Hazards turned harmless.

You think you will never win the fight against germs but Dentsply Sirona turns hygiene risks into manageable maintenance. With DAC Universal S you'll benefit from an automated and quick way of cleaning, lubricating and sterilizing dental instruments. The process takes approx. 21 minutes making it possible to comply with hygiene requirements by simply pressing a button. Your patients and your team can fully rely on our comprehensive protection against hazards.

Find out more at dentsplysirona.com/safehygiene



THE DENTAL
SOLUTIONS
COMPANY™

Dentsply Sirona CEE Central
Office & Showroom
Str. Vulturilor 98A, 030857, București
Tel.: 0774 074 094
office.romania@dentsplysirona.com
www.dentsplysirona.ro
<http://facebook.com/dentsplysirona.romania>

 **Dentsply
Sirona**

The **Stomatology Edu Journal** (*Stoma Edu J*) is one of the first **Green Open Access** journals in the field of dental medicine, publishing well-established authors, but equally committed to encouraging **early career researchers and professionals** alike to publish their work after a non-partisan, objective, double-blind rigorous peer-reviewed process. Our aim is to publish in the shortest possible time frame and ensure the rapid dissemination of your work via our journal page, but also through our indexing partners (**Dimensions, EBSCO, KUDOS, Google Scholar, Scilit**) which reach the vast mass of dental researchers, professionals and practitioners across the world. This journal fully adheres and complies to the policies and principles of the Committee on Publication Ethics (COPE).

1. Submission Instructions

The **Stomatology Edu Journal** (*Stoma Edu J*) publishes articles written only in English. All articles will be accompanied by the signed copyright form which can be returned by e-mail, fax (as scanned documents). All the responsibility for the originality of the material sent belongs to the author(s) alone. Each article will be evaluated by the peer-review committee composed of two independent peer-reviewers, in a blinded fashion, according to the peer-review protocol. All manuscripts must be original and exclusive. The Stomatology Edu Journal Editor will consider only articles that are original, have not been published elsewhere and have been submitted exclusively to the Stomatology Edu Journal. The manuscripts should be submitted online at www.ManuscriptManager.net/stom.

2. Ethics in publishing

The **Stomatology Edu Journal** (*Stoma Edu J*) and its editorial board fully adhere and comply to the policies and principles of Committee on Publication Ethics (COPE) (<https://publicationethics.org/files/2008CodeofConduct.pdf>). Your manuscript should not contain any information that has already been published. If you include already published figures or images, please obtain the necessary permission from the copyright holder to publish under the CC-BY license. Plagiarism, data fabrication and image manipulation are not tolerated. Plagiarism is not acceptable in the Stomatology Edu Journal (*Stoma Edu J*) submissions. Plagiarism includes copying text, ideas, images, or data from another source, even from your own publications, without giving any credit to the original source. Reuse of text that is copied from another source must be between quotes and the original source must be cited. If a study's design or the manuscript's structure or language has been inspired by previous works, these works must be explicitly cited.

If plagiarism is detected during the peer review process, the manuscript may be rejected. If plagiarism is detected after publication, we may publish a correction or retract the paper. Image files must not be manipulated or adjusted in any way that could lead to misinterpretation of the information provided by the original image. To verify the originality of content submitted to our journals, we use iThenticate (www.ithenticate.com) to check submissions against previous publications. All submitted manuscripts will be checked for any possible duplication or plagiarism with iThenticate (www.ithenticate.com). Nevertheless, corresponding authors are responsible for any fraud, intentional or unintentional malpractice.

3. Articles sent for publishing

The **Stomatology Edu Journal** (*Stoma Edu J*) publishes: original articles; reviews; case reports; technical procedures; consensus declaration coming from an association or from a group of specialists; letters to the editor. All articles must be up to 3,000 and 5,000 words for meta-analysis (the word count is for the manuscript text only). Letters to the editor must not exceed 400 words of text and have no more than 3 authors. Letters to the editor can be related to an article already published in the journal or it can represent original scientific contributions or events news/presentations etc. of interest for the reader.

4. Permissions and Ethics

For citations, tables, figures etc. which are not original, these must be accompanied by the written permission for their use and the full reference must be provided. Photographs of identifiable persons must be sent alongside the written permission of the person(s) and all regions that may allow the identification of the subject must be covered. The author must

have obtained, for all studies including human subjects, the permission of the subjects to be part of the study whilst keeping their anonymity. By sending the article, the author declares that he obtained this permission from all his subjects. All studies must respect the [Helsinki Declaration \(2013\)](#). For human and animal studies, the authors must have obtained the approval of the ethics committee from the University/Institute/etc. where the study was done. Consent for publication is required for studies involving human subjects - ALL case reports, letters that describe cases and some original articles. Cohort studies are exempt; instead evidence of IRB approval (name of IRB, date of approval and approval code/reference number) must be provided.

5. Manuscript preparation

The article must be written in conformity with the general recommendations of the International Committee of Medical Journal Editors.

<http://www.icmje.org/icmje-recommendations.pdf>

The **Stomatology Edu Journal** (*Stoma Edu J*) uses double-blind review, which means that both the reviewer and author name(s) are not allowed to be revealed to one another for a manuscript under review. The identities of the authors are concealed from the reviewers, and vice versa. To facilitate this, please include the following separately:

Title page (with author details): This should include the title, authors' names and affiliations, and a complete address for the corresponding author including an e-mail address, Author Contributions, Acknowledgements and Curriculum Vitae.

Blinded manuscript (no author details): The main body of the paper (including the references, figures, and tables) should not include any identifying information, such as the authors' names or affiliations. The articles must be sent either as a Microsoft Word 2000 document (*.doc) or as a Microsoft Word 2003/16/19 document (*.docx). The article will be written using Times New Roman font, size 12 for the characters with one and half (1 1/2) spaces between paragraphs. The manuscript must be sent in its final form. The pages will be numbered with the manuscript containing the following sections: title, authors, abstract, keywords, the text of article, contributions, acknowledgments, references, the figures and the tables legend.

A. The title of the manuscript will have a maximum of 100 characters without spaces, written in title case, centered capitals, and in 12 point bold Times New Roman font at the top of page. Abbreviations should be avoided within the title.

B. The author(s) will send their full name(s) and surname(s), the highest academic position, their full titles and their affiliations. All names are listed together and separated by commas. Provide exact and correct author names as these will be indexed in official archives. Affiliations should be keyed to the author's name with superscript numbers and be listed as follows: Laboratory, Department, Institute, Organization, City, State abbreviation (USA, Canada, Australia), and Country (without detailed address information such as city zip codes or street names).

The correspondent author will send his/her full name and surname, the highest academic position, his/her full title, his/her affiliation, his/her institution address, his/her telephone, fax and e-mail. The authors will send this information in the same format as that in the published articles.

C. The Structured Abstract

The abstract can have a maximum of 250 words. After the abstract, the author(s) must mention a maximum of 5 keywords. Keywords must be selected from **Medline Mesh**. Abbreviations are not accepted in the title or the abstract.

The abstract for Original Scientific Articles should be no more than 250 words using the following structure: Introduction; Methodology; Results; Conclusion.

The abstract for Review Articles should be no more than 250 words with the authors covering all the following information regarding the subject presented under the following subheadings: Background, Objective, Data Sources, Study Selection, Data Extraction, Data Synthesis.

The abstract for Case Reports should be no more than 250 words using the following structure: Aim, Summary and Key learning points: provide up to 5 short statements of the report.

The abstract for Clinical Articles should be no more than 250 words using the following structure: Aim, Methodology, Results and Conclusions.

D. The Article Text

Headings and Sub-headings

Except for special names (e.g. GABAergic), capitalize only the first letter of headings and subheadings. Headings and subheadings need to be defined in Times New Roman, 12, bold. You may insert up to 5 heading levels into your manuscript (not more than for example: 3.2.2.1.2 Heading title).

For original articles:

1. Introduction - a presentation of the most important aspects in the studied domain without doing a review of the literature. The purpose of this part is to present and backup the hypothesis on which the study was based.

2. Material and Methods - this section will include all required information so that the reader can verify the validity of the study including, but not limited to, subjects, measurements, statistics and ethics. The methods used should be discussed (why the methods have been chosen, which the limitations/advantages). A paragraph about the statistical analysis is required as well.

3. Results - the results of the study will be presented in a descending order of importance. An interpretation of the results will not be done in this section.

4. Discussion - the authors will present the way the results backup the original hypothesis, as well as the way in which the results are backed up or contradicted by the published literature. A paragraph must be dedicated to presenting the limitations of the study.

5. Conclusion - The conclusion presents the implications of this latest work. In addition, authors may consider discussing future plans or recommendations for future research etc. For all other types of articles, we recommend the use of a clear structure based on sections and sub-sections.

E. Author Contributions

The Author Contributions section is mandatory for all articles, including articles by sole authors. The Author Contributions statement must describe the contributions of individual authors and, in doing so, all authors agree to be accountable for the content of the work. Please list only 2 initials for each author, without periods, but separated by commas (e.g. AC, AS). In the case of two authors with the same initials, please use their middle initial to differentiate between them (e.g. AEC, ASC). Each author must be able to prove his active participation in the study by contributing to the concept, protocol, data gathering or analysis, their interpretation or by critically revising the manuscript.

F. Acknowledgments

Acknowledge persons who have made substantive contributions to the study. Specify grant or other financial support, citing the name of the supporting organization and grant number.

G. References

- The references will be written using the Vancouver style (<https://www.imperial.ac.uk/media/imperial-college/administration-and-support-services/library/public/vancouver.pdf>). All references that are identified with DOI (Digital Object Identifier) must be mentioned.

- For each reference use active links to the full text (DOI link), free PMC article, PubMed, Google Scholar, Scopus pages, and WoS were they exist:

- For all references identified with DOI the full-text link must be the CrossRef hyperlink

Examples

Articles with DOI

Singbartl G. Pre-operative autologous blood donation: clinical parameters and efficacy. *Blood Transfus.* 2011;9(1):10-18.

[CrossRef] [Free PMC Article] [PubMed] Google Scholar Scopus WoS

Articles without DOI

Mehta H, Shah S. Management of Buccal Gap and Resorption of Buccal Plate in Immediate Implant Placement: A Clinical Case Report. *J Int Oral Health.* 2015;7(Suppl 1):72-75.

[Full text links] [PubMed] Google Scholar

- The references will be numbered, in the order they appear in the text, in square brackets, as such: [3], [5,7-9].

- All sources found in the text must be present in the bibliography and all the papers mentioned in the bibliography must appear in the text.

- For references with more than 5 authors, list the first 3 authors followed by "et al."

- Full-page ranges should be given in expanded form (e.g., 426-429, not 426-9).

- If non-English-language titles are translated into English, bracketed indication of the original language should follow the title.

- All journals will be abbreviated and italicized names of journals according to the style in PubMed; refer to the National Library of Medicine (NLM) Journals Database (<http://www.ncbi.nlm.nih.gov/nlmcatalog/journals>) if needed. Journal names will be abbreviated according to the [List of Title Word Abbreviations](#)

- Information obtained from sources which are not published yet, but accepted for publishing will include at the end of the reference the mention "in print" between round parentheses.

- If the cited results have not been published yet the mention will be "personal communication" written in the text of article between round parentheses.

- Only references read by the authors of the article will be cited.

- An original article will have at most 50 references, a review will have at most 100 references, a letter to the editor 5 references, whilst all other types of articles will have the minimum number of references required.

6. Curriculum Vitae - Ultra Short version

Please provide a brief presentation of the first author and his contribution in the field, of maximum 130 words (with a 3.5x4.5 cm color photo).

7. Figures, Images, Tables

All illustrations must be numbered and cited in the text in order of appearance.

Figures and Images will be drawn professionally and sent in separate file(s) as jpeg, tiff or png files. Illustrations should preferably fill single column width (54 mm) after reduction, although in some cases 113 mm (double column) and 171 mm (full page) widths will be accepted. See the [Image quality specifications chart](#) for details. Image files also must be cropped as close to the actual image as possible.

In the text, each figure must be represented by a number, a title and a description. The authors will indicate where should the figure be placed in the text. All images or figures must come from the author's personal collection or the author must have rights to publish the image or figure. All images must be at or above [intended display size](#), with the following image resolutions: Line Art 800 dpi, Combination (Line Art + Halftone) 600 dpi, Halftone 300 dpi. We do not accept images or figures taken from the Internet.

The Tooth Identification System used in manuscripts must conform to the FDI International System. Units used in manuscripts must conform to the Système International d'Unités (SI).

Tables will be included in the text and each table will have a number and a short description if required.

8. Ownership Rights

By sending the article for publication the author(s):

- take full responsibility for the scientific content of the text and for the accuracy of the send data;

- become (co)author(s) of the manuscript (all further plagiarism accusation are addressed solely to the author(s) who signed the manuscript);

- declare they are the rightful owners of the images, figures and/or information sent for publishing and that they have the permission to publish all the materials for which they do not own the intellectual property rights;

- declare that the message/content of the manuscript is not influenced in anyway by commercial interests/previous engagements/ any sort of relations with other people or companies;

- transfer all rights for the manuscript to the Editorial Council for the *Stomatology Edu Journal* (*Stoma Edu J*).

9. Other

Previously mentioned limitations can be ignored in special cases with the agreement of the chief-editor and/or the publisher. All published materials cannot be returned.

Not taking into consideration the recommendations mentioned before can lead to delay in publishing the materials or may lead to not publishing the article.

The *Stomatology Edu Journal* (*Stoma Edu J*) also helps authors measure the impact of their research through specialist partnerships with Kudos and Altmetric.

SUBSCRIPTION



I want to subscribe to



- 1 year Subscription (4 issues of the journal) - 280 RON (72 Euro for foreign subscribers)
- 2 years Subscription (8 issues of the journal) - 540 RON (136 Euro for foreign subscribers)
- Single Issue - 80 RON (20 Euro for foreign subscribers)

Please send the filled subscription at the following e-mail: roposturo@gmail.com.

PLEASE COMPLETE ALL THE SUBSCRIPTION FIELDS IN CAPITAL LETTERS!

Name..... Surname

Mrs. Mr. Ms.

Home Address

City..... Sector..... District.....

Post office code..... Mobile phone.....

E-mail:..... Web.....

Student Resident Specialist doctor Primary doctor

Competence.....

Institution.....

Activity domain: Private Public

Department..... Position.....

Specialty..... Institution address.....

City..... Sector..... District.....

Post office code..... Phone.....

E-mail:..... Web.....

CUI (Institution Unique Registration Code)

VAT Payer: Yes No

Invoice - please fill all the necessary details for invoice:

Name..... CNP (Personal Identification Number).....

Or

Institution CUI (Institution Unique Registration Code).....

Date.....

Signature.....

After filling the subscription, please send it together with the proof of payment to:

ROPOSTURO

Romanian Association of Oral Rehabilitation and Posturotherapy

10, Ionel Perlea St., 1st District, RO-010209 Bucharest, Romania

Tel: +4021 314 1062, Fax: +4021 312 1357

e-mail: roposturo@gmail.com

www.roposturo.ro

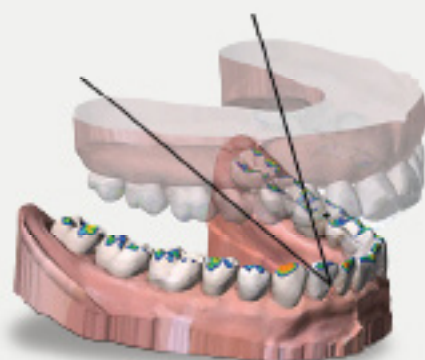
The New Dimension in Jaw Movement Analysis

zebris

JMA *Optic*

Welcome to the World of Functional Digital Dentistry

- Planning and preparation of dental restorations and dental splints under functional aspects



Digital function and occlusion analysis
Programming of articulators



The digital workflow with exocad
Export of all relevant position and movement data



fdi Istanbul 2024
World Dental Congress

See you in Istanbul

12-15 September 2024

Istanbul, Türkiye

B
In
Pe



See you in Istanbul !

12-15 September 2024

Istanbul, Türkiye

fdi Istanbul 2024
World Dental Congress