Nume Prenume: Borș Andrea Izabella

Gradul didactic: Șef lucrări

L I S T A

lucrărilor ştiinţifice în domeniul disciplinelor din postul didactic

A. Teza de doctorat:

Titlu: ***Cercetări privind eroziunea dentară, aspecte etiologice, epidemiologice și profilactice;***

Anul susținerii: 2013;

Conducător științific: Prof. Univ. Dr. Székely Melinda;

Diploma de Doctor nr. 218/26.11.2013, Universitatea de Medicină și Farmacie Tîrgu Mureș; Ordinul Ministrului Educației Naționale nr. 3930 MD/20.06.2013.

B. Cărţi si capitole în cărţi publicate

1. Beresescu FG., Mucenic SG., **Bors AI.** *Edentulism and Systemic Disease: A Comprehensive Review of Oral-Systemic Health Interactions.* In: Ardelean L.C., Rusu L.-C. (eds.), **Dentures Present State-of-the-Art and Future Perspectives**, IntechOpen, 2025. DOI: 10.5772/intechopen.1010996.
2. **Bors A,** Székely M, Molnar-Varlam C, Cămărășan A. ***Technology of Single Unit Dental Prostheses,*** University Press, Tîrgu-Mureș, 2022, 162 pag., ISBN 978-973-169-755-0.
3. Székely M, **Borș A**, Molnar-Varlam C. ***Dental Materials – Course for Students.*** Litografia UMFST G.E. Palade din Târgu Mureş, 2019;
4. Székely M, **Borș A**. ***Morphology of Teeth and Dental Arches – Course for Students.*** Litografia UMFST din Târgu Mureş, 2019;
5. Molnar Varlam C, Bica C, **Borş A**. ***Materiale dentare folosite în stomatologia pediatrică***. Editura University Press, Tîrgu Mureş, 2016, ISBN 978-973-169-450-4;
6. Molnar-Varlam C, Grozescu V, **Bors A.** ***Proteze dentare fixe: aspecte clinico-tehnice.*** Editura University Press, Tîrgu Mureș, 2016, ISBN 978-973-169-449-8;
7. **Borş A,** Székely M, Molnar-Varlam C. ***Tehnici adezive moderne în medicina dentară***, Editura University Press, Tîrgu-Mureș, 2015, 104 pagini, ISBN 978-973-169-381-1.
8. **Borș A.,** Székely M. ***Eroziunea dentară: diagnostic, etiologie și profilaxie***, Editura University Press, Tîrgu-Mureş, 2014, 168 pagini, ISBN 978-973-169-302-6.

C. Articole ISI

1. **Borş A**., Székely M., Beresescu L., Maier A., Beresescu F. Patient Satisfaction and Perception with Digital Complete Dentures Compared to Conventional Complete Dentures—A Pilot Study. *Dent. J.*, 2025, **13**, 291. doi:10.3390/dj13070291. **Q1, FI 3.1**

2. **Borş A**., Mucenic S., Monea A., Ormenișan A., Beresescu G. From Conventional to Smart Prosthetics: Redefining Complete Denture Therapy Through Technology and Regenerative Science. *Medicina*, 2025, **61**, 1104. doi:10.3390/medicina61061104. **Q1, FI 2.4**

3. **Borş A**. Fourier-Transform Infrared Spectroscopy Analysis of 3D-Printed Dental Resins Reinforced with Yttria-Stabilized Zirconia Nanoparticles. *Dent. J.*, 2025, **13**, 272. doi:10.3390/dj13060272. **Q1, FI 3.1**

4. **Borş A**., Beresescu F.G., Székely M. Longitudinal Assessment of Dental Erosion in a Romanian Cohort of Young Adults: A Ten-Year Follow-Up Pilot Study. *Dent. J.*, 2025, **13**, 302. doi:10.3390/dj13070302. **Q1, FI 3.1**

5. **Borş A**., Székely M., Bardocz-Veres Z., Corneschi I., Ciocoiu R., Antoniac A., Enăchescu C.I. Microstructure and mechanical properties of novel 3D-printed resin reinforced with modified YSZ nanoparticles. *University Series B – Chemistry and Materials Science*, 2024, **86**(4), 97–112. **Q4, FI 0.5**

6. Margaritis V., Alaraudanjoki V., Laitala M.L., Anttonen V., **Borş A***., Székely M., Alifragki P., Jász M., Berze I., Hermann P., Harding M. Multicenter study to develop and validate a risk assessment tool as part of composite scoring system for erosive tooth wear. *Clinical Oral Investigations*, 2021, **25**(5), 2745–2756. doi:10.1007/s00784-020-03589-7. **Q1, FI 3.573**

7. Dorner K., Kerekes-Máthé B., Kis M., **Borş A**., Molnar-Varlam C., Nimigean R., Nimigean V., Székely M. Quality Control of Emergency Dental Care in Mureș County. *Revista de Chimie*, 2019, 70(12), 4169–4174. **FI 1.755. Q4**

8. Dorner K., Kerekes-Máthé B., **Borş A**., Nimigean R., Székely M. Patients Attendance for Emergency Dental Services in Mureș County. *Revista de Chimie*, 2018, **69**(8), 2115–2120. **Q4, FI 0.41**

9. Birta O., Bica C., Farkas H., Kerekes-Máthé B., **Borș A**., Székely M. The Impact of Phosphoric Acid on Calcium Content of Dental Enamel – in vitro Examination. *Revista de Chimie*, 2017, **68**(9), 2066–2069. **Q4, FI 0.956**

10. **Borș A**., Cotruț C., Antoniac A., Székely M. Surface analysis of contemporary aesthetic dental filling materials after storage in erosive conditions. *Materiale Plastice*, 2016, 53(4). Q4, FI 0.778

D. Articole in reviste indexate BDI

1. Borș A., Kerekes-Máthé B., Beresescu G. Erosive Impact of Acidic "Healthy" Beverages on Dental Enamel: A Systematic Review (2013–2025). *Journal of Interdisciplinary Medicine*, 2025. doi:10.1515/jim-2025-0001.

2. Borș A., Bardocz-Veres Z., Kerekes-Máthé B., Székely M. Comparative study on the hardness of novel 3D-printed resin reinforced with different concentrations of modified yttria-stabilized zirconia nanoparticles. *Journal of Interdisciplinary Medicine*, 2024, **9**(1), 1–7. doi:10.1515/jim-2024-0017.

3. Borș A., Székely M., Molnar-Varlam C., Antoniac V. Bioactivity of retrograde dental root filling materials. *Key Engineering Materials*, 2016, **695**, 236–242. doi:10.4028/www.scientific.net/KEM.695.236.

4. Székely M., **Borș A.**, Kerekes-Máthé B., Balázs C.M., Ignat D., Matekovits G. Sarcinile speciale ale asistentei de medicină dentară în reabilitarea orală a bolnavilor cu astm bronșic. Partea a XXIII-a. *Dental Target*, 2016, **2**(11), 45–47.

5. Borș A., Székely M., Ponta O., Antoniac I. Erosion effects on morphology and chemical composition of direct dental restoratives. *Key Engineering Materials*, 2015, **638**, 286–295. doi:10.4028/www.scientific.net/KEM.638.286.

6. Borș A., Székely M. Effect of soft drinks on dental enamel – in vitro study. *Dental Target*, 2015, **3**(36), 42–44.

7. Székely M., **Borș A.**, Csik-Maticu G., Matekovits G. Temporo-mandibular joint: morpho-physiology and pathology. Practical guide for dental nurses. *Dental Target*, 2015, **3**(36), 45–47.

8. Székely M., **Borș A.**, Kerekes-Máthé B., Csik-Maticu G., Ignat D., Matekovits G. Sarcinile speciale ale asistentei de medicină dentară în reabilitarea orală a bolnavilor cu astm bronșic. *Dental Target*, 2015, **11**(2), 44–46.

9. Székely M., **Borș A.**, Kerekes-Máthé B., Csik-Maticu G., Matekovits G. Pain in the oral-facial region: guide for dental nurses. *Dental Target*, 2015, **4**(37), 44–46.

10. Borș A., Molnar-Varlam C., Birta O., Székely M. Erosive wear resistance of direct restorative materials – an in vitro study. *International Journal of Medical Dentistry*, 2014, **4**(4), 278–285.

11. Borș A., Molnar-Varlam C., Székely M. The behavior of composites, glass-ionomers and compomers in erosive conditions – in vitro study. *Acta Medica Marisiensis*, 2014, **60**(5), 200–203. doi:10.2478/amma-2014-0042.

12. Kerekes-Máthé B., Fazakas Z., Székely M., **Borș A.**, Cămărășan A., Mucenic S. Association between tooth agenesis and polymorphisms of FGFR1, IRF6, MSX1 and PAX9 genes in patients from Tîrgu-Mureș. *Acta Medica Marisiensis*, 2012, **58**(1), 20–24.

13. Cămărășan A., Székely M., **Borș A.**, Mucenic S., Kerekes-Máthé B., Cerghizan D. Use of dentifrices and fluoride supplements by preschool children – a pilot study. *Acta Medica Marisiensis*, 2012, **58**, 15–17.

14. Benedek (Bukhari) C., Kerekes-Máthé B., **Borș A.**, Kovács M., Pop M., Fazakas Z., Székely M. Smoking-related habits and attitudes of dental students. *Acta Medica Marisiensis*, 2012, **58**(5), 266–271.

15. Mucenic S., Beresescu G., **Borș A.**, Cămărășan A., Molnar-Varlam C., Kerekes-Máthé B., Székely M. Clinical study regarding the association between some etiological factors and tooth wear. *Acta Medica Marisiensis*, 2011.

16. Borș A., Farkas Z., Molnar-Varlam C., Cămărășan A. Quantifying human enamel erosion caused by freshly squeezed juices. *Acta Medica Marisiensis*, 2011.

17. **Borș A.**, Molnar-Varlam C., Cămărășan A., Mucenic S. Assessment of erosive potential of different beverages marketed in Târgu-Mureș on dental enamel: an in vitro study. *Acta Medica Marisiensis*, 2010, **56**(3), 255–257.

18. Cămărășan A., Fazakas Z., **Borș A.**, Mucenic S. Study regarding the relationship between the infusion time and fluoride content in different teas. *Acta Medica Marisiensis*, 2010.

Abstracte

1. Bors A, Székely M, Molnar-Varlam C. *Epidemiological survey of the prevalence of gingival recession in Tirgu-Mures, Romania*. Community Dental Health 2018; 35 (S51), doi:10.1922, IF: 0.956, 23th EADPH Congress.

2. Székely M., Borș A., Fazakas Z., Molnar-Varlam C. Erosive Tooth Wear Survey in Romania as Part of a Multi-Centre Study. *Community Dental Health*, 2018, **35**(S49). **FI 0.956.** Abstract – 23rd EADPH Congress.

3. Szekely M, Dorner K, Nagy M, **Bors A**. Public Emergency Dental Care Usage of Adults in Tirgu-Mures, Romania. Community Dental Health 2017; 34 (3), S20-21, doi: :10.1922, IF: 0.871, 22th EADPH Congress.

Selecţie cu maximum 20 lucrări în volume de conferinţe

1. **. Bors A**, Székely M, Molnar-Varlam C. *Epidemiological survey of the prevalence of gingival recession in Tirgu-Mures, Romania*. Community Dental Health 2018; 35 (S51), doi:10.1922, IF: 0.956, 23th EADPH Congress.

2. Székely M., Borș A., Fazakas Z., Molnar-Varlam C. Erosive Tooth Wear Survey in Romania as Part of a Multi-Centre Study. *Community Dental Health*, 2018, **35**(S49). **FI 0.956.** Abstract – 23rd EADPH Congress.

3. Szekely M, Dorner K, Nagy M, **Bors A**. Public Emergency Dental Care Usage of Adults in Tirgu-Mures, Romania. Community Dental Health 2017; 34 (3), S20-21, doi: :10.1922, IF: 0.871, 22th EADPH Congress.

4. **Borş A**, Székely M, Molnar-Varlam C. *Surface degradation of monolitic zirconia after exposure to acidic environment.* Acta Medica Marisiensis Book of abstracts. 2018;1:16, Days of University of Medicine, Pharmacy, Science and Technology of Targu Mures, ISSN 2602-1609

5. Szekely M, Franko E, Molnar-Varlam C, **Bors A**, Kerekes-Mathe B. *In vitro evaluation of mircoleakage in dental restorationsof nano-hybrid composite with flowable composite liner*. Bioremed 2017. Book of abstracts. 2017;1:167, ISSN 2601-0372.

6. Székely M, Bereșescu G, **Borş A**, Molnar-Varlam C: Influence of root canal morphology on the endodontic treatments, Scientific Sesion of University Educational Staff, 13 December 2017, Acta Medica Marisiensis Book of Abstracts, 2017, vol.63(suppl.4): 20; ISSN-L 2068-3324, ISBN 2068-3324.

7. Salahub V, **Bors A**, Susan AM, Molnar-Varlam C. *The dimensional stability of elastomers: when, how and especiallly why?*ActaMedicaMarisiensis 2016;62(suppl 4):83, ISSN 2068-3324.
8. **Bors A**, Szekely M, Molnar-Varlam C, Antoniac I. *Bioactivity of retrograde dental root filling materilas.* Bioremed 2015. 17-20 September 2015, Felix-Oradea, Romania. International Seminar on Biomaterials&Regenerative:120, ISSN 2457-7758.

9. **Bors A**, Szekely M, Molnar-Varlam C, *Restorative therapy of eroded anterior teeth: efficacy after one year.* Bioremed 2015. 17-20 September 2015, Felix-Oradea, Romania. International Seminar on Biomaterials&Regenerative:121, ISSN 2457-7758

10. **Borş A**, Székely M, Molnar-Varlam C, Ponta O, Antoniac I. *Effect of erosive conditions on aesthetic dental filling materials – in vitro study.* Clujul Medical 2015;88(suppl 1):26, ISSN: 1222-2119.

11. TiplicaS , Molnar-Varlam C, **Borş A.** *Polymerization shrinkage of light initiated tooth colored dental filling materials.* ActaMedicaMarisiensis 2015;16(suppl 2):79, ISSN 2068-3324.

12. Szolon T, **Borş A**, Molnar-Varlam C. *The hydro-alginate impression: why?*ActaMedicaMarisiensis 2015;16(suppl 2):78, ISSN 2068-3324.

13. **Bors A**, Szekely M, Ponta O, Antoniac I. *Direct tooth colored restoratives behavior in erosive conditions*. BiomMedD'2014. 17-20 September 2014, Constanta, Romania. Book of Abstracts:121, ISSN 2069-0193.

14. **Borş A**, Molnar-Varlam C, Birta O, Székely M. *In vitro study on erosive wear resistance of dental materials*. BiomMedD'2014. 17-20 September 2014, Constanta, Romania. Book of Abstracts:197, ISSN 2069-0193.

15. **Borş A**, Molnar-Varlam C, Székely M. *Prevalence of Dental Erosion among Young Swimmers: a pilot study.* ActaMedicaMarisiensis 2014;60 (suppl 4):14, ISSN: 2247-6113.

16. Molnar-Varlam C, Kerekes-Mathe B, Lazar L, Hadad M, Chifor A, Iancu D-G, **Bors A.** *Students' Perception on the E-learning Platform-Evidence from the Faculty of Dentistry*, UMF Tirgu Mures. ActaMedicaMarisiensis 2014;60 (suppl 4):14, ISSN: 2247-6113.

17. Szekely M, Fazakas Z, Camarasan A, **Bors A**. *SalivaryFluorideLevelsafterthe Use of Different Toothpastes.*ActaMedicaMarisiensis 2014;60 (suppl 4):14, ISSN: 2247-6113.

E. Brevete obţinute în întreaga activitate

Borș Andrea Izabella. *Metodă de determinare a eroziunii dentare*. *RO BOPI 12/2021 din 30.12.2021. 135354 A051 A61B5/00 G01B21/30*

F. Granturi / proiecte câştigate prin competiţie

1. Competiție internă câștigată pentru proiectul *Rășina compozită bioactivă modificată cu pulobere de zirconiu, o nouă abordare în medicina dentară restaurativă* organizat de UMFST GE Palade Tg Mureș contract nr. 10127/18/17.12.2020, director de proiect

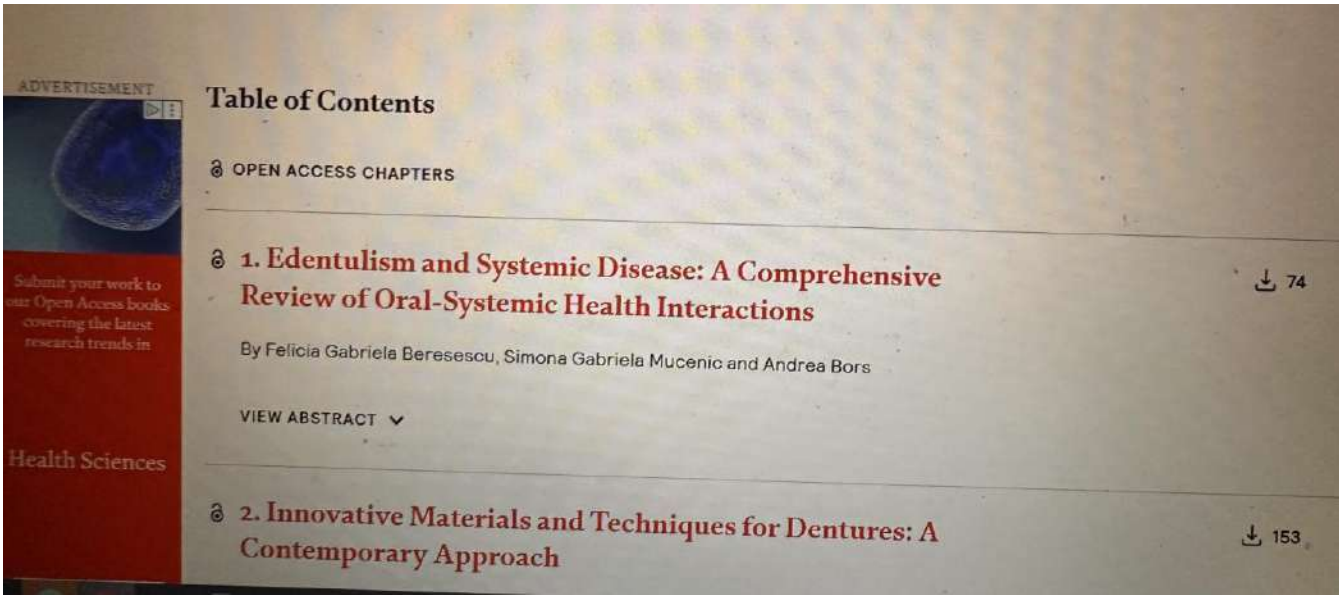
2. Competiție internă câștigată pentru proiectul cu titlul *Cercetări privind eroziunea dentară: aspecteetiologice și curativo-profilactice*, organizat de Universitatea de Medicină și Farmacie Târgu Mureș, contract nr.5/30.01.2013, director de proiect

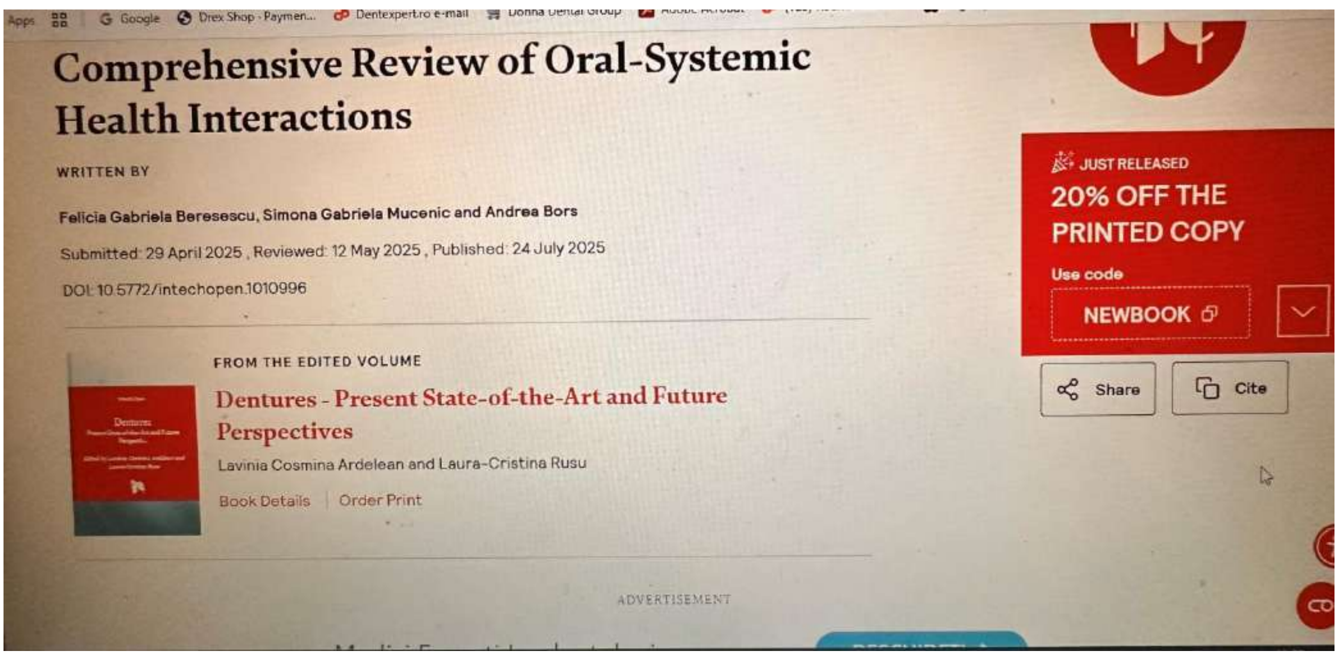
Data: **Semnătura**

15.01.2026. .

E. Cărţi si capitole în cărţi publicate

1. Beresescu FG., Mucenic SG., **Bors AI.** *Edentulism and Systemic Disease: A Comprehensive Review of Oral-Systemic Health Interactions.* In: Ardelean L.C., Rusu L.-C. (eds.), **Dentures Present State-of-the-Art and Future Perspectives**, IntechOpen, 2025. DOI: 10.5772/intechopen.1010996.





Chapter

Edentulism and Systemic Disease: A Comprehensive Review of Oral-Systemic Health Interactions

Felicia Gabriela Beresescu, Simona Gabriela Mucenic and Andrea Bors

Abstract

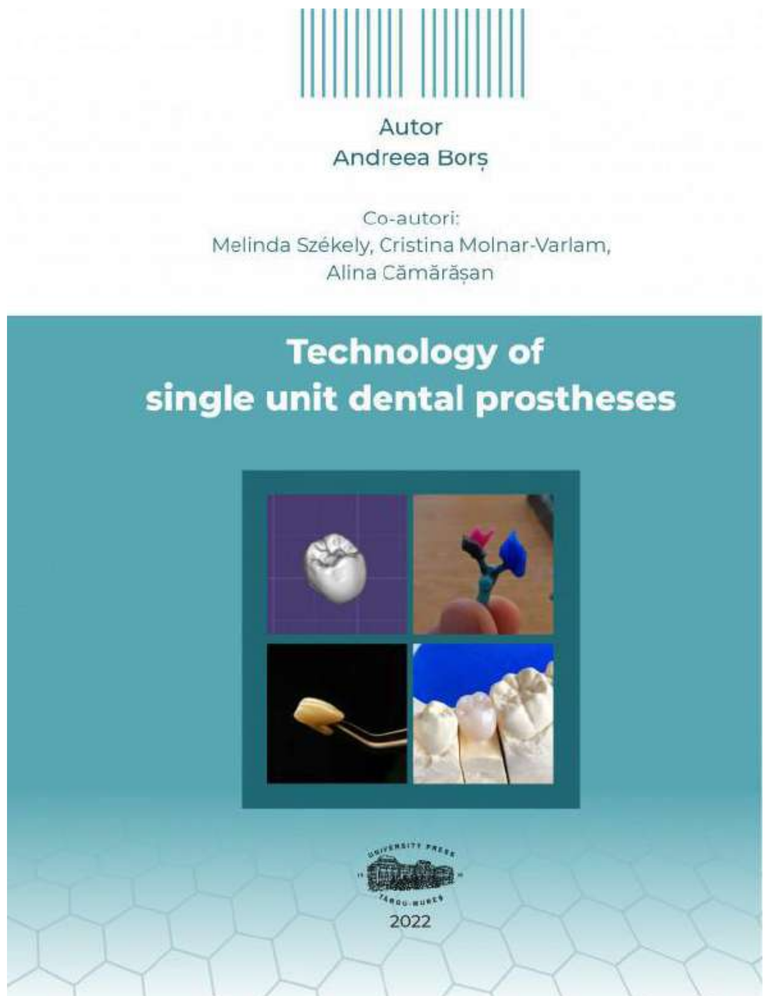
Edentulism, or complete tooth loss, is a significant public health problem with consequences that extend far beyond the oral cavity. Functionally, edentulism impairs chewing, speech, and oral proprioception, leading to progressive alveolar bone resorption and altered temporomandibular joint function. Nutritionally, edentulous individuals often adopt a softer, carbohydrate-rich diet, resulting in deficiencies of essential nutrients and contributing to systemic health deterioration. Poor mastication also stresses the gastrointestinal system, potentially leading to digestive disorders. Psychologically, toothlessness is associated with decreased self-esteem, depression, social withdrawal, and reduced quality of life. Changes in facial esthetics further exacerbate emotional distress. Systemically, edentulism is associated with increased risk of cardiovascular disease, diabetes, cognitive impairment, and mortality, likely through pathways involving chronic inflammation, malnutrition, and reduced cerebral stimulation. Effective management of edentulism requires more than prosthetic rehabilitation. While full dentures and implant-supported overdentures restore oral function, comprehensive care must also address nutrition, psychological support, and monitoring for systemic disease. With a rapidly aging global population, recognizing edentulism as a condition with broad systemic implications is critical to improving overall patient outcomes and public health strategies.

Keywords: teeth loss, edentulism, anatomic changes, physiological changes, systemic disease associated with edentulism

1. Introduction

Edentulism, or the complete loss of natural teeth, remains a major public health problem worldwide, particularly among the aging population. Despite advances in preventive dentistry, oral hygiene education and restorative technologies, edentulism continues to affect millions of people worldwide, particularly in socioeconomically disadvantaged and medically compromised groups. According to the World Health Organization, edentulism is one of the most prevalent chronic diseases with a significant impact on both oral and systemic health outcomes [1].

2. **Bors A**, Szekely M, Molnar-Varlam C, Camarasan A. ***Technology of single unit dental prosthesis.*** Editura University Press. Tîrgu Mureș. 2022, ISBN 978-973-169-755-0;



Technology of single unit dental prostheses (print color)

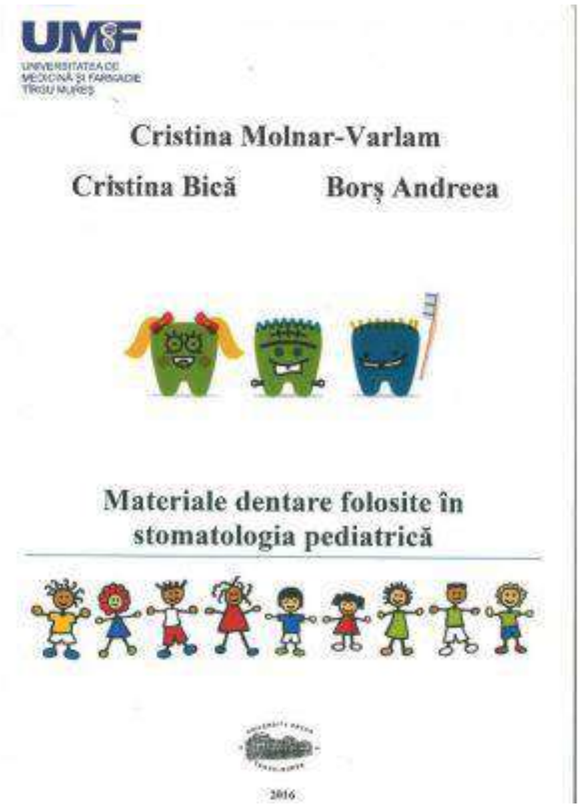
Autori: Andreea Borș Co-autori: Melinda Székely, Cristina Molnar Varlam, Alina Cămărășan Editura University Press, 2022 ISBN: 978-973-169-755-0

Descrierea CIP a Bibliotecii Naţionale a României
Technology of single unit dental prostheses / Andreea Borş, Melinda Székely, Cristina Molnar Varlam, Alina Cămărăşan. - Târgu Mureş : University Press, 2022
Conţine bibliografie
Index
ISBN 978-973-169-755-0
I. Borş, Andreea
II. Székely, Melinda
III. Molnar-Varlam, Cristina Stanca
IV. Cămărăşan, Alina
616.314

3. 3. Székely M, **Borș A**, Molnar-Varlam C. ***Dental Materials – Course for Students.*** Litografia UMFST G.E. Palade din Târgu Mureș, 2019;

4. Székely M, **Borș A**. ***Morphology of Teeth and Dental Arches – Course for Students.*** Litografia UMFST din Târgu Mureș, 2019;

5. Molnar Varlam C, Bica C, **Borş A**. ***Materiale dentare folosite în stomatologia pediatrică***. Editura University Press, Tîrgu Mureş, 2016, ISBN 978-973-169-450-4;



ISBN: 9789731694788
Editura: University Press

6. Molnar-Varlam C, Grozescu V, **Bors A.** ***Proteze dentare fixe: aspecte clinico-tehnice*.** Editura University Press, Tîrgu Mureș, 2016, ISBN 978-973-169-449-8;

ISBN: 9789731694498
Editura: University Press

F. Articole ISI

11. **Borș A.**, Székely M., Beresescu L., Maier A., Beresescu F. Patient Satisfaction and Perception with Digital Complete Dentures Compared to Conventional Complete Dentures—A Pilot Study. *Dent. J.*, 2025, **13**, 291. doi:10.3390/dj13070291. **Q1, FI 3.**

English Products

Web of Science™ Smart Search Advanced Searcl Andreea Bors

Smart Search › Author Profile ›

Patient Satisfaction and Perception with Digital Complete D

My Web of Science

Marked List

View your search history

Profile

My researcher profile EDIT

My records

Publications + ADD

Grants + ADD

Peer reviews + ADD

Editor records + ADD

Editorial board memberships + ADD

Pending records

Profile notifications 2

Saved Searches and Alerts

Free Full Text from Publisher

Full Text Links

Export Add To Marked List

2 of 9

Patient Satisfaction and Perception with Digital Complete Dentures Compared to Conventional Complete Dentures-A Pilot Study

By Bors, A (Bors, Andrea) [1] ; Szekely, M (Szekely, Melinda) [1] ; Beresescu, L (Beresescu, Liana) [1] ; Maier, A (Maier,

Journal information

DENTISTRY JOURNAL

Publisher name: MDPI

Journal Impact Factor ™

JCR Category	Category Quartile
DENTISTRY, ORAL SURGERY & MEDICINE *in ESCI edition*	Q1

Source: Journal Citation Reports Go to Journal Citation Reports

If you have access to Journal Citation Reports ™ through your institution's subscription, you can view the latest Journal Impact Factor ™ and additional metrics to better understand a journal's content and audience.

Journal Citation Indicator ™

1.15
2024

1.05
2023

JCI Category	Category Rank	Category Quartile

The Journal Citation Indicator is a measure of the average Category Normalized Citation Impact (CNCI) of citable items (articles and reviews) published by a journal over a recent three year period. It is used to help you evaluate journals based on other metrics besides the Journal Impact Factor (JIF). Go to Journal Citation Indicator

Interested in reviewing for this journal?

Add this journal to your reviewer interest list. Add Journal

32

dentistry journal

MDPI

Article

Patient Satisfaction and Perception with Digital Complete Dentures Compared to Conventional Complete Dentures—A Pilot Study

Andrea Bors [1,*], Melinda Szekely [1,*], Liana Beresescu [1], Alexandra Maier [2] and Felicia Beresescu [1]

[1] Faculty of Dentistry, George Emil Palade University of Medicine, Pharmacy, Science, and Technology; 38 Gheorghe Marinescu Street, 540142 Targu Mures, Romania

[2] ISmileLab, Bd 1848 Street, 540429 Targu Mures, Romania

* Correspondence: andrea.bors@umfst.ro (A.B.); melinda.szekely@umfst.ro (M.S.); Tel.: +40722649493 (A.B.); +40744878610 (M.S.)

Abstract

Background: Patient satisfaction is a critical outcome in the rehabilitation of edentulous patients. While conventional fabrication methods are widely used, digital workflows are emerging as viable alternatives. However, direct comparative evidence from the patient's perspective remains limited. **Objective:** To compare patient satisfaction between con- ventional complete dentures (C-CD) and digital complete dentures (D-CD) in maxillary edentulous patients, including changes in perceptions over time and final prosthesis pref- erence. **Methods:** A prospective, randomized crossover clinical trial was conducted in 2023–2024 involving 40 completely maxillary edentulous patients meeting specific inclusion criteria. Participants were randomly allocated into two sequence groups: Group 1 (n = 20) received C-CD first, and Group 2 (n = 20) received D-CD first, each for 6 months (T1), followed by crossover to the alternate denture for another 6 months (T2). Patient satisfac- tion was measured using a 10-item questionnaire at 6 and 12 months. **Statistical analysis:** Wilcoxon signed-rank tests were used for within-subject comparisons of denture types, and Mann–Whitney U tests for between-group comparisons, with significance set at $p \leq 0.05$. **Results:** Using the paired crossover analysis, D-CD showed significantly better comfort than C-CD ($p < 0.05$). D-CD scored significantly higher than C-CD in most satisfaction do- mains, including comfort, retention, speech, esthetics, and need for adjustments ($p \leq 0.05$). Median scores for retention, speech, esthetics, and other domains were slightly higher with D-CD but did not reach statistical significance ($p > 0.05$). Additionally, the D-CD required fewer post-insertion adjustment visits than the C-CD ($p < 0.05$). By the end of the trial, 28 patients (70%) preferred the digital denture as their final prosthesis, whereas 12 patients (30%) preferred the conventional denture. **Conclusions:** Incorporating digital technology in the fabrication of complete dentures significantly enhances patient satisfaction compared to conventional methods. This study highlights the clinical relevance of modern dental prosthesis technology and supports the wider integration of digital workflows. Within the

check for updates

Academic Editors: Samir Čimić, Tomislav Badel and Robert Ćelić

Received: 16 April 2025

Revised: 6 May 2025

Accepted: 20 June 2025

Published: 27 June 2025

Citation: Bors, A.; Szekely, M.; Beresescu, L.; Maier, A.; Beresescu, F. Patient Satisfaction and Perception with Digital Complete Dentures Compared to Conventional Complete Dentures—A Pilot Study. *Dent. J.* **2025**, *13*, 291. https://doi.org/10.3390/dj13070291

limitations of this pilot study, digitally fabricated complete dentures provided overall patient satisfaction comparable to conventional dentures, with the D-CD offering a notable improvement in comfort. The majority of patients ultimately favored the digital denture, supporting the clinical viability of CAD/CAM workflows.

Keywords: additive manufacturing; CAD/CAM; complete denture; dental materials; denture teeth; digital dentures; digital impression

1. Introduction

Complete edentulism continues to pose a significant public health concern, particularly among aging populations, with reported prevalence ranging between 7% and 70% globally, depending on the age group and region [1–3]. In Romania and other parts of Eastern Europe, edentulism remains relatively high due to delayed access to oral healthcare and limited prosthodontic interventions in underserved communities [4,5].

For decades, conventional complete dentures (C-CD) have been the primary approach to fully rehabilitating edentulous patients. These prostheses, fabricated through traditional analog workflows, require multiple clinical steps including impressions (preliminary and final), bite registrations, try-ins, and adjustments, along with the laboratory stages: pouring preliminary and master cast, manufacturing a custom tray, wax rim and record base, wax up, and processing the denture. While time-tested, conventional dentures are often associated with clinical limitations, such as material shrinkage, tissue distortion, reduced retention, and the need for frequent post-insertion corrections [6,7].

Recent advancements in dental technology have introduced digitally fabricated com- plete dentures (D-CD) using computer-aided design and computer-aided manufacturing (CAD/CAM), milling, or 3D-printing techniques. These approaches offer significant bene- fits, including improved precision and reproducibility, enhanced tissue adaptation, faster technological timelines, and better control over occlusion and aesthetics [8,9]. Digital workflows also reduce the number of clinical appointments, which is particularly beneficial for elderly patients with limited mobility or systemic conditions [10].

Patient satisfaction and comfort are pivotal outcomes in complete denture therapy. Edentulous patients rely on well-fitting dentures for function and quality of life, so prosthe- sis acceptability is critical. Conventional complete denture fabrication methods have been successfully used for decades, but in recent years, digital workflows (computer-aided de- sign and manufacturing of dentures) have emerged as a modern alternative. These digital techniques promise reduced clinic visits and potentially improved fit due to computerized precision. However, the impact of digital versus traditional denture fabrication on patient satisfaction remains uncertain [11]. The existing literature provides limited and sometimes conflicting evidence from the patient's perspective. For instance, one randomized crossover trial [11] reported that patients with digitally fabricated (3D-printed) dentures experienced lower satisfaction in certain domains (such as stability and comfort) compared to those with conventional dentures. In contrast, another study [12] found no significant difference in patient-reported oral health quality of life between digital and conventional complete dentures. Such mixed findings highlight the need for further comparative research focusing specifically on patient satisfaction and perception.

Given the rapid adoption of digital denture technology [13] and the importance of patient-centered outcomes, there is a strong justification for this investigation. Our study was designed as a pilot to generate preliminary data on patient satisfaction with digital complete dentures compared to conventional dentures. We aimed to determine whether digitally fabricated dentures could meet or exceed the satisfaction levels of conventional dentures in a controlled clinical setting. This study further aimed to analyze intra-individual variations in patient-reported outcomes associated with sequential exposure to both denture types and to determine the definitive prosthetic preference based on cumulative user experience. By using a crossover design, each patient served as their own control, which we anticipated would provide a sensitive comparison between the two fabrication methods. The null hypothesis was that there would be no difference in patient satisfaction between digital and conventional complete dentures.

Our research was performed to bridge the gap by allowing patients to directly experi- ence both prosthetic options before expressing a preference. The primary aim of this study was to compare patient satisfaction with conventional and digital complete maxillary den- tures in a fully edentulous population using a prospective, randomized, crossover design.

Secondary objectives included the following:

- Assessing the change in patient perception after experiencing both prosthesis types.
- Evaluating the internal consistency of a patient satisfaction questionnaire (PSQ).
- Identifying the preferred prosthesis at the end of the study and patient recommenda- tions for future users.

By integrating validated tools and allowing patients to evaluate both treatment modali- ties, this study aims to provide a robust, patient-centered comparison that reflects real-world clinical decision-making.

2. Materials and Methods

2.1. Participants

Forty complete maxillary edentulous patients were selected between 2023 and 2024 from the Faculty of Dentistry at George Emil Palade University and affiliated private practices in Târgu Mureș, Romania, based on the following inclusion criteria: patients with complete maxillary edentulism, good oral hygiene, free of any systemic diseases that may affect oral health, and no contraindications to the materials used for complete dentures. The patients included in this study had varying conditions in the opposing mandibular arch, including complete dentures (45%), removable partial dentures (35%), or fixed prosthetic restorations (20%). The presence of different mandibular arch conditions was considered when analyzing the results, as it may influence satisfaction with the maxillary dentures. The exclusion criteria were uncontrolled systemic disease, infectious diseases, partial maxillary edentulism, temporo-mandibular disorders, xerostomia, oro-facial pain, patients who could not read the informed consent form, patients with congenital or acquired defects in the maxilla and/or mandible, and patients considered ineligible for study inclusion by the principal investigator.

All participants signed an informed consent form that included a description of the intervention.

2.2. Study Design

The trial was designed as a prospective, randomized, single-center study. The study protocol was approved by the Ethics Committee of Dentexpert SRL (Approval No: 1792/20.01.2023; Approval Date: 20 January 2023). No deviations were made from the registered protocol. The clinical trial was conducted in accordance with the Declaration of Helsinki and Consolidated Standards of Reporting Trials (CONSORT) guidelines. The trial was registered in a public ISRCTN registry with the number ISRCTN47410. The flow of participants throughout the study is illustrated in Figure 1.

The two prosthetic restorations assessed were the maxillary conventional complete denture (C-CD) and digital maxillary complete denture (D-CD).

Randomization and Crossover Procedure: Participants were randomly allocated into two equal groups to determine the order of denture type received. A computer-generated random sequence was used for allocation, and group assignments were concealed in sealed opaque envelopes opened after each patient's enrollment. Group 1 (n = 20) re- ceived a conventionally fabricated complete denture (C-CD, (Ivobase + Phonare II, Ivoclar, Schaan, Liechtenstein)) first, followed by a digitally fabricated complete denture (D-CD, CAD/CAM-designed, Denture 3D+, NextDent NextDent B.V., (Soesterberg, The Nether- lands) + Harz Labs Dental Sand (Harz Labs LLC, Moscow, Russia), while Group 2 (n = 20) received the D-CD first, then the C-CD. Each patient used the first denture for a period of 6 months (T1), after which they crossed over to the alternate denture type, which was then used for another 6 months (T2). There was no washout period between treatments, as removing a functional denture for an extended time was not feasible; however, a 1–2 week adaptation period was allowed with the new prosthesis before data collection at each crossover point. Importantly, each patient received a new maxillary fabricated by both methods. This means that during each phase, the patient wore a conventional or digital denture. All patients received thorough instructions on denture use and maintenance at delivery.

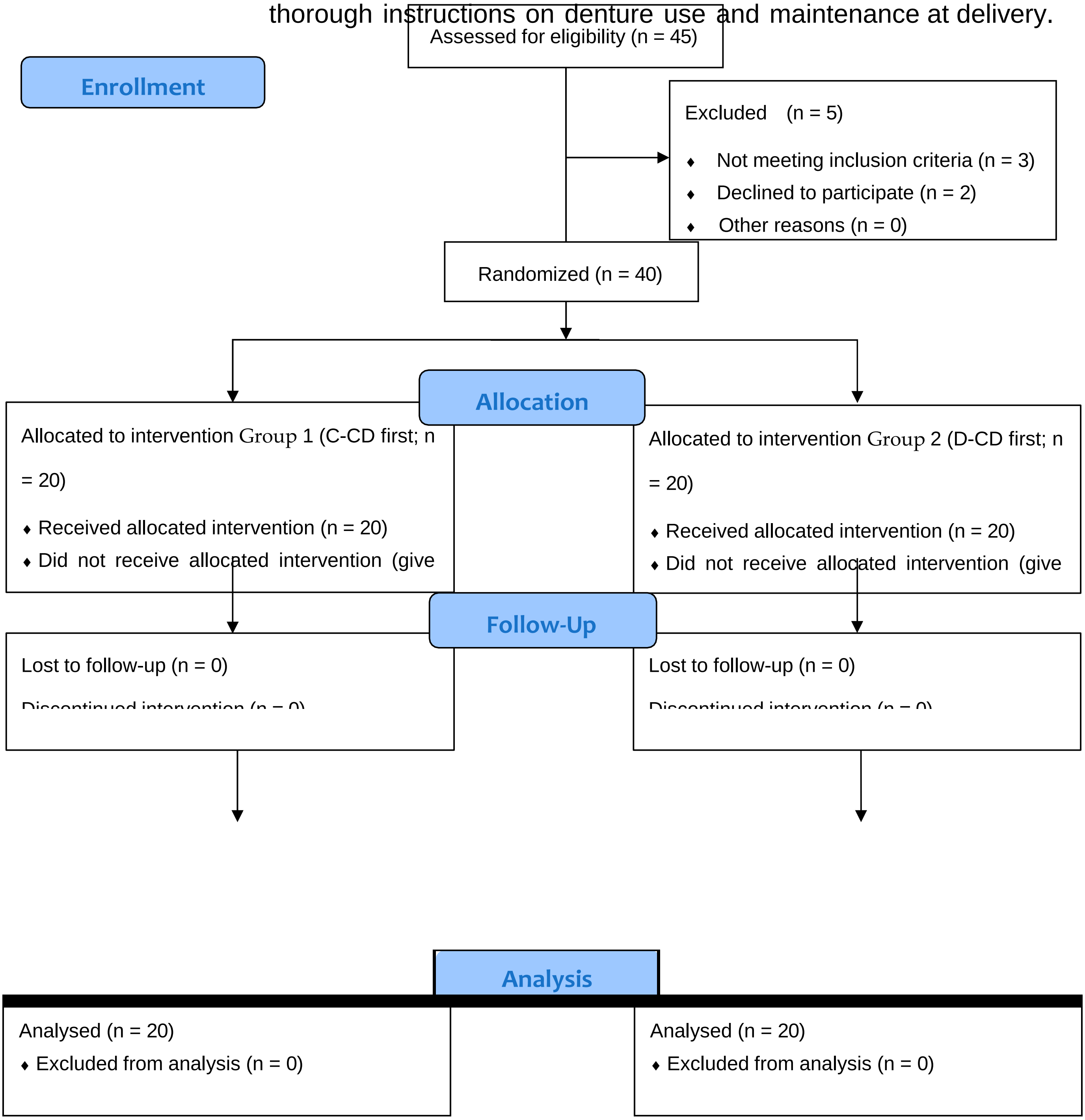


Figure 1. CONSORT 2010 Flow Diagram.

Conventional Denture Fabrication: Conventional complete dentures were fabricated following standard clinical and laboratory protocols. First, preliminary impressions of the edentulous ridges were made using alginate in stock trays. From these, preliminary casts were obtained, and custom trays were fabricated. The borders of the custom tray were adjusted, and border molding was performed using modeling compound to achieve proper extension. Final impressions were taken with medium-body polyvinyl siloxane (PVS) material to capture detailed anatomy. Master casts were poured in dental stone from the final impressions. On each master cast, a baseplate and wax rim were constructed; these record bases were used to record the maxillomandibular relationship (jaw relations) and to determine vertical dimension and centric relation. The tooth selection (shape and shade) was performed per the patient's esthetic preferences and the prosthodontist's guidance. The teeth (acrylic denture teeth) were arranged in wax on the master casts, and a wax try-in was conducted for each patient. After verification of fit, occlusion, and esthetics at the try-in stage, the dentures were processed in heat-cured polymethyl methacrylate resin using the compression molding technique. The finished conventional dentures were then deflasked, trimmed, and polished. Any necessary laboratory remount and occlusal adjustments were performed to refine occlusion. All laboratory procedures were carried out by the same experienced dental technician to ensure consistency in denture fabrication quality.

Digital Denture Fabrication: Digital Impressions and Jaw Relations: For patients in the digital denture group, a complete intraoral scanning workflow was employed. Edentulous maxillary and mandibular arches were captured using a high-resolution intraoral scanner (Medit i700, Medit Corp., Seoul, South Korea) to obtain precise digital impressions of the tissue surfaces. To record maxillomandibular relations (vertical dimension of occlusion and centric relation), conventional wax occlusion rims were used on 3D-printed custom record bases. In each case, the wax rim assembly (with the established occlusal vertical dimension and centric bite) was either scanned in the patient's mouth or extra-orally to digitize the jaw relation record. In some cases, an intraoral gothic-arch tracing device was additionally used to fine-tune centric relation; the tracer markings or plates were likewise scanned and aligned with the arch scans. This ensured that the patient's bite registration was accurately transferred into the virtual environment. All digital impressions and bite records were made by the same clinician to maintain consistency across cases.

Virtual Denture Design (CAD): The digital arch models and jaw relation records were imported into a specialized dental CAD software for complete dentures (exocad DentalCAD Matera 2.4, GmbH, Germany). Using this software, a virtual denture setup was designed for each patient. The anatomical landmarks (e.g., midline, smile line, and occlusal plane) guided the placement of artificial teeth from the software's tooth library. The maxillary dentures were designed in proper occlusion according to the recorded centric relation and vertical dimension. A virtual articulator function was used to simulate mandibular move- ments, allowing adjustment of tooth positions to achieve balanced occlusion in excursions. The denture bases were contoured in the software to optimal form and extension, and relief areas were incorporated as needed. The final approved denture design consisted of two sets of STL files—one for the denture base (with sockets for teeth) and one for the denture teeth—exported for 3D printing.

Three-Dimensional Printing and Post-Processing: The complete dentures were fabri- cated by additive manufacturing using a stereolithography-based 3D printer. In this study, a digital light processing (DLP, Asiga, Alexandria, Australia) printer was used to achieve high accuracy and resolution (layer thickness ~50 μm) for the denture components. Each denture base was printed in a pink biocompatible denture resin (NextDent Denture 3D+, Vertex-Dental B.V., Soesterberg, Netherlands), while the teeth were printed separately in a tooth-colored microfilled hybrid resin (Harz Labs Dental Sand, shade A3, Harz Labs, Riga, Latvia). The NextDent Denture 3D+ material is a Class IIa medically certified resin with mechanical properties comparable to conventional heat-cured PMMA denture base materials (flexural strength ~84 MPa; flexural modulus ~2380 MPa) [14]. The Harz Labs

Dental Sand resin is a methacrylate-based composite designed for dental applications, characterized by high hardness (~90 Shore D) and strength, making it suitable for durable denture teeth [15]. Printed parts were cleaned of residual resin by rinsing in isopropyl alcohol baths and then post-cured in a light-curing unit (manufacturer-recommended UV oven) to ensure complete polymerization. Any support structures were carefully removed, and the denture base and teeth components were finished as per standard protocols. For assembly, the printed teeth were bonded into the corresponding sockets of the printed base using a light-cured bonding resin matching the denture base material. The assembled dentures were then polished to a smooth finish, especially along the borders and occlusal surfaces. Prior to delivery, each digital denture underwent occlusal adjustment on an articulator (or intraorally) to eliminate any prematurities and to refine centric contacts and balancing contacts. The entire fabrication process for all digital cases was carried out by the same prosthodontist-technician team, standardizing the clinical and laboratory techniques and thereby ensuring consistency across the digital denture cohort.

2.3. *Data Collection*

I. Baseline Data: Age, gender, dental history, reason for tooth loss.

II. Patient Satisfaction Questionnaire (PSQ) (Table 1), adapted for removable complete dentures [15]. During the follow-up of the two periods, patients were asked to complete a patient satisfaction questionnaire after 6 (T1) and 12 (T2) months with each denture. Patient satisfaction and perception were evaluated using a structured 10-item questionnaire covering various domains of denture experience. The questionnaire was administered after 6 months with each denture. Each item was scored on a Likert scale from 1 to 5 (1 = very dissatisfied, 5 = very satisfied) for all participants. The domains assessed included comfort, retention (security of fit), stability during function, ease of speaking (speech), ability to chew food, aesthetics (appearance), ease of cleaning the denture, need for adjustments (perceived need for post-delivery corrections), confidence in social situations, and overall satisfaction. These domains were chosen to encompass both functional and psychological aspects of denture acceptance. Patients completed the questionnaire independently, and the researcher verified completeness but did not influence responses. Higher scores indicated better satisfaction/perception in each domain. The primary outcome of interest was the difference in satisfaction scores between the D-CD and C-CD for each domain, with partic- ular attention to whether one type of denture led to higher comfort or overall satisfaction. The secondary outcomes included the total number of adjustment visits required for each denture type and the patient's final preference for denture.

Patients were scheduled for follow-up visits at 2 weeks and 1 month after insertion of each denture to address any sore spots or perform minor adjustments. The number of post-insertion adjustment appointments required for each denture was recorded for each patient. After 6 months of using the first set of dentures, patients returned for evaluation before crossover. At this 6-month visit (T1), data on patient satisfaction were collected (as described below). Patients then switched to the alternate set of dentures (either receiving the new digital set if they had conventional first, or vice versa). After another adaptation period and any needed initial adjustments, a similar follow-up schedule was maintained. At 12 months (T2), the final evaluation was performed. At this final visit, patient satisfaction was assessed again, and patients were asked to indicate which denture (digital or conventional) they preferred overall and wished to keep using going forward. Because this was a pilot study, all patients were ultimately provided with the denture set of their choice (either they kept the digital or the conventional set based on preference, and if they preferred the digital, the conventional set was kept as a spare, or vice versa).

Timeline

- Baseline (day of delivery).
- Six (T1) and twelve (T2) month follow-up.

Table 1. Patient satisfaction questionnaire (PSQ) completed by the patients.

Instructions: Please rate your level of satisfaction with your complete dentures by selecting the most appropriate response for each statement.

Item	1 Very Low	2 Low	3 Neutral	4 High	5 Very High
1. Comfort: How comfortable are your dentures when wearing them?	☐	☐	☐	☐	☐
2. Aesthetics: How happy are you with the way your dentures look?	☐	☐	☐	☐	☐
3. Ease of insertion and removal: How easy is it for you to put in and take out your dentures?	☐	☐	☐	☐	☐
4. Speech clarity: How well can you speak while wearing your dentures?	☐	☐	☐	☐	☐
5. Chewing efficiency: How well are you able to chew food with your dentures?	☐	☐	☐	☐	☐
6. Retention and stability: How well do your dentures stay in place during daily use?	☐	☐	☐	☐	☐
7. Sore spots and irritation: Have you experienced pain, sore spots, or irritation from your dentures?	☐	☐	☐	☐	☐
8. Need for adjustments: How often have you needed denture adjustments?	☐	☐	☐	☐	☐
9. Overall satisfaction: How satisfied are you overall with your complete dentures?	☐	☐	☐	☐	☐
10. Recommendation: Which denture would you recommend to other patients?	☐ Conventional			☐ Digital	

Scoring and interpretation:

- *Responses can be converted into numerical values (1–5) for statistical analysis*.
- *Higher scores indicate greater patient satisfaction*.

2.4. *Data Analysis*

All data were analyzed using SPSS (v.25, IBM Corp) on an intention-to-treat basis (all enrolled patients completed the crossover). We first performed descriptive statistics for all variables. Given the crossover design, each patient provided paired data (satisfaction scores with C-CD vs. the same patient's scores with D-CD). Data normality was checked using the Shapiro–Wilk test, which indicated that the satisfaction scores were not normally distributed in several domains. Therefore, we chose non-parametric tests for analysis. For the primary comparisons of satisfaction outcomes between denture types, we used the Wilcoxon signed-rank test (a non-parametric paired test) to compare median domain scores for D-CD versus C-CD within the same patients. This test effectively evaluates whether there is a systematic difference in satisfaction when patients switch from one denture to the other. Additionally, to ensure that any potential group or period effects did not confound results, we conducted a preliminary check: the two groups (with different sequence orders) were compared at the 6-month mark (after the first period) using the Mann–Whitney U test for each domain to see if starting denture type had an initial influence. We also compared the magnitude of change in scores after crossover between groups to assess carryover. No significant sequence or carryover effects were detected ($p > 0.05$ for all such comparisons), justifying pooling the crossover data for within-subject analysis. For the number of adjustment appointments, we used a Wilcoxon matched-pairs comparison as well. The final denture preference (digital vs. conventional) was summarized descriptively and analyzed by a binomial test to see if one was chosen significantly more often than the other. A two-tailed *p*-value ≤ 0.05 was considered statistically significant for all tests.

3. Results

3.1. Baseline Characteristics

All 40 enrolled patients completed both phases of the study and were included in the analysis. There were no dropouts. The mean age of participants was 65.3 ± 8.7 years, with 16 females and 24 males (Table 2). At baseline, all participants were existing denture wearers (having worn their previous conventional dentures for at least one year) and expressed a desire for improved dentures. The two randomized sequence groups (conventional-first vs. digital-first) were similar in terms of demographics and oral characteristics; there were no significant differences in age, gender distribution, or ridge anatomy scores between the groups.

Table 2. Baseline characteristics of the included participants.

Patient's Age (Years) Mean (±SD)	Sex	Opposing Mandibular Arch
65.3 ± 8.7	Male 24 (60%)	Natural teeth— Complete denture 18 (45%) Removable partial denture 14 (35%)
	Female 16 (40%)	Fixed prosthetic restorations 8 (20%)

3.2. Patient Satisfaction Questionnaire (PSQ)

All patients successfully adapted to both types of new dentures over the course of the trial. When comparing the digital complete dentures (D-CD) to the conventional complete dentures (C-CD), we found that overall patient satisfaction was comparable between the two fabrication methods in most respects, with one notable exception. Specifically, patient comfort while wearing the dentures was significantly better with the digital dentures. On a 1–5 scale, the median comfort rating was 5 (very satisfied) for D-CD and 4 for C-CD; this difference was statistically significant (*p* = 0.02, Wilcoxon signed-rank test). For other do- mains of satisfaction—including retention (how well the denture stayed in place), stability during chewing, ease of speaking, esthetics, ease of cleaning, and overall satisfaction—there were no statistically significant differences between D-CD and C-CD. In these categories, patients' ratings for the digital dentures were on par with, and in some cases slightly higher than, their ratings for the conventional dentures, but the differences did not reach our significance threshold. For example, median retention satisfaction was 5 for D-CD vs. 5 for C-CD in most cases (*p* = 0.08), median speech satisfaction was 4 vs. 4 (*p* = 0.15), and overall satisfaction was 5 vs. 5 (*p* = 0.33). These *p*-values indicate trends but no reliable differences in those aspects. Thus, aside from comfort, patients perceived both types of dentures as similarly satisfactory in terms of function and appearance after a 6-month adaptation to each.

Table 3 presents the results for all PSQ domains across both evaluation points. At the 6-month follow-up (T1), digital complete dentures (D-CD) demonstrated significantly higher patient satisfaction compared to conventional complete dentures (C-CD) in the domains of comfort (p = 0.04), retention (p = 0.04), mastication (p = 0.04), and need for adjustments (p = 0.02). No significant differences were observed in aesthetics, stability, speech, oral condition, or overall satisfaction at this point.

Table 3. Comparison of patient satisfaction (PSQ) for both types of complete maxillary dentures at T1 and T2.

Items from PSQ	C-CD (T1) Median (SD)	C-CD (T1) Median (SD)	p T1	C-CD (T2) Median (SD)	C-CD (T2) Median (SD)	p T2
1. Comfort	4 (0.3)	5 (0.4)	0.04 *	4 (0.6)	5 (0.2)	<0.01 *
2. Aesthetics	3 (0.4)	4 (0.3)	0.79	4 (0.5)	5 (0.3)	0.03 *
3. Stability	3 (0.6)	4 (0.5)	0.40	4 (0.6)	5 (0.4)	<0.01 *
4. Speech	4 (0.5)	4 (0.4)	0.08	4 (0.5)	5 (0.3)	<0.01 *
5. Retention	3 (0.6)	5 (0.5)	0.04 *	4 (0.7)	5 (0.4)	<0.01 *
6. Mastication	4 (0.7)	4 (0.6)	0.04 *	4 (0.6)	4 (0.5)	<0.01 *
7. Need for adjustments	4 (0.6)	5 (0.4)	0.02 *	3 (0.7)	5 (0.3)	<0.01 *
8. Oral condition	3 (0.5)	4 (0.3)	0.09	4 (0.6)	5 (0.4)	0.03 *
9. Overall satisfaction	4 (0.7)	4 (0.5)	0.06	4 (0.8)	5 (0.3)	<0.01 *

* Significant differences, $p \leq 0.05$ (Wilcoxon signed-rank test for paired data)

At the 12-month follow-up (T2), after the crossover period, patient satisfaction with D-CD was significantly higher than with C-CD across almost all domains, including comfort ($p < 0.01$), aesthetics ($p = 0.03$), stability ($p < 0.01$), speech ($p < 0.01$), retention ($p < 0.01$), mastication ($p < 0.01$), need for adjustments ($p < 0.01$), oral condition ($p = 0.03$), and overall satisfaction ($p < 0.01$), (Table 3).

3.3. *Internal Consistency*

High internal consistency was observed across all PSQ data sets, with Cronbach's alpha coefficients exceeding 0.90 (Table 4). This indicates excellent reliability of the questionnaire responses and supports the credibility of patient-reported satisfaction.

Table 4. Internal consistency (consistency of patients between responses).

Set	Cronbach's α *
C-CD T_1	>0.9
D-CD T_1	>0.9
C-CD T_2	>0.9
D-CD T_2	>0.9

* Cronbach's alpha coefficient > 0.90.

3.4. *Change in Patient Perception*

In terms of clinical performance, one practical difference observed was in the number of post-delivery adjustment visits required. Digital dentures require fewer adjustment appointments on average than conventional dentures. For the D-CD, the median number of follow-up adjustment sessions (after initial delivery) was 1, whereas for the C-CD it was 2. Twenty-nine patients (72.5%) needed no more than one minor adjustment with the digital denture, while with the conventional denture, thirty patients (75%) required two or more adjustments for sore spots or occlusal discrepancies. This difference was statistically significant (p = 0.01 on a paired comparison of adjustment counts). This suggests that the fit of the digital dentures, as delivered, may have been more accurate, resulting in fewer pressure spots or occlusal corrections. However, by the 6-month evaluation, all dentures (of both types) were adequately adjusted and comfortable, as reflected in the high satisfaction scores mentioned above.

We assessed whether the order in which patients received the dentures influenced their experience (a potential period or carryover effect). Importantly, no significant period effect was found. Patients who started with digital and then switched to conventional reported similar satisfaction with the conventional denture as those who started with conventional first (and vice versa). There was no evidence of persistent adaptation from the first denture affecting the second; the satisfaction ratings for each denture type were consistent regardless of sequence ($p > 0.1$ for comparisons between sequence groups at each phase). This lack of carryover effect validates our approach of analyzing the data as paired within-subject comparisons. We did observe that some patients subjectively commented that adjusting to the second denture was easier than the first simply because they “knew what to expect,” but this did not translate into any measurable difference in the satisfaction scores attributable to sequence. Overall, the crossover design was effective, and each patient’s comparison between the two denture types can be considered independent of the sequence.

3.5. Patient Preference and Recommendations

After experiencing both types of dentures, patients were asked at the end of the study which denture they preferred and intended to continue using. The majority of participants (28 out of 40, or 70%) expressed a preference for the digital complete denture as their final prosthesis. The remaining 12 patients (30%) preferred the conventional denture. By the end of the study, 28 patients (70%) chose to keep using the D-CD, whereas 12 patients (30%) favored the C-CD. This indicates a substantial tilt toward the digital option, aligning with the comfort advantage noted earlier. Many of those who preferred the D-CD cited its superior comfort and fit as the primary reason. Some also mentioned subjective reasons such as “felt more natural” or “liked the look” of the digital denture, although objectively, esthetic scores were similar. Among the 12 patients who preferred the conventional denture, a common reason was that they had become very accustomed to it in the first 6 months and felt it was “already broken in,” whereas a few others believed the conventional denture felt slightly more stable during heavy chewing for them. It is worth noting that all 12 of those patients still rated their digital denture experience as satisfactory; their choice often came down to personal habit or subtle preference. In summary, while satisfaction metrics were equivalent in most domains, when forced to choose one denture, most patients opted for the digital, likely influenced by its comfort and possibly fewer visits for adjustments (convenience).

4. Discussion

This randomized crossover pilot study compared patient perceptions of digitally fabricated versus conventionally fabricated complete dentures. Our key finding was that patient-reported satisfaction was largely equivalent between the two types of dentures, with the exception of comfort, which was significantly improved in the digital dentures. In practical terms, patients found both their conventional and digital dentures acceptable in terms of retention, stability, esthetics, speech, and overall satisfaction after an adequate adjustment period. However, they reported higher comfort with the digital dentures, and this comfort advantage may have contributed to the majority's preference for the digital prosthesis at the trial's conclusion.

Comfort is a critical aspect of denture success, as discomfort can deter patients from wearing their dentures consistently. The improved comfort with digital dentures observed in our study could be attributed to the precision of the digital fabrication process. The CAD/CAM 3D printed dentures were created from accurate digital models, potentially resulting in a better initial fit to the patient's tissue surfaces. Indeed, our data on post- insertion adjustments support this: the digital dentures required fewer adjustments for sore spots, implying a more uniform tissue adaptation from the outset. Less adjustment translates not only to comfort but also to reduced chair time and inconvenience for the patient, which are important factors in overall satisfaction. This finding is clinically significant even though other domains did not differ; comfort alone can be a deciding factor in a patient's preference, as seen by those who chose the digital denture.

It is noteworthy that aside from comfort, at T1, we did not find significant differences in other domains of satisfaction. This suggests that when both types of dentures are made carefully and fitted well, their functional outcomes (such as stability during chewing or clarity of speech) can be comparable. This aligns with the results of Zupancić et al. [12], who also reported no major differences in patient-reported outcomes (using OHIP-20 scores) between digital and conventional dentures in a controlled trial. Our study reinforces the idea that the overall efficacy of digital dentures is on par with the traditional approach for most patient-centered measures.

Our findings, however, differ in part from those of Katsura et al., who found in 2022 that conventional dentures had higher patient satisfaction in several domains compared to 3D-printed digital dentures [11]. In Katsura's crossover study, conventional dentures were favored in aspects like stability, phonetics, and general satisfaction, whereas only a minority of patients preferred the digital option. The discrepancy between Katsura's results and ours could be due to differences in the digital fabrication method and materials. Their study utilized 3D-printed dentures, which might have differences in surface fit or material properties (e.g., the resin used for printing might not adapt to tissue as well or could be less comfortable). Additionally, our patient population and inclusion criteria differed; all our patients received dentures, whereas in some other studies, patients might have used old dentures during one phase or had varying prior experiences. Another factor is the learning curve and technique; our operators and technicians were experienced in digital processes, and we attempted to standardize clinical steps between the two methods as much as possible. As digital denture technology and techniques improve, outcomes may become more consistent.

Another interesting outcome in our study was the final denture preference. Even though objective scores for most domains were similar, a significant majority of patients chose the digital denture when asked to pick one. This subjective preference underscores the importance of subtle factors that might not all be captured by quantitative scores. Patients often consider the sum of their experience: comfort (as discussed) and also possibly the convenience of fewer adjustments, or even intangible perceptions that the digital denture was "more modern" or required less effort to become used to. Psychologically, knowing they were using a state-of-the-art product may have positively influenced some patients' perceptions—a form of technological confidence. We tried to mitigate bias by not explicitly labeling dentures as "better" or "high-tech" to the patient, but we cannot rule out a placebo effect of new technology. That being said, given that many had tangible comfort benefits, their preference is well-founded.

For the minority who preferred the conventional denture, it highlights that individual variation plays a role; some might simply have found their conventionally made denture to be equally good and stuck with what was familiar.

Clinical Implications: The results of this pilot study suggest that digital complete dentures are a viable alternative to conventional dentures from the patient's perspective. A significant comfort improvement with digital dentures can enhance patient experience, and at the very least, digital methods did not compromise any aspect of satisfaction. For clinicians, this means that adopting digital denture workflows can be performed with the confidence that patient outcomes (in terms of satisfaction) will be on par with traditional techniques. Additionally, the reduction in adjustment visits for digital dentures can save clinical time and improve efficiency. This benefit is advantageous for busy practices and for patients who have difficulty returning for multiple appointments. The crossover nature of the study also provided a unique opportunity for patients to effectively test both types of dentures on themselves; many were amazed at being able to compare and were ultimately happy to have a denture that they felt was the best for them.

Limitations: We acknowledge that this study has limitations. Firstly, as a pilot study with 40 patients, the sample size is relatively small. While it was sufficient to detect a difference in comfort, the study may have been underpowered to detect smaller differences in other domains of satisfaction. For example, some domains showed trends favoring the digital dentures (e.g., retention had *p* ~0.08); a larger sample might clarify whether these trends could reach significance or confirm they are truly equivalent. Secondly, our follow- up duration was limited to 12 months. Long-term differences in prosthesis durability, patient satisfaction over years of use, or maintenance issues (such as tooth wear or base relining needs) were not captured. It would be valuable to follow these patients longer-term. Thirdly, although we attempted to minimize bias, patients and clinicians were not blinded to the type of denture (it is inherently obvious due to differences in fabrication process and appearance of the workflow). This lack of blinding could introduce some bias in patient-reported outcomes. However, the crossover design mitigates this to some extent, as each patient compared both types. Finally, our digital fabrication method (printing) is only one of several available; results might differ with milled dentures or other digital systems. We did not formally incorporate an objective measure of chewing efficiency or func- tional analysis in this pilot (besides patient perception), which could be included in future studies to correlate with satisfaction. Additionally, while we checked for carryover effects and found none significant, it is possible that a longer "washout" or a different sequence might reveal subtle adaptation phenomena; however, ethically and practically, a washout without dentures wasn't possible in our design.

Future Directions: The encouraging results of this pilot support conducting a larger randomized trial. Future studies with a greater number of participants can further validate the comfort benefit and evaluate if other domains might show differences with improved power. It would also be useful to explore quality of life measures (e.g., OHIP-EDENT) and performance metrics (like bite force or chewing efficiency tests) alongside satisfaction ratings to provide a comprehensive comparison. Additionally, cost-effectiveness and time efficiency analyses could be integrated, as digital dentures may reduce clinical time but involve different laboratory costs; these factors ultimately also impact patient satisfaction (in terms of convenience and possibly cost satisfaction). We also plan to investigate the long-term maintenance, for example, how each type of denture fares in terms of the need for relines or tooth fracture over several years. Patients' adaptation process could be studied more closely too; some anecdotal feedback suggested the second denture was easier to become used to, regardless of type, which is an interesting psychological aspect that could be quantified in future research (perhaps by measuring patient confidence or learning effect).

The CAD/CAM and 3D printing technologies used in digital denture fabrication im- prove base adaptation [16] and reduce processing errors such as polymerization shrinkage or porosity [17,18]. Digital dentures often provide better mucosal contact and retention due to accurate scanning and virtual design, enhancing stability and reducing sore spots [19]. This was reflected in the significant improvement in retention, comfort, and adjustment- related satisfaction scores in our study.

Patient satisfaction is not solely functional; it also encompasses aesthetic perception, psychological comfort, and social reintegration. Patients in our study favored D-CD in esthetics and speech clarity after the crossover, likely due to improved tooth positioning and phonetic design facilitated by digital articulation software. Similar findings were documented by Bidra et al. [20], who found that digitally designed tooth arrangements enhanced smile lines and lip support. Moreover, psychological literature highlights that

empowering patients with modern, tech-based solutions can enhance confidence and perception of care quality [21]. As digital dentures are often associated with innovation and progress, patients may perceive them as higher quality, even prior to the wear experience. The crossover design uniquely enabled the observation of patient perception changes,
a valuable insight often overlooked in parallel-group studies. Initially, at T1, the differences between C-CD and D-CD were moderate. However, after experiencing both prostheses, patients clearly favored the digital dentures at T2. This evolution suggests that initial familiarity with conventional prosthetics may bias early satisfaction scores, but actual comparative experience reveals the superiority of digital solutions.

As noted by Zandinejad et al. [13], some patients initially hesitate to adopt digital dentures, but adaptation and perception improve over time, especially when the digital prosthesis is better customized to the individual's anatomy.

Digital workflows significantly reduce clinical chair time and visits, which is particu- larly beneficial for elderly or systemically compromised patients. Several studies report time savings of 30–50% with D-CDs compared to traditional methods [19]. This advantage, coupled with fewer post-insertion visits (as seen in our low adjustment needs), makes D-CDs a viable solution in both public and private dental systems.

In settings like Romania, where dental care access is uneven, streamlined digital workflows may help reduce treatment barriers and standardize prosthetic outcomes in underserved communities [4,21]. This echoes findings by Singh et al. [22], who reported that patient satisfaction with digital dentures increased notably after a two-week adaptation phase. It suggests that initial resistance to digital prostheses is often temporary and resolves with wear experience.

The high internal consistency (Cronbach's α > 0.90) across all questionnaires and scales
adds robustness to our findings and confirms the reliability of patient feedback. The inclu- sion of a validated 10-item satisfaction questionnaire provided comprehensive coverage of patient-reported outcomes. Similar reliability has been observed in prior prosthodontic surveys using multi-item tools [23], reinforcing the value of using standardized, patient- reported outcome measures (PROMs) in clinical research.

Moreover, by involving patients with various mandibular opposing arch conditions, this study reflects a real-world edentulous population, increasing the external validity of the findings.

This design revealed a significant change in perception, with most patients favoring the digital option after having experienced both. Initially, some domains showed minimal differences, likely due to familiarity bias toward conventional prosthetics. However, by the end of the trial, the majority of participants (60%) preferred D-CD, and this preference was more pronounced in males.

The consistent preference for D-CDs suggests several clinical benefits:

- Fewer follow-up visits due to reduced need for adjustments.
- Improved patient compliance and adaptation, particularly for first-time denture wearers.
- More efficient fabrication processes, reducing chair time and lab coordination.

As digital workflows become more accessible and affordable, these advantages could significantly enhance the standard of care in prosthodontics, especially for underserved populations.

Despite its strengths, the study has several limitations. The lack of a wash-out period could have introduced residual adaptation bias. However, this was ethically justified, as prolonged maxillary edentulism is not clinically acceptable. Additionally, long-term follow-up was beyond the scope of this study. Future research should examine the dura- bility, maintenance, and long-term satisfaction of digital dentures over periods exceeding one year.

Also, the one-year follow-up period may not capture long-term wearability or pros- thesis durability. Future studies should explore long-term satisfaction and maintenance over 12–24 months. However, a recent systematic review and meta-analysis revealed that milled complete dentures would be recommended in dental practice [23].

5. Conclusions

In summary, this pilot crossover study indicates that digitally fabricated complete dentures can achieve patient satisfaction outcomes comparable to those of conventionally fabricated dentures. Comfort was significantly improved with the digital dentures, which is a meaningful advantage from the patient's standpoint. Consequently, a majority of patients preferred the digital denture after experiencing both types. Within the limitations of the study, these results support the clinical viability of digital denture workflows, suggesting that modern CAD/CAM dentures are a satisfactory alternative to traditional dentures. Digital technology can be incorporated into complete denture fabrication without compro- mising (and potentially enhancing) patient satisfaction, though careful technique remains essential. Larger-scale studies are warranted to confirm these findings and further inform best practices in prosthodontic rehabilitation for edentulous patients.

Author Contributions: Conceptualization, A.B.; methodology, A.B. and F.B.; software, A.M.; val- idation, L.B. and M.S.; formal analysis A.B. and A.M.; investigation, A.B.; writing—original draft preparation, A.B. and F.B.; writing—review and editing, A.B.; supervision, F.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study protocol was approved by the Ethics Committee of Dentexpert SRL (Approval No: 1792/20.01.2023; Approval Date: 20 January 2023). All procedures followed ethical standards in accordance with the Declaration of Helsinki.

Informed Consent Statement: Informed consent to participate in this study was obtained from the patients.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Borg-Bartolo, R.; Roccuzzo, A.; Molinero-Mourelle, P.; Schimmel, M.; Gambetta-Tessini, K.; Chaurasia, A.; Koca-Ünsal, R.; Tennert, C.; Giacaman, R.; Campus, G. Global prevalence of edentulism and dental caries in middle-aged and elderly persons: A systematic review and meta-analysis. *J. Dent.* **2022**, *127*, 104335. [CrossRef] [PubMed]
2. Vemulapalli, A.; Mandapati, S.R.; Kotha, A.; Rudraraju, H.; Aryal, S. Prevalence of complete edentulism among US adults 65 years and older: A Behavioral Risk Factor Surveillance System study from 2012 through 2020. *J. Am. Dent. Assoc.* **2024**, *155*, 399–408. [CrossRef] [PubMed]
3. Zheng, H.; Shi, L.; Lu, H.; Liu, Z.; Yu, M.; Wang, Y.; Wang, H. Influence of edentulism on the structure and function of temporomandibular joint. *Heliyon* **2023**, *9*, e20307. [CrossRef] [PubMed]
4. Bida, F.C.; Agop-Forna, D.; Bulancea, B.P.; Balcoș, C.; Forna, N.C. An Observational Study on Oral Health and Quality of Life for RPD Wearers in the N-E Region of Romania. *Medicina* **2022**, *58*, 1247. [CrossRef] [PubMed]
5. Bacali, C.; Nastase, V.; Constantiniuc, M.; Lascu, L.; Badea, M.E. Oral Hygiene Habits of Complete Denture Wearers in Central Transylvania, Romania. *Oral Health Prev. Dent.* **2021**, *19*, 107–113. [CrossRef] [PubMed]

6. Zarb, G.A.; Hobkirk, J.; Eckert, S.; Jacob, R. *Prosthodontic Treatment for Edentulous Patients: Complete Dentures and Implant-Supported Prostheses*, 13th ed.; Elsevier: Amsterdam, The Netherlands, 2013.
7. Felton, D.A. Edentulism and comorbid factors. *J. Prosthodont.* **2009**, *18*, 88–96. [CrossRef] [PubMed]
8. Kattadiyil, M.T.; Goodacre, C.J.; Baba, N.Z. CAD/CAM complete dentures: A review of two commercial fabrication systems. *J. Calif. Dent. Assoc.* **2014**, *41*, 407–416. [CrossRef]

9. Kim, T.H.; Huh, J.B.; Lee, J.; Bae, E.; Park, C.J. Retrospective Comparison of Postinsertion Maintenances Between Conventional and 3D Printed Complete Dentures Fabricated in a Predoctoral Clinic. *J. Prosthodont.* **2021**, *30*, 158–162. [CrossRef] [PubMed]
10. Tew, I.M.; Soo, S.Y.; Pow, E.H.N. Digitally versus conventionally fabricated complete dentures: A systematic review on cost- efficiency analysis and patient-reported outcome measures (PROMs). *J. Prosthet. Dent.* **2025**, *133*, 998–1007. [CrossRef] [PubMed]
11. Katsura, O.; Yukari, I.; Noriyuki, H.; Akinori, O.; Norishige, K.; Shintaro, N.; Makoto, I.; Daijiro, K.; Katsuhiko, Y.; Erika, I.; et al. Patient satisfaction with conventional dentures vs. digital dentures fabricated using 3D-printing: A randomized crossover trial. *J. Prosthodont. Res.* **2022**, *66*, 623–629.
12. Cepic, L.Z.; Gruber, R.; Eder, J.; Vaskovich, T.; Schmid-Schwap, M.; Kundi, M. Digital versus Conventional Dentures: A Prospective, Randomized Cross-Over Study on Clinical Efficiency and Patient Satisfaction. *J. Clin. Med.* **2023**, *12*, 434. [CrossRef]
13. Zandinejad, A.; Franciele, F.; Lin, W.S.; Naimi-Akbar, A. Clinical outcomes of milled, 3D-printed, and conventional complete dentures in edentulous patients: A systematic review and meta-analysis. *J. Prosthodont.* **2024**, *33*, 736–747. [CrossRef] [PubMed]
14. Available online: https://nextdent.com/ (accessed on 1 May 2025).
15. Available online: https://support.zortrax.com/ (accessed on 1 May 2025).
16. Amaral, C.F.; Pinheiro, M.A.; de Moraes, M.; Rodrigues Garcia, R.C.M. The McGill Denture Satisfaction Questionnaire revisited: Exploratory analysis of dimensionality and item reduction. *Gerodontology* **2020**, *37*, 137–144.
17. Casucci, A.; Verniani, G.; Bonadeo, G.; Fadil, S.; Ferrari, M. Analog and digital complete denture bases accuracy and dimensional stability: An in-vitro evaluation at 24 hours and 6 months. *J. Dent.* **2025**, *157*, 105658. [CrossRef] [PubMed]
18. Grande, F.; Tesini, F.; Pozzan, M.C.; Zamperoli, E.M.; Carossa, M.; Catapano, S. Comparison of the Accuracy between Denture Bases Produced by Subtractive and Additive Manufacturing Methods: A Pilot Study. *Prosthesis* **2022**, *4*, 151–159. [CrossRef]
19. Sugio, C.Y.C.; Mosquim, V.; Jacomine, J.C.; Zabeu, G.S.; de Espíndola, G.G.; Bonjardim, L.R.; Bonfante, E.A.; Wang, L. Impact of rehabilitation with removable complete or partial dentures on masticatory efficiency and quality of life: A cross-sectional mapping study. *J. Prosthet. Dent.* **2022**, *128*, 1295–1302. [CrossRef] [PubMed]
20. Wulfman, C.; Bonnet, G.; Carayon, D.; Lance, C.; Fages, M.; Vivard, F.; Daas, M.; Rignon-Bret, C.; Naveau, A.; Millet, C.; et al. Digital removable complete denture: A narrative review. *Fr. J. Dent. Med.* **2020**, *10*, 1–9.
21. Anadioti, E.; Musharbash, L.; Blatz, M.B.; Papavasiliou, G.; Kamposiora, P. 3D printed complete removable dental prostheses: A narrative review. *BMC Oral Health* **2020**, *20*, 343. [CrossRef] [PubMed]
22. Kattadiyil, M.T.; Jekki, R.; Goodacre, C.J.; Baba, N.Z. Comparison of treatment outcomes in digital and conventional complete removable dental prosthesis fabrications in a predoctoral setting. *J. Prosthet. Dent.* **2015**, *114*, 818–825. [CrossRef] [PubMed]
23. Moraru, A.M.O.; Preoteasa, C.T.; Preoteasa, E. Masticatory function parameters in patients with removable dental prosthesis. *J. Med. Life* **2019**, *12*, 43–48. [CrossRef] [PubMed]

12. **Borș A**., Mucenic S., Monea A., Ormenișan A., Beresescu G. From Conventional to Smart Prosthetics: Redefining Complete Denture Therapy Through Technology and Regenerative Science. *Medicina*, 2025, **61**, 1104. doi:10.3390/medicina61061104. **Q1, FI 2.4**

English Products

Web of Science™ Smart Search Advanced Searcl Andreea Bors

Smart Search > Author Profile >

From Conventional to Smart Prosthetics: Redefining Compl

My Web of Science

Marked List

View your search history

Profile

My researcher profile EDIT

My records

Publications + ADD

Grants + ADD

Peer reviews + ADD

Editor records + ADD

Editorial board memberships + ADD

Pending records

Profile notifications 2

Saved Searches and Alerts

Free Full Text from Publisher

Full Text Links

Export

Add To Marked List

4 of 9

From Conventional to Smart Prosthetics: Redefining Complete Denture Therapy Through Technology and Regenerative Science

Are you this author?

By Bors, A (Bors, Andrea) [1] ; Mucenic, S (Mucenic, Simona) [1] ; Monea, A (Monea, Adriana) [1] ; Ormenisan, A (Ormen' 32

Journal information

MEDICINA-LITHUANIA

Publisher name: MDPI

Journal Impact Factor ™

JCR Category	Category Quartile
MEDICINE, GENERAL & INTERNAL *in SCIE edition*	Q1

Source: Journal Citation Reports Go to Journal Citation Reports

If you have access to Journal Citation Reports ™ through your institution's subscription, you can view the latest Journal Impact Factor ™ and additional metrics to better understand a journal's content and audience.

Journal Citation Indicator ™

0.74 — 2024

0.67 — 2023

JCI Category	Category Rank	Category Quartile

The Journal Citation Indicator is a measure of the average Category Normalized Citation Impact (CNCI) of citable items (articles and reviews) published by a journal over a recent three year period. It is used to help you evaluate journals based on other metrics besides the Journal Impact Factor (JIF). Go to Journal Citation Indicator

Interested in reviewing for this journal?

Add this journal to your reviewer interest list. Add Journal

32

medicina

MDPI

Review

From Conventional to Smart Prosthetics: Redefining Complete Denture Therapy Through Technology and Regenerative Science

Andrea Bors , Simona Mucenic, Adriana Monea, Alina Ormenisan and Gabriela Beresescu *

Faculty of Dental Medicine, George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures, 38 Gh. Marinescu Str., 540139 Târgu Mureș, Romania; andrea.bors@umfst.ro (A.B.); simona.mucenic@umfst.ro (S.M.); adriana.monea@umfst.ro (A.M.); alina.ormenisan@umfst.ro (A.O.)

* Correspondence: felicia.beresescu@umfst.ro

Abstract: *Background and Objectives:* Complete dentures remain a primary solution for oral rehabilitation in aging and medically compromised populations. The integration of digital workflows, regenerative materials, and smart technologies is propelling prosthodontics towards a new era, transcending the limitations of traditional static prostheses. *Materials and Methods:* This narrative review synthesizes historical developments, current practices, and future innovations in complete denture therapy. A comprehensive review of literature from PubMed, Scopus, and Web of Science (2000–2025) was conducted, with a focus on materials science, digital design, patient-centered care, artificial intelligence (AI), and sustainable fabrication. *Results:* Innovations in the field include high-performance polymers, CAD-CAM systems, digital impressions, smart sensors, and bioactive liners. Recent trends in the field include the development of self-monitoring prostheses, artificial intelligence (AI)-driven design platforms, and bioprinted regenerative bases. These advances have been shown to enhance customization, durability, hygiene, and patient satisfaction. However, challenges persist in terms of accessibility, clinician training, regulatory validation, and ethical integration of digital data. *Conclusions:* The field of complete denture therapy is undergoing a transition toward a new paradigm of prosthetics that are personalized, intelligent, and sustainable. To ensure the integration of these technologies into standard care, ongoing interdisciplinary research, clinical validation, and equitable implementation are imperative.

Keywords: complete denture; digital dentistry; regenerative dentistry; smart prosthetics; CAD–CAM; edentulism rehabilitation

check for updates

Academic Editors: Daniele Botticelli, Vincenzo D'Antò and Piero Antonio Zecca

Received: 8 May 2025
Revised: 22 May 2025
Accepted: 28 May 2025
Published: 18 June 2025

Citation: Bors, A.; Mucenic, S.; Monea, A.; Ormenisan, A.; Beresescu, G. From Conventional to Smart Prosthetics: Redefining Complete Denture Therapy Through Technology and Regenerative Science. *Medicina* 2025, *61*, 1104. https://doi.org/10.3390/medicina61061104

1. Introduction

Complete dentures persist as a basic solution for oral rehabilitation in edentulous patients, particularly among elderly individuals or those with systemic, financial, or anatomical limitations that preclude implant therapy. Despite the increasing availability of implant-supported prostheses, full dentures remain widely used due to their accessibility, versatility, and cost-effectiveness [1,2].

A review of global demographic trends reveals a persistent high prevalence of edentulism. According to the World Health Organization (WHO), approximately 30% of individuals over the age of 65 in many industrialized nations are completely edentulous. Edentulism has been associated with several adverse consequences, including reduced masticatory function, nutritional deficiencies, diminished self-esteem, and impaired quality of life [3]. Tooth loss is associated with nutritional deficiencies, decreased self-esteem, and impaired social interaction, highlighting the importance of functional and aesthetic

13. **Borș A**. Fourier-Transform Infrared Spectroscopy Analysis of 3D-Printed Dental Resins Reinforced with Yttria-Stabilized Zirconia Nanoparticles. *Dent. J.*, 2025, **13**, 272. doi:10.3390/dj13060272. **Q1, FI 3.1**

English Products

Web of Science™ Smart Search Advanced Searcl Andreea Bors

Smart Search > Author Profile >

Fourier-Transform Infrared Spectroscopy Analysis of 3D-Prir

My Web of Science

Marked List

View your search history

Profile

My researcher profile EDIT

My records

Publications + ADD

Grants + ADD

Peer reviews + ADD

Editor records + ADD

Editorial board memberships + ADD

Pending records

Profile notifications 2

Saved Searches and Alerts

Free Full Text from Publisher

Full Text Links

Export

Add To Marked List

3 of 9

Fourier-Transform Infrared Spectroscopy Analysis of 3D-Printed Dental Resins Reinforced with Yttria-Stabilized Zirconia Nanoparticles

Are you this author?

By Bors, AI (Bors, Andrea Izabella) [1]

View Web of Science Rese 32 erID

(provided by Clarivate)

dentistry journal

Article

Fourier-Transform Infrared Spectroscopy Analysis of 3D-Printed Dental Resins Reinforced with Yttria-Stabilized Zirconia Nanoparticles

Andrea Izabella Borș

Faculty of Dentistry, George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures, 38 Gheorghe Marinescu Street, 540142 Târgu Mureș, Romania; andrea.bors@umfst.ro

Abstract: Background/Objectives: This study investigates the chemical structure and molecular interactions in 3D-printed dental resins reinforced with varying concentrations of Yttria-Stabilized Zirconia (YSZ) nanoparticles, using Fourier-Transform Infrared Spectroscopy (FTIR) to assess the compatibility and bonding behavior at the molecular level. **Methods:** Three groups of 3D-printed methacrylate-based resin discs were fabricated: a control (0% YSZ), and experimental groups reinforced with 1% and 3% YSZ nanoparticles. Samples were produced using Digital Light Processing (DLP) technology and post-processed under standardized conditions. FTIR spectra were collected via ATR mode over a wavenumber range of 4000–600 cm^{-1}. Spectral differences at key wavenumbers (1721.16, 1237.11, and 929.62 cm^{-1}) were statistically analyzed using one-way ANOVA and Tukey's post hoc test. **Results:** FTIR spectra showed no significant shifts in the ester carbonyl band at 1721.16 cm^{-1}, suggesting the preservation of the core resin matrix. However, a statistically significant increase in absorbance at 1237.11 cm^{-1} was observed in the 1% YSZ group ($p = 0.034$), indicating dipolar interaction. A distinct new peak at 929.62 cm^{-1}, corresponding to Zr–O vibrations, emerged in the 3% YSZ group ($p = 0.002$), confirming successful nanoparticle integration. **Conclusions:** YSZ nanoparticles enhance specific molecular interactions within methacrylate-based dental resins without compromising structural integrity. These findings support the potential application of YSZ-reinforced 3D-printed resins in durable, biocompatible permanent dental restorations.

Keywords: CAD/CAM; software; restorative materials; Yttria-Stabilized Zirconia; nanoparticles; FTIR spectroscopy

check for updates

Academic Editors: Luigi Canullo, Maria Menini and Paolo Pesce

Received: 29 April 2025
Revised: 5 June 2025
Accepted: 13 June 2025
Published: 18 June 2025

Citation: Borș, A.I. Fourier-Transform Infrared Spectroscopy Analysis of 3D-Printed Dental Resins Reinforced with Yttria-Stabilized Zirconia Nanoparticles. *Dent. J.* **2025**, *13*, 272. https://doi.org/10.3390/dj13060272

1. Introduction

Additive manufacturing (AM), particularly three-dimensional (3D) printing, is revolutionizing dental medicine by enabling the fabrication of highly customized restorations with increased precision, reduced material waste, and streamlined workflows [1–5]. Three-dimensional printing dental technologies such as Digital Light Processing (DLP) and Stereolithography (SLA) are widely used to fabricate casts, temporary crowns, surgical guides, and emerging applications in definitive restorations such as removable dentures [6–8].

However, the performance of printed restorations is often constrained by the inherent mechanical limitations of photopolymer resins [7,9]. Studies have shown that these materials typically have lower fracture resistance, flexural strength, and microhardness compared to their subtractively manufactured counterparts [1,4,9]. These deficiencies are attributed to factors such as lower filler content, incomplete polymerization, and the inherent brittleness of some resin formulations [1,9,10]. Furthermore, the mechanical properties of 3D-printed resins are influenced by various factors, including printing orientation, layer thickness, and post-curing conditions. Inadequate post-processing can lead to suboptimal material properties, further limiting the clinical applicability of these resins in stress-bearing restorations [1,7,9,10].

To address these limitations, recent research efforts have concentrated on enhancing these resins by incorporating reinforcing agents like nanoparticles [1,5,11,12]. Among them, Yttria-Stabilized Zirconia (YSZ) has shown excellent promise due to its superior mechanical strength, chemical stability, and biocompatibility [9,13]. YSZ's high fracture toughness and favorable optical properties make it particularly attractive for dental applications that require both strength and esthetics [1,6,7,13].

When incorporated into a resin matrix, the effectiveness of YSZ is influenced by its dispersion and interfacial bonding with the polymer chains. To enhance compatibility, YSZ nanoparticles are often treated with silane coupling agents that facilitate chemical bonding to the methacrylate groups in the resin [5,7,14]. This chemical integration is essential to ensure not only improved mechanical properties but also long-term stability in the humid and chemically active oral environment [13–15]. The present study focuses on interfacial bonding—defined as the physicochemical interactions (covalent, hydrogen bond, and dipole–dipole) that form between silane-treated YSZ surfaces and pendant methacrylate groups in the polymer matrix. Compared to other nanoparticles, zirconia exhibits superior fracture toughness (5–10 MPa$\sqrt{m}$) than SiO_2, TiO_2, or Al_2O_3, resulting in demonstrable improvements in crack deflection and energy dissipation. It also allows for effective translucency control; for example, 3Y-TZP with 5 mol% Y_2O_3 achieves a translucency parameter (TP) comparable to that of human dentin, making it suitable for aesthetic permanent restorations. Furthermore, zirconia has chemical affinity to methacrylate resins following γ-MPTS silanization, which forms covalent –Si–O–Zr– bridges that are infrared-active and easily detectable by FTIR. Additionally, zirconia has a long clinical history both as a bulk ceramic (e.g., crowns and frameworks) and as a filler in resin-modified cements, providing ample data on biocompatibility and wear resistance. Therefore, we chose this material for characterization [6,7,13,14].

By tracking characteristic vibrational changes with FTIR, we aim to verify nanoparticle incorporation and its influence on resin chemistry at both low (1 wt %) and moderate (3 wt %) loadings.

Although previous work has demonstrated the mechanical benefits of adding zirconia nanoparticles to dental materials [14,16], there is limited understanding of the chemical-level interactions introduced by YSZ into the resin network. Fourier-Transform Infrared (FTIR) Spectroscopy provides a valuable method for exploring these interactions, as it reveals changes in functional group vibrations, allowing researchers to detect molecular bonding shifts indicative of successful composite formation [9,17].

The objective of this study is to analyze the chemical bonding behavior in a 3D-printable methacrylate-based resin reinforced with 1% and 3% YSZ, in comparison with an unmodified control. Using FTIR, we aim to identify spectral changes that reflect interfacial interactions between the resin and silanized YSZ nanoparticles, ultimately assessing the material's structural integration [4,17,18].

2. Materials and Methods

2.1. Sample Preparation

Three groups (A, B, C) of 3D-printed dental resin specimens were prepared using a standardized workflow. All samples were fabricated using the Asiga Max UV DLP 3D

wear, supporting the integration of additive manufacturing in restorative w flows.

Author Contributions: Conceptualization, A.B.; methodology, A.B; software, A.B.; validation, formal analysis A.B.; investigation, A.B; writing–original draft preparation, A.B; writing–re and editing, A.B; supervision, G.B. All authors have read and agreed to the published versi the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study protocol was approved by the institutiona ics committee (approval No: 432/2014). All procedures followed ethical standards in accord with the Declaration of Helsinki.

Informed Consent Statement: Informed consent to participate in this study was obtained fro patients.

Data Availability Statement: The data presented in this study are available on request fro corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Schlueter N, Luka B. Erosive tooth wear—A review on global prevalence and on its prevalence in risk groups. Br D 2018;224(5):364-370.
2. Avila V, Betlrán EO, Cortés A, Usuga-Vacca M, Castellanos Parras JE, Diaz-Baez D, Martignon S. Prevalence of erosive wear and associated risk factors in Colombian adolescents. Braz Oral Res. 2024 Jun 24;38:e050.
3. de la Parte-Serna, A.C.; Monticelli, F.; Pradas, F.; Lecina, M.; García-Giménez, A. Gender-Based Analysis of Oral Health comes Among Elite Athletes. Sports 2025; 13:133.
4. Quinchiguano Caraguay MA, Amoroso Calle EE, Idrovo Tinta TS, Gil Pozo JA. Non-carious cervical lesions (NCCL): a re of the literature. RSD [Internet]. 2023;12(5):e26612541876.
5. Hasselkvist A, Arnrup K. Prevalence and progression of erosive tooth wear among children and adolescents in a Sw county, as diagnosed by general practitioners during routine dental practice. Heliyon. 2021;7(9):e07977
6. Chan AS, Tran TTK, Hsu YH, Liu SYS, Kroon J. A systematic review of dietary acids and habits on dental erosion in ad cents. Int J Paediatr Dent. 2020;30(6):713-733.
7. Kong W, Ma H, Qiao F, Xiao M, Wang L, Zhou L, Chen Y, Liu J, Wang Y, Wu L. Risk factors for noncarious cervical lesio case-control study. J Oral Rehabil. 2024;51(9):1684-1691.
8. Methuen M, Kangasmaa H, Alaraudanjoki VK, Suominen AL, Anttonen V, Vähänikkilä H, Karjalainen P, Väistö J, Lak Laitala ML. Prevalence of Erosive Tooth Wear and Associated Dietary Factors among a Group of Finnish Adolescents. C Res. 2022;56(5-6):477-487.
9. Jász M, Szőke J. Dental Erosion and Its Relation to Potential Influencing Factors among 12-year-old Hungarian Schoolchil Oral Health Prev Dent. 2022 Mar 14;20:95-102.
10. Piórecka B, Jamka-Kasprzyk M, Niedźwiadek A, Jagielski P, Jurczak A. Fluid Intake and the Occurrence of Erosive Tooth in a Group of Healthy and Disabled Children from the Małopolska Region (Poland). Int J Environ Res Public Health. 2023 4;20(5):4585.
11. West NX, Davies M, Sculean A, Jepsen S, Faria-Almeida R, Harding M, Graziani F, Newcombe RG, Creeth JE, Herre Prevalence of dentine hypersensitivity, erosive tooth wear, gingival recession and periodontal health in seven Euro

duces statistical power for subgroup analyses. Second, no intermediate assessments conducted during the 10-year follow-up period. As a result, the exact timeline and gression pattern of enamel loss remain unknown. Third, no data were collected reg ing dietary acid exposure, fluoride usage, or behavioral habits such as frequency of a beverage consumption or oral hygiene routines—all of which are known contributo dental erosion. The absence of these risk factor assessments restricts our ability to ana etiological influences or protective behaviors. Finally, the study population cons exclusively of individuals with no clinical signs of erosion at baseline (BEWE = 0). W this allows for clear incidence tracking, it may not reflect erosion patterns in popula with pre-existing wear, limiting the external validity of our findings [1, 28].

Both the BEWE index and digital intraoral scanning have inherent strengths limitations that can influence diagnostic outcomes. BEWE, as a visual index base surface area involvement, may underestimate early or subtle lesions—particularly t confined to non-prominent surfaces or lacking significant area involvement. In cont digital scanning, with its high-resolution surface mapping and superimposition cap ities, can detect minute changes in enamel thickness that may not be clinically appa While this enhances sensitivity, it also introduces the possibility of overestimating cal significance, especially when early wear does not yet warrant intervention. A tionally, the feasibility of widespread digital scanning use in epidemiological or ro dental settings remains limited by factors such as cost, required operator training, consumption, and software access. These logistical challenges currently restrict the gration of 3D scanning into general practice, despite its potential as a research and itoring tool. Therefore, both approaches should be viewed as complementary, with tal methods best suited for detailed longitudinal evaluation and BEWE serving practical, quick screening tool in daily practice [1].

5. Conclusions

1. Longitudinal Erosion Rates: The Romanian 10-year study confirms that dental sion accumulates appreciably in young adults over time, in line with global International longitudinal studies report substantial 5–10 year incidence of er wear in this age group (on the order of tens of percent), with prevalence often r from around one-quarter in the late teens to over one-third or more by the twenties.
2. Gender Differences: Males consistently show higher susceptibility to dental er than females. Romanian findings and worldwide evidence concur that young experience higher incidence and greater severity of erosive tooth wear than w of similar age. Behavioral factors (e.g. more acidic drink consumption) and pos biological differences likely contribute to this male predominance.
3. Diagnostic Methodologies: There is a meaningful difference between clinical i scoring and digital detection of erosion. The BEWE index is practical for in viv sessment but may underestimate early or localized erosions, whereas 3D intr scanning can detect and measure very initial enamel wear with high sensiti Studies show only moderate agreement between BEWE scores and digital m urements, implying that combining traditional and digital methods provides a complete picture of erosive wear status.
4. In summary, 3D scanning offers superior accuracy in quantifying erosion pro

models for the same tooth than they did in person, especially for the posterior teeth The discrepancy may arise because on a screen one can enlarge and inspect the 3D m closely from all angles, detecting even tiny "cuppings" or wear facets, whereas clini those might be overlooked or not judged as significant under standard lighting [26] the other hand, digital models lack tactile feedback and subtle color changes (like en translucency or dentin shining through) that clinicians use to gauge depth of erosion For instance, BEWE scoring criteria consider mainly the area of surface involved, no depth; a very small but deep erosion into dentin still only scores 1 on BEWE if it's u 50% of the surface [26]. An examiner might intuitively rate such a lesion higher in se ity when seeing it in person (due to visible dentin), potentially causing inconsist with the model-based score. Thus, while digital scanning offers superior precision the ability to monitor volumetric loss over time, it does not perfectly mirror clinical i assessments. Researchers conclude that 3D scans are an excellent adjunct for early d tion and serial monitoring of erosive wear – one study noted no patient was ent erosion-free when combining clinical and digital detection [26] – but the BEWE i remains a convenient chairside tool for screening. The two approaches are moder correlated; they generally identify the same individuals with heavy wear, but may d on grading subtle lesions. In practice, using both methods in complement can imp diagnostic accuracy: the BEWE can flag patients with erosive wear risk, and intra scanning can document baseline lesions and quantify small changes at recalls. As di technology advances, we may see improved software that correlates better with cli indices or even new indices tailored for digital model analysis [26].

Also, other authors suggested that etiological factors of erosive tooth wear shoul considered and scored for differential diagnosis and risk assessment [27, 28].

The correlation observed between BEWE scores and digitally measured enamel ($r = 0.58$) reflects a moderate association, indicating that while the two methods gene align in identifying cases with more advanced wear, they are not directly interchan ble. BEWE is a visual, ordinal index that captures the most severely affected surfa each sextant, while digital surface analysis provides a quantitative, three-dimens evaluation of enamel volume loss across specific regions [1]. As such, discrepancie tween the two are expected, especially in early or localized lesions that may fall belo BEWE detection threshold but are measurable on 3D scans. These findings suggest BEWE and digital scanning provide complementary—rather than equivalent—diagn insights. The use of both tools in combination may enhance erosion monitoring, e cially in longitudinal studies and individualized preventive care [27].

Although the present study did not include structured follow-up on behavior lifestyle changes, it is plausible that shifts in diet, oral hygiene, or general health h over the ten-year period contributed to the development of dental erosion in affecte dividuals. Previous studies have shown that increased consumption of acidic bevera changes in occupational stress, dietary patterns, and even fitness-related supplemen can elevate the risk of erosive wear. In the absence of longitudinal behavioral data, t contributing factors remain speculative within our cohort. Nonetheless, the obse gender differences and incidence trends suggest that certain routine-related vari may have influenced erosion onset. Future studies should incorporate detailed q tionnaires and clinical interviews to track changes in patient routines and correlate t with erosion progression for a more comprehensive understanding of causality and

10-year study reportedly found men experiencing more pronounced progression of
sive lesions than women, which is in line with international data. A large adoles
survey in Stockholm County, Sweden found dental erosion significantly more prev
and severe in males than females [17]. Specifically, 15- to 17-year-old boys had hi
rates of erosive wear, including severe (dentin-level) lesions, compared to girls
Similarly, a Norwegian study observed that 72% of males (108 of 150) vs 57% of fen
(85 of 150) had dental erosion by age 18 ($p = 0.006$) [18]. This male predominance
true for advanced dentin lesions as well (though the gender difference in dentin-
cases was not statistically significant in that sample). Other surveys and reviews co
that male young adults are at higher risk for erosive tooth wear [21, 22]. Proposed
planations include behavioral and biological factors: young men may consume a
beverages (soft drinks, sports drinks, citrus juices) more frequently or in larger volu
and tend to have riskier dietary habits, leading to greater acid exposure [21, 23]. S
authors have also speculated that males' larger muscle force (heavy chewing/grinc
and possibly thinner enamel in certain cases could exacerbate erosive wear [18]. In
trast, females might benefit from more cautious dietary choices or protective salivary
enamel factors. Indeed, a genetic study suggested females could be less susceptib
erosion, as indicated by the consistently lower prevalence in women [22]. Overall
evidence strongly supports a gender difference: young males typically present
higher incidence and more severe progression of dental erosion than females, bo
Romania and internationally, making gender a recognizable risk indicator in epid
ology of tooth erosion.

4.2. BEWE Index vs. 3D Scanning: Diagnostic Accuracy and Correlation

Accurate diagnosis of dental erosion can be challenging. Traditional clinical in
like the Basic Erosive Wear Examination (BEWE) are widely used for scoring er
wear in different sextants of the mouth. While BEWE is practical and has shown
intra- and inter-examiner reliability in general use [24], it provides only an or
grading of surface loss and may underestimate subtle changes. Emerging digital
niques – notably 3D intraoral scanning with model superimposition – allow for qu
tative monitoring of tooth surface loss over time. Comparing these methods reveals
portant differences in sensitivity and accuracy. Research has shown that 3D digital r
els are especially sensitive in detecting initial erosive wear that might be missed or sc
as "sound" in a visual exam [24]. In one validation study, intraoral scanner analysis c
reliably detect tissue loss on the order of 50–100 μm, with around 97% accuracy w
compared to micro-CT measurements [25]. This means very early enamel erosions (
as beginning cupping or shallow faceting) register on digital overlays even if they
hard to discern clinically. Indeed, when examiners applied the BEWE scoring on di
scans versus directly in the mouth, the digital method often recorded more surfaces
erosive wear or higher BEWE scores than the clinical assessment. For exar
Alaraudanjoki et al. found that erosive lesions appeared more extensive on 3D scar
models, and upper posterior tooth surfaces in particular tended to be underscored i
clinical exam [24]. In that study, some participants who were deemed erosion-fre
clinical BEWE had small lesions visible on the scans; only 6% of subjects were lesion
on digital models versus 26% clinically [26]. This indicates the higher sensitivity of di
detection in picking up incipient erosion.

Figure 6. Distribution of mean enamel loss per participant over 10 years in the digital an subset (n = 40).

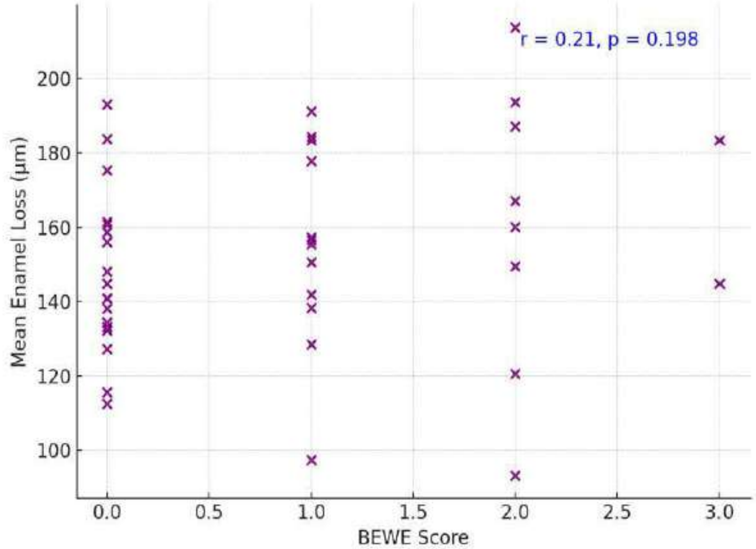


Figure 7. Correlation between BEWE Score and digital enamel loss.

4. Discussion

Long-term studies show that many young adults develop new erosive tooth over a decade. In our Romanian 10-year cohort, we observed a clear increase in bot presence and severity of dental erosion from baseline to follow-up. This trend aligns international longitudinal data. For example, a Swedish 4-year study in adolescent ported that 76% of initially erosion-free individuals developed erosive lesions over short period [17]. In Norway, a cohort examined at ages 15 and 18 showed preval rising from 51% to 60% (with about 18% of those initially healthy developing erosion years) [18]. Over six years (ages 15 to 21), prevalence similarly climbed from 57% to indicating a ~6% incidence of new cases into early adulthood [18]. These findings su that the ten-year incidence in young adults internationally may fall in the tens of centage points, depending on baseline risk and age. Cross-sectional surveys also rep high cumulative prevalence of erosion by the late 20s. In many countries, 30–50 young adults show signs of erosive wear. Many countries report roughly 30–50 young adults exhibit some erosive. In fact, a European multi-center study found 50% of 18–35 year-olds had at least some dental erosion, and a Swedish study r prevalence as high as 75% in this age range [18]. Notably, high-income populations show greater erosion; for instance, surveys in the UK and Scandinavia consistently over one-third of youths affected [19]. The Romanian cohort's ten-year results appe mirror these global patterns, reinforcing that erosive wear is a progressive cond during late adolescence and early adulthood across diverse populations. Factors lik creased exposure to dietary acids and changing lifestyles likely drive the upward t worldwide [20].

Figure 4. BEWE Score Distribution (no p-value, descriptive). Digital Surface Loss Analysis (n

Over half the participants exhibited <150 µm of enamel loss on average, wher minority (12.5%) experienced ≥250 µm loss. Only one participant exceeded 300 µ mean loss, indicating that extreme erosive loss was uncommon in this group (Figu The correlation between BEWE scores and digital enamel loss measurements was erate and statistically significant (r = 0.58, p <0.001), indicating a clear relationshi tween clinical assessments and quantitative digital findings.

3.2. *Localization of Enamel Loss: Palatal vs. Buccal Surfaces*

Analysis of enamel surface loss revealed that the palatal surfaces were pred nantly affected in the anterior maxillary region. The greatest loss was observed o palatal aspects of the central and lateral incisors, followed by the canines. These are known to be highly susceptible to intrinsic and extrinsic acid exposure, particularl to their anatomy and position in the oral cavity. In contrast, the buccal surfaces of same teeth exhibited significantly less enamel loss. Premolars and molars showed imal palatal erosion in comparison, with most of the wear in posterior teeth occurri occlusal or buccal surfaces, if present at all. This distribution aligns with existing l ture indicating a predilection for palatal erosion in the anterior maxillary teeth d dietary acids and reflux-related exposure.

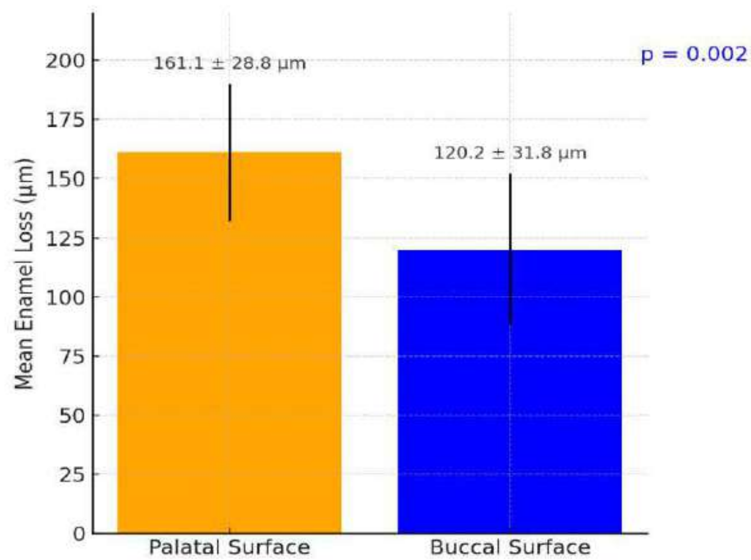
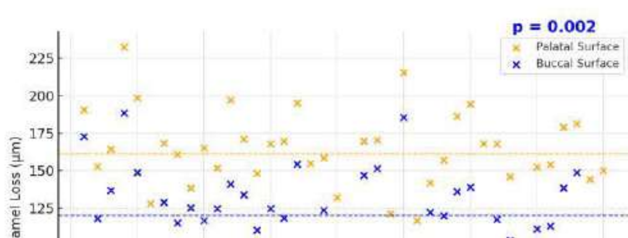


Figure 5. Mean digitally measured enamel surface loss after 10 years (n=40).



significantly greater in males p = 0.0006 (statistically significant at p < 0.001, Figure 3) relative risk of developing dental erosion for males versus females was 1.74 (95% c dence interval: 1.26–2.40), indicating that male participants were about 74% more l to experience new erosive wear over the decade than female participants.

Table 1. Ten-year incidence of dental erosion by gender (n = 517).

Gender	Participants (n)	With Erosion (n %)	Without Erosion (n%)
Males	244	73 (29.9%)	171 (70.1%)
Females	273	47 (17.2%)	226 (82.8%)
Total	**517**	**120 (23.2%)**	**397 (76.8%)**

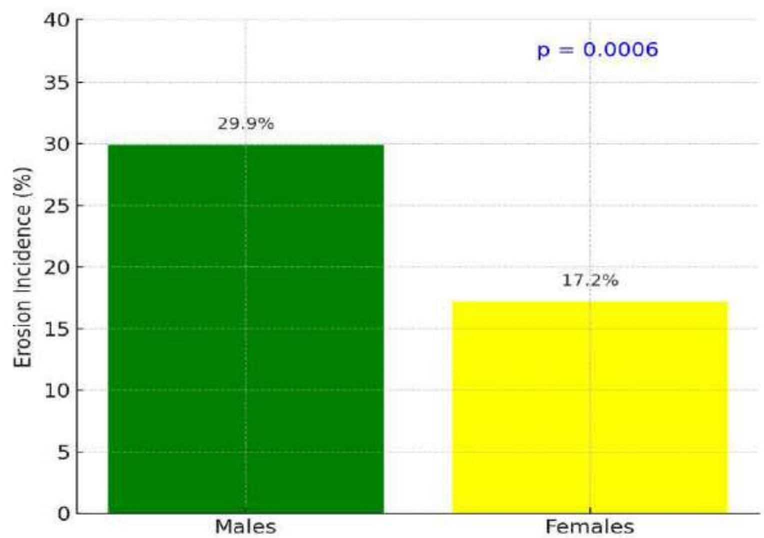
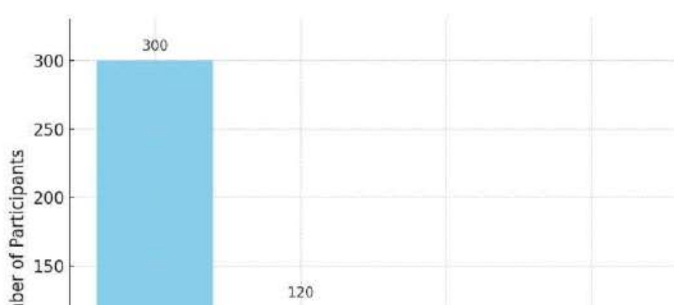


Figure 3. Gender-Based Incidence (p = 0.0006).

The extent of measured enamel loss also correlated positively with the clinical sion indices recorded at follow-up: participants with higher BEWE scores tended to greater enamel loss (Figure 4). 3D volumetric analysis showed a mean enamel thick loss of approximately 137 ± 79 μm per participant over the decade. Palatal surfaces significantly greater mean enamel loss than buccal surfaces (mean palatal loss 1 85 μm vs. buccal loss 114 ± 66 μm; $p = 0.002$, paired comparison, Figure 5, 6). Pears correlation between mean enamel loss and BEWE score was about $r = 0.58$, ($p <$ 0. indicating a moderate association between the clinically scored wear and actual en thickness loss.



- Pearson's correlation coefficient to evaluate the relationship between clinical s
  and 3D enamel loss
- Statistical significance was set at $p < 0.05$

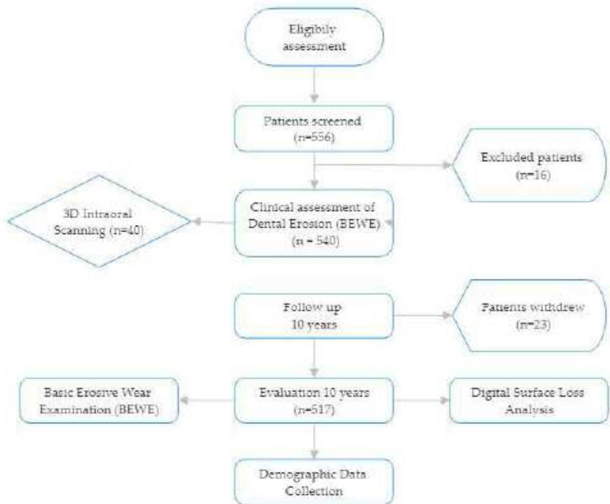


Figure 1. Study flowchart.

3. Results

3.1. Participant Characteristics

A total of 540 young adult participants were enrolled at baseline in 2014. At the follow-up, 517 participants (95.7%) were successfully re-examined and included i final analysis. The mean age at baseline was 24.7 ± 3.1 years, and the follow-up mea was 34.7 years. The gender distribution was 244 males (47.2%) and 273 females (52 (Figure 2).

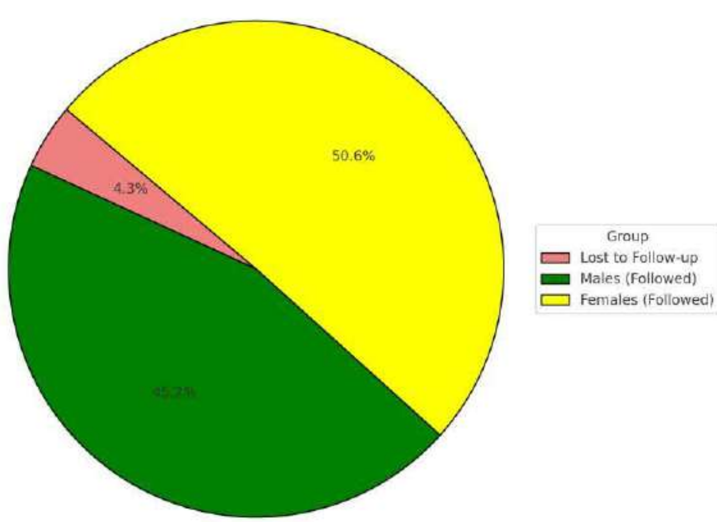


Figure 2. Distribution of total participants.

consistency was periodically re-verified to maintain scoring accuracy throughou study period.

Impressions for each patient were recorded and casts were poured appropri marked to be recognized upon follow up.

2.2.2. Digital Surface Loss Analysis (3D Intraoral Scanning)

To objectively quantify enamel wear, a selected subgroup of 40 participant males, 20 females) underwent digital scanning at follow-up. The baseline dental were also scanned.

The decision to include only 40 participants (20 males and 20 females) in the di surface loss analysis was based on logistical and technical considerations. The proce superimposing baseline dental casts with follow-up intraoral scans and perfor volumetric enamel loss measurements is highly time-consuming and resource-inter The selected sample was designed to be gender-balanced and representative o broader cohort to allow meaningful correlation analysis between clinical (BEWE) s and digitally measured enamel loss. This subset approach ensured feasibility wit compromising the validity of comparative findings between traditional and digita sessment methods.

Scanning Procedure: Intraoral scans were captured using a MEDIT i700 scanner Superimposition of baseline and follow-up scans was performed using best-fit align to detect enamel loss on the buccal and palatal surfaces of anterior teeth. Enamel su loss >30 μm was defined as clinically significant [1]. For each of the 40 selected pa pants (20 males and 20 females), intraoral scans were obtained at the 10-year follo visit. Baseline records were derived from digitized gypsum casts originally obtain 2014 and scanned using the same intraoral scanner to ensure consistency. The STL from baseline and follow-up were aligned using Exocad DentalCAD software throu "best-fit" registration protocol. The registration accuracy of the software is within 15 as per manufacturer specifications. Enamel surface loss was calculated through su imposition and 3D subtraction analysis. Surface loss greater than 30 μm was consid clinically significant. The palatal and buccal surfaces of maxillary anterior teeth (ce incisors, lateral incisors, and canines) were evaluated, as these are the most erosion-p regions. This scanning and analysis protocol ensures reproducibility and allows qu fication of subtle enamel changes that may not be visually apparent.

Digital Outcomes:

- Mean enamel loss per participant (in microns)
- Localization of wear (palatal vs buccal surfaces)
- Correlation with BEWE score and intraoral scanning

2.2.3. Demographic Data Collection

Basic demographic variables (age and sex) were collected at baseline. Due to non-interventional design, no dietary, behavioral, or salivary data were recorded.

2.2.4. Statistical Analysis

ital quantification of dental erosion over successive time points. This approach allow precise monitoring of changes in enamel volume or surface contours, overcoming s limitations of visual indices and providing a valuable validation tool for clinical find [16].

The present longitudinal study was conducted over a ten-year period in T Mureș, Romania, with the following aims:

1. To assess the ten-year incidence of dental erosion in a cohort of healthy young a using the BEWE index.
2. To investigate whether gender or other demographic factors are associated wit development of new erosive lesions.
3. To evaluate the sensitivity of the digital surface analysis in detecting early or l ized erosive changes not captured by BEWE.
4. To validate clinical findings through 3D digital surface loss analysis using intr scanning and quantitative measurement of enamel wear.

2. Materials and Methods

2.1. Study Design and Ethical Approval

This prospective, longitudinal observational study was conducted over ten y (2014–2024) in Târgu Mureș, Romania. The study aimed to evaluate the incidence progression of dental erosion in a cohort of healthy young adults. Ethical approval granted by the Institutional Ethics Committee (Approval No. 432/2014), and writte formed consent was obtained from all participants in accordance with the Declarati Helsinki.

Participant Selection and Follow-Up

A total of 540 healthy adults aged 18–30 years were recruited in 2014 from unive and community clinics. Inclusion required a full dentition (excluding third molars) a BEWE score of 0 (no signs of erosion) at baseline. Exclusion criteria included:

- Diagnosed gastroesophageal reflux disease (GERD) or eating disorders,
- Use of medications causing xerostomia,
- Fixed orthodontic appliances or extensive restorations affecting enamel integrit

At the 2024 follow-up, 517 participants (95.7%) were successfully re-examine participants were lost for follow up.

2.2. Clinical Assessment of Dental Erosion

2.2.1. Basic Erosive Wear Examination (BEWE)

Dental erosion was assessed at baseline and follow-up using the BEWE index The dentition was divided into six sextants, and the most severely affected tooth su in each sextant was scored as follows: 0: No erosion; 1: Initial loss of surface textu Distinct hard tissue loss <50% of the surface area; 3: Hard tissue loss ≥50% of the su area.

A BEWE score ≥1 in any sextant at follow-up indicated dental erosion diagnosi clinical assessments were performed by two calibrated examiners, and inter-exan reliability was high (Cohen's kappa = 0.87).

delayed intervention [3]. The importance of identifying erosion early is underscore its irreversible nature and potential to affect quality of life through hypersensiti enamel translucency loss, and restorative complications [4].

Erosive tooth wear (ETW) is a multifactorial condition encompassing the pro sive and irreversible loss of dental hard tissue due to chemical, mechanical, or comb actions [1]. Dental erosion—defined as the chemical loss of enamel and dentin from not derived from bacteria—is one of the principal causes of ETW. While dental er specifically refers to the chemical process, ETW often includes attrition (tooth-to- contact) and abrasion (external mechanical forces). These processes may interact sy gistically, with acidic softening of enamel surfaces increasing susceptibility to mecha wear. As such, assessing dental erosion within the broader context of ETW is cru particularly in young adults, where lifestyle factors such as dietary acids parafunctional habits can accelerate the condition's onset and progression. The cu study focuses on the chemical component—dental erosion—while acknowledgin clinical overlap with other wear mechanisms [2].

Global evidence suggests that dental erosion is increasingly common in y adults [2]. Recent systematic reviews and meta-analyses estimate the worldwide p lence of erosive tooth wear in youth to range from 25% to over 50%, depending o group, region, and diagnostic criteria [5, 6, 7]. However, the incidence of dental sion—defined as the number of new cases developing over a period of time—is r reported, particularly in prospective studies. While prevalence data reflect a snapsh disease burden, incidence studies are crucial for understanding the dynamic natu disease progression and for identifying emerging trends in specific populations [7].

Despite growing interest in erosion-related research globally, there is a notable of longitudinal studies in Eastern European populations [8, 9, 10, 11, 12]. Most res from this region, including Romania, remains cross-sectional and does not provid formation on the natural course of erosive wear [13]. In particular, there is limited da erosion development in young adults—a group often considered at the early stag exposure and disease onset. Understanding erosion incidence in this population c provide important guidance for preventive strategies, early diagnosis, and targeted lic health messaging [12].

Furthermore, little is known about how demographic variables such as gender influence the development of erosive lesions over time. However, studies have sugg that males may be at higher risk due to behavioral, anatomical, or physiological fa [12], still findings remain inconsistent and underexplored in Eastern European con [11].

The BEWE index was first introduced in 2008 by Bartlett et al. as a simpl standardized scoring system designed to facilitate clinical and epidemiological as ments of erosive tooth wear [14]. Since then, it has become a cornerstone tool in general dentistry and research for tracking the severity and progression of non-ca enamel loss. For clinical and research purposes, the Basic Erosive Wear Examin (BEWE) index has been widely adopted as a standardized method for assessing er tooth wear [8]. Its structure allows clinicians to classify severity by scoring the mo fected surface in each sextant, generating a cumulative score that guides clinical ri sessment and monitoring over time. The BEWE has shown good intra- an ter-examiner reliability and has been recommended by the European consensus grou

14. **Borș A**., Beresescu F.G., Székely M. Longitudinal Assessment of Dental Erosion in a Romanian Cohort of Young Adults: A Ten-Year Follow-Up Pilot Study. *Dent. J.*, 2025, **13**, 302. doi:10.3390/dj13070302. **Q1, FI 3.1**

Journal information

DENTISTRY JOURNAL

Publisher name: MDPI

Journal Impact Factor ™

JCR Category	Category Quartile
DENTISTRY, ORAL SURGERY & MEDICINE *in ESCI edition*	Q1

Source: Journal Citation Reports Go to Journal Citation Reports

If you have access to Journal Citation Reports ™ through your institution's subscription, you can view the latest Journal Impact Factor ™ and additional metrics to better understand a journal's content and audience.

Journal Citation Indicator ™

1.15
2024

1.05
2023

JCI Category	Category Rank	Category Quartile

The Journal Citation Indicator is a measure of the average Category Normalized Citation Impact (CNCI) of citable items (articles and reviews) published by a journal over a recent three year period. It is used to help you evaluate journals based on other metrics besides the Journal Impact Factor (JIF). Go to Journal Citation Indicator

Interested in reviewing for this journal?

Add this journal to your reviewer interest list. Add Journal

32

dentistry journal

Article

Longitudinal Assessment of Dental Erosion in a Romanian Cohort of Young Adults: - A Ten-years Follow-Up Pilot Study

Andrea Bors [1*], Felicia Gabriela Beresescu [1] and Melinda Szekely [1]

[1.] Faculty of Dentistry, George Emil Palade University of Medicine, Pharmacy, Science, and Technolo Gheorghe Marinescu Street, Târgu Mureș, 540142, Mureș County, Romania; andrea.bors@umfst.ro (A.B.); cia.beresescu@umfst.ro (F.B.); melinda.szekely@umfst.ro (M.S.)

* Correspondence: andrea.bors@umfst.ro (A.B.); Tel: +40722649493; felicia.beresescu@umfst.ro (F.B.);

Abstract: Background: Dental erosion is the irreversible loss of tooth structure from exposure. Its prevalence is rising globally, making it an important oral health con However, longitudinal data from Eastern Europe are scarce, especially in Romania. pilot study aimed to assess the 10-year incidence of dental erosion in Romanian y adults and to compare clinical index scoring compared with digital scanning. **Meth** A 10-year prospective study followed 540 Romanian adults (aged 18–30) selected wi erosive lesions at baseline (Basic Erosive Wear Examination BEWE = 0). Erosive wear assessed at 10-year follow-up using BEWE, with 40 participants also undergoing di intraoral scanning to measure enamel loss (µm). Gender differences were analy Chi-square tests, relative risk, and correlation analyses were performed. **Results:** Aft years, 23.2% of participants developed dental erosion. Males exhibited a higher incid than females (29.9% vs 17.2%; RR = 1.74, p < 0.001). Among the scanned subset (n = mean enamel loss was 137 ± 79 µm, with greater wear on palatal vs buccal surfaces 0.002). BEWE scores were moderately correlated with digital enamel loss (r = 0.58 0.001). **Conclusions:** Erosion progressed over time in this cohort, with males at hi risk. Digital scanning detected subtle enamel loss not captured by BEWE, indic higher sensitivity for early changes. BEWE and digital methods provided compleme information; combined use offers a more comprehensive assessment.

Keywords: BEWE index; diagnostic; digital dentistry; enamel wear; gender differe intraoral scanning; lesions; longitudinal study; preventive dentistry; Romanian coho

1. Introduction

Dental erosion, defined as the irreversible loss of dental hard tissue due to che processes not involving bacterial activity, has emerged as a growing oral health co in the 21st century [1]. Unlike caries and periodontal disease, which are associated bacterial biofilms, dental erosion progresses due to extrinsic or intrinsic chemical lenges acting directly on the tooth surface. These processes may go unnoticed unti nificant structural injury has occurred, leading to functional and aesthetic complica [2].

The diagnosis of erosion may be clinically challenging due to its asymptor

15. **Borș A**., Székely M., Bardocz-Veres Z., Corneschi I., Ciocoiu R., Antoniac A., Enăchescu C.I. Microstructure and mechanical properties of novel 3D-printed resin reinforced with modified YSZ nanoparticles. *University Series B – Chemistry and Materials Science*, 2024, **86**(4), 97–112. **Q4, FI 0.5**

Journal information

UNIVERSITY POLITEHNICA OF BUCHAREST SCIENTIFIC BULLETIN SERIES B-CHEMISTRY AND MATERIALS SCIENCE

Publisher name: POLYTECHNIC UNIV BUCHAREST

Journal Impact Factor ™

JCR Category	Category Quartile
CHEMISTRY, MULTIDISCIPLINARY *in ESCI edition*	Q4

Source: Journal Citation Reports Go to Journal Citation Reports

If you have access to Journal Citation Reports ™ through your institution's subscription, you can view the latest Journal Impact Factor ™ and additional metrics to better understand a journal's content and audience.

Journal Citation Indicator ™

0.05	0.06
2024	2023

JCI Category	Category Rank	Category Quartile

The Journal Citation Indicator is a measure of the average Category Normalized Citation Impact (CNCI) of citable items (articles and reviews) published by a journal over a recent three year period. It is used to help you evaluate journals based on other metrics besides the Journal Impact Factor (JIF). Go to Journal Citation Indicator

Interested in reviewing for this journal?

Add this journal to your reviewer interest list. Add Journal

U.P.B. Sci. Bull., Series B, Vol. 86, Iss. 2, 2024. ISSN 1454-2331

CHARACTERIZATION OF INNOVATIVE DENTAL RESIN REINFORCED WITH ZIRCONIA NANOPARTICLES OBTAINED BY 3D PRINTING

Andreea BORS[1], Melinda SZEKELY[2], Zsuzsanna BARDOCZ VERES [3], Iuliana CORNESCHI*[4], Robert CIOCOIU[5], Aurora ANTONIAC[6], Catalin Ionel ENACHESCU[7]

Three-dimensional printed resins are gaining significant interest in dentistry. The demand for advanced materials with improved mechanical properties is on the rise to fulfill the growing need for technological developments. The incorporation of zirconia to reinforce three-dimensional (3D) printed resin has demonstrated significant potential in the field of dental restorations. These fillers have been found to improve the mechanical and biological characteristics of dental resins, thereby establishing them as a highly promising alternative dental material in restorative dentistry. Zirconium oxide is a metal oxide that exhibits commercial viability, affordability, non-hazardous properties, and sustainability, hence rendering it suitable for a wide range of prospective applications. The objective of this study was to evaluate the mechanical characteristics of 3D printed resin that has been enhanced with modified Yttrium stabilized zirconia (YSZ) nanoparticle additions. The specimens were analyzed via scanning electron microscopy (SEM), surface-free energy (SFE) measurements, and Shore® (Durometer) test. The results suggest that YSZ nanoparticles could improve the mechanical properties of the reinforced resin. The findings have the potential to enhance the advancement of indirect restorative dental materials.

Keywords: microstructure, mechanical properties, three-dimensional printing, additive manufacturing, Yttrium stabilized zirconia, reinforced resin

[1] Lect., Faculty of Dental Medicine, *George Emil Palade* University of Medicine, Pharmacy, Science, and Technology of Targu Mures, e-mail: andreea.bors@umfst.ro
[2] Prof., Faculty of Dental Medicine, *George Emil Palade* University of Medicine, Pharmacy, Science, and Technology of Targu Mures, e-mail: szekely.melinda@umftgm.ro
[3] Assistant, Faculty of Dental Medicine, *George Emil Palade* University of Medicine, Pharmacy, Science, and Technology of Targu Mures, e-mail: zsuzsanna.bardocz-veres@umfst.ro
[4] Student, Faculty of Materials Science and Engineering, National University of Science and Technology POLITEHNICA Bucharest, e-mail: iuliana.corneschi@stud.sim.upb.ro
[5] Lect., Faculty of Materials Science and Engineering, National University of Science and Technology POLITEHNICA Bucharest, e-mail: robert.ciocoiu@upb.ro
[6] Researcher, Faculty of Materials Science and Engineering, National University of Science and Technology POLITEHNICA Bucharest, e-mail: antoniac.aurora@gmail.com
[7] Doctor, Department of Dermatology, *Elias* Emergency University Hospital, Bucharest, e-mail: catalin_enachescu@yahoo.com

16. Margaritis V., Alaraudanjoki V., Laitala M.L., Anttonen V., **Borș A***., Székely M., Alifragki P., Jász M., Berze I., Hermann P., Harding M. Multicenter study to develop and validate a risk assessment tool as part of composite scoring system for erosive tooth wear. *Clinical Oral Investigations*, 2021, **25**(5), 2745–2756. doi:10.1007/s00784-020-03589-7. **Q1, FI 3.573**

Multicenter study to develop and validate a risk assessment tool as part of composite scoring system for erosive tooth wear

Vasileios Margaritis, Viivi Alaraudanjoki, Marja-Liisa Laitala, Vuokko Anttonen, Andreea Bors, Melinda Szekely, Panagiota Alifr et

ONLINE FIRST

Clinical Oral Investigations

ISSN 1432-6981

Clin Oral Invest
DOI 10.1007/s00784-020-03589-7

Springer

Clinical Oral Investigations
https://doi.org/10.1007/s00784-020-03589-7

ORIGINAL ARTICLE

Multicenter study to develop and validate a risk assessment tool as part of composite scoring system for erosive tooth wear

Vasileios Margaritis[1] · Viivi Alaraudanjoki[2] · Marja-Liisa Laitala[2,3] · Vuokko Anttonen[2,3] · Andreea Bors[4] · Melinda Szekely[4] · Panagiota Alifragki[5] · Máté Jász[6] · Ildikó Berze[6] · Péter Hermann[6] · Mairead Harding[7]

Received: 30 December 2019 / Accepted: 15 September 2020

Abstract

Objectives (i) To develop, validate, and apply in practice a new risk assessment tool for erosive tooth wear (ETW) including a risk factors questionnaire and a saliva secretion evaluation, which combined with a clinical index, can be part of an ETW composite scoring system; (ii) to assess ETW lesions and current and past erosive challenges in younger age groups.

Methods The Tooth Surface Loss/Erosion Working Group of the European Association of Dental Public Health consisted of an international panel of experts designed the survey component of the new tool (Erosive Wear Assessment of Risk—EWAR) and confirmed its construct and content validity. After receiving ethical approvals and informed consents, the EWAR tool (questionnaire + saliva secretion evaluation) was applied in a multicenter cross-sectional study with 207 participants aged 15–21 years old from four countries (Finland, Greece, Romania, the USA). BEWE score was used for the clinical assessment of ETW.

Results A total of 58.5% of participants had ETW. 10.9% and 20.3% of participants had low secretion of stimulated (< 1 ml/min) and unstimulated saliva (< 0.25 ml/min), respectively. The following factors were bivariately significantly associated with ETW: energy drink consumption, low secretion of stimulated saliva, juices consumption, erosive drink consumption for quenching thirst between meals, erosive drink kept in the mouth, feeling pain/icing after consuming something acidic or cold, and co-existence of other type of tooth wear. In regression analysis, only energy drink consumption (OR = 3.5, 95% CI: 1.39, 8.9), low secretion of stimulated saliva (OR = 36.3, 95% CI: 4.71, 78.94), and feeling pain/icing (OR = 8.8, 95% CI: 1.92, 40.04) remained significant.

Conclusions The examiners of the study reported that the EWAR tool appeared to be an affordable and easy-to-use instrument. Some challenges occurred during the saliva collection process. Inferential analysis revealed that the risk factors/indicators of low stimulated salivary flow, energy drink consumption, and pain/icing with ETW were considered the most important in ETW occurrence.

Clinical relevance EWAR tool combined with the BEWE clinical index can be used for ETW risk assessment for epidemiological studies and chairside use.

Keywords Erosive tooth wear · Risk assessment · Erosive risk factors · Saliva flow · BEWE

✉ *vasileios.margaritis@mail.waldenu.edu a.b@umfst.ro*

1 School of Health Sciences, Walden University, 100 Washington Av. South. Suite 1210, Minneapolis, MN 55401, USA

2 Research Unit of Oral Health Sciences, University of Oulu, Oulu, Finland

3 Medical Research Center, Oulu University Hospital and University of Oulu, Oulu, Finland

4 Faculty of Dental Medicine, George Emil Palade University of Medicine, Pharmacy, Science and Technology of Targu Mures, Targu Mures, Romania

5 School of Medicine, National and Kapodistrian University of Athens, Athens, Greece

6 Department of Prosthodontics, Faculty of Dentistry, Semmelweis University, Budapest, Hungary

7 Oral Health Services Research Centre, Cork University Dental School and Hospital, University College Cork, Cork, Ireland

Multicenter study to develop and validate a risk assessment tool as part of composite scoring system for erosive tooth wear

By Margaritis, V (Margaritis, Vasileios) [1] ; Alaraudanjoki, V (Alaraudanjoki, Viivi) [2] ; Laitala, ML (Laitala, Marja-Liisa) [2] , [3] , [4] ; Anttonen, V (Anttonen, Vuokko) [2] , [3] , [4] ; Bors, A (Bors, Andreea) [5 32 ; Szekely, M (Szekely, Melinda)

17. **Borș A**., Cotruț C., Antoniac A., Székely M. Surface analysis of contemporary aesthetic dental filling materials after storage in erosive conditions. *Materiale Plastice*, 2016, 53(4). Q4, FI 0.778

Surface Analysis of Contemporary Aesthetic Dental Filling Materials after Storage in Erosive Solutions

ANDREEA BORS[1], IULIAN ANTONIAC[2], COSMIN COTRUT[2], AURORA ANTONIAC[2*], MELINDA SZEKELY[1]
[1]University of Medicine and Pharmacy, Faculty of Dental Medicine,67A Gheorghe Petrascu,031593,Tirgu Mures, Romania
[2] University Politehnica of Bucharest,Materials Science and Engineering Faculty, 313 Splaiul Independentei,060042,Bucharest, Romania

Clinical performance of restorative materials and their adhesive interfaces can be affected by erosion after rehabilitation of erosive lesions. The aim of the present in vitro study was to evaluate the erosive wear resistance and adhesive bond strength of direct restorative materials, using four different testing tools. Four aesthetic dental filling materials were included in the study: a universal nano-filled composite, a light curing posterior filling composite resin, a tooth-coloured polyacid modified composite resin (compomer) and a coloured compomer indicated in restorations of deciduous teeth. Fifteen specimens were prepared according to each of the four tested restorative materials. Following manufacturers' instructions for the manipulation/ mixing of the materials, adhesive systems and unset pastes were placed in cavities of 4mm length, 3mm width and 1mm depth prepared in bovine extracted teeth and cured. After 24 hours of rehydration in distilled water, each group was immersed in erosive solutions chosen for testing: 1% citric acid and 0.02% phosphoric acid. Scanning electron microscopy (SEM) and atomic force microscopy (AFM) were used in order to analyze the degrees of erosive wear of the materials following exposure to the various erosive solutions. Also, microtensile bond strength (μTBS) was made and the obtained data was analyzed by one-way ANOVA test and two-sample t-test, with a level of significance that was set at $p<0.05$. Experimental results reveal that the dental filling materials showed different behaviour under the same erosive conditions. These findings suggest that erosive wear resistance of direct dental restoratives could influence their longevity in intraoral acidic conditions.

Keywords: dental materials, composites, erosive, wear, microscopy, bond strength.

The improvement in life quality and longevity with the consequent longer maintenance of the teeth in the oral cavity, significantly increased the prevalence and severity of tooth wear in the world population. In addition to that, the combination of factors such as higher consumption of acidic foods and the presence of psychosomatic eating disorders transformed dental erosion in a disorder of great concern to dentists and also in an important and increasing issue worldwide addressed by the researchers [1]. Defined as an irreversible loss of dental hard tissue due to chemical mechanisms, dental erosion does not involve acids derived from oral bacteria, such as the dental caries, but, chelating substances and acids derived from the diet, medication and occupational intrinsic sources [1, 2]. With the development of adhesive systems and within the concepts of minimally invasive restorative treatment the direct composite restorations are conservative procedures that can rehabilitate teeth affected by erosion [3]. Furthermore, it is conceivable that patients will fall back into their old *erosive behaviour* after the application of restoratives [2, 4, 5], therefore the clinical performance of the dental materials and adhesive interfaces can be affected.

Many previous reports have found dental erosion to be significantly associated with the diet factors [6], particularly soft drinks consumption [7]. Unfortunately, consumption of acidic soft drinks has increased continuously during the recent decades in both developed and developing countries [2] and might have led to the increased prevalence of dental erosion [3, 8]. The harmful effects of these beverages include enamel or dentin erosion, dental material and adhesion alteration [9, 10]. Hence, a number of studies described erosion dynamics by acidic beverages, associated or not with abrasion on enamel [8-11, 13] or dentine [12, 14]. Conversely, there is less evidence on the impact of erosive drinks on aesthetic coloured restoratives and on adhesive bond strength between tooth and material [1, 15, 16].

Only few studies have been conducted to investigate any detectable damage on the adhesion of hybrid composite resin samples or other tooth-coloured materials under persisting erosive conditions using dietary acids [1, 17]. Given the growing use of these restoratives and the wide spread use of soft drinks in diet it seemed worthwhile to conduct further studies in this regard.

The aim of this study was to determine the surface changes of contemporary dental direct restoratives subjected to an erosive challenge and the quality of the aesthetic material-tooth structure bonded interfaces using scanning electron microscopy, atomic force microscopy and microtensile bond strength. It was aimed to provide information on aesthetic dental filling materials regarding their relative abilities to resist to erosive attack. The tested experimental hypothesis was that exposure to erosive solutions would influence surface degradation, chemical composition and the created resin–dentine interfaces of the evaluated dental restoratives.

Experimental part

Material and methods

Four aesthetic dental filling materials (shown in table I) were included in the study: (1) a universal nano hybrid composite; (2) a light curing posterior filling composite resin; (3) a tooth-coloured polyacid modified composite

*email: antoniac.aurora@gmail.com; Phone: 0745206509

All authors have participated equally in developing this study

Journal information

REVISTA DE CHIMIE

Publisher name: CHIMINFORM DATA S A

Journal Impact Factor ™

JCR Category	Category Quartile
CHEMISTRY, MULTIDISCIPLINARY *in SCIE edition*	Q3
ENGINEERING, CHEMICAL *in SCIE edition*	Q3

Source: Journal Citation Reports Go to Journal Citation Reports

If you have access to Journal Citation Reports ™ through your institution's subscription, you can view the latest Journal Impact Factor ™ and additional metrics to better understand a journal's content and audience.

Journal Citation Indicator ™

JCI Category	Category Quartile

The Journal Citation Indicator is a measure of the average Category Normalized Citation Impact (CNCI) of citable items (articles and reviews) published by a journal over a recent three year period. It is used to help you evaluate journals based on other metrics besides the Journal Impact Factor (JIF). Go to Journal Citation Indicator

Interested in reviewing for this journal?

Add this journal to your reviewer interest list. Add Journal

← Journal information ×

REVISTA DE CHIMIE

Publisher name: CHIMINFORM DATA S A

Journal Impact Factor ™

JCR Category	Category Quartile
CHEMISTRY, MULTIDISCIPLINARY *in SCIE edition*	Q3
ENGINEERING, CHEMICAL *in SCIE edition*	Q3

Source: Journal Citation Reports Go to Journal Citation Reports

If you have access to Journal Citation Reports ™ through your institution's subscription, you can view the latest Journal Impact Factor ™ and additional metrics to better understand a journal's content and audience.

Journal Citation Indicator ™

JCI Category	Category Quartile

The Journal Citation Indicator is a measure of the average Category Normalized Citation Impact (CNCI) of citable items (articles and reviews) published by a journal over a recent three year period. It is used to help you evaluate journals based on other metrics besides the Journal Impact Factor (JIF). Go to Journal Citation Indicator

Interested in reviewing for this journal?

Add this journal to your reviewer interest list. Add Journal

32

Journal information

MATERIALE PLASTICE

Publisher name: REVISTA CHIMIE SRL

Journal Impact Factor ™

JCR Category	Category Quartile
MATERIALS SCIENCE, MULTIDISCIPLINARY *in SCIE edition*	Q4

Source: Journal Citation Reports Go to Journal Citation Reports

If you have access to Journal Citation Reports ™ through your institution's subscription, you can view the latest Journal Impact Factor ™ and additional metrics to better understand a journal's content and audience.

Journal Citation Indicator ™

0.12	0.12
2024	2023

JCI Category	Category Rank	Category Quartile

The Journal Citation Indicator is a measure of the average Category Normalized Citation Impact (CNCI) of citable items (articles and reviews) published by a journal over a recent three year period. It is used to help you evaluate journals based on other metrics besides the Journal Impact Factor (JIF). Go to Journal Citation Indicator

Interested in reviewing for this journal?

Add this journal to your reviewer interest list. Add Journal

JIM Journal of Interdisciplinary Medicine
A journal of basic and clinical medical research

Târgu Mures, January 10, 2025

To whom it may concern!

We hereby certify that the article entitled "**Erosive Impact of Acidic "Healthy" Beverages on Dental Enamel: A Systematic Review (2013–2025)**" by authors ***Andrea- Izabella Bors, Bernadette Kerekes- Máthé and Gabriela Beresescu*** has been accepted for publication and will be published in 2025 in Journal of Interdisciplinary Medicine, with DOI: 10.1515/jim-2025-0001.

With consideration,

Prof. Theodora Benedek

Editor-in-Chief

[redacted]

ADDRESS OF CORRESPONDECE
Journal of Interdisciplinary Medicine
b.-dul 22 Decembrie 1989, nr. 76, Targu Mures, Romania
phone: +40-265-21 73 33; fax: +40-265-21 73 33
office@interdisciplinary.ro
www.interdisciplinary.ro

JIM Journal of Interdisciplinary Medicine

ORIGINAL RESEARCH

DENTISTRY // BIOPHYSICS // BIOMEDICINE

Comparative Study on the Hardness of Novel 3D-Printed Resin Reinforced with Different Concentrations of Modified Yttrya-Stabilized Zirconia Nanoparticles

Andrea-Izabella Bors[1], Zsuzsanna Bardocz-Veres[2*], Bernadette Kerekes-Máthé[1], Melinda Székely[1]

[1] Department of Tooth and Dental Arch Morphology, Faculty of Dental Medicine, George Emil Palade University of Medicine, Pharmacy, Science, and Technology, Târgu Mureș, Romania

[2] Department of Oral Rehabilitation and Occlusology, Faculty of Dental Medicine, George Emil Palade University of Medicine, Pharmacy, Science and Technology, Târgu Mureș, Romania

CORRESPONDENCE

Zsuzsanna Bardocz-Veres
Email: zsuzsanna.bardocz-veres@umfst.ro

ARTICLE HISTORY

Received: March 27, 2024
Accepted: May 30, 2024

ABSTRACT

Additively manufactured resins are gaining popularity in dentistry due to their unique material properties and improved mechanical performance. The incorporation of yttria-stabilized zirconia (YTZ) particles into 3D-printed resin has shown considerable potential in prosthodontics, supporting the growing demand for technological advancements. These nanoparticles are versatile because of their mechanical strength, thermal stability, chemical inertness, and electrical properties, making them suitable for a wide range of applications. The aim of this study was to analyze the hardness of 3D-printed resin reinforced with modified YTZ nanoparticles and to determine whether a correlation existed between YTZ content and Durometer Shore D values. Specimens were produced using 3D printing technology and categorized according to the amount of YTZ incorporated into the resin: 0%, 1%, and 3%. he results indicate that material performance can be improved through YTZ reinforcement, although further research is required to fully support the broader adoption of this technology.

Keywords: hardness, additive manufacturing, zirconia suspension, 3D-printed resin, yttria-stabilized zirconia

INTRODUCTION

The growing utilization of additive manufacturing (AM) in dentistry over the past decade, particularly in maxillofacial surgery, dental implantology, prosthodontics, orthodontics, and tissue regeneration, has directed researchers' attention toward improving the materials used. AM technology, also known as 3D printing, involves creating three-dimensional objects layer by layer based on a previously generated digital model. Various materials, such as metals, ceramics, polymers, and hydrogels, are used for dental applications, each offering distinct advantages and challenges. Over the years, multiple printing techniques have

Journal of Interdisciplinary Medicine 2025; Epub ahead of print DOI: 10.2478/jim-2024-0004

Bioactivity of Retrograde Dental Root Filling

Materials

• December 2016
• Key Engineering Materials 695:236-242
DOI:10.4028/www.scientific.net/KEM.695.236

Key Engineering Materials
ISSN: 1662-9795, Vol. 695, pp 236-242
doi:10.4028/www.scientific.net/KEM.695.236

Submitted: 2016-11-07
Revised: 2016-12-04
Accepted: 2016-12-04
Online: 2016-12-22

Bioactivity of Retrograde Dental Root Filling Materials

Andreea Borș[1,a], Melinda Székely[1,b], Cristina Molnar-Varlam[1,c], Iulian Antoniac [2,d*]

[1] Faculty of Dental Medicine, University of Medicine and Pharmacy of Tirgu-Mureș, Romania
[2] University Politehnica of Bucharest, Romania

[a]andreeabors@gmail.com, [b]szekely.melinda2013@gmail.com, [c]molnar.stanca@gmail.com, [d]antoniac.iulian@gmail.com (corresponding author)

Keywords: endodontic, biomaterials, scanning electron microscopy, bioactivity.

Abstract. The placement of appropriate root-end filling materials in contact with periradicular tissues, with improved adaptation and biological properties is critical for the long-term success of the periapical surgery. The purpose of the present study was to evaluate and compare the bio-properties of four different root canal filling materials with respect to storage media. Two mineral trioxide aggregates: MTA-Angelus (Angelus, Londrina, PR, Brazil) and ProRoot MTA (Dentsply Maillefer, Ballaigues, Switzerland) and two glass ionomer cements: one conventional Ketac Molar (3M ESPE AG, Seefeld, Germany) and a resin reinforced core build-up glass ionomer Vitremer (3M ESPE AG, Seefeld, Germany) were evaluated. Eighty healthy single-rooted human extracted teeth without curvature and with closed apices were included in this experiment. Each group was divided in two subgroups (n=10) and stored in polypropylene sealed containers for 60 days at 37°C. Specimens of the first subgroup were immersed in 5ml of a physiological-like buffered Ca- and Mg-free solution (PBS, pH=7.4) and those of the second subgroup were in 5ml of deionized water (DW, pH 6.8) After 10 minutes of immersion and at the established endpoint times, the specimens were analyzed by scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDX). Statistical analysis was performed by *t*-test and one-way ANOVA ($p<0.05$). Glass ionomer cements showed the presence of thick irregular deposits ($p<0.05$). In deionized water, EDX analyses revealed no deposits forming after 60 days. SEM analysis showed the margins of MTA and ProRoot MTA with significant discontinuities compared with glass ionomer cements ($p<0.05$). Mineral trioxide aggregate cements are significantly more bioactive compared to conventional or reinforced glass ionomers upon aging in PBS. Glass ionomer cements provide more optimal adaptation to dentinal cavity walls of all cements than MTA cements when used as retrograde fillings.

Introduction

Surgical root canal therapy is often the indicated treatment when nonsurgical retreatment has failed or cannot be performed. Once the root-end preparation has been completed, a suitable root-end filling material is inserted [1, 2]. Most endodontic failures occur as a result of leakage of irritants and microbes from infected root canals, therefore the root-end filling material must provide an adequate apical seal and be biocompatible. Its anti-bacterial effects and ability to stimulate regeneration of the periodontium will accelerate the healing process and reduce the incidence of failures [3]. Root-end materials must be non-toxic, non-irritant, radio-opaque and non-corrosive [1]. Unlike orthograde root canal filling materials, root-end filling materials are placed in direct contact with vital periapical tissues. The tissue response to these materials, therefore, becomes important and may influence the outcome of surgical endodontic treatment.

The deposition of cementum on the root surface after apicectomy is considered a desired healing response and a prerequisite for the reformation of a functional periodontal attachment [4]. Cementum deposition occurs from the circumference of the root-end and proceeds centrally toward the apicected root canal. The cementum provides a 'biological seal,' in addition to the 'physical seal' of the root-end filling by creating a 'double seal' [5].

Bioactivity of Retrograde Dental Root Filling Materials

Article *in* Key Engineering Materials · May 2016

DOI: 10.4028/www.scientific.net/KEM.695.236

4 authors:

Andreea Bors
University of Medicine and Pharmacy of Târgu Mures

Melinda Szekely
University of Medicine and Pharmacy of Târgu Mures

Cristina Molnar-Varlam
George Emil Palade University of Medicine, Pharmacy, Science and Technology, T…

Iulian Vasile Antoniac
Polytechnic University of Bucharest

Competitii

1. Competiție internă câștigată pentru proiectul *Rășina compozită bioactivă modificată cu pulobere de zirconiu, o nouă abordare în medicina dentară restaurativă* organizat de UMFST GE Palade Tg Mureș contract nr. 10127/18/17.12.2020, director de proiect

CONTRACT DE FINANȚARE
PENTRU EXECUȚIE PROIECTE DE CERCETARE
NR. 10122/18 / 17.12.2020

Finanțare:	Venituri proprii
Tip de proiect:	Competiția Internă pentru Granturi de Cercetare Științifică (CIGCS)
Valoarea contractului	24.348 lei
Durata contractului:	12 luni
Nr. de pagini al contractului:	10 (zece)
Finanțator:	Universitatea de Medicină, Farmacie, Științe și Tehnologie „George Emil Palade" din Târgu Mureș
Beneficiar:	Dr. Bocș Andrea Cahila
Semnături:	

De acord pentru Finanțator

De acord pentru Beneficiar [redacted]

Data: 17 decembrie 2020

Data: 17 decembrie 2020

[redacted]

Rector
Prof. Dr. Leonard Azamfirei
[redacted]

Beneficiar
Dr. Bocș Andrea Cahila
[redacted]

Contabil Șef
Ec. Paraschiva Munteanu [redacted]

Consilier juridic
Jr. Manuela Sălăgean
[redacted]

Competiție internă câștigată pentru proiectul cu titlul *Cercetări privind eroziunea dentară: aspecteetiologice și curativo-profilactice*, organizat de Universitatea de Medicină şi Farmacie Târgu Mureş, contract nr.5/30.01.2013, director de proiect

Nr. înregistrare Universitatea de Medicină și Farmacie Tîrgu Mureș 1097/30.01.2013

CONTRACT DE FINANȚARE
PENTRU EXECUȚIE PROIECTE DE CERCETARE
NR. 5 / 30.01.2013

Finanțare:	Venituri proprii
Tip de proiect:	Competiția internă pentru granturi de cercetare
Valoarea contractului	22480 RON
Durata contractului:	12 luni
Nr. de pagini al contractului:	15
Finanțator:	Universitatea de Medicină și Farmacie din Tîrgu Mureș
Beneficiar:	Borș Andreea Izabella
Semnături:	

De acord pentru Finanțator	De acord pentru Beneficiar
Data..................	Data 15.01.2013

Rector
Prof. Dr. Leonard Azamfirei
[redacted]

Contabil Șef
Ec. Paraschiva Munteanu [redacted]

Oficiu juridic
Jr. Manuela Sălăgean
[redacted]

Beneficiar
Borș Andreea
[redacted]

Între:

Universitatea de Medicină și Farmacie din Tîrgu Mureș, cu sediul în Tîrgu Mureș, str. Gh. Marinescu nr. 38, cod poștal 540139, având cont IBAN RO60TREZ476504601X000425 deschis la Trezoreria Tîrgu Mureș, cod fiscal 4322742,, reprezentată prin Rector, prof. Dr. Leonard Azamfirei și Contabil șef, Paraschiva Munteanu, în calitate de **FINANȚATOR,**

și

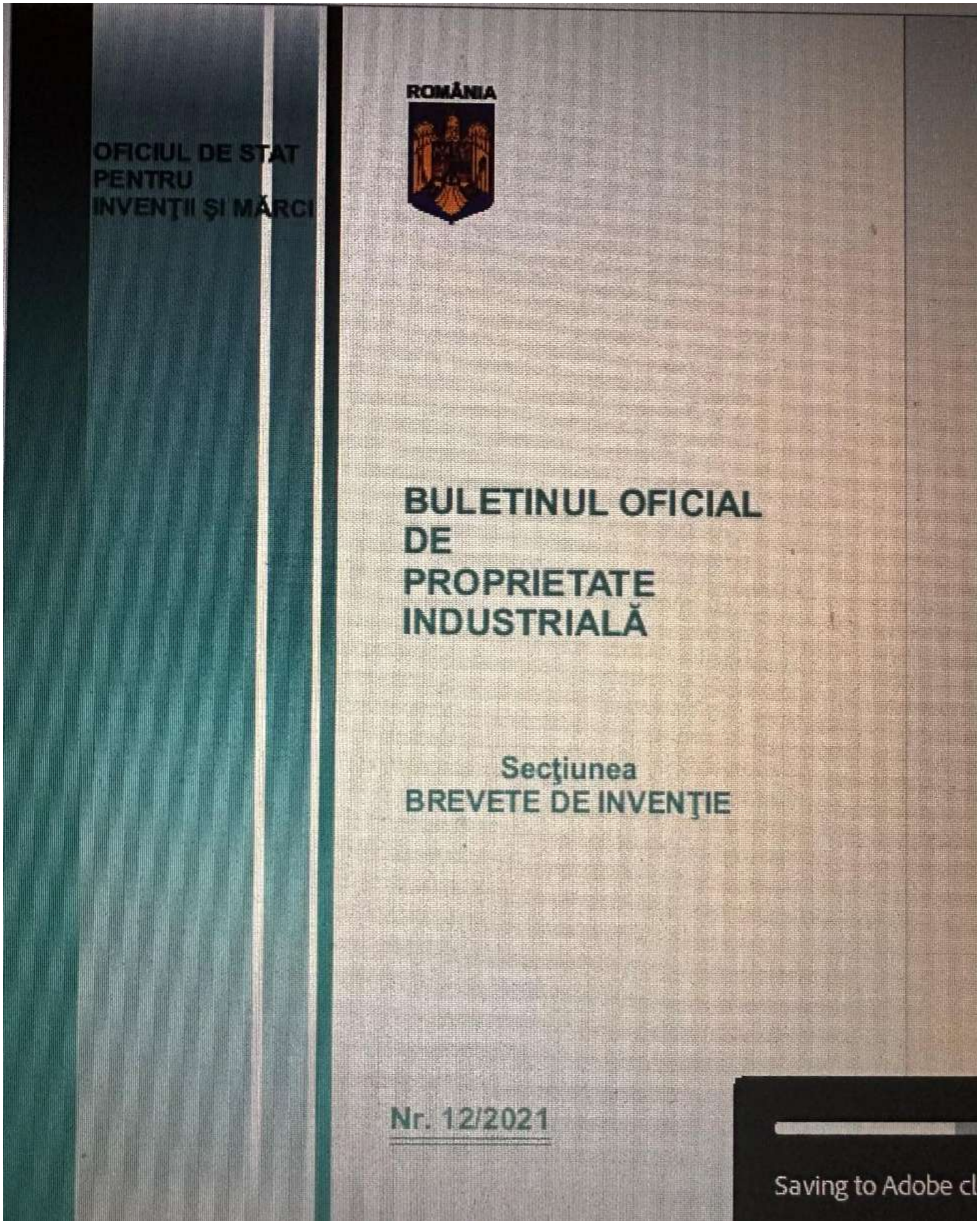
(titularul proiectului)

Borș Andreea Izabella cu domiciliul în Târgu Mureș str. Păltiniș nr. 25 tel cod poștal 540520 tel 0722649493 email andreeabors@gmail.com, angajat la Universitatea de Medicină și Farmacie, Facultatea de Medicină Dentară, Departamentul Medicină dentară II, Disciplina Morfologia dinților și arcadelor dentare; Tehnologia protezelor; Materiale dentare, în funcția de asistent universitar în calitate de **BENEFICIAR,**

s-a încheiat prezentul contract de finanțare a proiectului cu titlul: [redacted]

F. Brevete obţinute în întreaga activitate

Borș Andrea Izabella. Metodă de determinare a eroziunii dentare. RO BOPI 12/2021 din 30.12.2021. 135354 A051 A61B5/00 G01B21/30


OFICIUL DE STAT
PENTRU
INVENŢII ŞI MĂRCI
ROMÂNIA
BULETINUL OFICIAL
DE
PROPRIETATE
INDUSTRIALĂ
Secţiunea
BREVETE DE INVENŢIE
Nr. 12/2021
Saving to Adobe cl

CERERE DE BREVET DE INVENTIE

Nr. referinta solicitant/mandatar	Registratura OSIM (numarul si data primirii):
	A/00290 27-05-2021

Se completeaza de catre OSIM

Numarul cererii de brevet de inventie	
Data primirii la Registratura Generala a OSIM	OSIM
Data de depozit:	
Data primirii partii lipsa la Registratura Generala a OSIM	
Data de depozit după primirea părții lipsă la Registratura Generală a OSIM	
Data primirii cererii de retragere a partii lipsa la Registratura Generala a OSIM	
Data de depozit atribuita cererii de brevet	

1.Solicitanți (nume și prenume/denumire,adresă de domiciliu/sediu,telefon, fax, e-mail)

BORȘ ANDREA-IZABELLA

MUN. TÎRGU MUREȘ, STR. PĂLTINIȘ, NR.25, JUD. MUREȘ

CNP. 2750220264374

2. Solicitam în baza Legii nr. 64/1991 privind brevetele de invenție, republicată, modificată prin Legea nr.83/2014 privind invențiile de serviciu acordarea unui brevet de invenție cu titlul:

Metodă de determinare a eroziunii dentare

2.1. Solicitantul este îndreptățit la depunerea cererii de brevet de invenție în baza :
- Legii nr. 64/1991 privind brevetele de invenție, republicată;
- Legii nr.83/2014 privind invențiile de serviciu,
- unui contract de cercetare

2.2. Referinta la o cerere depusă anterior (numar, data de depozit, tara/oficiul):

3. Declarăm că inventatorii sunt cei desemnați în formularul „ Declarație conținând desemnarea inventatorilor" anexat care va fi transmis ulterior

4. Rezumatul invenției se publică împreună cu figura numarul:

5. Revendicăm prioritatea convențională (stat, numar, data depozit):

6. Revendicăm prioritatea internă (numar cerere de brevet, data depozit):

1/3

7. Cererea de brevet este:
- divizionara din cererea de brevet (numar, data depozit):
- transformată din cererea de brevet european (nr., data de depozit)
- rezultată din conversia unei cereri de înregistrare a unui model de utilitate (nr. cerere inreg. data depozit)

8. La data depunerii cererii solicităm următoarele proceduri:

FORM. B 01 - citiți Ghidul de completare