2023 | Volume 6 | Issue 1

ACTA STOMATOLOGICA MARISIENSIS

Journal

Acta Stomatologica Marisiensis is an official journal of the George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures

Acta Stomatologica Marisiensis
(PRINT) ISSN 2601-6877, ISSN-L 2601-6877
(ONLINE) ISSN 2668-6813, ISSN-L 2601-6877
is published by University Press Tirgu Mures

Corespondence:
Acta Stomatologica Marisiensis
George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures
38, Gh. Marinescu St., 540139, Tirgu Mures, Romania

ACTA STOMATOLOGICA MARISIENSIS

Last update: July 31, 2020

Acta Stomatologica Marisiensis is indexed in the following international databases:

- Baidu Scholar, CNKI Scholar (China National Knowledge Infrastructure), CNPIEC – cnpLINKer, Dimensions, DOAJ, EBSCO, ExLibris, Google Scholar, J-Gate, KESLI-NDSL (Korean National Discovery for Science Leaders), MyScienceWork, Naver Academic, Naviga (Softweco), ProQuest, ReadCube, Semantic Scholar, TDOne (TDNet), WanFang Data, WorldCat (OCLC), X-MOL

AIMS AND SCOPE

Acta Stomatologica Marisiensis is an official Journal of the George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures, Romania, and is published twice a year.
Acta Stomatologica Marisiensis is an international journal dedicated to publishing high-quality peer-reviewed articles about all fields of dental medicine. The important topics covered by the journal refer to the complete, complex and interdisciplinary treatment of the patient with dental problems. This involves addressing all branches of dental medicine and does not exclude research in the field of nanomaterials, biotechnology or medical engineering.
By focusing on the publication of new documents and evidence of high quality research, Acta Stomatologica Marisiensis aims to improve research and clinical practice of dental medicine at an international level.
The journal focuses on the publication of quality medical research articles that bring new insights into dental medicine from the perspective of diagnosis and treatment methods as well as the materials used. No less important are presentations of interesting clinical cases that can bring new light into diagnosis and treatment methods or interdisciplinary therapeutic approaches or collaborations with various fields of engineering for the development of innovative new technologies.
Acta Stomatologica Marisiensis addresses the entire community of dental specialists or related specialties at national and international level and aims to provide studies and materials for a better understanding of diseases and treatments in the sphere of dental medicine.
The Journal emphasis is primarily on original high-quality medical research but also accepts manuscripts relating to the basic sciences, review articles, systemic reviews and meta-analysis, case reports, and observational studies of all types, including randomised control trials, editorial commentary and opinions covering the entire spectrum of research in dental medicine.
The role of the Journal is to inform its readers of ideas, opinions, developments and key issues concerning dental medicine, stimulating interest, debate and discussion amongst dental medicine colleagues and those of related disciplines.
Acta Stomatolocica Marisiensis has institutional support from the George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures, the owner of the journal.

INFORMATION ABOUT THE JOURNAL

ASMJ is an official Journal of the George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures, Romania, and is published twice a year.

Annual subscription rate

Annual subscription rate is 50 Euros for individuals and 100 Euros for institutions (or RON equivalent). Prices include postage and are subject to change.
Methods of payment:
Payments should be made by bank transfer to one of the following accounts:

- in Euros, in the following account:
  Universitatea de Medicină, Farmacie, Științe și Tehnologie "George Emil Palade" (UMFST) Tîrgu Mureș, str. Gheorghe Marinescu 38, Mureș, Romania, CF 4322742, Banca Comercială Română, București, b-dul Regina Elisabeta 5, COD IBAN: RO92RNCB0193015967800002, for: Banca Comercială Română, Sucursala Central Tîrgu-Mureș, Piața Trandafirilor nr. 26.
- in RON, in the following account:
  RO29TREZ47620F331600XXXX, Trezoreria Tîrgu Mureş, for: Universitatea de Medicină, Farmacie Științe și Tehnologie "George Emil Palade" Tîrgu-Mureș, CF 4322742, Str. Gh. Marinescu nr. 38, Mureș.
- On the bank transfer please mention: name/name of the institution; subscription ASMJ.
- Cheques are not accepted.

Publication fee

This journal does not charge for any fees for the publication of articles

Authors reprints

For all queries in connection with author reprints, contact: asmj@umfst.ro
Supplements are normally supplied to subscribers without any extra charge. Single back issues from current or recent volumes are available at the current single issue price of 20 Euros/issue from the University Press Publishing House.
Methods of payment: see annual subscription rate

Digital object identifier

For information about DOIs, please visit http://www.doi.org/

Derivative work

Subscribers may reproduce tables of contents and prepare lists of articles including abstracts for internal use within their own institutions. However, permission from the Publisher is required for resale or distribution of the above mentioned materials outside the institution and for all other derivative works, including compilation and translation.

Environmental policy

The journal is printed on environmentally-friendly ECF (elemental chlorine free) wood-free paper.

Electronic storage and Usage

Permission from the publisher is required to store or use electronically any material contained in this journal.

Advertising inquires

Advertising inquires should be addressed to: asmj@umfst.ro

Drug disclaimer

Any method or technique described, which involves the use of any kind of drug should be interpreted only in accordance to the drugs manufacturer's own published literature. The mention of trade names or commercial products does not imply any endorsement by the journal. The editorial board takes the necessary precautions to verify drug names and dosage, the results of the studies published in the journal and their clinical implications, however the responsibility for the use and dosage of drugs mentioned in the article lies with the medical practitioners.

Material disclaimer

Statements or opinions expressed in ASMJ reflect the view of the authors, who undertake the full responsibility for their work. The editorial board will carefully organize and supervise the entire process of manuscript verification and review to make sure that no inaccurate or misleading data are published in the journal. However, the data and opinion appearing in an article are the responsibility of the contributing authors. Accordingly, the journal accepts no liability for the consequences of such inaccurate or misleading data, opinion or statement. Any kind of scientific misconduct including plagiarism will be immediately reported according to international regulations.

Funding body agreements and policies:

Authors are requested to indicate in the manuscript the source of funding.

Photocopying

Single photocopies of single articles may be made for personal use as allowed by national and international copyright laws. Multiple or systematic copies, copying for promotional or advertising purposes require prior permission from the publisher.

CONTENTS

EDITORIAL

sciendo

DOI: 10.2478/asmj-2023-0001

The power of digital dentistry.

Diana Cerghizan[1], Janosi Kinga Maria[1]

[1] George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Târgu-Mureș, Romania.

Digital technology is present in all fields of our life, including in healthcare. This is because computers work with higher speed and accuracy and lower costs than humans. Nowadays, most of the aspects of clinical practice are computer-assisted. Digital dentistry is used in many dental areas, such as medical record management, photography, digital radiology, intraoral imaging, computer-aided treatment planning, diagnosis, shade matching, and occlusal analysis. Digital technologies help the practician to deliver a treatment plan based on an accurate diagnosis and help the patient to understand the proposed treatment and give informed consent [1-3].

A significant step in dental digitalization occurred in 1980 when the first Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) system was used in dentistry [4, 5]. The primary purpose of this technology was to deliver well-fitting restorations, reduce the cost and processing time, and improve patient satisfaction and aesthetics [1].

This technology provides many advantages, such as the accuracy of a computer-based treatment design/planning, the speed of the digital intraoral impression, the high quality of the digital manufacturing restorations, and any-time reproducibility [1,6]. Another major advantage offered by this technology is the tridimensional simulation which allows the display on the screen of each step of the treatment plan allowing the practician to evaluate from each point of view, enhancing the diagnosis and accuracy capabilities of the treatment. Also, this technology allows rapid and easy communication between the practician, dental technician, and patient, shortening the time in restoration manufacturing [1].

CAD/CAM systems consist of these components: a scanner with software that aids in processing the scanned data and a fabrication system that is comprised of a digital design software and a digital milling machine. The digital workflow, which records both dental arches, allows dental clinicians to evaluate the tooth preparation in real-time. The digital file can be quickly sent via the cloud server to the dental technician, and if any adjustments are necessary, those can be performed before proceeding to the next step [1].

The most considerable innovations in digital dentistry are digital impressions, optically detected by intraoral scanners (IOS), the introduction of the Cone-Beam Computerized Tomography (CBCT), and their combination, thanks to which a faster, more predictable, and safer diagnosis and planning are possible [7]. Intraoral optic impressions of the IOS allow tridimensional captures of the patient's dentitions. Digital impressions provide information about dentition spatial arrangements, occlusal relationships, teeth texture, and shade details [8-10].

The digital models allow progressive treatment planning for surgical and restorative interventions. Intraoral scanners represent the perfect complement for the CAD/CAM technology; the main benefit is the possibility of checking immediately with the patient in the dental chair for impression accuracy. Another significant advantage is the possibility of analyzing interocclusal relationships in such a way as to determine if the occlusal clearance is

appropriate for the specific materials used for manufacturing the restorations through CAD/CAM technologies [1, 11].

Numerous studies have been carried out with the aim of comparing the data obtained by scanning and the reference material. The results show minor differences between intraoral, extraoral scans, and conventional impression data within acceptable limits for clinical use. Many factors, such as sharps margins, powder coating, presence/absence of the buccal fluids, and long cross-arch spans, can influence the accuracy of the digital impressions [12-14].

The primary concern in clinical practice is if the restorations fabricated with the help of the data obtained through digital impressions are equal to those obtained through conventional impressions. Regarding the marginal fit, most of the studies showed no statistical difference between these two approaches to data acquisition [13, 15, 16]. It was proven that the internal fit of the restorations obtained through digital impressions is slightly worse than those obtained from conventional impressions but without clinical significance [17]. A ceramic 3-unit framework digitally performed will fit better than a metallic 3-unit framework fabricated by conventional technology [18].

Digital dentistry gained more significance in implantology, starting with the diagnosis and finishing with well-adapted implant-supported prosthetic reconstructions. A digital impression of the scan bodies allows the implant to reposition in this precise position with the help of CAD software that matches the specific shape of the scan body with its dedicated library, creating the possibility of performing abutments, frameworks, and crowns. This system is more accurate because there are no distortions that can occur in the case of conventional impressions. The combination between the digital impression and data obtained from CBCT allows for a more precise diagnostic and virtual planning of the implant positioning, including the designing/manufacturing surgical guides. In the end, the virtual implant planning can be performed according to a precise prosthetic design, and the surgical template can be realized through the help of 3D printing [1, 19].

Orthodontics has benefited from the introduction of facial and intraoral scanning, 3d printers, and digital radiographs, including CBCT, allowing to facilitate and improve diagnosis as well as the execution of the treatment. Digital models provide advantages over cast stone models, such as easier and quicker data transfer, immediate analysis, and limited storage space. Digital impressions/models can be analyzed with the help of specific software that can provide information about teeth, arch shape, degree of crowding or spacing, etc. All of this can allow simulation and per-visualization of the orthodontic treatment results. The 3D printing technology is also an essential component in orthodontics. Besides assisting in obtaining the model, 3D printing technology is often used in manufacturing aligners. With the help of this technology guides can be performed for the indirect bandaging of brackets, retainers, and appliances for sleep apneas [1].

Intraoral scanning and digital workflow also have applications in dental aesthetics. Digital impressions, photos of the patient's face and smile, and digital smile design software allow the shaping of the aesthetic area of dental arches providing a virtual simulation of the results. This approach is extremely valuable in complex, multidisciplinary oral rehabilitations. In this case, the patient must be involved in choices that affect aesthetics and setting realistic expectations the patient has for treatment outcomes [1, 20, 21].

Dental occlusion is a critical factor in restoration design, longevity, and patient satisfaction [21]. Dynamic and static occlusion captured through CBCT or facial and intraoral scanners allow the creation of a virtual articulator. It can be beneficial in cases involving smile aesthetics, changes in the vertical dimension, computer-assisted implant planning, or digital maxillofacial surgery planning [22, 23].

The development of digital dentistry is now focused on creating 3D virtual patients [24]. Over the course of time different approaches were proposed in order to obtain o reliable method to superimpose the 3D data obtained by intraoral and facial scanning and CBCT [25]. While intraoral scanners are widely studied in literature, and their accuracy and limitations are recognized, the management of facial scans still needs to be investigated [24].

In conclusion, digital dentistry has evolved, facilitating treatment planning and the treatment itself in almost all dental medicine areas. The most important but underestimated tool of digital dentistry and digital workflow is the involvement of the patient, who can view the 3D image of the teeth and the proposed treatments, even contributing to planning.

Conflict of interest: None to declare.

References

1. Tallarico M. Computerization and Digital Workflow in Medicine: Focus on Digital Dentistry. Materials. 2020;13(9):2172.
2. Jahangiri L, Akiva G, Lakhia S, et al. Understanding the complexities of digital dentistry integration in high-volume dental institutions. Br Dent J. 2020;229:66–168.
3. Spagnuolo G, Sorrentino R. The Role of Digital Devices in Dentistry: Clinical Trends and Scientific Evidences. Journal of Clinical Medicine. 2020;9(6):1692.
4. Sulaiman TA. Materials in digital dentistry—A review. J Esthet Restor Dent. 2020;32:171– 181.
5. Tatarciuc M, Diaconu-Popa D, Vitalariu A. Digital dentistry. The Medical-Surgical Journal. 2019;123(4):735-8.
6. Polatoğlu S, Bahadir HS. Digital dentistry. In Kural C: Current Research in Health Sciences. 2023 Mar. pp. 55-70.
7. D. Rekow. Digital dentistry: a comprehensive reference and preview of the future surrey. UK: Quintessence; 2018, P. 41-50
8. Blatz MB, Conejo J. The current state of chairside digital dentistry and materials. Dent Clin North Am 2019; 63:175-197.
9. Miyoshi K, Tanaka S, Yokoyama S, Sanda M, Baba K. Effects of different types of intraoral scanners and scanning ranges on the precision of digital implant impressions in edentulous maxilla: An in vitro study. Clin Oral Implants Res 2020; 31:74-83.
10. Takeuchi Y, Koizumi H, Furuchi M, Sato Y, Ohkubo C, Matsumura H. Use of digital impression systems with intraoral scanners for fabricating restorations and fixed dental prostheses. J Oral Sci 2018;60:1-7.
11. Suese K. Progress in digital dentistry: The practical use of intraoral scanners. Dental Materials Journal. 2020;39(1):52-6.
12. Kirschneck C, Kamuf B, Putsch C, Chhatwani S, Bizhang M, Danesh G. Conformity, reliability and validity of digital dental models created by clinical intraoral scanning and extraoral plaster model digitization workflows. Computers in biology and medicine. 2018;100:114-22.
13. Rekow ED. Digital dentistry: The new state of the art—Is it disruptive or destructive?. Dental Materials. 2020;36(1):9-24.
14. Kim RJ, Park JM, Shim JS. Accuracy of 9 intraoral scanners for complete-arch image acquisition: A qualitative and quantitative evaluation. The Journal of Prosthetic Dentistry. 2018;120(6):895-903.
15. Abdel-Azim T, Rogers K, Elathamna E, Zandinejad A, Metz M, Morton D. Comparison of the marginal fit of lithium disilicate crowns fabricated with CAD/CAM technology by using conventional impressions and two intraoral digital scanners. The Journal of prosthetic dentistry. 2015;114(4):554-9.
16. Rödiger M, Heinitz A, Bürgers R, Rinke S. Fitting accuracy of zirconia single crowns produced via digital and conventional impressions—a clinical comparative study. Clinical oral investigations. 2017;21:579-87.
17. Juntavee N, Sirisathit I. Internal accuracy of digitally fabricated cross-arch yttria-stabilized tetragonal zirconia polycrystalline prosthesis. Clinical, Cosmetic and Investigational Dentistry. 2018:129-40.
18. Benic GI, Sailer I, Zeltner M, Gütermann JN, Özcan M, Mühlemann S. Randomized controlled clinical trial of digital and conventional workflows for the fabrication of zirconia-ceramic fixed partial dentures. Part III: Marginal and internal fit. The Journal of prosthetic dentistry. 2019;121(3):426-31.
19. Kumar PK, Chopra S. CAD-CAM Technology in Dentistry: A Brief Review. MAR Dental Sciences. 2021;2(1):1-11.
20. Yassmin F, Blatz MB. The Impact of Digital Dentistry in Interdisciplinary Esthetic Treatment.

Compendium of Continuing Education in Dentistry (Jamesburg, N.J. : 1995). 2022;43(9):571-576;
21. Queiroz ME, Dallazen E, Tsutsumi MS, et al. Virtual occlusal record: a literature review about the digital method. Research, Society and Development. 2021;10(14):e44101421507.
22. Kwon JH, Im S, Chang M, Kim JE, Shim JS. A digital approach to dynamic jaw tracking using a target tracking system and a structured-light three-dimensional scanner. Journal of prosthodontic research. 2019;63(1):115-9.
23. Lepidi L, Chen Z, Ravida A, Lan T, Wang HL, Li J. A full digital technique to mount a maxillary arch scan on a virtual articulator. Journal of Prosthodontics. 2019;28(3):335-8.
24. Mangano C, Luongo F, Migliario M, Mortellaro C, Mangano FG. Combining intraoral scans, cone beam computed tomography and face scans: the virtual patient. Journal of Craniofacial Surgery. 2018;29(8):2241-6.
25. Raffone C, Gianfreda F, Pompeo MG, Antonacci D, Bollero P, Canullo L. Chairside virtual patient protocol. Part 2: Management of multiple face scans and alignment predictability. Journal of Dentistry. 2022;122:104123.

Corresponding author:
Janosi Kinga Maria
George Emil Palade University of Medicine, Pharmacy, Science and Technology of Târgu Mureș, 38 Gheorghe Marinescu street, Târgu Mureș, 540139, Romania.
Email: kinga.janosi@umfst.ro

Received: April 28, 2023 / Accepted: May 15, 2023

REVIEW

sciendo

DOI: 10.2478/asmj-2023-0002

The link between Noncarious Cervical Lesions (NCCL) and gingival recession. Etiology and treatment. A narrative review.

Luminița Lazăr[1], Zsigmond-Loránd Makkai[1], Timea Dakó[1], Mircea Suciu[1], Ana-Petra Lazăr[1]

[1] George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Târgu-Mureș, Romania

Abstract

Noncarious cervical lesions (NCCL) have a multifactorial etiology. The terms abfraction, abrasion, and erosion are also used to describe the same lesion. NCCLs can lead to gum recession which is one of the most frequent gingival defects. NCCLs generally also involve loss of tooth structure. Therefore, treatments should be planned and performed in an interdisciplinary manner. When NCCL is minimal, the choise to use simple direct restorations is the main therapeutic option. If it is serious, microsurgical treatment or, more precisely, interdisciplinary treatment might be necessary. Root coverage by microsurgical methods is the most challenging esthetic procedure. There are many techniques available of which we must always choose the method that can ensure and control root coverage in the long term.

Keywords: noncarious cervical lesions, gingival recession, root coverage.

Introduction

Noncarious cervical lesions (NCCLs) involve the destruction of hard tissue in the cervical area of the tooth crown and the underlying root surface by pathologies other than tooth decay (without the involvement of microorganisms) [1,2].

It is currently incorrect to label a single mechanism as causing all types of NCCL. Thus, the current state in the field of study mentions a multifactorial etiology of NCCLs [1,3–8]. Once tooth decay is ruled out as the origin of this condition, other factors involved must be recognized. The multifactorial origin manifests with combinations of distinct processes, including stress (abfraction), mechanical wear (abrasion), and biocorrosion (erosion) [1,3,9-12]. Studies indicate that due to noncarious cervical lesions together with dental decay, restoration of permanent teeth is needed [13]. Different terminologies in the literature such as "cervical erosion", "cervical abrasion", and "abfraction" describe the same injury.

There are factors directly linked to the onset of NCCL, such as sex, age, occlusion, diet, saliva, and parafunctions [1,12].

The prevalence of noncarious cervical lesions ranges from 5% to 85% [1,14,15], and their prevalence and severity exhibit age dependency [15–17].

When performing a clinical examination, NCCLs appear as hollow or deep craters, round-shaped or cuneiform irregularity close to the enamel-cementum junction [9]. These lesions can affect the structural integrity of the tooth, facilitate the retention of bacterial plaque, contribute to tooth sensitivity, and influence the vitality and esthetics of the pulp [1,11,18]. These are frequently linked to gingival recession that causes architectural fragility indicated by a low crown-root ratio and esthetic problems [19].

The cervical part of the tooth differs morphologically and histologically from the coronal and root part of the teeth. The enamel gradually becomes thinner approaching the cemento-enamel junction and this is the reason why the cervical region becomes the most vulnerable place, where the dentin can be exposed to the action of irritating agents. The direction of the enamel prisms is flattened, in contrast to their undulating direction in the crown enamel region. The enamel in the cervical region of the tooth contains less minerals and is physically thinner than the rest of the prismatic enamel [20].

Clinical manifestations

Abrasion is the wearing of dental surfaces by interdental foreign substances or bodies. Generally, it is the consequence of friction between a tooth and an external agent [21]. Abrasion can develop because of excessive brushing, one-sided chewing or only on a limited number of teeth, inappropriate use of toothpicks, floss, or parafunctional oral habits. Often, abrasions appear as painless cavities with polished surfaces, but sometimes pain can also occur. Generally, when incorrect brushing is a causing factor, the enamel reacts otherwise compared the dentin that deteriorates in a path made by the toothbrush [11,22-27].

The term erosion or biocorrosion is used to explain the loss of dental hard tissues by electrochemical, biochemical or chemical process without microorganisms. Corrosion has two main causes: endogenous and exogenous factors. When the cause is endogenous (bulimia or gastroesophageal reflux), the enamel seems narrow and see-through. Also, there is loss of enamel on the occlusal surface of posterior teeth, and on the oral surfaces of anterior teeth. Furthermore, on the cervical surfaces of upper frontal teeth, sometimes depressions may occur. If the cause of corrosion is exogenous, the appearance is very much alike, but the location is related to the path of the corrosive item [9]. Studies found that food substances with a lower pH value than 5.5 could be corrosive and teeth demineralizers. When highly acidic foods and carbonated drinks are consumed, corrosion occurs. Mouthwashes that are highly acidic have a similar effect. Teenagers and young children consume a lot of carbonated soft drinks as a main element of their diet. This affection involves not only the cervical areas, but it is coactive with other factors [9]. The interaction of biological, chemical, and behavioral factors is essential and benefits the explanation of why some patients have more erosive lesions than others [11,24].

Dental abfraction defines a dental wear lesion, which occurs mostly at the cervical level, on the buccal surfaces of the frontal and lateral teeth. One of the abfraction theories claims that cervical lesions are caused by physical stress in the form of occlusal pressure, resulting in the breaking of the bonds between the hydroxyapatite crystals, resulting in microfractures in the tooth enamel. These microfractures will favor the loss of dental substance in the cervical region. There are studies that have shown that abfraction may be present with a higher prevalence in patients with bruxism compared to patients without bruxism [28-30].

Gingival recession or retraction (RG), one of the most common gingival defects, is described as the apical movement of free gingival margin towards the CEJ exposing the surface of the root to the oral cavity [31].

A modern recession classification based on the interdental CAL measurement was proposed by Cairo et al. and was incorporated into the new WWC2017 classification as follows [32]:

- Recession Type 1 (RT1): Gingival recession with no loss of interproximal attachment. Interproximal CEJ is clinically not detectable at both mesial and distal aspects of the tooth.
- Recession Type 2 (RT2): Gingival recession associated with loss of interproximal attachment. The amount of interproximal attachment loss (measured from the interproximal CEJ to the depth of the interproximal sulcus/pocket) is less than or equal to the buccal attachment loss (measured from the buccal CEJ to the apical end of the buccal sulcus/pocket).
- Recession Type 3 (RT3): Gingival recession associated with loss of interproximal attachment. The amount of interproximal attachment loss (measured from the interproximal CEJ to the apical end of the sulcus/pocket) is greater than the buccal attachment loss (measured from the buccal CEJ to the apical end of the buccal sulcus/pocket).

Methods of treatment

NCCLs involve loss of tooth structure and gingival recession. If we aim to accomplish a good esthetic result in the course of time, the evaluation and approach to the diagnosis, as well as the treatment must be performed from an interdisciplinary point of view. As treatment methods may alter depending on the form of gingival recession, the level of the free gingival margin and the degree of NCCL, the clinical characteristics of every lesion should be taken into account prior to treatment [33]. At the same time, awareness of a multifactorial etiology guides the practitioner to develop a suitable treatment plan for the patient.

Zucchelli et al. categorized NCCLs and proposed some guidelines to choose the best treatment option. The main indications for treating NCCL are:

1) esthetics, specifically when the lesion is pigmented or combined with gingival recession.
2) dentine hypersensitivity, which causes discomfort for the patient and pain, or dental plaque build-up.
3) carious lesions/demineralization accompanied or not by dentine hypersensitivity.
4) the accumulation of bacterial plaque caused by the aspect or depth of the lesion that not only hinders oral hygiene but even renders it impossible [34].

Topographically, an NCCL can interest only the crown of the tooth (enamel or crown dentin) or only the surface of the root (cementum or root dentin) or may affect both structures. In cases in which NCCL affects the surface of the root, gingival recession can also be observed. NCCLs that only interest the crown region of the tooth can be resolved with direct restorations, while NCCLs that involve the root of the tooth, should receive periodontal surgery. Since in most cases NCCL interests both the crown and root of teeth, it often destroys the cemento-enamel junction, which is the anatomical separation between the crown and the root [35]. After that, the primary criterion for choosing the therapeutic strategy is no longer valid. The clinical and anatomical definitions of the crown and root do not always line up, and the exposed entire surface of the root is covered in soft tissues (Miller classes III and IV) [32]. Furthermore, even in the absence of loss of interdental periodontal support, a tooth with gingival recession may have local circumstances that limit the amount of root covering (i.e., loss of papilla tip or papilla tips, tooth rotation, and tooth extrusion with or without occlusal wear) [35].

When NCCL is minimal, supervision accompanied by using direct restorations is the ideal treatment option. When symptoms are severe, restorative therapy and ongoing interdisciplinary treatment might be required. To be able to make an accurate diagnosis and develop a successful treatment plan, the physician must have access to the patient's complete social, medical, and dental histories as well as a thorough clinical examination that is backed by additional tests such as salivary flow and radiography. Before beginning any irreversible invasive treatment, long-term follow-up is required in some patients [36]. If the patient is troubled by the appearance of their teeth and the lesion is active and causing symptoms, therapeutic action should be taken. Prior to beginning treatment, these aspects must be addressed because they are extremely important. In addition, liaison with general practitioners is indispensable for identifying or developing therapeutic solutions for any general conditions [37].

The treatment of choice for corono-radicular NCCLs should be a combination between restorative and periodontal therapy and should vary depending on the severity, complexity, and cause of the disease [37]. Completion of restorative therapy prior to mucogingival surgery results in several clinical advantages for both strategies. Restorative therapy can be easily performed and completed without compromising the soft tissue, while root coverage treatment is eased by clinical crown reconstruction, which provides a smooth, round and solid substrate for the

periodontal flap [34]. The maximum root coverage (MRC) term is defined by the height at which the gingival margin persists to remain stable after healing from a surgical root coverage procedure [38].

Root coverage is the most demanding esthetic procedure. Azzi, Takei et al. [39,40] found that the prognostication for Miller classes I and II is good to exceptional, while for classes III and IV only limited recovery is expected by using existing techniques.

Numerous feasible techniques known nowadays, such as pedicled grafts, free gingival grafting, subepithelial connective tissue grafting, coronally positioned crescentic flap or guided tissue regeneration, have various degrees of success. Even now, despite numerous cutting-edge surgical techniques and the development of surgical options, a result with 100% root coverage is still impossible. Finding a surgical technique that can guarantee and maintain solid root coverage is thus always important. [41,42].

Pedicled flaps are classified according to the direction of their movement: 1) The rotated flap (rotated or displaced laterally) which includes: laterally positioned flap, transposition flap, double papillary flap. 2) Extended flap (without rotation or lateral displacement) comprising: coronally positioned flap [43].

Coronally positioned flap was used exclusively or combined with other procedures (guided tissue regeneration and subepithelial connective tissue graft). This technique is relatively simple with good esthetic results. It is a predictable procedure to achieve root coverage in Miller class I and II mucogingival defects. The most decisive component in accomplishing full root coverage is the initial gingival thickness. For this reason, this technique (as well as the other pedicled flap techniques) is advised when sufficient keratinized tissue near the gingival recession is present [44,45].

The laterally advanced flap is highly satisfying in the treatment of isolated gingival recessions [46,47]. By combining the esthetics and root coating highlights of the coronally positioned flap technique and the elevated gingival width and keratinized tissue provided by the laterally positioned flap, this technique is highly popular with clinicians. For an effective and predictable result, healthy gingival tissue must be present [48].

It is indicated when there are local anatomical conditions that prevent the formation of a coronally positioned flap, such as: 1. the absence of apical keratinized tissue; 2. the presence of the frenulum or muscle insertion near the gingival margin; 3. white fissures extending to the alveolar mucosa; 4. the presence of deep root abrasions, which require a greater thickness of soft tissues for the formation of a correct profile [49].

Incisions are made in the marginal gingiva and in the interdental papilla at the donor site. A vertical discharge incision is prepared in the apical direction from the gingival margin to the distal surface of the donor area in the sulcular position. A partial thick flap is raised leaving the periosteum intact, which will accelerate the healing of the donor area. The donor flap is rotated in place to cover the defect and is tightly adjusted by suture [45].

The development in gingival width and keratinized tissue height suggests an improvement in the outcome of progressive, isolated recessions and benefits the periodontal health and esthetics of the patient [46,50,51].

The free gingival graft includes both the epithelium and the underlying connective tissue, which is usually harvested from the hard palate and transplanted to the prepared site [45].

In gingival augmentation, free gingival grafting increases buccal depth more predictably than other techniques. Nonetheless, free gingival grafting has certain limitations, like an open wound localized at the donor site and the wound left behind the gingival graft at the recipient site, which may cause postoperative bleeding and pain [52]. The main disadvantage of the free gingival graft is the lack of predictability from an esthetic standpoint [53-55].

Previous studies have shown that the outcome of root covering therapy by using the free gingival graft will not be esthetically successful, as such, from this point of view the conjunctive graft offers better esthetics [52,56-60]. Currently, even if free gingival grafts have proven to be less effective than subepithelial connective grafts in terms of root coverage, they still retain an advantage: they are simple, several teeth can be treated simultaneously, they have easy tissue manipulation, and can be performed when the adjacent keratinized gingiva is insufficient [52]. This technique is optimal in cases with low buccal gingival depth or for teeth that need appropriate root coverage prior to a subgingival filling [60].

Conjunctival grafts are harvested mainly from the level of the palate or from the area of the retromolar trigone. This graft is carefully sutured using at the same time a coronally positioned flap and sutured over it [45]. These are divided into two categories: mucoperiosteal techniques (lamina propria and complete submucosa, periosteum included) [61,62], and mucosal techniques (lamina propria and a fragment of the submucosa) [63,64].

There is an agreement in the field of study that subepithelial connective grafts can improve the prognosis of long-term results [65]. The use of connective tissue for gingival augmentation is preferred when we have a thin mucosa and adequate vestibular depths. Conjunctival grafting can reproduce the appearance of keratinized epithelium, by putting a keratinized tissue under a non-keratinized mucosa changes the epithelium into keratinized tissue [60].

Conjunctival grafting has shown better esthetic and biological results than other techniques (free gingival grafting and guided tissue regeneration) [41,66-68], especially when combined with the modified tunneling technique [69]. But we can achieve equally good results in the reconstruction of the interdental papilla [70,71].

The most important task of the guided tissue regeneration (GTR) technique is to prevent the apical proliferation of the gingival epithelium, thus promoting the regeneration of the connective tissue [72]. It allows a particular restoration of the cementum by the cells of the periodontal ligament, which may form a different attachment from connective tissue in the space between the cementum and the cortical plate of the alveolus. This is done by placing a barrier (membrane) on the surface of the root [45].

Another basic principle in GTR is the formation and preservation of a slot between the cementum and the collagenous membrane [45]. Next to cell exclusion and space maintenance, the membranes used must act as a biomaterial and fulfill other conditions: biocompatibility, tissue acceptance, easy operation, physiological activeness [72].

The thickness of the tissue is the factor that can negatively influence the success of this technique, because if we want to obtain a favorable result, the thickness of the gingival tissue must be at least 1 mm [73].

Today GTR has lost its importance in the management of gum recession due to multiple complications [74].

Conclusions

Noncarious cervical lesions (NCCL) have a multifactorial etiology. Etiological factors and factors favoring the patient can lead to the initiation and progression of these lesions.

The fact that there is a clear link between NCCLs and gingival recession implies the possibility of microsurgical treatment of the lesions in most cases. Since the procedure is very delicate to technique, efficacious surgical intervention is tightly linked to the detection and reduction of causes, the careful choice of the surgical technique, and its appropriate implementation. There are many surgical procedures available to treat gingival recessions, each having benefits and drawbacks. The surgical technique must be carefully chosen for the best possible outcomes over the long term, keeping in mind a number of important considerations. The most effective method to date for treating gingival

recessions is a combination of a coronally advanced flap and a subepithelial connective tissue graft.

It is essential that we continue to understand the etiology, prognosis, and treatment of these lesions with further in vivo studies and meta-analyses.

Conflict of interest: None to declare.

References

1. Galvão ADM, Gonzaga RCQ, Oliveira MAVC, Machado AC, Barbosa GLR, Soares PV, Silva GRD. Can non-carious cervical lesions depth affect clinical response in pain intensity and remaining dentin thickness? Braz Dent J. 2022 Sep-Oct;33(5):108-115.
2. Ali AST, Varghese SS, Shenoy RP. Association Between Cervical Abrasion, Oral Hygiene Practices and Buccolingual Dimension of Tooth Surfaces: A Cross-Sectional Study. J Pharm Bioallied Sci. 2022 Jul;14(Suppl 1):S403-S409.
3. Grippo JO, Simring M, Coleman TA. Abfraction, abrasion, biocorrosion, and the enigma of noncarious cervical lesions: a 20-year perspective. J Esthet Restor Dent. 2012 Feb;24(1):10-23.
4. Deepika BA, Ramamurthy J. Evaluation of occlusal pattern in periodontitis patients using T-scan analysis. J Adv Pharm Technol Res. 2022 Nov;13(Suppl 1):S265-S271.
5. Gomes RR, Zeola LF, Barbosa TAQ, Fernandes Neto AJ, de Araujo Almeida G, Soares PV. Prevalence of non-carious cervical lesions and orthodontic treatment: a retrospective study. Prog Orthod. 2022 May 16;23(1):17.
6. Rusu Olaru A, Popescu MR, Dragomir LP, Popescu DM, Arsenie CC, Rauten AM. Identifying the Etiological Factors Involved in the Occurrence of Non-Carious Lesions. Curr Health Sci J. 2019 Apr-Jun;45(2):227-234.
7. Kitasako Y, Ikeda M, Takagaki T, Burrow MF, Tagami J. The prevalence of non-carious cervical lesions (NCCLs) with or without erosive etiological factors among adults of different ages in Tokyo. Clin Oral Investig. 2021 Dec;25(12):6939-6947.
8. Lussi A, Schlueter N, Rakmatullina E, Ganss C: Dental erosion–an overview with emphasis on chemical and histopathological aspects. Caries Res, 2011; 45 (Suppl 1), 2–12, 2011.
9. Bartlett DW, Shah P: A critical review of non-carious cervical (wear) lesions and the role of abfraction, erosion, and abrasion. J Dent Res, 2006; 85:306–312.
10. Worawongvasu R. Scanning electron microscope characterization of noncarious cervical lesions in human teeth. J Oral Maxillofac Pathol. 2021 Jan-Apr;25(1):202.
11. Badavannavar AN, Ajari S, Nayak KUS, Khijmatgar S. Abfraction: Etiopathogenesis, clinical aspect, and diagnostic-treatment modalities: A review. Indian J Dent Res. 2020 Mar-Apr;31(2):305-311.
12. Hayashi M, Kubo S, Pereira PNR, Ikeda M, Takagaki T, Nikaido T, Tagami J. Progression of non-carious cervical lesions: 3D morphological analysis. Clin Oral Investig. 2022 Jan;26(1):575-583.
13. Sirous S, Navadeh A, Ebrahimgol S, Atri F. Effect of preparation design on marginal adaptation and fracture strength of ceramic occlusal veneers: A systematic review. Clin Exp Dent Res. 2022 Dec;8(6):1391-1403.
14. Haralur SB, Alqahtani AS, AlMazni MS, Alqahtani MK. Association of Non-Carious Cervical Lesions with Oral Hygiene Habits and Dynamic Occlusal Parameters. Diagnostics (Basel). 2019 Apr 12;9(2):43.
15. Teixeira DNR, Thomas RZ, Soares PV, Cune MS, Gresnigt MMM, Slot DE. Prevalence of noncarious cervical lesions among adults: A systematic review. J Dent. 2020 Apr;95:103285.
16. Al-Khalifa KS. The Prevalence of Tooth Wear in an Adult Population from the Eastern Province of Saudi Arabia. Clin Cosmet Investig Dent. 2020 Nov 17;12:525-531.
17. Kothari S, Ranjan M, Ganesh B. Association of age and gender of patients undergoing class V tooth coloured restoration in maxillary teeth. Bioinformation. 2020 Dec 31;16(12):1121-1127
18. Marinescu IR, Popescu SM, Răghici EC, Scrieciu M, Mercuț V, Turcu AA, Nicola AG. Etiological Aspects of Noncarious Dental Lesions. Curr Health Sci J. 2017 Jan-Mar;43(1):54-61.
19. Peumans M, Politano G, Van Meerbeek B. Treatment of noncarious cervical lesions: when, why, and how. Int J Esthet Dent. 2020;15(1):16-42. PMID: 31994534.
20. Barnhart EC, Campbell PM, Noureldin A, Julien K, Buschang PH. The quality of etched enamel in different regions and tooth types and its significance in bonding and the development of white spot lesions. Angle Orthod. 2021 Sep 1;91(5):576-582.

21. Dzakovich JJ, Oslak RR: In vitro reproduction of noncarious cervical lesions, Journal of Prosthetic Dentistry, 2008, 100(1):1–10.
22. Fischer VL, Winkler DE, Głogowski R, Attin T, Hatt JM, Clauss M, Wegehaupt F. Species-specific enamel differences in hardness and abrasion resistance between the permanent incisors of cattle (Bos primigenius taurus) and the ever-growing incisors of nutria (Myocastor coypus). PLoS One. 2022 Mar 17;17(3):e0265237.
23. Borges AB, Santos LF, Augusto MG, Bonfiette D, Hara AT, Torres CR. Toothbrushing abrasion susceptibility of enamel and dentin bleached with calcium-supplemented hydrogen peroxide gel. J Dent. 2016 Jun;49:54-9.
24. Donovan T, Nguyen-Ngoc C, Abd Alraheam I, Irusa K. Contemporary diagnosis and management of dental erosion. J Esthet Restor Dent. 2021 Jan;33(1):78-87.
25. Crastechini E, Borges AB, Torres C. Effect of Remineralizing Gels on Microhardness, Color and Wear Susceptibility of Bleached Enamel. Oper Dent. 2019 Jan/Feb;44(1):76-87.
26. Sobral-Souza DF, Gouveia THN, Ortiz MIG, Condeles AL, Junior JCT, Franz-Montan M, Aguiar FHB, Lima DANL. Altered physical-chemical properties of home bleaching gels after an accelerated stability study and their effects on tooth enamel. Clin Oral Investig. 2022 Dec;26(12):7229-7242.
27. Pinelli MD, Catelan A, de Resende LF, Soares LE, Aguiar FH, Liporoni PC. Chemical composition and roughness of enamel and composite after bleaching, acidic beverages and toothbrushing. J Clin Exp Dent. 2019 Dec 1;11(12):e1175-e1180.
28. Nascimento MM, Dilbone DA, Pereira PNR: Abfraction lesions: etiology, diagnosis, and treatment options. Clin Cosm and Invest Dent, 8:79-87, 2016.
29. Rees JS. The biomechanics of abfraction. Proc Inst Mech Eng H. 2006 Jan;220(1):69-80.
30. Silva AG, Martins CC, Zina LG et al: The association between occlusal factors and noncarious cervical lesions: a systematic review. J Dent, 41(1):9–16, 2013.
31. Cairo F, Nieri M, Cincinelli S, Mervelt J, Pagliaro U. The interproximal clinical attachment level to classify gingival recessions and predict root coverage outcomes: an explorative and reliability study. J Clin Periodontol. 2011;38:661–666.
32. Cortellini P, Bissada NF. Mucogingival conditions in the natural dentition: Narrative review, case definitions, and diagnostic considerations. J Clin Periodontol. 2018 Jun;45 Suppl 20:S190-S198.
33. Yang SE, Lee HJ, Jin SH: A combined approach to non-carious cervical lesions associated with gingival recession. Rest Dent and End, 41(3):218-224, 2016.
34. Zucchelli G, Gori G, Mele M, Stefanini M: Non-Carious Cervical Lesions Associated With Gingival Recessions: A Decision-Making Process. J Perio, 82(12):1713-1724, 2011.
35. Zucchelli G, Testori T, De Sanctis M: Clinical and anatomical factors limiting treatment outcomes of gingival recession: A new method to predetermine the line of root coverage. J Perio, 77:714- 721, 2006.
36. Chu FC, Yip HK, Newsome PR, Chow TW, Smales RJ. Restorative management of the worn dentition: I. Aetiology and diagnosis. Dent Update. 2002 May;29(4):162-8.
37. Milosevic A, O'Sullivan E; Royal College of Surgeons of England. Diagnosis, prevention and management of dental erosion: summary of an updated national guideline. Prim Dent Care. 2008 Jan;15(1):11-2.
38. Zucchelli G, Mele M, Stefanini M, Mazzotti C: Predetermination of Root Coverage. J Perio, 2010, 81(7):1019-1026.
39. Takei H, Azzi R: Periodontal plastic and esthetic surgery. In: Newman MG, Takei HH, Carranza FA, editors. Carranza's Clinical Periodontology, 2002, p. 804
40. Takei H, Azzi R, Han J: Periodontal plastic and esthetic surgery. In: Newman MG, Takei HH, Carranza FA, editors. Carranza's Clinical Periodontology, 2006, p. 1005
41. Chambrone L, Tatakis DN. Periodontal soft tissue root coverage procedures: a systematic review from the AAP Regeneration Workshop. J Periodontol. 2015 Feb;86(2 Suppl):S8-51.
42. Cairo F, Nieri M, Pagliaro U. Efficacy of periodontal plastic surgery procedures in the treatment of localized facial gingival recessions. A systematic review. J Clin Periodontol. 2014 Apr;41 Suppl 15:S44-62.
43. Nanavati B, V Bhavsar N, Jaydeepchandra M. Coronally Positioned Flap for Root Coverage: Comparison between Smokers and Nonsmokers. J Int Oral Health. 2013 Apr;5(2):21-7.
44. Mitra D, Kandawalla S, Potdar P, Patil S, Naniwadekar A, Shetty G. Evaluation of the efficacy of sticky bone and concentrated growth factor membrane along with a coronally advanced flap as compared to coronally advanced flap alone in the

treatment of Miller's Class I and Class II gingival recession defects. J Indian Soc Periodontol. 2022 Nov-Dec;26(6):577-584.
45. Martu S. Managementul terapeutic chirurgical al recesiunii gingivale. Date din literatura. Rom J of Med and Dent Educ, 2015, 4(1):36-43.
46. Ahmedbeyli C, Ipci SD, Cakar G, Yilmaz S: Laterally positioned flap along with acellular dermal matrix graft in the management of maxillary localized recessions. Clin Oral Invest, 2019, 23:595-601,
47. Chambrone LA, Chambrone L. Treatment of Miller Class I and II localized recession defects using laterally positioned flaps: a 24-month study. Am J Dent. 2009 Dec;22(6):339-44.
48. Zucchelli G, Cesari C, Amore C, Montebugnoli L, De Sanctis M. Laterally moved, coronally advanced flap: a modified surgical approach for isolated recession-type defects. J Periodontol. 2004 Dec;75(12):1734-41.
49. Zucchelli G. Mucogingival Esthetic Surgery, Hardcover, 2013, p. 330.
50. Hwang D, Wang HL: Flap thickness as a predictor of root coverage: a systematic review. J Perio, 2006, 77(10):1625–1634.
51. Imber JC, Kasaj A. Treatment of Gingival Recession: When and How? Int Dent J. 2021 Jun;71(3):178-187.
52. Camargo PM, Melnick PR, Kenney EB. The use of free gingival grafts for aesthetic purposes. J Perio, 2001, 27:72-96.
53. Griffin TJ, Cheung WS, Zavras AI, Damoulis PD: Post-operative complications following gingival augmentation procedures. J Perio, 2006, 77:2070-2079.
54. Berlucchi I, Francetti L, Del Fabbro M, Basso M, Weinstein RL: The influence of anatomical features on the outcome of gingival recessions treated with coronally advanced flap and enamel matrix derivative: a 1-year prospective study. J Perio, 2005, 76(6):899-907.
55. Goyal L, Gupta ND, Gupta N, Chawla K: Free Gingival Graft as a Single Step Procedure for Treatment of Mandibular Miller Class I and II Recession Defects Lata Goyal. World J of Plastic Surgery, 2019, 8(1):12-17.
56. Shah R, Thomas R, Mehta DS. Recent modifications of free gingival graft: A case series. Contemp Clin Dent. 2015 Jul-Sep;6(3):425-7.
57. Cortellini P, Tonetti M, Prato GP. The partly epithelialized free gingival graft (pe-fgg) at lower incisors. A pilot study with implications for alignment of the mucogingival junction. J Clin Periodontol. 2012 Jul;39(7):674-80.
58. Lopes TR, Machado CN, Rogacheski MC, Verbicaro T, Giovanini AF, Deliberador TM: Aesthetic improvements in free gingival graft due to its association with frenectomy. RSBO (online). 2013, 10:135-142.
59. Ripoll S, Fernández de Velasco-Tarilonte A, Bullón B, Ríos-Carrasco B, Fernández-Palacín A. Complications in the Use of Deepithelialized Free Gingival Graft vs. Connective Tissue Graft: A One-Year Randomized Clinical Trial. Int J Environ Res Public Health. 2021 Apr 23;18(9):4504.
60. Raoofi S, Asadinejad SM, Khorshidi H. Evaluation of Color and Width of Attached Gingiva Gain in Two Surgical Techniques: Free Gingival Graft and Connective Tissue Graft Covered By Thin Mucosal Flap, a Clinical Trial. J Dent (Shiraz). 2019 Dec;20(4):224-231
61. Sanz-Martín I, Rojo E, Maldonado E, Stroppa G, Nart J, Sanz M. Structural and histological differences between connective tissue grafts harvested from the lateral palatal mucosa or from the tuberosity area. Clin Oral Investig. 2019 Feb;23(2):957-964.
62. Tavelli L, Barootchi S, Greenwell H, Wang HL. Is a soft tissue graft harvested from the maxillary tuberosity the approach of choice in an isolated site? J Periodontol. 2019 Aug;90(8):821-825.
63. Reino DM, Novaes AB Jr, Grisi MF, Maia LP, de Souza SL. Palatal harvesting technique modification for better control of the connective tissue graft dimensions. Braz Dent J, 2013, 24:565-568.
64. Carranza N, Rojas MA. Bilaminar Palatal Connective Tissue Grafts Obtained With the Modified Double Blade Harvesting Technique: Technical Description and Case Series. Clin Adv Periodontics. 2020 Dec;10(4):186-194.
65. Cortellini P, Pini Prato G: Coronally advanced flap and combination therapy for root coverage. Clinical strategies based on scientific evidence and clinical experience, Periodontology 2000, 59:158–184, 2012.
66. Zuhr O, Baumer D, Hurzeler M: The addition of soft tissue replacement grafts in plastic periodontal and implant surgery: critical elements in design and execution. J Clin Periodontol, 41:S123-S142, 2014.
67. Thoma DS, Naenni N, Figuero E, Hämmerle CHF, Schwarz F, Jung RE, Sanz-Sánchez I. Effects of soft tissue augmentation procedures on peri-implant health or disease: A systematic review and meta-analysis. Clin Oral Implants Res. 2018 Mar;29 Suppl 15:32-49.

68. Chambrone L, Salinas Ortega MA, Sukekava F, Rotundo R, Kalemaj Z, Buti J, Pini Prato GP. Root coverage procedures for treating localised and multiple recession-type defects. Cochrane Database Syst Rev. 2018 Oct 2;10(10):CD007161.
69. Zuhr O, Rebele SF, Schneider D, Jung RE, Hürzeler MB. Tunnel technique with connective tissue graft versus coronally advanced flap with enamel matrix derivative for root coverage: a RCT using 3D digital measuring methods. Part I. Clinical and patient-centred outcomes. J Clin Periodontol. 2014 Jun;41(6):582-92.
70. Gadi S, Subramanian S, Prakash PSG, Appukuttan D, Thanigaimalai A, Bahammam MA, Alzahrani KJ, Alsharif KF, Halawani IF, Alnfiai MM, Balaji TM, Patil S. Interdental Papillary Reconstruction by Microtunnelling Technique Using Autologous Biomatrices-A Randomised Controlled Clinical Trial. Medicina (Kaunas). 2022 Sep 22;58(10):1326.
71. Sharma E, Sharma A, Singh K: The role of subepithelial connective tissue graft for reconstruction of interdental papilla: Clinical study. Singapure Dent J, 38:27-38, 2017.
72. Ul Hassan S, Bilal B, Nazir MS, Naqvi SAR, Ali Z, Nadeem S, Muhammad N, Palvasha BA, Mohyuddin A. Recent progress in materials development and biological properties of GTR membranes for periodontal regeneration. Chem Biol Drug Des. 2021 Dec;98(6):1007-1024.
73. Müller HP, Stahl M, Eger T. Failure of root coverage of shallow gingival recessions employing GTR and a bioresorbable membrane. Int J Periodontics Restorative Dent. 2001 Apr;21(2):171-81.
74. Lim G, Lin GH, Monje A, Chan HL, Wang HL. Wound Healing Complications Following Guided Bone Regeneration for Ridge Augmentation: A Systematic Review and Meta-Analysis. Int J Oral Maxillofac Implants. 2018 January/February;33(1):41–50.

Corresponding author:
Timea Dakó
George Emil Palade University of Medicine, Pharmacy, Science and Technology of Târgu -Mureș, 38 Gheorghe Marinescu Street, Târgu -Mureș, 540139, Romania
Email: timea.dako@umfst.ro

Received: February 8, 2023 / Accepted: February 24, 2023

ORIGINAL RESEARCH

sciendo

DOI: 10.2478/asmj-2023-0003

Evaluation of the tensile properties of polished and unpolished 3D SLA- and DLP-Printed specimens used for surgical guides fabrication.

Silvia Izabella Pop[1], Mircea Dudescu[2], Laura Roxana Contac[1], Radu Vasile Pop[3]

[1] George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Târgu-Mureș, Romania

[2] Technical University of Cluj-Napoca, Department of Mechanical Engineering, Cluj-Napoca, Romania

[3] Private practice, Natural Smile Dental Clinic, Târgu Mureș, Romania

Abstract

Introduction: The fundamental mechanical properties of 3D printed surgical guides used in orthodontics represent an important indicator for the accuracy of the insertion of skeletal anchorage devices. The tensile strength of devices printed by stereolithography (SLA) and digital light processing (DLP) methods, respectively, is influenced by factors such as finishing process.

Aim of the study: This study illustrates a comparison of the tensile strength in two different types of 3D printed devices (SLA, DLP respectively) undergoing or not a standard process of polishing.

Material and methods: Twenty-four specimens obtained according to ASTM D638-14 (Standard Test Method for Tensile Properties of Plastics) were used for the evaluation of tensile strength. Four groups of 6 samples from each category were created: SLA polished, SLA unpolished, DLP polished and DLP unpolished. After removing the support, finishing was performed to obtain smooth surfaces, according to the manufacturer's recommendation. Type V specimen was used to perform tensile tests in accordance with the standard procedures ASTM D638-14 which recommends at least five specimens to be tested for each sample.

One-way analysis of variance (ANOVA) and t-test showed statistically significant results at $p < 0.05$. SPSSv17 software was used for statistical analysis of the numerical variables, and also descriptive statistics were performed.

Results: The measurements included: tensile strength (maximum load), tensile stress at maximum load and tensile strain at maximum load. The maximum load (tensile strength) of the polished specimens was lower, both for the SLA and DLP, with no statistical significance results.

Conclusions: The conclusions indicated differences between maximum load and tensile stress at maximum load between polished and unpolished specimens, in both SLA and DLP groups. Althought the polishing process reduces the tensile strenght, the data analysis did not present statistically significant results.

Keywords: 3D printing; surgical guide; tensile testing; tensile strength.

Introduction

Additive manufacturing (AM), has been intensively used in several fields of dentistry for obtaining three-dimensional (3D) printed devices [1,2]. In orthodontics, printed surgical guides are used to aid miniimplant placement in the palatum. Numerous studies have shown that the use of printed surgical guides for mini-implants have increased their placement precision in the anterior region of the palate, thus increasing the predictibility of the treatment with temporary anchorage devices (TADs) [1,3,4-9].

Regarding the different printing technologies, extrusion, resin curing and powder fusion are most frequently used [2,3-9]. The stereolithography and digital light processing are resin curing techniques, caractherised by exposure of photosensitive monomers to controlled high energy or ultraviolet light in order to obtain layers of cured materials [8,10-19]. The advantages of the stereolithography (SLA) and digital light processing (DLP) techniques are high resolutions and extra-finishing of the printed specimens in comparison with the extrusion or powder fusion methods [20].

The evaluation of the mechanical properties of the printed components is a valuable indicator on the clinical behaviour of the above mentioned materials. Several studies investigated the effects of the aging process, building orientation of the layers and pre-conditioning [10,21-30]. Furthermore the resin producer provided information about basic mechanical properties as well [20-23].

Tensile test represents a testing method that provides information about the tensile strength

which enables performance prediction during clinical use of a resin material. Tensile properties rely on several factors regarding the orientation of the layers and printing methods. However, few studies referred to the modifications of the tensile properties due to polishing and processing techniques [8,20-21,24-27].

The main purpose of the present study is to measure the tensile strength in two different types of 3D printed devices (SLA, DLP respectively) undergoing a standard polishing process or not.

Material and methods

Twenty-four standard specimens were manufactured in accordance with ASTM D638-14 (Standard Test Method for Tensile Properties of Plastics) to examine the tensile properties of the polished and unpolished mass materials and were used for the two different kind of printing methods. Using the recommended mass of materials for the manufacturing of surgical guides (DentaGuide, Asiga and Dental SG Resin, Formlab, respectively) were obtained twelve samples by digital light processing procedure (Asiga Max UV, Asiga, Sidney, Australia), and other 12 samples were obtained by stereolitography technique (Form 2, Formlabs, Boston, MA, USA. The specimens obtained using each printing method were distributed into two sub-groups: polished and unpolished. The post-processing sequence of the SLA printed specimens consisted of a 5 min rinsing cycle in 99% isopropanol solution, drying process by air exposure, and light curing (λ = 405 nm) at 60 ◦C for thirty minutes. Finally, after removing the supports and evening the surface, finishing was performed. The polishing treatment was done according to the manufacturers recommendation: high grit sandpaper was used to even out and smooth support marks, then a pumice and a rag wheel were used to obtain a perfectly smooth surface.

Type V specimen was used to perform tensile tests in accordance with the standard procedures ASTM D638-14. When a thickness of 7 mm or less is available the type I specimen shall be used as an optimal option.

This test method can be used to generate data referring to tensile properties for the specification and control of plastics. This information is additionally helpful for the study of quality features, also sustaining the research and development domains.

The testing machine is made of a testing device of the constant-rate-of-crosshead-movement type that consists primarily of the following:

- Fixed member- grip-carrying member that is fixed or virtually stationary.

-A second moveable grip-carrying component is also described in the instruction manual. The grips used to hold the test specimen between the testing machine's fixed and movable members can either be fixed or self-aligning. The testing device's fixed and movable parts are rigidly connected to the fixed grips.

When using this type of fixture, special care must be taken to insert and clamp the specimen so that the direction of pull through the center line of the grip assembly perfectly coincides with the long axis of the test specimen. The self aligning grips are joined to the immovable and movable parts of the testing machine so that they align freely when a force is applied (the longitudinal axis of the specimen coalignes with the centreline of the grip assembly. The specimens should be completely aligned with the direction of pull to prevent any rotating motion that could cause slippage in the grips. The amount of misalignment that self-aligning grips can tolerate has a precise limit. In order to prevent slippage related to the grips as much as possible, the test specimen must be held.

-A drive mechanism that imparts a constant, controlled velocity to the moving element in relation to the stationary element. The control of this pace shall be in accordance with all the provided indications. A reliable load indicator that displays the total tensile load the specimen is carrying while being held by the grips is called a load indicator.

Standard procedures for tensile properties recommends at least five specimens for each sample where isotropic materials or molded specimens are used [28]. For each specimen the process consisted in being loaded at a speed of 1 mm/min during the test and the tensile

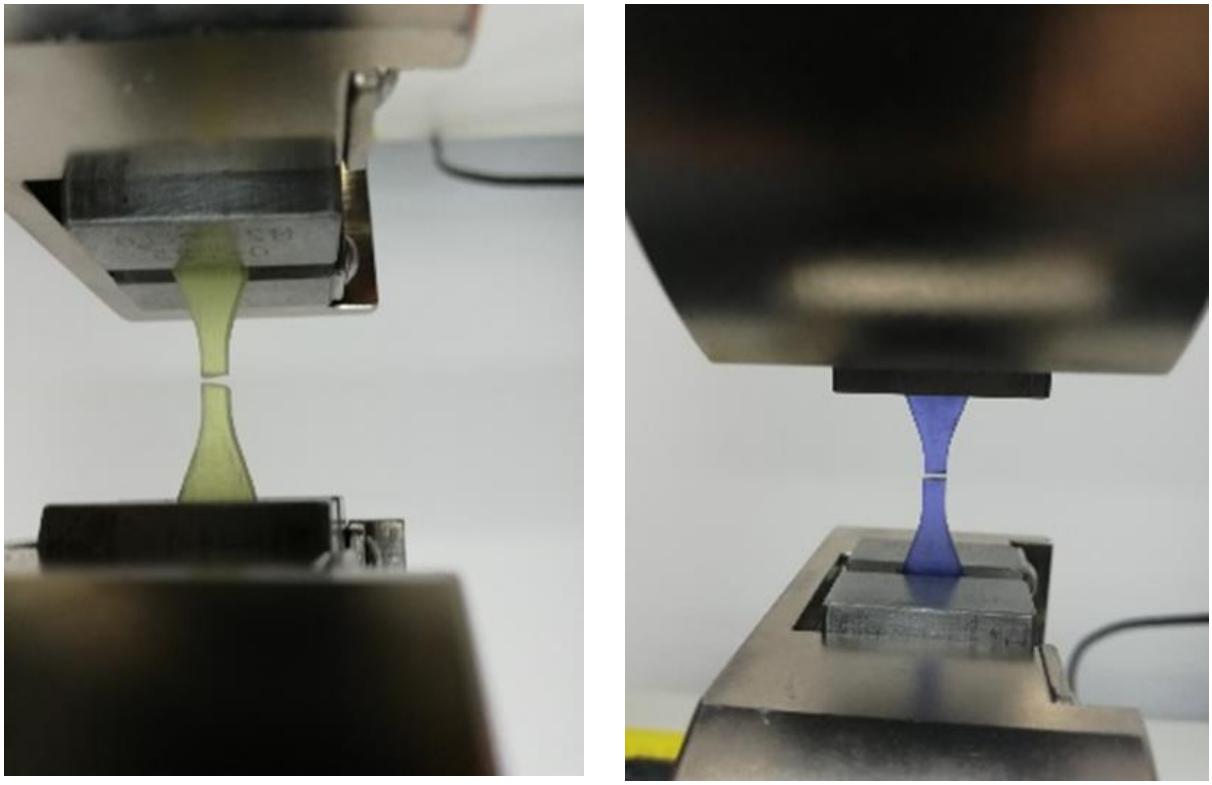
properties of the material were measured as follows: tensile strength (tensile stress at maximum load), tensile strain at maximum load, and tensile modulus of elasticity (figure 2).

To get the tensile strength divide the greatest load that the specimen could withstand in newtons (pounds-force) by the specimen's average original cross-sectional area in square meters (square inches) in the gage length segment. Tensile strength at yield or tensile strength at break, depending on which phrase is appropriate, should be reported and referenced to three significant figures and expressed in Pascals (pounds force per square inch).

When consistent deformation occurs along the specimen gage length, elongation values are accurate and can be recorded. For engineering design, elongation values are quantitatively significant and appropriate. Nominal strain values are reported when non-uniform deformation (such as necking) takes place within the specimen gage length. Nominal strain values are only useful in terms of quality. The percentage change in grip separation related to the starting grip separation represents nominal strain.

The modulus of elasticity, or the ratio of stress (nominal) to corresponding strain below a material's proportional limit, is calculated by extending the initial linear portion of the load-extension curve and dividing the difference in stress corresponding to any segment of section on this straight line by the corresponding difference in strain.

Tensile strength at yield is the measurement made at the point where the maximum stress occurs. Tensile strength at break is defined as the tensile load per unit area of minimal original cross section, borne by the test specimen at any given moment, within the gage boundaries, when the maximum stress occurs at break.



A B

Figure 1. Standard tensile test ASTM D638-14: A - SLA printed specimen, B - DLP printed specimen

The data were analyzed using SPSSv17 software for statistics. For the interpretation of the numerical variables registered, descriptive statistics were performed. Statistical analysis was performed using one-way analysis of

variance (ANOVA) and t-test. The results were considered significant at $p < 0.05$.

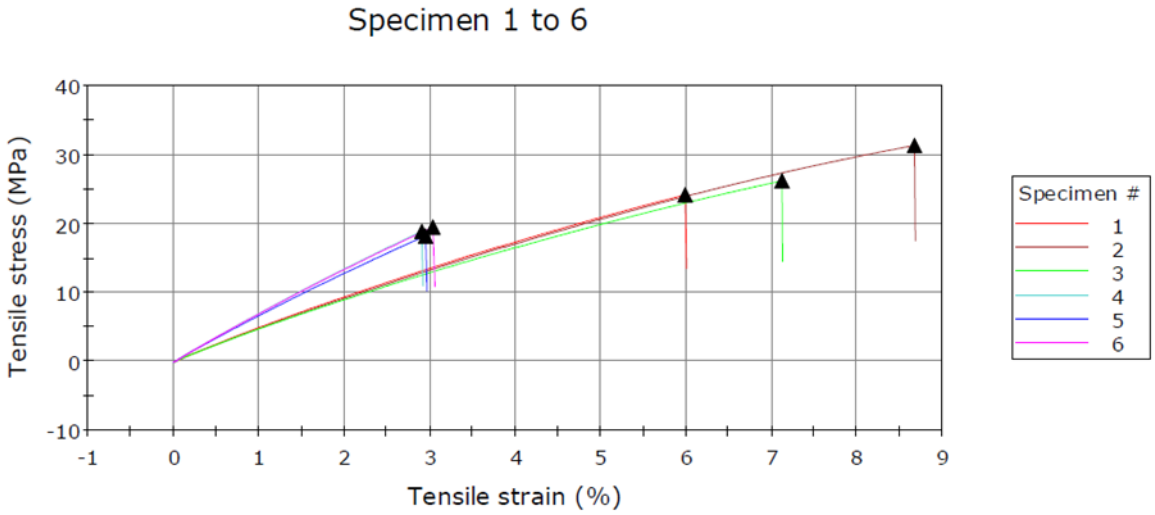


Figure 2. Stress-strain curves of the tensile test: SLA unpolished specimen

Maximum load, tensile stress at maximum load and tensile strain at maximum load were measured for DLP and SLA 3D printed polished and unpolished guides. All data obtained after the evaluation the specimens are represented in table 1.

Table 1. Mean and standard deviations of the measured parameters for the specimens during the tensile test. p value of the ANOVA test

Tensile property	SLA Polished Mean± SD	SLA Unpolished Mean± SD	DLP Polished Mean± SD	DLP Unpolished Mean± SD	*p* Value [c]
Maximum Load (N)	239.51 55.89	428.34 43.54	331.00 30.53	456.83 106.02	**0.003372**
Tensile stress at Maximum Load (MPa)	23.03 5.12	51.08 4.66	32.70 2.97	43.69 10.20	**0.02**
Tensile strain at Maximum Load (%)	**5.11** **2.50**	**8.53** **1.36**	**9.15** **3.35**	**12.45** **1.98**	**0.36**

The values for the maximum load (tensile strength) of the tested specimens were significantly different when all the four groups were compared (p=0.003372). The tensile stress at maximum load was also statistically different. Regarding the tensile stress, the same decrease was observed in this parameter for the SLA and DLP polished printed specimens, compared to the unpolished ones. The maximum load (tensile strength) of the

polished specimens was decresed, both for the SLA and DLP printed specimens, however there was no statistical significance present.

Table 2. p values of the t test: is-insignificant, s- significant

	Polished-Unpolished		SLA-DLP	
	SLA (p)	DLP (p)	Polished (p)	Unpolished (p)
Maximum Load (N)	0.08[is]	0.21[is]	0.2[is]	0.44 [is]
Tensile stress at Maximum Load (MPa)	0.03[s]	0.01[s]	0.25 [is]	0.15 [is]
Tensile strain at Maximum Load (%)	0.43 [is]	0.07 [is]	0.2 [is]	0.3 [is]

Discussions

The aim of this present study is to measure the tensile properties of the materials that 3D printed surgical guides are made of, for orthodontic mini-implant positioning. Regarding the printing methods, SLA and DLP were considered. Both SLA and DLP printing methods work by exposing a resin in liquid form to a light source, UV (ultraviolet) laser beam (for SLA) and stationary UV light (for DLP) [11,12-22, 25]. Evaluation of the tensile properties of a certain material is recommended, especially when in vitro studies of their clinical behaviour are limited [27-30]. According to Chantarapanich, additively printed materials have mechanical properties that can be affected by both the unprinted material properties and the manufacturing method. The tensile strenght of epoxy resin materials increased after a 24 days cycle of ageing because the material has become stiffer but more brittle [30,31]. The same author studied the influence of post-processing treatment of the epoxy materials on their mechanical properties. His study concluded that increasing UV exposure time, increased the strength of the samples [30].

Polishing is recommended after the post processing sequence of the printed guides [31-35]. Our study shows a decreased tensile strenght for both the SLA and DLP printed specimens after polishing, being in agreement with the principles cited in some recent articles [36, 37]. Our study is also in accordance with the findings of Kazemi and Rahimi [38]. They studied the influence exerted by the presence of the supports on the tensile strength of the samples printed by stereolitography. Their study demonstrated that the tensile strenght is influenced by the increasing roughness of the external surface of the specimens. In the meantime, it is well known that the strength of the appliance with symmetrically support was lower than in the same appliance, but unsymmetrically supported [39].

When comparing the stereolitography printed specimen with the digital light processing-printed, neither the maximum tensile load and tensile stress were not significantly different (not for the polished and also not for the unpolished ones). There are several studies that investigated the fundamental tensile strenght and elasticity modulus of the elements printed by SLA technology. [27,40,41]. The results indicated that there are differences between the tensile modulus of 3D prints and their mass materials. Regarding specimens with edge build orientation the tensile properties are slightly different compared to the specimens with flat orientation [42, 43, 44, 45].

When it comes to the interpretation of the measurement results of our study concerning the usual prototypes, the standard samples underlined the mechanical effects on the material's behaviour during polishing procedure.

The main disadvantage of the present research is represented by the in vitro design. Observing and testing how the surgical splints clinically behave could help in obtaining more accurate data. Amplfying the number of the samples and widening the testing methods to include flexurale and bending properties would also introduce significant data for further studies.

Conclusions

The conclusions of our study are as follows:

1. When comparing the polished and unpolished specimens, for both the SLA and DLP printed materials, there were differences between maximum load and tensile stress at maximum load.

2. Polishing reduces the tensile strenght of the specimens, however the values were not statistically significant.

Conflict of interest: None to declare.

Acknowledgments: This work was supported by the George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures, research grant number 10127/16/17.12.2020.

References

1. Mendes JA, Miguel T, Ettore do Valle SF. Immediate orthodontic load on dental implants: an option for adult treatment. Dental Press Journal of Orthodontics. 2019. doi:org/10.1590/2177-6709.24.6.069-079.bbo
2. Graber TM, Vanarsdall RL.Orthodontics. Current principles and techniques. Missouri: Mosby, Inc.; 2000. P.1005-1010.
3. Chung KR, Kim SH, Kook YA. C-Orthodontic microimplant as a unique skeletal anchorage. J Clin Orthod. 2004; 38:478-86.
4. Bae M, Kim J, Park C, KimCD, Hwang HJ. Accuracy of miniscrew surgical guides assessed from cone-beam computed tomography and digital models. Am. J. Orthod. Dentofac. Orthop. 2013;143(6): 893-901.
5. Ligon SC, Liska R, Stampfl J, Gurr M, Mülhaupt R. Polymers for 3D printing and customized additive manufacturing. Chem. Rev. 2017;117:10212–10290.
6. Egan PF, Shea KA, Ferguson SJ. Simulated tissue growth for 3D printed scaffolds. Biomech. Model. Mechanobiol. 2018;17:1481–1495.
7. Egan PF. Integrated Design Approaches for 3D Printed Tissue Scaffolds: Review and Outlook. Materials. 2019;2:2355.
8. Ngo TD, Kashani A, Imbalzano G, Nguyen KT, Hui D. Additive manufacturing (3D printing): A review of materials, methods, applications and challenges. Compos. Part B Eng. 2018;143:172–196.
9. Ventola CL. Medical applications for 3D printing: Current and projected uses. Pharm. Ther. 2014;39:704.
10. Liaw CY, Guvendiren M. Current and emerging applications of 3D printing in medicine. Biofabrication. 2017;9:024102.
11. Jonathan G, Karim A. 3D printing in pharmaceutics: A new tool for designing customized drug delivery systems. Int. J. Pharm. 2016;499:376–394.
12. Yuan X, Xuan M, Tian W, Long J. Application of digital surgical guides in mandibular resection and reconstruction with fibula flaps. Int J. Oral. Maxillofac. Surg. 2016; 45:1406–1409.
13. Török G, Gombocz P, Bognár E, et al. Effects of disinfection and sterilization on the dimensional changes and mechanical properties of 3D printed surgical guides for implant therapy—Pilot study. BMC Oral. Health. 2020; 20:19
14. Lee KY, Cho JW, Chang NY, et al. Accuracy of three-dimensional printing for manufacturing replica teeth. Korean J. Orthod. 2015;45:217–225.
15. Juneja M, Thakur N, Kumar D, Gupta A, Bajwa B, Jindal P. Accuracy in dental surgical guide fabrication using different 3-D printing techniques. Addit. Manuf. 2018; 22:243–255.

16. Rutala WA, Gergen MF, Weber Qiu L, et al. Accuracy of orthodontic miniscrew implantation guided by stereolithographic surgical stent based on cone-beam CT-derived 3D images. Angle Orthod. 2012;82(2):284-93.
17. Mora MA, Chenin DL, Arce RM. Software tools and surgical guides in dental-implant-guided surgery. Dent Clin North Am. 2014;58(3):597-626.
18. Kim T, Lee S, Kim GB, et al. Accuracy of a simplified 3D-printed implant surgical guide. J. Prosthet. Dent. 2020; 124(2):195-201.
19. Shaheen E, Alhelwani A, Van De Casteele E, Politis C, Jacobs R. Evaluation of Dimensional Changes of 3D Printed Models After Sterilization: A Pilot Study. Open Dent J. 2018;12(Suppl-1, M3):72–9.
20. Arefin AME, Khatri NR, Kulkarni N, Egan PF. Polymer 3D Printing Review: Materials, Process, and Design Strategies for Medical Applications. Polymers. 2021;13(9):1499.
21. Figl M, Weber C, Assadan O, et al. Splint sterilization-a potencial registration hazard in computer-assisted surgery. J Oral Maxillofac Surg. 2012;70:966–71.
22. Safia S, Prashant N Shoeb SY, Arshad JS, Mohammed AH. Current perspectives of 3d printing in dental applications. Brazilian Dental Science. 2021;24(3):1-9.
23. Taormina G, Sciancalepore C, Bondioli F, Messori M. Special resins for stereolithography: In situ generation of silver nanoparticles. Polymers. 2018;10(2):212.
24. Pohlmann AR, Fonseca FN, Paese K, et al. Poly(-caprolactone) microcapsules and nanocapsules in drug delivery. Expert Opin. Drug Deliv. 2013;(10):623–638.
25. Tofail SAM, Koumoulos EP, Bandyopadhyay A, Bose S, O'Donoghue L, Charitidis C. Additive manufacturing: Scientific and technological challenges, market uptake and opportunities. MaterialsToday. 2018;(21):22–37.
26. Miedzinska D, Gieleta R, Popławski A. Experimental Study on Influence of Curing Time on Strength Behavior of SLA-Printed Samples Loaded with Different Strain Rates. Materials. 2020;13(24):5825.
27. Camus D, Thiveaud D, Josseran A. New European medical device regulation: How the French ecosystem should seize the opportunity of the EUDAMED and the UDI system, while overcoming the constraints thereof. Therapies. 2019;(74):73-85.
28. Choong YYC, Maleksaeedi S, Eng H, Yu S, Wei J, Su PC. High speed 4D printing of shape memory polymers with nanosilica. Appl. MaterialsToday. 2020;18:100515.
29. Agrawal S, Ray H, Kulat A, et al. Evaluation of tensile property of SLA 3D printed NextDent biocompatible Class I material for making surgical guides for implant surgery, MaterialsToday: Proceedings 2022;(09):288.
30. Chantarapanich N, Puttawibul P, Sitthiseripratip K, Sucharitpwatskul S, Chantaweroad S. Study of the mechanical properties of photo-cured epoxy resin fabricated by stereolithography, Songklanakarin J. Sci. Technol. 2013; 35(1):91–98.
31. Mansour S, Gilbert M, Haguec R. A study of the impact of short-term ageing on the mechanical properties of a stereolithography resin, Mater. Sci. Eng. 2007;(447): 277–284.
32. Kim SY, Shin YS, Jung HD, Hwang CJ, Baik HS, Cha JY. Precision and trueness of dental models manufactured with different 3-dimensional printing techniques. Am. J. Orthod. Dentofac. Orthop. 2018;(153):144–153.
33. Unkovskiy A, Bui PH, Schille C, Geis-Gerstorfer J, Huettig F, Spintzyk S. Objects build orientation, positioning, and curing influence dimensional accuracy and flexural properties of stereolithographically printed resin. Dent. Mater. 2018;(34): 324–333.
34. Kokkinis D, Schaffner M, Studart AR. Multimaterial magnetically assisted 3D printing of composite materials. Nat Commun. 2015;(6):8643.
35. Ober TJ, Foresti D, Lewis JA. Active mixing of complex fluids at the microscale. Proc. Natl. Acad. Sci. USA. 2015;(112):12293–12298.
36. Wendel B, Rietzel D, Kühnlein F, Feulner R, Hülder G, Schmachtenberg E. Additive Processing of Polymers. Macromol. Mater. Eng. 2008;(293):799–809.
37. Sodupe-Ortega E, Sanz-Garcia A, Pernia-Espinoza A, Escobedo-Lucea C. Accurate Calibration in Multi-Material 3D Bioprinting for Tissue Engineering. Materials 2018;(11):1402.
38. Kazemi M, Rahimi AR. Supports effect on tensile strength of the stereolithography parts. Rapid Prototype. J. 2015;(21):79–88.
39. Qipeng G. Thermosets. Structure, Properties and Applications, 1st Edition. Cambridge: Woodhead Publishing Limited; 2012. P.328.
40. Takemori MT. Towards an understanding of the heat distortion temperature of thermoplastics. Polym. Eng. Sci. 1979;(19):1104–1109.
41. Zhang Z, Zhang J, Liu H. High-impact toughness Poly(vinyl chloride)/(α-Methylstyrene)-Acrylonitrile-Butadiene-Styrene copolymer/Acrylic resin blends: Thermal properties and toughening mechanism. J. Vinyl Addit. Technol. 2014;(21): 205–214.
42. Pillai S, Upadhyay A, Khayambashi P, et al. Dental 3D-Printing: Transferring Art from the Laboratories to the Clinics. Polymers. 2021;(13):157.
43. Pawar BA. Maintenance of space by innovative three-dimensional-printed band and loop space

maintainer. J. Indian Soc. Pedod. Prev. Dent. 2019;(37):205–208.
44. Sanchez-Monescillo A, Duarte S. PROA concept: Prosthetic restoration with orthodontic appliance. Quintessence Int. 2020;(51):304–308.
45. Graf S, Vasudavan S, Wilmes B. CAD-CAM design and 3-dimensional printing of mini-implant retained orthodontic appliances. Am. J. Orthod. Dentofac. Orthop. 2018;(154):877–882.

Corresponding author:
Laura Roxana Contac
George Emil Palade University of Medicine, Pharmacy, Science and Technology of Târgu Mureș, 38 Gheorghe Marinescu street, Târgu Mureș, 540139, Romania
Email: lauracontac92@gmail.com

Received: April 7, 2023 / Accepted: May 29, 2023

CASE SERIES

sciendo

DOI: 10.2478/asmj-2023-0004

The influence of the prosthetic abutments colour in the aesthetics of the frontal teeth. A case report.

Denisa Tabita Sabău[1], Raluca Iulia Juncar[1], Abel Emanuel Moca[1], Mihai Juncar[1]

[1]University of Oradea, Faculty of Medicine and Pharmacy, Department of Dental Medicine

Abstract

Introduction: Prosthetic restorations in the frontal teeth, in addition to functional and prophylactic requirements, must respond in a special way to aesthetic needs. This desideratum is a challenge, especially when the support for the future prosthetic parts is not characterized by a uniformity of color. This paper wants to highlight the importance of the color of prosthetic abutments, in the case of single restorations, for the frontal teeth. Case presentation: This manuscript presents the clinical case of a patient, with different prosthetic abutments, namely: a hybrid implant abutment - titanium and zirconium (lateral incisor - 1.2), nonvital natural teeth (central incisors – 1.1 and 2.1) and a vital natural tooth (lateral incisor – 2.2). Three single ceramic crowns on zirconium were confectioned, one with implant support and the other two on dental support, and a veneer for the vital lateral incisor. Conclusions: The prosthodontist must develop the best prosthetic solution for each individual case, together with the technician, so that the aesthetic results are not negatively influenced by the different colors of the existing prosthetic abutments.

Keywords: aesthetics, mixed abutments, anterior area, single crowns, case report.

Introduction

Over the years, numerous implant systems, implant abutments and types of prosthetic restorations have been introduced, with the aim of providing functional and aesthetic results as natural as possible, in cases of single teeth [1]. The use of implants in the aesthetic area is well documented in the specialized literature. Numerous studies have reported a success rate of implants inserted in this area, compared to those inserted in other segments of the maxillary bones [2]. The criteria underlying the success of an implant over time include: its biological integration, the absence of mechanical complications, and the aesthetic integration of the restoration with the adjacent teeth [2,3].

High demands and expectations are challenges for implant restorations in the aesthetic area [4]. Choosing the most suitable type of implant abutment is a critical step for the success of the final results. Titanium abutments have demonstrated longevity based on excellent biocompatibility and increased mechanical strength, although they often result in gray discoloration of the peri-implant mucosa [3,5]. Aesthetic requirements and high expectations are real challenges for prosthetic rehabilitation. Esthetic results have been improved by the development of ceramic oxide abutments, such as aluminum oxide and zirconium oxide, which have even better strength than titanium abutments [6]. Systematic studies comparing ceramic abutments with titanium abutments have not revealed significant differences in mechanical complications or their survival rate [7]. In terms of aesthetic results, zirconium abutments obtained better values than other materials [1] and a better color match was observed for ceramic restorations, although a color change of the mucosa could be highlighted for both types of materials [8]. Ytrium-stabilized zirconia for CAD-CAM technology has increased mechanical strength compared to alumina and biocompatibility comparable to that of titanium [9].

Regarding the influence of the type of crown retention: screwed or cemented, on the aesthetic results, in zirconia abutments, no significant differences were revealed between the two groups [10].

The aesthetic results of different types of implant abutments were also evaluated according to the degree of patient satisfaction.

Most comparative studies between ceramic and titanium have not revealed significant differences in this regard [7,11]. Most of the time, however, when patients were dissatisfied, the main reason reported was related to the color of the dental crowns and their morphology [12].

The aim of this paper was to compare the aesthetic results obtained in the anterior area, when single multilayered ceramic crowns were made on zirconium support, also when the prosthetic substrate was different, both in color and in structure, such as: an implant abutment, dental abutments, next to a vital tooth, prepared for a ceramic veneer.

Case presentation

This case was conducted by a specialist in Prosthodontics with a clinical experience of more than 15 years (D.T.S.). In addition, the technical part was carried out by a dental laboratory, run by a technician with more than 10 years of experience.

A 26-year-old patient presents to a private dental clinic from Oradea, for specialized treatment in the maxillary frontal area, the main complaint being the dissatisfaction related to the color differences at the level of the upper incisors and therefore the unaesthetic smile. Following a thorough clinical examination and radiological investigations, it was found that tooth 1.2 (upper right lateral incisor), covered with a metal-ceramic crown, had a periapical granuloma, as a recurrence following an apical resection. For these reasons, it was decided to extract and replace it with an implant.

Tooth 1.1 (upper right central incisor) had an inadequate filling with secondary caries and a negative response to the vitality test, so an endodontic treatment was recommended. The upper left central incisor (tooth 2.1), already had an appropriate endodontic treatment, as a result, two crowns were proposed for both central incisors. For tooth 2.2 (upper left lateral incisor), being vital and without dental diseases, besides a slight rotation, the application of a dental veneer was recommended to improve the aesthetic effect in this area.

Figure 1 shows the dental and periapical status when the patient arrived in the dental office.

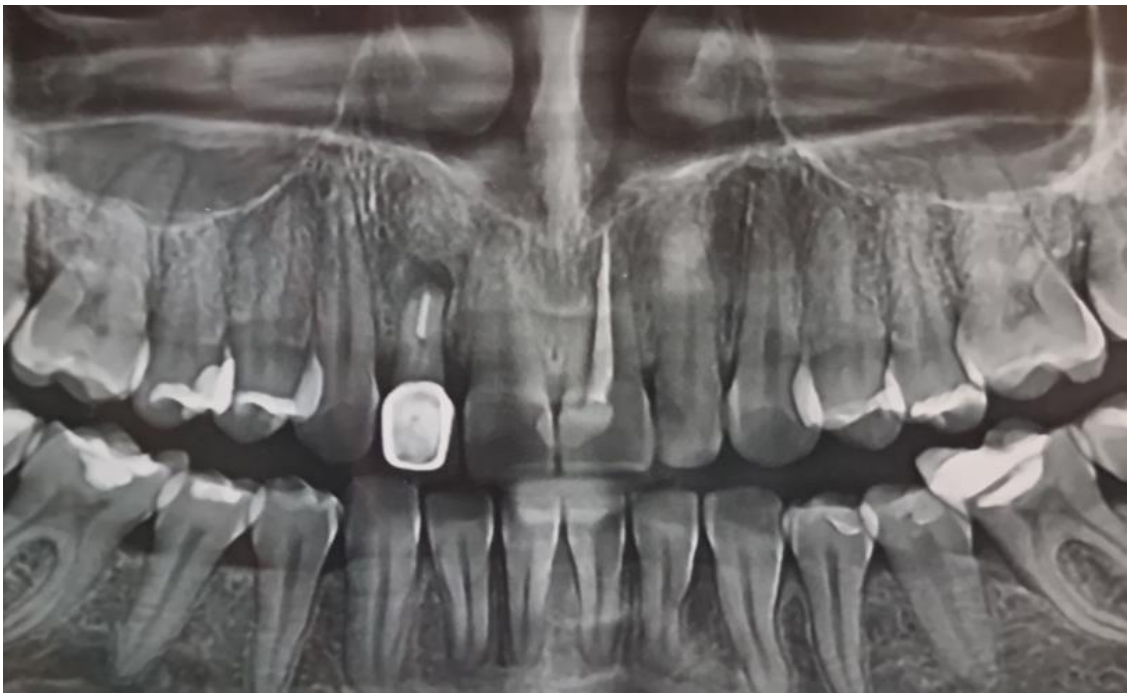


Figure 1. Panoramic radiograph

After obtaining the patient's consent for this treatment plan, the extraction and insertion of an implant was performed in the same session. A Megagen Anyone implant with a diameter of 4 mm and a length of 10 mm was chosen.

In order to support the aesthetic and phonetic function for the pacient, an acrylic Kemeny flipper was made to cover the missing thooth 1.1 during the osseointegration period.

Figure 2 represents the periapical radiograph at the time the healing cap was positioned and the endodontic treatment for 1.1 was done.

At the end of the approximately 6-month of osseointegration period, the patient presented for the continuation of the prosthetic treatment, for the maxillary frontal teeth.

A healing cap was applied for 3 weeks to obtain a healthy gingival biotype and emergence profile for the future implant crown (Figure 3).

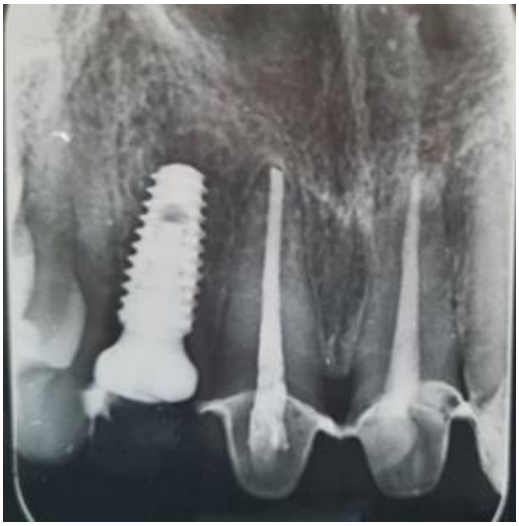


Figure 2. Radiograph after implant placement

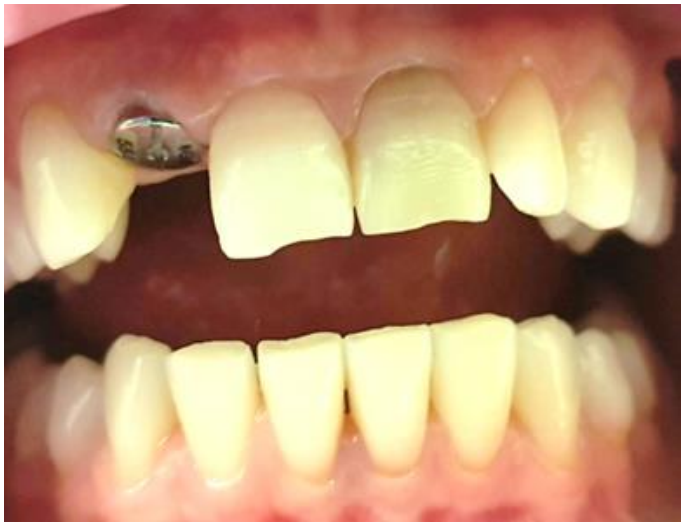


Figure 3. Healing cap

The established prosthetic treatment consisted of: three single porcelain crowns fused to zirconia, one was a screwed implant supported crown with a hybrid abutment (titanium t-base and customized zirconium abutment) for tooth 1.2, and the other two crowns, on natural teeth, with different shades, respectively maxillary central incisors 1.1 and 2.1, as well as a ceramic veneer on a vital tooth, therefore with a specific shade, on the lateral incisor 2.2.

The major challenge in this case was represented precisely by the difference in color of the prosthetic substrate, and the need to obtain uniform, optimal and satisfactory aesthetic results for the patient.

When the emerging gingival period has ended, before the preparation stage of the teeth for the covering crowns, respectively the veneer, an impression was recorded with a condensation silicone in a standard tray, to obtain temporary crowns by the direct method, as a provisional prosthetic treatment.

The upper central incisors were prepared with a Chamfer finish line, and the 2.2 lateral incisor was made suitable for a veneer (Figure 4).

For the purpose of the impression, a transfer rod was fixed in the implant, and an individual open tray was used, the impression was made using an addition silicone, by the compressive method in one step (Figure 5).

Figure 4. Incisors preparation

Figure 5. Transfer rod in the implant

Given the particular characteristics of this case, together with the dental laboratory, the use a hybrid implant abutment was decided, specifically titanium t-base on which a customized zirconium abutment was cemented. To cover the discoloration of dental abutments, single multilayered ceramic crowns on zirconium caps were made, and the veneer was made of E-max ceramic.

One week later, the patient was called for an intermediate session for the trial of the zirconium caps, which was attended by the ceramist to check and establish a desired final color, with a uniformizing and homogenous effect, which would lead to the desired aesthetic results for this area (Figure 6, 7).

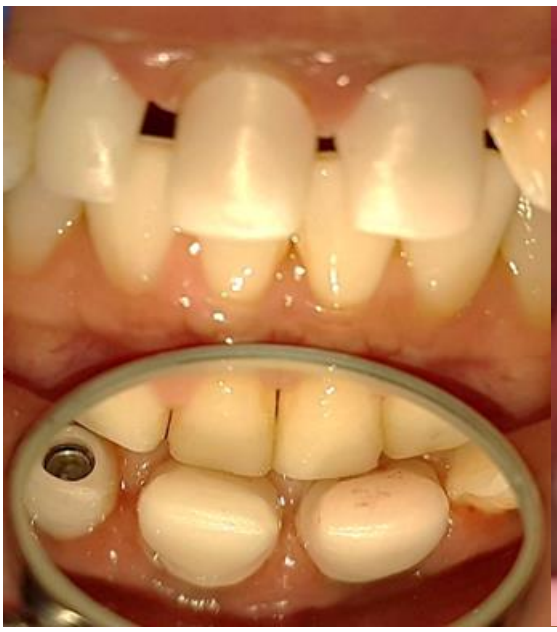


Figure 6. Zirconium caps

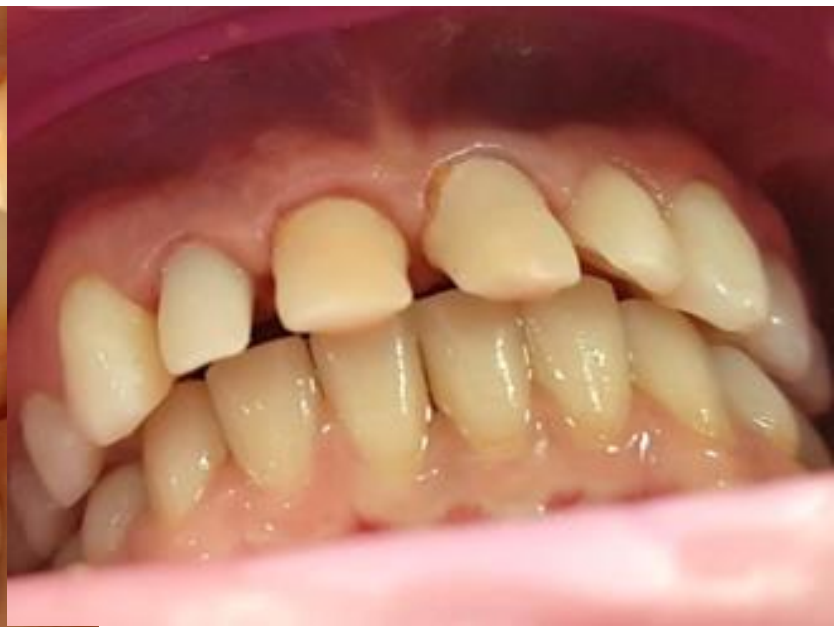


Figure 7. Try-in of the zirconium caps

Five days later, another trial session was done, for the zirconium caps with layered ceramics, when all the details related to length, shape, angles, phonation, and occlusion, were established (Figure 8).

Next day, the final glazing stage was carried out (Figure 9).

Figure 8. Layered ceramics

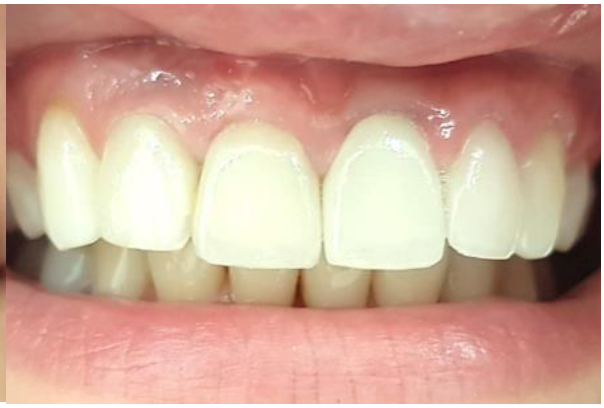


Figure 9. Crowns after glazing

Dental crowns and the veneer, were cemented intraorally in the same session (Figure 10). In this regard, a recommended cement for the covering crowns was used, and a specific cement for veneers.

The screwed implant crown was fixed in the implant and the screw tightened with a force of 25 N cm. Teflon was placed in the head of the screw and the inspection hole was closed with composite. The crowns were then checked in terms of the desired aesthetic results and occlusal adaptation.

Figure 10. Crowns after cementation

Discussions

Starting from the different shades of the prosthetic abutments and the need to cover and standardize them, it was decided to use zirconium caps, which will later be covered with the stratified ceramic by the manual technique.

In the area of maximum visibility, such as the maxillary frontal teeth, achieving prosthetic perfection is most often challenging, an ideal that can be achieved by a perfect fusion between the pink area and the white area. In the case of implant supported crowns, we can therefore say that the pink aesthetics focus on the appearance of the peri-implant soft tissues, and the white aesthetics on the visually pleasing result of the crown itself [13]. The type of abutment chosen can influence the results, both of pink and white aesthetics. In the evolution of dental materials and the prosthetic workflow, the use of zirconium is increasingly common. Compared to metal abutments, this material offers advantages, especially related to an improvement in the appearance of soft tissues, by avoiding the "gray" discoloration of the mucosa, a particularly important aspect especially in situations with thin gingival biotype [10]. Zirconium is characterized by a

dense monocrystalline homogeneity, with a low corrosive potential and good radiopacity [14]. It has been vastly applied in dentistry due to its good mechanical properties, improved aesthetics, and excellent biocompatibility [15]. Aesthetics remain the major advantage of zirconium abutments over titanium, despite concerns about mechanical complications. Data on zirconia abutments with titanium inserts are insufficient, although the outlook for this design is promising [16]. There are numerous clinical studies that have highlighted the excellent clinical performance, including the esthetic results obtained in the case of single implant crowns in the anterior area, when a screw-mounted multilayer ceramic crown was used on a customized zirconia abutment [10]. Chen and Pan (2019) observed a high implant survival rate, a good biological integration and an outstanding aesthetic performance in a retrospective study, that aimed to assess the clinical performance of zirconia implant abutments supporting all-ceramic crowns [17].

Based on all these aspects, we can conclude that zirconium abutments or zirconium ceramic prosthetic crowns represent an advantageous prosthetic option.

Conclusions

Zirconia as a dental biomaterial has firmly established its indications and is a gold standard. No contraindications are reported.

Conflict of interest: None to declare.

References

1. Totou D, Naka O, Mehta SB, Banerji S. Esthetic, mechanical, and biological outcomes of various implant abutments for single-tooth replacement in the anterior region: a systematic review of the literature. Int J Implant Dent. 2021; 7:85.
2. Papaspyridakos P, Chen CJ, Singh M, Weber HP, Gallucci GO. Success criteria in implant dentistry: a systematic review. J Dent Res. 2012; 91:242-8.
3. Beschnidt SM, Cacaci C, Dedeoglu K, Hildebrand D, Hulla H, Iglhaut G, Krennmair G, Schlee M, Sipos P, Stricker A, Ackermann KL. Implant success and survival rates in daily dental practice: 5-year results of a non-interventional study using CAMLOG SCREW-LINE implants with or without platform-switching abutments. Int J Implant Dent. 2018; 4:33.
4. Qutub OA, Basunbul GI, Binmahfooz AM. Influence of abutment material on the shade of dental implant restorations in the esthetic zone: a single case report. Clin Cosmet Investig Dent. 2019; 11:73-80.
5. Pjetursson BE, Sailer I, Latyshev A, Rabel K, Kohal RJ, Karasan D. A systematic review and meta-analysis evaluating the survival, the failure, and the complication rates of veneered and monolithic all-ceramic implant-supported single

In this case, the solution to use a hybrid abutment (titanium t-base and customized zirconium abutment) for the missing frontal tooth 1.2, proved to be a successful one. Regarding the color difference between soft tissues around teeth and implants, the hybrid zirconia abutments resulted in the least color difference. A porcelain fused to zirconia screw retained single crown proved to be a good prosthetic choice to cover the abutment in this area.

For the frontal teeth 1.1. and 2.1. with different colors of the dentine abutment, using porcelain fused to zirconia crowns proved to be also a good prosthetic option. Zirconium caps with multilayered ceramics, using the manual technique of layering in different ceramic shades, allowed to obtain the desired result. This case report highlights the need for a prosthetic substrate with as homogeneous color as possible, in order to obtain satisfactory final results, otherwise, obtaining them is possible, but the challenge is greater.

The solution of covering prosthetic abutments with different structures and shades, with multilayered ceramic crowns fused to zirconia, proved to be a viable prosthetic treatment.

It is important to emphasize that the prosthodontist must develop a specific treatment for each individual case.

crowns. Clin Oral Implants Res. 2021;32(Suppl 21):254-288.
6. Vazouras K, Gholami H, Margvelashvili-Malament M, Kim YJ, Finkelman M, Weber HP. An Esthetic Evaluation of Different Abutment Materials in the Anterior Maxilla: A Randomized Controlled Clinical Trial Using a Crossover Design. J Prosthodont. 2022; 31:673-680.
7. Baldini N, D'Elia C, Clementini M, Carrillo de Albornoz A, Sanz M, De Sanctis M. Esthetic Outcomes of Single-Tooth Implant-Supported Restorations Using Metal-Ceramic Restorations with Zirconia or Titanium Abutments: A Randomized Controlled Clinical Study. Int J Periodontics Restorative Dent. 2016; 36:e59-66.
8. Hosseini M, Worsaae N, Schiodt M, Gotfredsen K. A 1-year randomised controlled trial comparing zirconia versus metal-ceramic implant supported single-tooth restorations. Eur J Oral Implantol. 2011; 4:347-61.
9. Halim FC, Pesce P, De Angelis N, Benedicenti S, Menini M. Comparison of the Clinical Outcomes of Titanium and Zirconia Implant Abutments: A Systematic Review of Systematic Reviews. J Clin Med. 2022;11:5052.
10. Wittneben JG, Gavric J, Belser UC, Bornstein MM, Joda T, Chappuis V, Sailer I, Brägger U. Esthetic and Clinical Performance of Implant-Supported All-Ceramic Crowns Made with Prefabricated or CAD/CAM Zirconia Abutments: A Randomized, Multicenter Clinical Trial. J Dent Res. 2017; 96:163-170.
11. Carrillo de Albornoz A, Vignoletti F, Ferrantino L, Cárdenas E, De Sanctis M, Sanz M. A randomized trial on the aesthetic outcomes of implant-supported restorations with zirconia or titanium abutments. J Clin Periodontol. 2014; 41:1161-9.
12. Zembic A, Kim S, Zwahlen M, Kelly JR. Systematic review of the survival rate and incidence of biologic, technical, and esthetic complications of single implant abutments supporting fixed prostheses. Int J Oral Maxillofac Implants. 2014; 29:99-116.
13. Buser D, Halbritter S, Hart C, Bornstein MM, Grütter L, Chappuis V, Belser UC. Early implant placement with simultaneous guided bone regeneration following single-tooth extraction in the esthetic zone: 12-month results of a prospective study with 20 consecutive patients. J Periodontol. 2009; 80:152-62.
14. Manicone PF, Rossi Iommetti P, Raffaelli L. An overview of zirconia ceramics: basic properties and clinical applications. J Dent. 2007; 35:819-26.
15. Han A, Tsoi JKH, Lung CYK, Matinlinna JP. An introduction of biological performance of zirconia with different surface characteristics: A review. Dent Mater J. 2020; 39:523-530.
16. Naveau A, Rignon-Bret C, Wulfman C. Zirconia abutments in the anterior region: A systematic review of mechanical and esthetic outcomes. J Prosthet Dent. 2019; 121:775-781.e1.
17. Chen JY, Pan YH. Zirconia implant abutments supporting single all-ceramic crowns in anterior and premolar regions: A six-year retrospective study. Biomed J. 2019; 42:358-364.

Corresponding author:
Abel Emanuel Moca
University of Oradea, Faculty of Medicine and Pharmacy, Department of Dental Medicine, 10 Piața 1 Decembrie Street, 410073, Oradea, Romania

Email: abelmoca@yahoo.com

Received: April 3, 2023 / Accepted: May 10, 2023

CASE SERIES

sciendo

DOI: 10.2478/asmj-2023-0005

Total and partial magnetic retained overdenture. A clinical report.

Claudia Florina Bogdan-Andreescu[1], Andreea Mariana Bănățeanu[1], Oana Botoacă[1], Diana Eugenia Rădulescu[1]

[1] Titu Maiorescu University, Bucharest, Romania

Abstract

An overdenture is a denture supported partly by soft tissues and partly by retained teeth or implants. Magnetic tooth-retained overdentures are used to increase support, retention, and stability but also prevent alveolar ridge resorption. Magnetic attachments increase the retention of partial or complete dentures regardless of the path of the insertion and, in addition, can be used for abutment teeth with periodontal disease. This paper discusses two oral rehabilitation cases with total and partial tooth-retained overdenture.

Keywords: magnetic attachment, overdenture, complete and partial edentulism.

Introduction

An overdenture is a denture supported partly by soft tissues and partly by retained teeth or implants. The connection between the remaining teeth and the denture is made with attachments, which are rigid or resilient connectors that redirect the occlusal forces. The attachments like bar and clip, stud, or magnetic attachment increase the stability and retention of the denture.

Magnetic devices were introduced in prosthetic dentistry since the 1960s [1]. Since then, dental magnets have spread widely into prosthetic dentistry; current magnetic devices can be used successfully for natural abutments or osseointegrated implants [2, 3]. The magnets are manufactured in small dimensions, so they are used as retentive devices for complete dentures, removable partial dentures, obturators, and maxillo-facial prostheses [4].

Compared to implant-retained overdenture, tooth-retained overdenture is a cost-effective and straightforward treatment modality [5]. Conventional tooth-retained overdenture placement involves embedding the magnetic assembly into the denture base and introducing its corresponding keeper into the abutment root. The magnetic assembly holds the keeper with a retentive force [6].

This clinical report presents two oral rehabilitation cases with total and partial magnetically tooth-retained overdenture.

Presentations of case series

The first patient is a 52 years old male in good health with difficulties in mastication that wants a fixed restoration (figure 1). Computer tomography reveals insufficient bone for immediate implant placement due to extractions and maxillary sinuses pneumatization (figure 2).

During the discussion of treatment options: an implants-supported restoration or a removable denture, the patient decides on magnet-retained overdenture because it is affordable, the final restoration is ready in a shorter period compared with implant-borne restoration, and relies on magnetic-attachment retention.

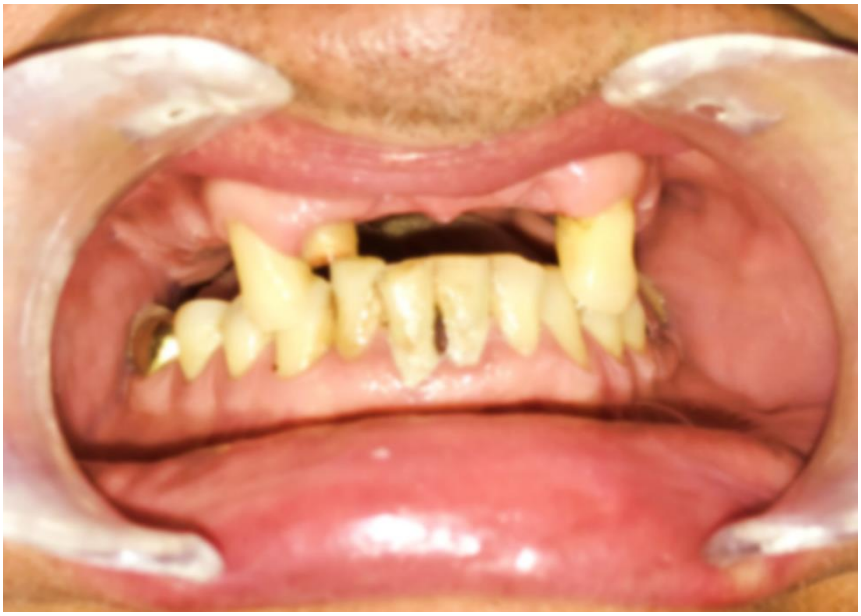


Figure 1. Preoperative aspect

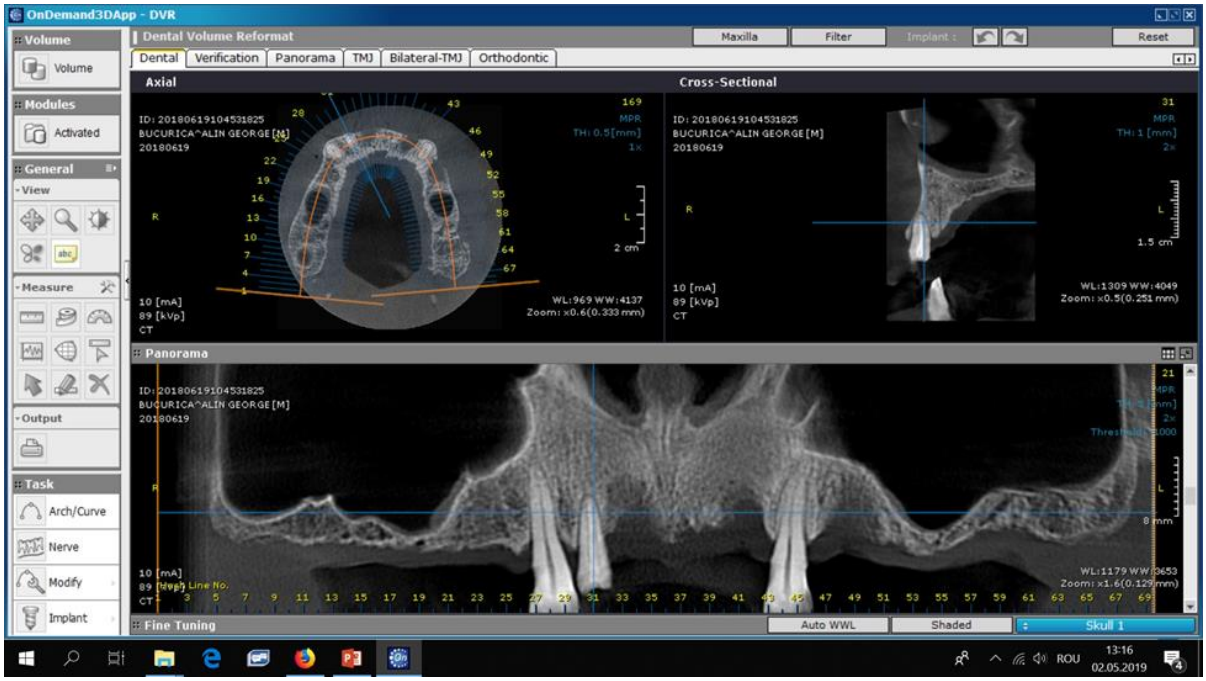


Figure 2. Imagistic aspect of maxillary arch

The treatment plan includes a professional cleaning, root canal treatment for chosen abutment teeth, upper canines, preparation of abutment teeth for magnetic attachments, and reduction of remaining lateral incisor at the gingival level and sealing with a composite filling. The impression is taken for cast dowels and individual tray.

The magnetic attachments used are Magfit® DX, Aichi Steel Corporation, Japan. The magnet is thin, has a round shape, and is embedded in the denture base. The keeper is cemented into the root canal.

Abutment teeth need root canal treatment and crown section. The preparation of each abutment tooth involves a chamfer-type margin line, slightly divergent walls of the root canal, and a slightly convergent axial wall.

After cementing the keepers', the functional impression is taken, and recorded the occlusal relationship. A complete maxillary overdenture

is fabricated, improving the patient's appearance and mastication (figures 3 and 4).

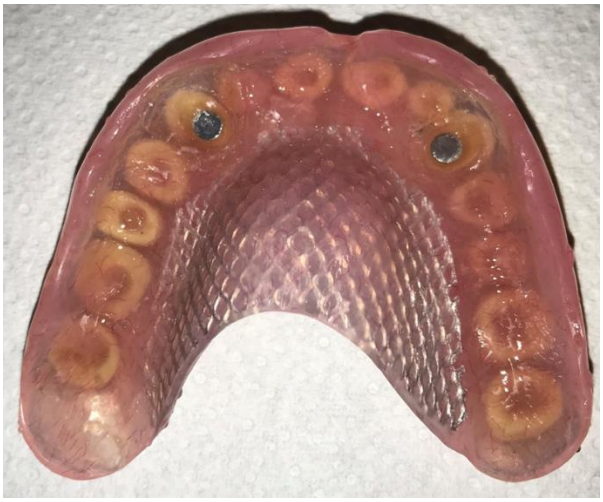


Figure 3. Maxillary magnetic retained overdenture – mucosal aspect

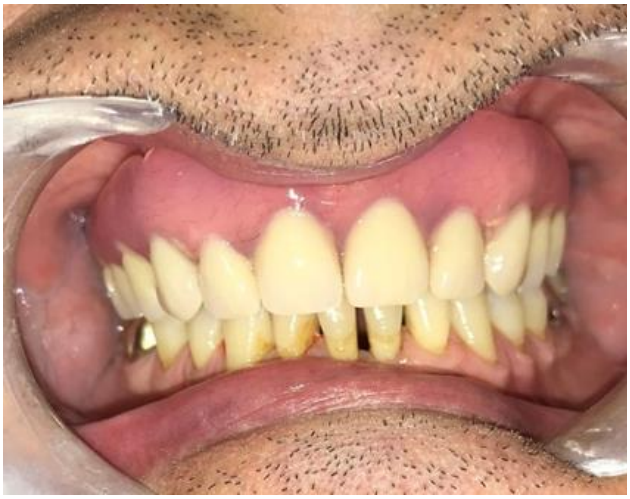


Figure 4. Postoperative aspect

The second case is a 60 years old female patient with osteoporosis (figure 5). She complains about old bridges, which move, and mastication difficulties. She requests dentures as prosthetic treatment because of the medical conditions and the cost of implant therapy.

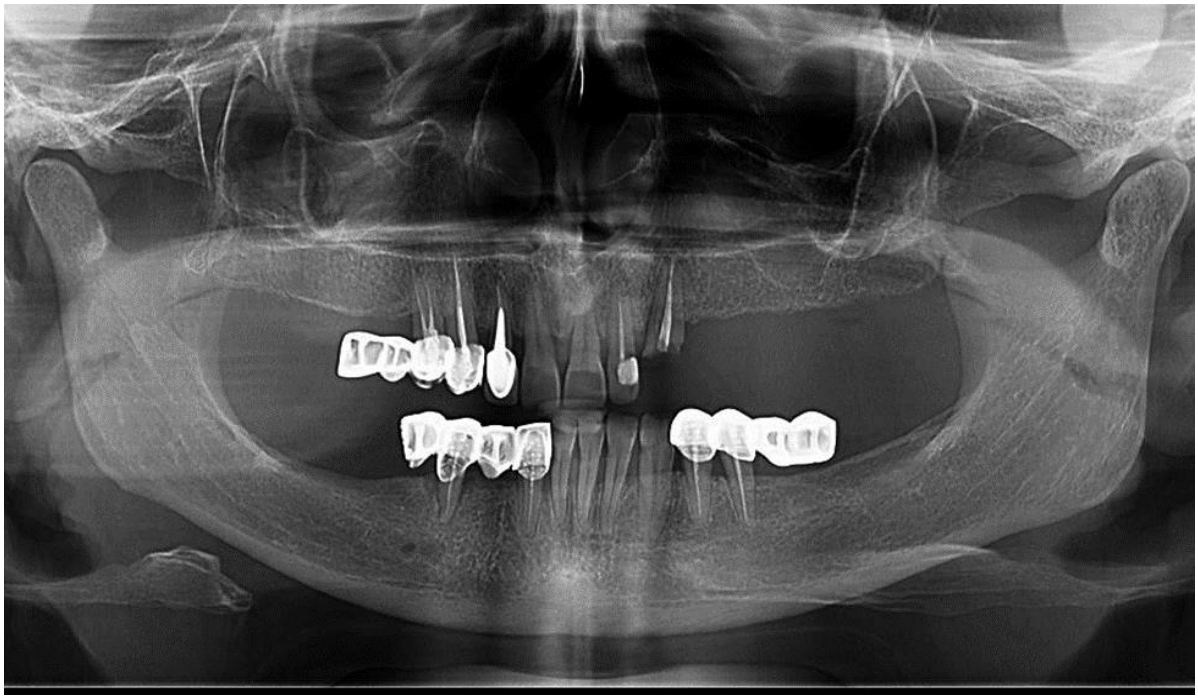


Figure 5. Preoperative orthopantomography.

The treatment plan involves removing the old bridges, extracting mobile teeth (1.4. and 4.4.), and rehabilitating magnetic-retained partial overdenture with abutment teeth 1.3. and 2.3. for the maxilla and mixed prosthesis (bridge and partial skeletal denture) for the mandible (figures 6 and 7). The same magnetic abutments, Magfit® DX, are used for maxillary partial overdenture.

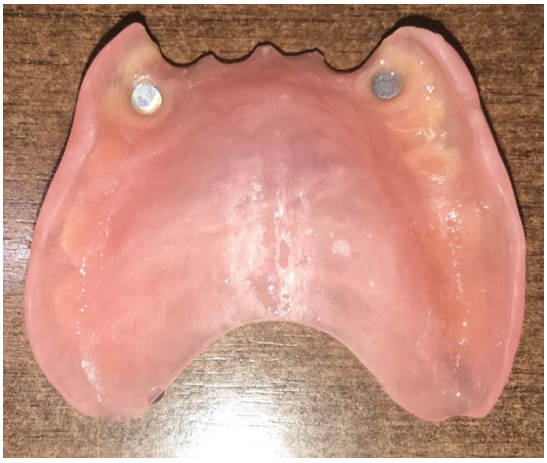


Figure 6. Mucosal aspect of magnetic retained partial overdenture.

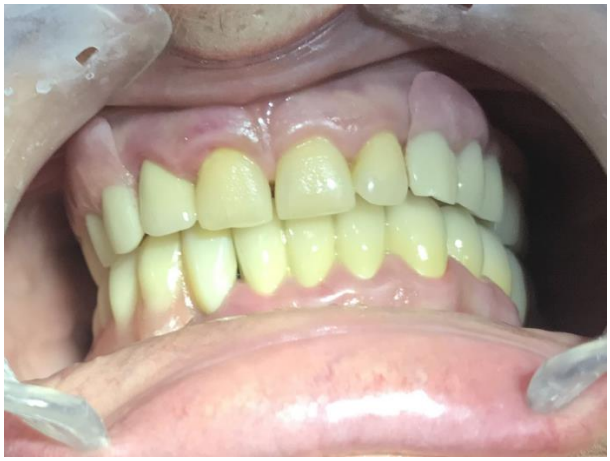


Figure 7. Postoperative aspect.

Discussions

The main objective in removable prosthodontics is to preserve the remaining teeth structure and the alveolar bone. Tooth-retained overdentures transfer occlusal forces to the alveolar bone through the periodontal ligament of remaining teeth, consequently preventing alveolar bone resorption.

The overdenture with magnetic attachments is a practical choice for abutment teeth with chronic periodontal disease because the magnetic assembles dissipate the lateral stress on the abutment teeth and improve clinical crown-to-root ratios [7, 8]. Even when the quantity of bone supporting the remaining teeth is not adequate for other attachments, it is suitable for magnetic attachment because cutting the crown improves the crown/root ratio, and no friction is involved in retaining the overdenture.

Another advantage of magnetic attachments is that they do not depend on a particular insertion path like other attachments [9]. They can be used for partial or complete overdentures alone or with other retainers.

Due to affordable treatment costs is a better alternative for implant overdenture [10].

Magfit® DX is suitable for a wide range of cases owing to its small size; it is suitable for situations where vertical space is limited [11]. The magnet is round and must be checked on the abutment root. Always root diameter should be wider than the magnet diameter to achieve the best magnetic force. In both cases, abutment teeth are maxillary canines that have adequate magnet sizes. Because the magnet is thin and the artificial canine has a good amount of structure, overdenture hide the magnet efficiently.

The evaluation at 6, 12, and 24 months after treatment reveals good condition for remaining roots and dentures. No structural or functional modifications were found during the examination.

The disadvantages include: it is more expensive than a simple denture, and the magnet can cause image distortion during the magnetic resonance imaging of the head and neck [12].

Conclusions

Magnetic-retained overdenture is an uncomplicated treatment method. It is easy to use because it does not require special skills or equipment and has multiple patient benefits.

The advantages of magnet retained overdenture are: simplicity, efficiency, low cost, minimal trauma for retained root, and no need for adjustment.

Conflict of interest: None to declare.

References

1. Behrman S. The implantation of magnets in the jaw to aid denture retention. J Prosth Dent. 1960; 10:807–841.

2. Gonda T, Yang TC, Maeda Y. Five-year multicenter study of magnetic attachments used for natural overdenture abutments. Journal of oral rehabilitation, 2013, 40(4): 258-262.
3. Martínez–Lage-Azorín JF, Segura-Andrés G, Faus-López J, Agustín-Panadero R. Rehabilitation with implant-supported overdentures in total edentulous patients: a review. Journal of clinical and experimental dentistry. 2013; 5(5), e267-72.
4. Anupam P, Anandakrishna GN, Vibha S, Suma J, Shally K. Mandibular Overdenture retained by magnetic assembly: a clinical tip. J Indian Prosthodont Soc (December 2014) 14(Suppl. 1):328–333.
5. El Mekawy N, Ibrahim CRM, Hegazy S. Tooth Overdentures Denture Base Materials. Highlights on Medicine and Medical Research, 2021, 9: 76-96.
6. Angdrijono A, Herdijantini N, Eka H. Magnetic Attachment Retained Complete Overdenture as Treatment for Maintaning Alveolar Ridge Height–A case report. Indonesian Journal of Dental Medicine. 2018; 1(1), 54-58.
7. Matsumura H, Kawasaki K Magnetically connected removable sectional denture for a maxillary defect with severe undercut: a clinical report. J Prosthet Dent. 2000; 84:22–26 20.
8. Riley MA, Walmsley AD, Harris IR. Magnets in prosthetic dentistry. J Prosthet Dent. 2001; 86:137–142.
9. Costea RC, Perieanu VŞ, Burcea CC, Burlibaşa M, Chirilă M, Marcov N, ... & Moraru L. Practical Aspects Regarding Magnetic Retained Overdenture. Acta Medica Transilvanica 2012: 26(2), 62-66.
10. Pradeep Raja B T, Manoharan P S, Rajkumar E. Tooth-supported attachment retained overdenture: forgotten concept revisited - A case report. SRM J Res Dent Sci 2021;12:177-80.
11. ***New Generation Dental Magnetic Attachment MAGFITTM Full Product Line-up Catalog. https://www.aichi-steel.co.jp/ENGLISH/products/pdf/magfit_catalog-en.pdf
12. Chalakuzhiyl AM, Sudhakara M, Maheshwaran. Interactions between magnetic resonance imaging and dental material. J Pharm Bioallied Sci, 2013, 5.Suppl 1: S113-6.

Corresponding author:
Claudia Florina Bogdan-Andreescu
University Titu Maiorescu, Bucharest, 67A Gheorghe Petraşcu Street, sector 3, code 031593, Bucharest Romania

Email: claudia_andreescu@yahoo.com

Received: December 18, 2022 / Accepted: January 23, 2023

STATEMENT OF ETHICS

All research studies involving human subjects must have received approval of the appropriate institutional ethics committee and informed consent must be obtained from all the patients participating in the studies, prior to manuscript submission.

In cases where the institutional ethics review committee ruled that approval from them was not required or that the need for informed consent was unnecessary, a statement from the committee to this end should be forwarded to the Editor with the manuscript.

Human and animal rights

Studies involving experimental research on animals or humans must conform to the guiding principles of the Declaration of Helsinki. In order to respect a patient`s right to privacy, identifying information such as patients` names, images, initials of hospital numbers should not be included in any published material (tables, figures, text), unless the information is essential for scientific content. In these cases written permission must be obtained from the patient, and should be submitted to the editorial office at the time of manuscript submission. In the case of animal experiments, both national and the institutional guidelines pertaining to the experimental use of laboratory animals should be rigidly followed.

Conflict of interest (Declaration of Interests)

The manuscript should contain a statement fully disclosing any conflict of interest related to the manuscript. If there are no conflicts of interest, this should be stated as “none declared”. Material and financial support should also be acknowledged.

Scientific misconduct

Scientific misconduct includes data fabrication, falsification, plagiarism, redundant publication, ghost authorship or other fraudulent research practices. In order to prevent plagiarism issues, all manuscripts sent to the journal will be screened using anti-plagiarism soft-ware. Where there is a suspicion of scientific misconduct, the Editor will act in conformity with the principles stated in the COPE guidelines and if the fraudulent practice is confirmed the manuscript will be rejected outright and without the Editor entering into any further correspondence.

Clinical trials

In case of manuscripts presenting clinical trials, the clinical trial should be registered in a public trials registry at or before the time of first patient enrollment, as a condition for consideration for publication. Trials should be preferably registered in ClinicalTrials.gov, but any registry that is a primary register of the WHO International Clinical Trials Registry Platform (ICTRP) is acceptable, in accordance with the guidelines of the International Committee of Medical Journal Editors.

INSTRUCTIONS FOR AUTHORS

Acta Stomatologica Marisiensis Journal is an international journal dedicated to publishing high quality peer-reviewed articles pertaining to dental medicine. The themes covered by the journal include all the fields of dentistry, within a broad spectrum of disciplines and therapeutic areas, including, but not restricted to oral health, prosthetic dentistry, endodontics, paedodontics, orthodontics, oro-maxillo-facial surgery, implantology, dental materials, digital dentistry, nanotechnology and materials or medical engineering.

The journal does not have article processing charges, neither article submission charges.

Therefore, authors are asked to indicate their agreement to abide by an open-access license. The license permits any user to download, print out, extract, archive, and distribute the article, so long as appropriate credit is given to the authors and source of the work. The license ensures that your article will be as widely available as possible and that your article can be included in any scientific archive.

All manuscripts submitted to Acta Stomatologica Marisiensis must be original, high quality and conform to the “Uniform Requirements for Manuscript Submitted to Biomedical Journals” published in Annals of Internal Medicine (1997;126:36-47).

Authors should not submit the same manuscript simultaneously to more than one journal, in the same or different language.

Authorship

All individuals listed as authors should qualify for authorship and should have participated sufficiently in the work to take public responsibility for appropriate portions of the content.

Authors included in the manuscript should meet all of the following conditions as stated in the ICMJE (International Committee of Medical Journals Editors) guidelines:

- Substantial contributions to the conception and design of the work, acquisition, analysis or interpretation of data;
- Drafting the article or revising it critically, for important intellectual content;
- Final approval of the version to be published.

- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Any other contributors, who do not qualify for authorship, should be acknowledged in an acknowledgment section. For further information about authorship, please refer to the ICMJE guidelines.

Studies involving experimental research on animals or humans must conform to the guiding principles of the Declaration of Helsinki. In case of research involving human subjects, the manuscript must contain a statement within the "Material and Methods" section indicating that the study protocol has been approved by the author(s) institutional ethical committee and that all study participants have given informed consent to the participate, or that the ethical committee has waived the need for informed consent. In order to respect patient confidentiality and the right to privacy, identifying information such as patient's names, images, hospital or hospital record details, should not be included in any published material unless the information is essential for the scientific content. If so, written permission must be obtained from the patient, and this permission should be submitted to the editorial office prior to publication.

In case of manuscripts reporting clinical trials, these should be registered in a public trials registry at or before the time of first patient enrolment, as a condition for consideration for publication. Trials should preferably be registered in ClinicalTrials.gov, but in accordance with the guidelines of the International Committee of Medical Journal Editors any primary register of the WHO International Clinical Trails Registry Platform (ICTRP) is acceptable.

The journal does not have article processing charges nor article submission charges.

All manuscripts should be submitted via email to the email address asmj@umfst.ro

The submission should include the following attachments:

1. Cover letter
2. License to publish
3. Manuscript
4. Figures
5. Tables
6. Appendices

1. Cover letter

All manuscripts should be submitted together with a cover letter attached as a separate file, stating that:

- the manuscript is original
- no portion of the manuscript is under consideration for publication in any other journal or has been previously published, except as an abstract of fewer than 400 words.
- all authors have read and approved the manuscript and accept responsibility for the full content.
- Authors must state all possible conflicts of interest relating to the manuscript or, if there are none, this should be stated as "none declared".

The cover letter should be signed by all authors. The corresponding author submits the manuscript and annexes on their behalf.

2. License to publish

A license to publish statement should be signed by be signed by all authors. The standard format of this document is available at www.asmj.ro

3. Manuscript

The manuscripts, including all tables and references, must be prepared in Word format. The text should be typed double-spaced with no indent, using "Times New Roman" font size 12.

Please arrange the contents of your manuscript in the following order:

I. Essential title page information

- Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
- Author names and affiliations. Where the family name may be ambiguous (e.g., a double name), please indicate this clearly. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript number immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.
- Corresponding author. Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. Ensure that phone numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address. Contact details must be kept up to date by the corresponding author.

II. Abstract – an abstract of no more than 300 words should accompany manuscripts relating to original research, case presentations and review articles. This should be structured using the following headings: Introduction, Aim of the study, Material and Methods, Results, Conclusions. Detailed instructions on abstract preparation according to each manuscript type are given below.

III. Key words – up to 10 keywords should be supplied by the author(s).

IV. Full text – should be formatted in Microsoft Word, double-spaced, single columned. Use headings and subheadings in all the sections. Original research articles should not exceed 5.000 words including references, tables, table legends and figure legends, and should be divided into the following sections:

a. Introduction

This must be presented in a structured format, covering the following subjects, although actual subheadings should not be included:

- succinct statements of the issue in question;
- the essence of existing knowledge and understanding pertinent to the issue (reference);
- the aims and objectives of the research being reported relating the research to dentistry, where not obvious.

b. Materials and methods

- describe the procedures and analytical techniques.
- only cite references to published methods.
- include at least general composition details and batch numbers for all materials.
- identify names and sources of all commercial products e.g.Voltarol® Emulgel® Gel (Company, Town, Country).
- specify statistical significance test methods.

c. Results

- refer to appropriate tables and figures.
- refrain from subjective comments.
- make no reference to previous literature.
- report statistical findings.

d. Discussion

- explain and interpret data.
- state implications of the results, relate to composition.
- indicate limitations of findings.
- relate to other relevant research that should be cited and listed in the references section.

e. Conclusion

- must NOT repeat Results or Discussion
- must concisely state inference, significance, or consequences

When preparing your manuscript, consider the following rules:

- Define abbreviations that are not standard the first time they appear in the text, followed by the abbreviation in brackets.. Such abbreviations that are unavoidable in the Abstract must be defined at their first mention there. Ensure consistency of abbreviations throughout the article
- All references, tables and figures should be cited in numerical order.
- Language editing will be available during the editorial process, however authors whose native language is not English are strongly advised to seek appropriate grammatical assistance when preparing the manuscript. Poorly written manuscript will be returned for improvement before commencing the editorial process.

V. Acknowledgments – collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

Please indicate any source of funding including grants, contracts or any other form of financial support relating to the study.

VI. References – Number the references in the order in which they are first cited in the text. References should be indicated as full-size Arabic numerals in square brackets placed before punctuation marks.

VII. Reference style – List all authors if six or less; otherwise list first three and add “et al”. Please abbreviate titles of periodicals according to Index Medicus, or spelled out in full if not listed in Index Medicus. Use the following formats, paying close attention to the use of punctuation i.e.colon (:), semi-colon (;), coma (,) and full-stops (.).

For journal articles: Kim J, Fitzgerald JG, Sanders AK, Hofman HG. Long term survival following implantation of drug eluting stents. J Am Coll Cardiol. 2002;42:652-8.

For articles-in-press: Hendricks-Ferguson VL, Sawin KJ, et al. Novice Nurses’ Experiences with Palliative and End-of-Life Communication. J Pediatr Oncol Nurs. 2015. doi: 1043454214555196. [Epub ahead of print]

For a chapter in a book: La Rovere MT, Schwartz PJ: Baroreflex sensitivity. In Opie, L: Drugs for the Heart, Sixth Edition. Philadelphia: WB Saunders. 2006, pp.67-93.

For a Book: Eisen HN. Immunology: an introduction to molecular and cellular principles of the immune response. 5thed. New York: Harper&Row; 1974. P.406.

VIII. Units – follow internationally accepted rules and conventions: use the international system of units (SI). If other units are mentioned, please give their equivalent in SI.

4. Figures

Figures should be prepared separately and sent as additional files, in TIF or JPG format, or compressed into one ZIP file. The figures should be prepared at the standard resolution of 300 dpi. All abbreviations used in a figure should be explained in the figure legend. Figure legends should be concise but explicit, enabling a clear understanding of the illustration. Figures and figure legends should be numbered in Arabic numerals in the order of appearance in the text and should not be imbedded within the text. Colour figures are preferred. Where a figure(s) is reproduced

or adapted from another source, the author must first seek permission from both the author and publisher of the original material. Written evidence of permission for reproduction in both print and electronic formats for worldwide distribution must be forwarded with the manuscript and state "Reproduced with permission from…" or "Adapted with permission from…".

5. Tables

These must be self-explanatory and should not duplicate the text. Tables should be numbered in Arabic numerals in the order of mention in the text and should not be imbedded within the text. Instead, each table should be typed on a separate page at the end of the manuscript. All the abbreviations used in the table should be typed as footnotes immediately below the table. Tables should be created with Word's Insert Table function in order to be editable. Do not submit tables as image files.

6. Appendices

If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Acta Stomatologica Marisiensis Journal also publishes the following types of papers:

Reviews

The journal publishes comprehensive review papers on actual topics of interest related to dental medicine. Review articles should include a brief non-structured abstract of no more than 300 words and the text should be limited to 5.000 words including tables and figures, excluding references. In extraordinary situations or relevant and extensive topics, the Editor-in-Chief may decide to accept papers with a higher number of words, a maximum of 400 words for the abstract and 6.500 for the text, including tables and figures, excluding the references. Review articles can be submitted by invitation or unsolicited. In both cases, full consideration will be given to articles providing a substantial contribution to a better understanding of a pathophysiological or clinical aspect in a field related to dental medicine.

Case reports and case series

Case reports should be limited to presentation of a single particular and uncommon case, or uncommon presentation of a disease. Case series include description of a series of a maximum of 10 cases with common particularities. The abstract should be limited to 300 words, being divided into introduction, case presentation / presentation of case series and conclusions. The full manuscript should not exceed 3.000 words including references, figures and tables, being divided into sections headed Introduction, Case presentation / presentation of case series, Discussions, Conclusions. In manuscripts pertaining to case presentation or case series, the number of authors should be limited to four, the number of references to thirty and the number of figures to 8.

Original papers

Definitive reports on a full study, describing original preclinical or clinical study (which is not a case presentation or a case series report) represent research of high scientific level and timeliness. A concise abstract of no more than 300 words is required. The abstract should briefly state the purpose of the research, the main results and major conclusions. An abstract is often presented separate from the article, so it must be able to stand alone. The manuscript should be written clearly and concisely. The authors are responsible for providing the correct nomenclature, which must be consistent and unambiguous. The text should be arranged in the following order: Introduction, Materials and Methods, Results, Discussion and Conclusions.

The length of the manuscript should be limited to 5000 words (including references, tables and figures).

Brief reports

Brief reports refer to articles presenting a short communication related to an original preclinical or clinical study which is not a case presentation or a case series report. While the structure of the abstract and of the full text should be detailed similar to that for full original articles, the length of the manuscript should be shorter, the abstract limited to 200 words and the full text (including references, tables and figures) to 2.000 words.

Letter to editor

A letter to the editor may refer to an article recently published by the journal, commenting on the article in a constructive professional manner the content of which, in the opinion of the author(s) would add the current status of knowledge in the field. If accepted, the letter will be sent to the authors of the original article who will have the opportunity to respond and to have their response published in the same journal issue as the letter to the editor. The letters should be limited to 500 words, 5 references and 3 authors. No abstract is required.

Editorial

Editorials should be limited to 3000 words (including references) and should be related to an article published in the current number or to a specific topic that is current and of high interest to the readers.

State-of-the-art papers

The journal publishes state-of-the-art articles that aim to provide an update on the current status of areas of high interest to dental medical specialists. The main aim of such articles is to offer the specialist and other practitioners a source of continuous

education and forum for discussion. A state-of-the-art article should have a full text limited to 5.000 words, in addition to a 300 word unstructured abstract. Sections of the article should be divided using headings relevant to each particular case.

Peer review process

Submitted manuscripts are first checked to ensure that they comply with instructions to authors and are in accordance with the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals", Annals of Internal Medicine, 1997,126, 36-47, and that all references, figures and tables meet the journal's requirements.

All manuscripts sent to the journal are routinely screened using specialized anti-plagiarism soft-wares. In all cases where any possible irregularity exists, the editorial office will follow the principles stated in COPE (Committee on publication ethics) guidelines.

Only manuscripts complying with the above requirements and free of possible irregularities, will be entered into the review process. The author(s) will be informed that the manuscript has been accepted for review.

Authors may suggest the names of potential reviewers and the Editor may choose, without obligation or explanation, to use one or more of these. Authors may also specify the names of a person(s) which they do not wish to review their manuscript, in which case a brief explanation should be given.

All articles will be reviewed by at least two peers with expertise in the manuscript's subject matter. The identities of the reviewers, chosen by the editor, will not be disclosed to the authors.

The average time from submission to a decision following the first review is approximately 4-6 weeks. Based on the reviewers' opinion, the Editor will choose one of the following alternatives:

- Accepted;
- Minor revisions required;
- Major revisions required;

In cases where revision is required, the author(s) will be invited to amend their manuscript, which should be resubmitted as soon as possible, but not later than 6 weeks. The revised manuscript will be reappraised by the initial reviewers and notification of a final decision will be sent to the author in approximately three weeks.

After acceptance and prior to publication, authors will receive a pdf file with the edited version of their manuscript for final proofreading and will be asked to carefully check the completeness and accuracy of the text, tables and figures.

Complaints

In cases where the authors wish to file a complaint, please contact the editorial office:

Acta Stomatologica Marisiensis Journal

George Emil Palade University of Medicine, Pharmacy, Science and Techology from Tirgu Mures

Gheorghe Marinescu street no.38, Tirgu Mures, 540139, ROMANIA

Phone: +40-265-21 55 51, fax +40-265-21 04 07

Email: asmj@umfst.ro

Please describe the reason for the complaint and specify the address for correspondence. Where the complaint is related to the editorial process, related to a manuscript, please include the name of the manuscript and the date the manuscript was submitted. The Editor in Chief, together with the editorial office will analyze the complaint and will answer to your complaint in a maximum of three working days.