ROMANIAN ACADEMY

STOMATOLOGY EDU JOURNAL

2018 VOLUME 5 ISSUE 1

stomaedu

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1
2018

CE PROGRAM FAQs

HOFIGAL®

Hofident Q10

Product presentation: Solution for oral hygiene.

Composition (INCI): aqua/water, alcohol, *Capsella Bursa Pastoris* extract, *Plantago Lanceolata* extract, *Chamomilla Recutita* extract, *Achillea Millefolium* extract, *Aesculus Hippocastanum* extract, *Mentha Piperita* extract, Ubiquinone.

Action: The product has antiseptic, healing, hemostatic, anti-inflammatory aetion, it acts as a antioxidant, detoxifier, deodorant. It is strongly recommended in gingivitis, stomatitis, thrush, compression pain causedby dental prostheses, after tooth extraction, in case of nipple lesion, bleeding gums, mouth and gum ulcers.

Recommendations: It delays dental plaque formation, it prevents bad odour and provides daily mouth hygiene.

HofImun® FORTE

Product presentation:
Chewable tablets to stimulate the immune system

Composition: Each chewable tablet contains raspberry fruit extract *(Rubii idaei fructus)*, Echinacea extract *(Echinacea purpurea)*, concentrated extract of licorice root *(Glycyrrhiza radix)*, magnesium ascorbate and excipients.

Action: It stimulates the immune system, it is antiinflammatory, antiviral, antiseptic, it fluidifies the bronchial and pharyngeal secretions, antioxidant, cardioprotective, vasoprotective, it has antineoplastic antileukimic action, (due to the ellagic acid), it contributes to wound healing, fortifies and remineralizes (it regulates the potassium balance), it has antiulcer effects and is an overall body tonic.

Recommendations: to supplement the diet with nutrients and bioactive substances in: acute and chronic infections of the upper airways (angina, pharyngitis, laryngitis, bronchitis), prophylactic during periods with increased risk of infection with influenza viruses, it has sweating effects in fever, in recurrent herpes episodes of mucocutaneous rash, frequent urinary tract infections, inflammatory urogenital processes; immunodepression after radiotherapy or chemotherapy, bacterial skin infections, psoriasis, neurodermitis, chronic cardiovascular diseases associated with hypercholesterolemia, adjuvant in the diet indicated in the treatment of gastroduodenal ulcers, tonic during periods of physical and mental strain, exhaustion.

Bucoprotect gel

Product presentation: Gel for oral hygiene.

Composition (INCI): aqua, *capsella bursa pastoris, calendula officinalis, achillea milefolium, hippophae rhamnoides, olea europea, hypericum perforatum,* carbomer, triethanolamine, collagen, *foeniculum vulgare, mentha piperita, citrus amara.*

Action: Antiseptic, anti-inflammatory, healing, stimulates the inside lining of the mouth and gums trophicity, reduces pain caused by specific oral diseases (gingivitis, stomatitis, lesions of the prosthesis, thrush, periodontitis).

Recommendations: Fights against bad breath (halitosis).

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stomaeduj

2018 Volume 5 Issue 1
Pages 1-66

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ISSN 2360 – 2406 (Print)
ISSN 2502 – 0285 (Online)
ISSN – L 2360 – 2406

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EDITORIAL BOARD

The ethical responsibility of teaching

Jean-François ROULET
DDS, PhD, Dr hc, Prof hc, Professor
Editor-in-Chief

Dear readers,

If you were a general, going to war, you would teach your students warfare, strategies and tactical movements to reach your objective to defeat the enemy. In order to do so you accept that people would die, some on your enemy side and some within your own troops. If you were a physician, you would teach your students how to prevent and treat diseases. Would you teach them how to kill a human being? – Of course not, since physicians must comply with the Hippocratic Oath. This simple example shows that in medicine teaching is not that easy. The amount of new knowledge created per year has dramatically increased in every field and the speed of change is still increasing. Unfortunately, it takes sometimes many years until a discovery makes it into accepted clinical routine. For instance, Buonocore had first published a method to bond resins to enamel in 1955. When I was entering clinical dentistry as a student in 1972 we were taught enamel etching techniques as the newest thing. How do we teachers deal with this time difference? A standard way is not to teach new procedures until there is some evidence that the new therapy is effective and does not show any negative side effects. This may be a good way out, but unfortunately, there are more complications. Many years ago, when worldwide adhesive technology was accepted as being clearly superior, I visited a dental school and was shocked to see that they were teaching how to prepare dove tail retentions for Class III composite restorations. I asked why they do this. The answer was that the students need to know this, because it was required by the state board and if they were not able to do this they would fail. Knowing that the board exam is done on real teeth of real patients this creates an ethical dilemma. Hippocrates taught us "primum nil nocere" so my ethical compass tells me not to teach a dove tail retention, because it definitely requires removal of more sound tooth tissue than required for the restoration using adhesive techniques. On the other hand, I know that my students have a higher risk to fail the board, if they don't practice. This creates a conflict of interest, since on one side as a physician I must comply with ethical rules and protect the patients from harm but as a teacher, I am expected to be loyal to my students. A similar conflict with some boards exists in the interpretation of the radiological interpretation of proximal caries in posterior teeth. Many years ago it was unchallenged that when a decalcification was radiographically visible in the proximal enamel and deeper, this was an indication for a Class II restoration. Over the years the knowledge in cariology has increased and we have learned that lesions can be managed as long as the surface is macroscopically intact. It is known from epidemiological studies that approximately half of the lesions that radiologically appear to just have reached the dentin do not show any cavitation. Many years ago techniques have been described how to separate teeth with such lesions, in order to inspect the proximal area. With this, the correct treatment decision can be made. Despite such appealing evidence, there are boards that ignore these facts and insist that the ideal lesion is one that has just reached the dentin-enamel junction. In order to have measurable criteria, a "board" cavity preparation must be one similar to the ones GV Black has described more than a 100 years ago, which means that not only a cavity is drilled, where according to today's standards there is no indication for, but the cavity preparation is not

only larger than needed, but also has a shape that does not allow the best possible bond between the composite material and the tooth. In the view of these facts, the conflict of interest is the same as described above. Some schools offer so-called mock boards, which I consider even worse, because in this scenario the student clearly uses the patient to practice an unethical procedure for his/her own benefit. This sends out the wrong signal: "You can sacrifice ethical considerations for your own benefit". Doing this we should not be surprised that some dentists do overtreatment just to improve their financial situation.

Good teaching requires feedback; better teaching allows self-assessment by the students. This means that reproducible measurements are needed, which is very difficult to achieve with defect oriented cavities for adhesive restorations. So this is a problem for beginners, learning how to cut into plastic teeth. One way around this is to first instruct box-shaped cavities for Class III cavity preparations, which can be easily measured with a periodontal probe. However, doing this we engrave in the students brain a faulty cavity preparation, which does not correspond to the clinical reality. I wonder if the harm that may result from this can be justified for the advantage of a simple measurement.

Looking at all these conflicts, it seems almost impossible to find a solution. To find one we have to look at a different, even more complex teaching situation. The best way of how to learn to fly is flying on a plane with double controls - one for the student and one for the teacher. Tell, show, do, is the classical approach here. The problem of flight instructors is how to teach difficult situations that are dangerous. Therefore I ask, would you as a flight instructor teach your pilot students to perform an emergency landing with a crash with a complex airplane that costs millions, and which is loaded with passengers? Of course, not at all. There, as long as I can think, simulation is the answer. Modern flight simulators can be so realistic, that the trainees forget that they are not really flying and it is reported that even experienced pilots exit the simulator ashen and drenched in sweat after some emergency training. So why not do the same in dentistry? We have all the tools. Scanners can measure what the student has done and compare it to the requested even complex and complicated shape and computers can visualize to the student the degree of discrepancy. There is no better way for grading or examining the psychomotor skills of students, without running the risk of an ethical conflict. Just do it!

J-F Roulet
Editor-in-Chief

DOI: 10.25241/stomaeduj.2018.5(1).edit.1

Recommended action plans for oral health in older Europeans

Anastassia E. KOSSIONI
DDS, MSc, PhD

The current oral health delivery system fails to meet the oral health care needs of many population groups, including the frail and care-dependent older people.

Physical and mental illness, frailty and care dependency, socioeconomic inequalities, living in nursing homes, unhealthy diet, smoking, poor oral health literacy, lack of effective oral health policies including limited public dental care coverage, and limited training of healthcare professionals in oral conditions are some of the barriers to oral health faced by older persons [1-3]. Frail older people rarely visit the dentist, but they frequently meet other healthcare providers, such as physicians, nurses, physical therapists, occupational therapists, and pharmacists. However, few of those healthcare providers are adequately trained to initially assess oral problems and offer oral hygiene advice, as, for many years general and oral health have been viewed in isolation [3]. Consequently, oral health conditions in older people often remain underdiagnosed and untreated, leading to high prevalence of tooth loss, dental decay, periodontal disease, xerostomia, denture-related conditions and oral pre-cancer and cancer [4,5]. Moreover, there is evidence of an association between oral and general disease, such as cardiovascular disease, diabetes mellitus, respiratory disease and frailty [4,6-8].

In response to these challenges, the European College of Gerodontology (ECG) and the European Geriatric Medicine Society (EuGMS) have developed policy recommendations on oral health in older Europeans [9]. This expert opinion document identified three major areas for further action: a) educational plans for healthcare professionals, b) health policy plans, and c) citizens' empowerment and involvement.

The authors highlighted the importance of training non-dental healthcare professionals in oral health assessment and promotion, and provided a list of learning objectives as a basis for a dedicated "geriatric oral health curriculum" [9]. Healthcare professionals should be competent to initially assess oral health, identify oral conditions, discriminate between normal and abnormal findings in the mouth, decide when to refer to the dentist, demonstrate oral hygiene measures to older people and their caregivers, assist in daily oral hygiene provision, and work collaboratively with the elders' healthcare team. Moreover, although more than 86% of the European dental schools teach Gerodontology at the undergraduate level, more dental training is necessary in oral health assessment and provision in nursing homes and at home, and in collaborative practice between dentists and other healthcare professionals [10].

The ECG/EuGMS recommendations further provided a list of health policy measures with emphasis on the integration of oral health into general health care assessment, prevention, provision and funding, and development of appropriate policies and protocols for oral health prevention and promotion in institutional settings for older residents [9]. Minimum requirements for nursing homes should include oral health assessment at entry, access to emergency and routine dental care, regular training of caregivers in oral hygiene provision to residents, provision of daily dental and denture hygiene and provision of regular oral screenings [9,11,12]. Other suggested actions included removing barriers to dental care, promoting domiciliary care, and promoting

geriatric oral health campaigns for the public.

Finally, the document stressed the need for direct citizen involvement in actions related to oral health. Well informed citizens may guide decision-makers in enacting legislation for oral health promotion in frail older people and coverage by state or social security.

Given that the major chronic oral conditions, such as caries, periodontal disease, tooth loss, and many oral lesions are largely preventable and share common risk factors with chronic general diseases [4], it is imperative for healthcare, welfare, and educational authorities, public health planners and citizen organizations, to support the above ECG/EuGMS recommendations aiming to improve oral health and quality of life in older people.

Acknowledgements

The author would like to thank the co-authors of the ECG/EuGMS expert opinion document (in alphabetical order): Dr Justyna Hajto-Bryk, Professor Stefania Maggi, Dr Gerry McKenna, Professor Frauke Müller, Professor Mirko Petrovic, Professor Regina Elisabeth Roller-Wirnsberger, Professor Martin Schimmel, Professor Marija Tamulaitienè, and Professor Jacques Vanobbergen.

Conflict of interest

The author declares no conflict of interest with any financial organization regarding the material discussed in this document.

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DOI: 10.25241/stomaeduj.2018.5(1).edit.2

Stage-level analysis: five years dedicated to the dental community

Marian-Vladimir CONSTANTINESCU
DDS, PhD, Professor
Editor-in-Chief

Dear readers,

Now, in the 5th year of the Stomatology Edu Journal's existence (Stoma Edu J), I have the pleasure and honor to carry out an analysis of the main events that have been going on since its foundation. It has not been easy and neither was it uncomplicated to contact the most important national and international personalities in the field of research, education and dental practice.

They have rallied around the idea of putting together a new journal for colleagues from Romania, the Republic of Moldova and the other former communist countries in Central and Eastern Europe only after being informed that the well-known Professor Jean-François Roulet of the Department of Restorative Dental Science, The College of Dentistry, University of Florida, Gainesville, FL, USA, editor of three quoted journals, voluntarily accepted to coordinate the work of the Editorial Board of the Stomatology Edu Journal as Editor-in-Chief. Guided by this symbol of professionalism, fairness and editorial stringency, colleagues both from Romania and from abroad joined our team, including the renowned Professor for Cranio Maxillofacial and Oral Surgery, Rolf Ewers, Chairman em. at the Medical University of Vienna, Vienna, Austria.

Then there followed other colleagues who wanted to contribute to the development of this journal as Senior Editors, namely Professor Bruce R. Donoff of the Department of Oral and Maxillofacial Surgery, Dean at the Harvard University of Harvard University, Boston, MA, USA, Professor of Biomedical Optics Adrian Podoleanu, Head of the Applied Optics Group, University of Kent, Canterbury, UK and Professor Emeritus David Wray, Department of Oral Medicine at the University of Glasgow, UK. To provide the Journal with scientific weight in all areas of stomatology, a series of professors, well-known for their extensive professional experience, were invited to join the team as Emeritus Editors-in-Chief.Let me mention Professor Birte Melsen from Aarhus University, Aarhus, Denmark, Professor Prathip Phantumvanit from Thammasat University, Bangkok, Thailand, Professor Rudolf Slavicek of the Medical University of Vienna, Austria and the late Professor Emeritus Julian B. Woelfel of The Ohio State University, Columbus, USA.

Other distinguished colleagues enthusiasically joined our team, while efficiently contributing significant important articles to the Journal. They are our Co-Editors-in-Chief, namely Professor Nicoleta Ilie of the Department of Operative Dentistry and Periodontology of Ludwig-Maximilians-Universität Munich, Germany, Professor Alexandre Mersel, Director of FDI Europe, Geneva-Cointrin, Switzerland, Professor Constantinus Politis, Head of Oral and Maxillofacial Surgery at University of Leuven, Belgium,Professor Hom-Lay Wang of the Department of Periodontics and Oral Medicine at the University of Michigan, Ann Arbor, MI, USA, Clinical Professor Mauro Marincola of the State University of Cartagena, Colombia, Professor George E. Romanos of the Department of Periodontology at Stony Brook University, NY, USA, Professor Mahesh Verma, Principal Director, Maulana Azad

Institute of Dental Sciences New Delhi, India and recently Associate Professor Hiroshi Ogawa of the Department of Oral Health Science at Niigata University, Japan.

While attending the 2013 FDI Congress in Istanbul, I met Professor Anton Sculean, Chairman of the Department of Periodontology at University of Berne, Switzerland and presented him with an advanced copy of our Journal. He looked at it as any thorough researcher would do it, and with the swiftness of a surgeon, he coldly replied that "an international journal appears only in English, and Abstracts are not justified in a national language!" After seeing all the journals published by the various publishing houses present at the FDI Congress, I left myself convinced. I suffered for Eminescu, our national poet, and the other major representatives of our culture!

Back home, I found myself in front of a final obstacle, the English Language Editor team. Previously, for everything related to the publication of abstracts or articles abroad, I used to ask two old friends of mine, both of them English teachers, who were not familiar with the dentistry terminology, as one worked in aviation and the other in the field of virusology. Such an ambitious project could only be achieved with high linguistic expertise. I tried to see who was the Head of the English Language Department at the Faculty of Foreign Languages, University of Bucharest. I found Professor Dr. Alexandra Cornilescu's phone number, who was also the Dean of the Faculty back then. I called, and a meeting was scheduled at her office. She thumbed through the advanced copy of the Journal with the researcher's minuteness and a linguist's attention. After a few moments, in perfect silence, instead of shouting "Eureka! Eureka!" like Archimedes, she gave me the name of Associate Professor Roxana-Cristina Petcu. She told me that the lady was a very close co-worker, and that I could rest assured that everyting was going to work out to perfection, as she had excellent translation expertise. I contacted Associate Professor Petcu and presented her with the copy of the journal, stating that it had been published after having been corrected seven times. I also told her that after the first correction, when I had the impression that the document was good for printing, I experienced what a boxer goes through when he is knocked-out during the first round. With a linguist's exigency and exactness, she asked me for the first issue to assess it. After receiving the proof, I found that if Professor J-F Roulet has the ability to evaluate a manuscript from the point of view of scientific accuracy, the art of making a translation is another profession mastered only by professionals who practice it daily and continually improve it. Professor J-F Roulet reached the same conclusion when his Editorial [1], published in the 2017 Stoma Edu J number 2 and corrected by Professor Roxana-Cristina Petcu, was published in Dental Materials [2], Factor Impact journal (IF): 4.070. Indeed, I can say that without the constant contribution of the exceptional linguist who is Professor Roxana-Cristina Petcu, the 143,000 readers of the Stomatology Edu Journal, would not have had the joy to read a high-level publication from the very beginning.

The first and second 2014 issues of the Stomatology Edu Journal were published by SC Media Systems Communication SRL. Besides the task of finding articles for publication, the publishing house asked me to provide sponsors before sending each issue to print. Despite all the advertising contracts concluded for 2015 and 2016, the publishing house claimed that their accounts had been frozen, therefore, in 2015, it did not send to print any issues, neither did it send the first 2016 issue. The lack of honesty and professionalism of this company forced me to put an end to our collaboration. In order to honor Florin, my son's and my own promises to a foreign company, and especially to safeguard our country's image, we released 250 CDs with the first 2016 issue of the Stoma Edu J carrying the advertisment of the company that had made full payment for all advertising materials. I myself paid for those 250 CDs. Florin attended the congress organized by that company, he himself delivered the

CDs, which were well received in lieu of the journals, and were included in the congress folders. I regret to have to say that I understood that you could not trust a private company and I had to look for a state-owned publishing house.

After a brief analysis I understood that only the Publishing House of the Romanian Academy was the one to take over the publication of the journal. I approached the director of the Publishing House, Academician D. R. Popescu, and following our discussion I understood that the Romanian Academy Publishing House only publishes journals included in the portfolio of publications approved by the Presidium of the Romanian Academy. I submitted an application to the Presidium of the Romanian Academy in which I described the editorial board and the purpose of the journal. In response, I was advised to seek the agreement of the Academy of Medical Sciences, as there was no member of the Romanian Academy on our board, there were only members of the medical branch. Given this situation, I asked to be received by the person in charge of the Academy publications, its vice-president, Academician Alexandru Surdu. Very kindly, he advised me to include at least one full member of the Academy in the Editorial Board and not to request any funds for publication. So I contacted Professor Constantin Ionescu-Tîrgoviște, member of the Romanian Academy and president of the Romanian Medical Association. With the courtesy of the master, he accepted to help us, especially as between diabetes and the periodontal disease there are a series of connections. It so happened that, at that time, a famous American professor of Romanian origin, Adrian Bejan, honorary member of the Romanian Academy, was in Bucharest to hold a conference in the Polytechnic University. I described the stomatologists' problem to him and I invited him to become a board member as Deputy Editor in Chief, as between his constructal theory, the stomatognathic system and the whole body there are a series of laws that draw us closer. As generously as any great master or any elite athlete he accepted this position.

Then, with a substantially strengthened board, I appealed to the members of the journal board, holders of academic titles in their own countries, to recommend and support the Journal with the Romanian Academy. This is how the Office of the Presidium of the Romanian Academy received letters of recommendation and support from the German National Academy of Sciences Leopoldina (founded 1652) by Professor Gottfried Schmalz, The Croatian Academy of Sciences and Arts (founded 1866) by Professor Vjekoslav Jerolimov, l'Academie Nationale de Chirugie Dentaire (founded 1956) by Professor François Duret and Doctor Hubert - Pierre Ouvrard, DDS, PhD, former President of the l'Academie Nationale de Chirugie Dentaire (ANCD) and President of the l'Association d'Enseignement d'Odontologie et de Stomatologie. Following this cumulated approach, I was finally granted the approval of the Office of the Presidium of the Romanian Academy that the Stomatology Edu Journal (Stoma Edu J) be included in the portfolio of Romanian Academy journals, mentioning that the publication will be self-financed.

After relating this journey, I still remember that, while we were on board an imposing yacht in the Tasman Sea, a colleague wearing a seaman's uniform ironically replied that he did not see the purpose of a new dental journal because there are too many already. It might be so for somebody who has free access to quoted journals.

The colleague wearing a seaman's uniform did not understand the urgent need to publish the over 85,000 dentists in the Central and Eastern European countries had [3]. The figure I quoted covers the 2013 census and out of this figure there are 15,500 dentists in Romania and 1,600 in the Republic of Moldova.

I personally know that there are no specialized journals in our country, and, like my colleagues, I had to resort to

quoted journals in other fields. Only in this way have I been able to publish articles and earn the required credits for promotion. It was an undertaking I had to clearly embark upon, the more so as the oldest specialized journal in our country, the Romanian Journal of Stomatology, published since1923, is rated only B +. Publishing an article in a journal with an high IF is difficult. Successfully publishing an article with a group of Italian colleagues after almost four years determined and motivated me to continue my work!

Due to the readiness manifested by Professor Michael Glick, DMD, Editor-in-Chief of the Journal of the American Dental Association, JADA [4], Mr. Michael Springer, Publisher, JADA, Mr. Nawin Gupta, Director of Business Operations, ADA and Mrs Stefanie K. Jewell-Thomas, Elsevier, due to their exceptional generosity and willingness to share scientific information, since our first 2017 issue we have been receiving an article with CE Program FAQs to be accessed by our readers.

Also in 2017, in order to increase the visibility of the online and print publication of the Stomatology Edu Journal, we asked Crossref to assign a single alphanumeric string, the Digital Object Identifier (DOI) [5]. The DOI identification is to be retrospectively assigned to all articles published starting with the first issue.

For the Stomatology Edu Journal to be included in the list of quoted publications starting with its 2017 number 3, all references to articles published online must include DOI and active links from PubMed, Google Scholar and Scopus. It was, in fact, a broad retrospective integrating process.

The Stomatology Edu Journal, the publication that has been published online and in print since 2014, is recognized by a number of databases, such as the National Library of Medicine (NLM) [6], Crossref, SHERPA / RoMEO, Google Scholar, InfoBase Index (IBI Factor 2015: 2,76) and Academia edu. Currently, as a result of the efforts of our editors, the Stomatology Edu Journal is being evaluated by the Scientific Index Services (SIS) and the Directory of Open Access Journals (DOAJ), and this year is subject to admission to Medline, PubMed Central (PMC) and Emerging Survey Citation Index (ESCI).

In order to meet these new requirements, as of the first 2018 number, the first page of each article has a new design, while the online version includes an abstract, a pdf, xml, and html format as well as references. It is a very time-consuming activity, carried out by the newest member of the operative editorial team, the very competent and energetic Professor Gabriel Octavian Lazăr, as Deputy Editor-in-Chief.

Professor Emeritus, Stephen F. Rosenstiel, from the Ohio State University, Columbus, USA, Reviewer-in-Chief, together with his team, played a decisive role in the publication by the Stoma Edu J of its over 95 articles. In 2017 a series of prestigious Academic Editors joined this team. Until now, after monitoring the visibility of articles published by the Stoma Edu J, we found the following articles on the Academia.edu site: Salivary and Serum Enzymes as Diagnostic Biomarkers in Patients with Periodontal Disease by Miricescu D, et al., 2014, 191 views; Silk fibroin and potential uses in regenerative dentistry - a systematic review by Virlan MJR, et al., 2014, 159 views; Treatment effects of R-appliance in vertically growing patients-case series by Showkatbakhsh R, et al., 2014, 112 views; Fundamentals of occlusion and masticatory function by Meyer GB, et al., 91 views; The use of rotation instruments in endodontic treatment of older dental patients by Retsas A., et al., 2015, 86 views; An implant supported maxillary fixed prosthesis with a substructure-suprastructure-design and clinical case by Kempler J, 2014, 84 views; Remineralisation of affected dentine by different bioactive materials in the stepwise excavation technique by Andrian S, et al., 74 views [7].

The readers of the Stomatology Edu Journal are highly appreciative of the support provided by the prestigious

publishing houses which have been generous enough to send us their latest publications to be reviewed in our Journal. Here they are: Quintessence International, Quintessence Publishing Company, Inc., Jaypee Brothers Medical Publishers (P) Ltd, Quintessence Editora - Sao Paulo , Brazil, Nova Science Publishers, Inc., Georg Thieme Verlag KG, Lippincott Williams &Wilkins, Quintessenz Verlag, Thieme Publishers, dentaConcept, and ExistIT Publisher. I am honored to mention the initial contribution of Prof. Christian KNELLESEN and Prof. Jean-Louis GIOVANNOLI from Quintessence International, and then the effective and constant support of Mrs. Karin Wintonowycz and Dr. h.c. H.-W. Haase from Quintessenz Verlag-GmbH to regularly send us the requested books for review.

It is a significant example of support allowing our readers to have the continuous opportunity to be informed about the latest publications in all areas of dentistry starting with the first issue of our journal.

The time has come now for us to thank all our sponsors who have made possible the publication of the Stomatology Edu Journal. Here they are: Hofigal, Gral Medical, Dr. Fischer-Dental Laboratory, SisoMM, Bicon Europe Ltd, Angelus Dental, Dentsply Sirona , and Ivoclar Vivadent. They have all helped improve the quality of life of the patients of our more than 143,000 readers.

It is a stock-taking moment, so I warmly invite all our Editorial Board members to look at their activity as compared to that of their colleagues so as to find ways to improve it in the interest of our more than 143,000 readers.

In order to respond to the invitation extended by the Romanian Academy to stimulate the international dissemination of scientific information via the electronic archive - "Academica Romanian Index", I would like to ask every editor who considers himself an active member of the Board to send us by April 15 a 250-word CV on their contribution in the field, surname, name, scientific titles, current administrative titles, the logo of the institution and a recent 3.5 x 4.5 cm color photograph.

On behalf of the entire editorial board, I would like to take this opportunity and wish you an Easter filled with peace, happiness and joy, and a year that is bright with blessings.

Sincerely yours,

M-V Constantinescu
Editor-in-Chief

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DOI: 10.25241/stomaeduj.2018.5(1).edit.3

In Memoriam

Ionel Valentin Vlad, "Galileo Galilei" Prize winner of the International Commission of Optics (2005), died in Bucharest on 24 December 2017. He was 74.

Ionel Valentin Vlad was the President of the Romanian Academy (the highest academic forum in Romania), since 2014.

He was also the Head of the "Nonlinear and Information Photonics" group in the Laser Department of the National Institute for Laser, Plasma and Radiation Physics, as well as Professor at the University of Bucharest, Faculty of Physics.

A distinguished scientist honoured by several prestigious societies and national and international bodies, with a prodigious career in publishing and international conference organisation, he is credited with many milestones and accomplishments as can be read here.

To sum things up, he was a Fellow of the OSA, SPIE, IOP, an Honorary member of the Academy of Sciences of the Republic of Moldova and Honoris Causa of several Romanian Universities.

He was a leader among those who promoted Optics in Romania to the level we know it today. He supported the dissemination of Optics research as chair of many editions of the Romopto international conference.

On a personal note, I was a student of his in 1973, when he taught us "Optical transmission of information", as an external lecturer coming from a distinguished research institute. He emanated professionalism and rigour which inspired me in choosing optics as my career. Later on, in 1991, we went to San Diego together to meet the SPIE Board to represent the desire of the Romanian optics scientists to establish a Chapter of SPIE in Romania. I traversed together with him some memorable moments in the opening of Eastern Europe towards the rest of the world. He manifested both wisdom and delicacy in handling important moments faced by the Romanian Science community due to the challenges that followed. He was a role model, a true leader in the practice and teaching of Science, as well as in its administration.

Ionel Valentin Vlad will be sorely missed by the Optics Community, by the family of Romanian Physicists. He will be fondly remembered by all who knew him.

Adrian Podoleanu
Vice President International Commission of Optics
Senior Editor Stomatology Edu Journal

In Memoriam

The Moldovan dental community lost Professor Ion Lupan, exceptional doctor and academician.

Professor Dr. habilitatus Ion Lupan, aged 65, passed away on November 22, 2017. He was Dean of the Faculty of Dentistry, Head of the Department of Oro-Maxillofacial Surgery Pediatric and Orthodontic Pedodontics, senior specialist in dentistry in the Republic of Moldova, member of the Academy of Sciences.

He was a talented scholar and renowned pediatric surgeon, his life devoted to organizing Pediatric Oro-Maxillofacial Surgery services in Moldova and led the relevant Department of the Emilian Coțaga Children's Clinical Hospital for 35 years.

Ion Lupan, experienced educator and outstanding manager, organized the training of dentists and contributed to the connection of the Faculty of Dentistry to international standards. He chaired the Association of Moldovan Dentists and the Association of Cranio-Maxillo-Facial Surgeons in Moldova.

Ion Lupan was born in 1952, in the village of Șestaci. He attended the Middle School in his native village, in 1970 he graduated from the Medical College in the city of Bălți, and in 1975 from the Faculty of Dentistry of the State Medical Institute in Chișinău.

Between 1975-1977 he was a professor at the Tiraspol College of Medicine and Dentist at the Stomatological Clinic. Between 1978-1983 he worked in the Maxillofacial Surgery Department of the Republican Clinical Hospital, and in 1983 he was transferred to the Emilian Coțaga Children's Republican Clinical Hospital, where he established and organized the Maxillofacial Surgery Department, whose manager he was for 35 years.

In 1993 he began teaching at the State University of Medicine "Nicolae Testemițanu", and in 1993 he defended his doctoral thesis in medical sciences. In 2004 he defended his habilitation thesis on "Medical recovery of children with congenital malformations of the face" and in 2009 he became full professor at the Department of Oral and Maxillofacial Surgery at Pediatrics, Pedodontics and Orthodontics.

In 2007, following an open election process, he was elected head of the Department of Oro-Maxillo-Facial Surgery, Pediatrics and Orthodontics at the "Nicolae Testemițanu" USMF. In 2009 he became Dean of the Faculty of Dentistry. In 2016, under Ion Lupan's deanship, the Faculty of Dentistry obtained its international accreditation certificate from the Dental Council of the State of California, USA.

Professor Ion Lupan's research work includes about 160 scientific and didactic papers, two monographs, a manual and two compendia, 10 patents and 45 innovator certificates.

He was very actively involved in his Alma Mater's activities as a member of the Scientific Council and the University Senate. In 2008 he was elected member of the Assembly of the Academy of Sciences of Moldova.

With Professor Ion Lupan's death, the medical community lost a talented educator and skilled oro-maxillo-facial surgeon, and also an exceptional person, remarkable for his sense of responsibility and professionalism, his intelligence, honesty, modesty, refinement, empathy and respect when dealing with students, colleagues, patients, and acquintances.

The "Nicolae Testemițanu" State University of Medicine and Pharmacy extends its condolences and deep compassion to the bereaved family. Professor Ion Lupan's memory will remain that of an energetic man who loved the world, his family, country and Alma Mater, an example for dozens of generations of dentists and colleagues.

May he rest in peace!

Sergiu Ciobanu, DDS, PhD, Profesor, Dean
"Nicolae Testemițanu" State Medical and
Pharmaceutical University, Chișinău, Moldova
Associate Editor-in-Chief Stomatology Edu Journal

ESCD congress in Zagreb a "truly international meeting"

September 21 - 23, 2017, Sheraton Zagreb Hotel, Zagreb, Croatia


Caps & Gowns ceremony - a tradition during each annual meeting

ZAGREB, Croatia: The 14th annual meeting of the European Society of Cosmetic Dentistry (ESCD) celebrated the discipline with an exceptional scientific programme that featured 32 speakers from 17 countries and a diverse audience. Among the social highlights was the society's welcome of new ESCD members with a traditional cap and gown ceremony at the presidential dinner.

Among the highlights of the scientific programme were the lectures by Prof. Anton Sculean from Switzerland and Dr. Marius Steigmann from Germany, who discussed treatment concepts for soft-tissue defects around teeth and dental implants, as well as the presentation by US dentist Dr. Henry Salama on the extraction site management in the aesthetic zone. Dr. Stefen Koubi from France and Dr. Josef Kunkela from the Czech Republic updated the audience about new smile design techniques and approaches.

"This year, the ESCD congress became a truly international meeting. We had participants from more than 38 countries, with two important delegations from China and India," ESCD President Dr. Florin Lăzărescu said. "The success of ESCD is due to the backbone of our society, the national study clubs. We are now present in 28 countries through our country chairpersons and we have 12 active study clubs," he added.

In addition to a range of social events, such as the presidential dinner at the Esplanade Zagreb Hotel, a guided tour through Zagreb and a 1920s-themed party at the Johann Franck club, the ESCD again held its traditional certification ceremony for new members at the event. To be granted membership, nominees have to demonstrate competence in the field by completing a number of highly aesthetic treatments and presenting at least one of these cases at the annual meeting. During the ceremony, successful candidates are then presented with a certificate of membership and the designated membership pin. This year's new ESCD members were Dr. Alessandro Iorio from Italy, Dr. Abby Abraham from India, Dr. Ivan Puljić from Croatia, and the German dentists Dr. Alina Lazar and Dr. Jan Kurtz-Hoffmann. More information about the certification process can be found at www.escdonline.eu.

Jointly organised with the Croatian Dental Chamber, the congress took place from 21st to 23rd September 2017, its theme being "Heart of Esthetics" in Zagreb. "The Croatian Dental Chamber continues to cooperate with organisations and partners that in our profession represent the top of dentistry in Europe and worldwide. One of these organisations is certainly the European Society of Cosmetic Dentistry," commented Dr. Hrvoje Pezo, President of the Croatian Dental Chamber, on the successful event.

Founded in 2003 by a group of practising dentists, dental technicians and academics from different universities all over Europe, the ESCD (formerly the European Society of Esthetic Dentistry) was established in response to growing public interest in cosmetic and aesthetic dentistry and to the corresponding need of European dental practitioners to enhance their skills and knowledge in the field.

This year, the ESCD will meet in Lisbon in Portugal from 20th to 22nd September 2018.

Dr. Florin Lăzărescu
ESCD President

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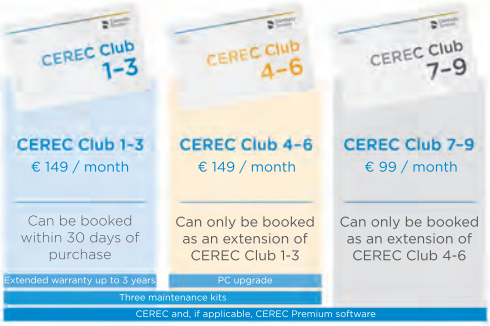

Stoma Edu J. 2018;5(1):14

From The Journal of the American Dental Association

JADA ONLINE CE EXAMS
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January 2018

Vázquez-Otero C, Vamos CA, Thompson EL, Merrell LK, Griner SB, Kline NS, Catalanotto FA, Giuliano AR, Daley EM.
ASSESSING DENTISTS' HUMAN PAPILLOMAVIRUS-RELATED HEALTH LITERACY FOR OROPHARYNGEAL CANCER PREVENTION
J Am Dent Assoc. 2018 Jan;149(1):9-17. doi: 10.1016/j.adaj.2017.08.021. Epub 2017 Oct 12.
PMID: 29031503

This article has an accompanying online continuing education activity available at:
http://jada.ada.org/ce/home.

http://dx.doi.org/10.1016/ j.adaj.2017.08.021.
http://jada.ada.org/article/S0002-8177(17)30747-X/fulltext

Continuing Education Online

Original Article

TOUGHNESS MEASUREMENT IN DIRECT RESIN COMPOSITES USING QUANTITATIVE FRACTOGRAPHIC ANALYSIS

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ABSTRACT

DOI: 10.25241/stomaeduj.2018.5(1).art.1

Objective: To outline a procedure to determine the fracture toughness of direct resin composites failing from "natural" flaws.
Methodology: Tensile (hour glass) tests (n = 30) of a conventional hybrid dental composite (Tetric EvoCeram, Ivoclar Vivadent) were fabricated and fractured in uniaxial tension loaded at a crosshead speed of 1 mm/min (≥ 10 MPa/s). The fracture toughness of the material was then calculated using the stress at failure and measurement of the crack size from fractographic analysis using SEM. Hardness (H) measurements were taken using a Vickers pyramidal diamond indenter. Elastic modulus (E) was calculated from the E/H ratio using a Knoop indenter.
Results: The values for fracture toughness found were similar to other Bis-GMA based dental composites 0.5 ±0.2 MPa $\sqrt{m}$. The Vickers Hardness was 509 ± 27 MPa and the Knoop Hardness was 495 ± 14 MPa using 0.5 kg/30 s, while the elastic modulus was 9.5 ±1.4 GPa.
Conclusion: The differences found in fracture toughness between this study and previous published studies are most likely due to variation in technique and material. Quantitative fractographic analysis offers a different method to evaluate the toughness of direct resin composites.
Keywords: fracture toughness, resin composites, fractography, dental materials.

Peer-Reviewed Article

Citation: Angus BM, Mecholsky Jr JJ, Abdulhameed N. Toughness measurement in direct resin composites using quantitative fractographic analysis. Stoma Edu J. 2018;5(1):18-23.

Academic Editor: Nicoleta Ilie, Dipl. Eng, PhD, Professor, University Hospital, Ludwig-Maximilians-Universität München, Munich, Germany

Received: January 09 ,2018
Revised: February 04, 2018
Acccepted: February 22, 2018
Published: February 26, 2018

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1. Introduction

Dental composites are a mixture of polymers and glass particles used in dental restorations to mimic the appearance and performance of teeth and are often used to repair damaged teeth [1]. Their mechanical properties have improved over the last years and consequently a lot of research has been performed to assess these properties and how they are affected by variations in particle size, polymerization depth, and viscosity [2-4].

In one longitudinal study it was found that out of 926 restorations investigated, 8% failed by fracture. This number increases to 18% when considering the failure of only resin composites restorations [5]. In a review of prospective studies, it was found that fracture of dental restorations is the most common cause of restoration failures in the first 5 years. [6] Therefore fracture toughness is a property that has received a lot of attention in dental composites. Fracture toughness is a property that represents the ability of some materials to resist crack propagation [7]. The load continuously applied in different directions with temperature and humidity variation leads to the progressive degradation and failure of the restoration, mainly due to the crack propagation. The introduction of imperfections in the material during processing, finishing, and/or in service has a high impact on the restoration failure probability. The organic matrix of dental composites has viscoelastic properties, which means that the response to stress will be time dependent. Under a rapid stressing rate, the stress-strain response will be primarily linearly elastic. Under a slow stressing rate, the stress-strain response will be viscoelastic [8]. The presence of filler also has a high impact on the mechanical properties [9]. The greater the amount of fillers, the greater the modulus of elasticity. The combination of the viscous matrix and greater modulus reinforcement leads to a tougher composite [10]. The main concern with the increase in fracture toughness of the restorative material is maintaining or improving the lifetime service in the oral environment while maintaining the esthetic value. The mechanical properties of dental composites have been highly improved in the last few years [11]. Even though there are many tests done to correlate *in vitro* data with the clinical behavior of dental composites, there still is a need to improve these methods to be more realistic and comparable to material behavior while in service [12].

There are several ways to measure fracture toughness such as the single edge notch test, compact tension test, or double torsion test [13]. However, the tests for toughness, in almost all cases for resin composites, involve large crack techniques. Resin composites mostly fail from small cracks so it is important to develop small crack techniques to determine fracture toughness. The quantitative fractography method offers the advantage of using flaw sizes of those encountered in service, i.e., small cracks. There are two approaches when using fractographic procedures to determine

toughness: controlled crack techniques [14] and direct observation of "natural" flaws or cracks [15]. "Natural" here means cracks or processing defects caused by fabrication and handling of the material before testing. It was not possible to develop controlled cracks in the material so the controlled crack technique could not be used. This result of difficulty in forming controlled cracks agrees with a similar observation in a previous study by other authors [16]. Using the "natural" crack means that an assessment of the fracture toughness of the material as used in clinical practice can be found. Finishing operations will yield cracks of size on the order of "natural" cracks. The advantage of this technique over others is that it provides a tool for forensic analysis. Once the toughness is determined from flaws of the size considered in this work, any strength from field failures of the same material will be able to be determined.

There are limited studies in the field of dental composites using quantitative fractographic analysis. Therefore, the aim of the study was to outline a procedure to determine the fracture toughness of direct resin composites failing from "natural" flaws. The materials used in this study are compared to those in analogous studies using different materials and fabrication techniques.

2. Methodology

The material used in this study was a hybrid conventional dental composite (Tetric EvoCeram, Ivoclar Vivadent)[1]. The Tetric EvoCeram composite is a light cured resin composite. The standard composition and physical properties of Tetric EvoCeram are listed in Table 1 as given by the manufacturer [17]. Tensile "hour glass" samples with average cross-sectional dimensions of 1.76 mm by 1.51 mm and a 3 mm gauge length were made by filling a mold with the resin and curing the samples for 10 seconds each. The mold was covered with a thin Mylar strip to ensure a flat surface. The curing process was done using an LED light curing unit (Bluephase Style, Ivoclar Vivadent) which emits light with an approximate intensity of 1000 mW/cm^2. The light cure unit was calibrated prior to use by means of a dental radiometer (BluePhase meter II, Ivoclar Vivadent). The tip of the light cure unit was positioned directly on top of the Mylar strip and stabilized with the plastic tip. Once the samples were cured they were polished with very light pressure to ensure that the corners were smooth. This was done using Sof-Lex[2] extra thin polishing discs of medium grit followed by fine grit at 6000-10000 rpm.

The polished samples were then broken in tension using a universal tensile testing machine[3] loaded at a crosshead speed of 1 mm/min (≥ 10MPa/s) using an anti-torsion parallel holder, and the load at failure, P, was recorded for each sample. The load-displacement graphs were linear until there was fracture with little or no non-linear behavior before fracture. The fracture stress, σ, was calculated from the load at failure and the dimensions of each specimen using equation 1:

$$\sigma = \frac{P}{A} \quad (1)$$

where A is the cross section within the narrow region (gauge section) of the specimen (3 mm). Any sample that did not break in the narrow cross section was discarded and not used for the data presented. Weibull parameters were calculated by maximum likelihood estimation according to ASTM C1239 – 13[18].

Table 1. Composition and physical properties of the Tetric Evoceram Dental Composite.

Standard – Composition (in weight %)	
Bis-GMA, Urethane dimethacrylate, Ethoxylated Bis-EMA	16.8
Barium glass filler, Ytterbium trifluoride, Mixed oxide	48.5
Prepolymers	34.0
Aditives	0.4
Catalysts and Stabilizers	0.3
Pigments	<0.1
Physical Properties	
Flexural Strength (Mpa)	120
Flexural Modulus (Mpa)	10,000
Compressive Strength (Mpa)	250
Vickers Hardness HV 0.5/30 (Mpa)	580
Density (g/cm^3)	2.10

Fracture toughness was calculated using the quantitative fractographic analysis. The method uses optical and scanning electron microscopy to locate and measure the size of the origin of the fracture for each specimen [13]. Once the flaw, or crack, at the origin starts to propagate it travels with increasing speed spreading out in all directions. As the speed increases, the surface increases in roughness. The origin of the fracture can be determined by the observation of the characteristic markings surrounding the fracture origin on the fracture surface. Generally surrounding the fracture origin there is a relatively smooth region, sometimes called the "mirror" region, that transitions to a slightly rougher region, sometimes termed the "mist" region. These regions and other markings, such as twist hackle, can be used to identify the location of the failure origin [13, 15]. The fracture origin is situated approximately at the center of the surrounding topography. All surface cracks were treated as elliptical cracks for calculating the fracture toughness. Images were taken using a scanning electron micrograph SEM[4]. Once the crack sizes were obtained the fracture toughness was calculated using equation 2 where σ is the stress at failure, a the crack size, and Y is a geometric factor of loading, the crack shape, and location. Y was calculated using the solutions of Newman and Raju for locations at the surface of the crack or internal cracks [19]:

$$K_C = Y\sigma\sqrt{a} \quad (2)$$

The hardness, H, was determined in a conventional manner using a Vickers pyramidal diamond with an indentation load of 0.5 kg at a loading and unloading time of 30 s [20]. The Vickers diamond was used for hardness because it offers an equi-axed diamond

[1] Lot Number V23426, Exp. 2020-5, Ivoclar Vivadent AG, Schaan, Liechtenstein
[2] 3M, 3M Center St. Paul, MN 55144
[3] Instron, 825 University Ave, Norwood, MA, 02062
[4] Phenom Pro SEM, Phenom World, Eindhoven, Netherlands

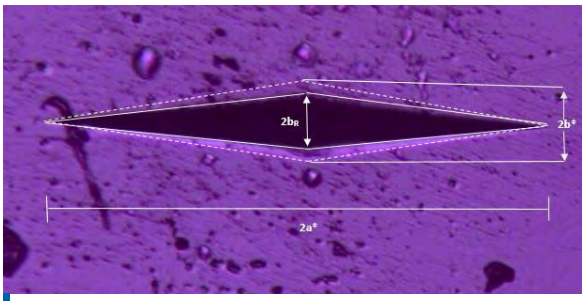

Figure 1. Optical Micrograph of Knoop Indentation Demonstrating the Measurement for Elastic Modulus.

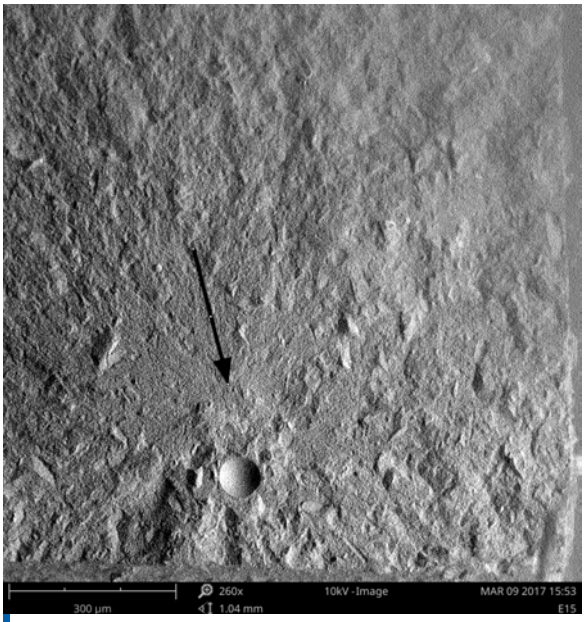

Figure 2. Example of an internal crack. The arrow points to fracture origin.

and thus increases the number of measurements and increases precision. For completeness, the Knoop hardness value was also determined at 0.5 kg at a loading and unloading time of 30 s.

The elastic modulus was determined using a technique developed by Marshall [21] and Conway [22]. The method used the geometry of the Knoop indenter, i.e., due to the asymmetrical shape of the indenter, one direction of the impression is elongated and the transverse direction is considerably shortened. Upon loading, the geometry of the impression will be determined by the shape of the diamond (cf. Figure 1). Upon unloading, the shorter direction ($2b^*$) will contract ($2b_R$) due to the elasticity of the material. The elongated end ($2a^*$) will not be measurably changed because of the length. Thus, the difference between the original measurement of the diagonals (from the shape of the diamond) and the impression on the material will provide a measure of the elasticity of the material. The E/H ratio can be calculated from the measurement of the diagonals as shown in equation 3 [22]:

$$\frac{E}{H} = 1 - 2[\tan\gamma(1-\nu^2)]\left(\frac{b^*}{b_R}\right)^2 \qquad (3)$$

where H is the Knoop hardness, ν is Poisson's ratio (0.3), $\gamma = 75$ (the average half angle of the Knoop indenter), b^* is half the minor diagonal at maximum load, and b_R is half the residual minor diagonal that is measured. The value of b^* can be calculated for the Knoop indenter because it is related to the major diameter, i.e., $b^* = 7.11a^*$, where a^* is half the major diagonal, assumed to be the same before and after indentation.

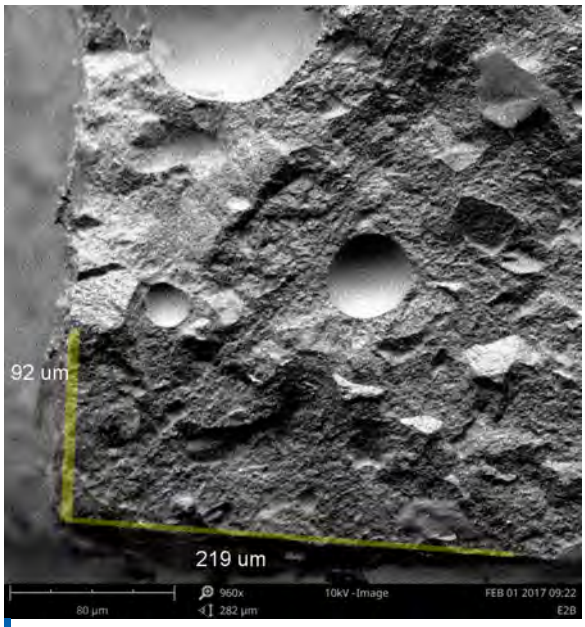

Figure 3. Example of a corner crack. The lines indicate the dimensions of the crack at the fracture origin.

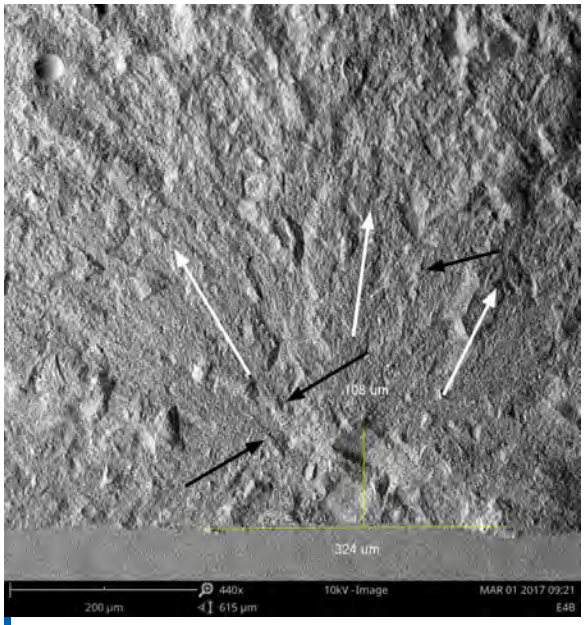

Figure 4. Example of a surface crack. Yellow lines indicate the width and depth of the crack at the fracture origin. Black arrows indicate direction of crack propagation away from the crack origin. White arrows indicate twist hackle marks on the fracture surface.

Table 2. Average values of obtained data.

Physical Property		Standard Deviation
Fracture toughness (MPa$\sqrt{m}$)	0.5	0.2
Vickers Hardness (MPa)	509	27
Y (geometric constant)	1.28	0.04
Elastic Modulus (GPa)	10	1.7
		90% Confidence Interval
Unbiased Weibull Modulus	4.4	3.4 - 5.6
Characteristic Strength (MPa)	26	24 - 28

3. Results

The average values of toughness, hardness, Y, elastic modulus, Weibull modulus, and characteristic strength can be found in Table 2. The detailed strength and toughness data obtained are presented in Table A-1 in the Appendix. The average fracture toughness for this material was found to be 0.5 ± 0.2 MPa$\sqrt{m}$. Of the 30 samples investigated, most cracks originated at the surface of the material, often at a corner that was polished. Only 3 of the 30 samples had internal crack origins. An example of an internal origin is shown in Figure 2. Figures 3 and 4 show the more common edge and corner cracks at the surface of the samples. They are also representative of the measurement technique. Figure 3 also illustrates the presence of voids in various samples often found near crack origins. The Vickers Hardness was 509 ± 27 MPa using 0.5 kg/30 s, while the elastic modulus was 10 ±1.7 GPa.

A Weibull graph for the data is presented in Figure 5. The unbiased Weibull modulus and characteristic strength were calculated using MATLAB and found to be 4.4 (90% confidence intervals as per [16]: 3.4 - 5.6) and 26 MPa (90% confidence intervals as per [16]: 24 MPa - 28 MPa) respectively. The locations of the fracture origins are also depicted on the Weibull graph. All origins appear to be uniformly distributed.

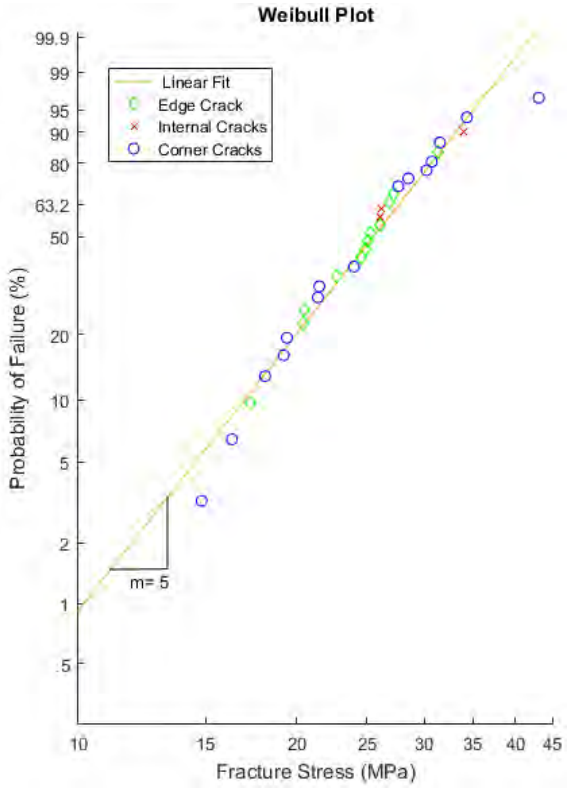

Figure 5. Weibull graph of the composite strengths.

4. Discussion

While the values for fracture toughness could not be found from the manufacturer, the value obtained agrees with other Bis-GMA based dental resin composites [23]. Our value is less than the value of 1.11 MPa$\sqrt{m}$ found by Cho et al. for the same material [24] and less than the value of 1.1 MPa$\sqrt{m}$ found by Quinn et al. for materials that are resin based, but manufactured in a different way [16]. Note that a different technique was used by Cho et al. to measure the fracture toughness. The notched bend test is noted for producing increased values of fracture toughness unless the notch is artificially sharpened [13]. In the present study, as well as the one in Quinn et al., we were not able to produce a sharp crack artificially due to the viscoelastic nature of the material [16]. The condition at the crack tip can explain the difference in the numerical values between the notched bend test and the "natural" flaws. The material used in Quinn et al. [16] is an indirect resin composite block (Paradigm, 3M ESPE, MN) used for indirect restorations. The composition of the indirect material used in their research contains a high fraction of filler particles (85 wt% ultrafine zirconia-silica ceramic to reinforce a highly crosslinked polymeric matrix). Thus, as the authors state, this material is closer to ceramic behavior. The materials used in this research is a direct dental composite material which contains 40-48 wt% Baria-aluminosilicate glass filler as well as 34.0% pre-polymer fillers. In addition, the sample preparation was different in the two studies. The present study used a prefabricated mold followed by a light cure and then shaped for tensile specimens, while in the Quinn et al. article, a hard block was used and it was sectioned to get the desired shape for flexural tests. Thus, we should not expect the values to be comparable. While there are many fractographic studies of resin composites [25, 26] and determination of toughness values for resin composites [27, 28], to our knowledge there is no record of toughness values for direct resin composites measured using the quantitative fractographic technique used here. Thus, we provide useful information for use in *in vitro* analysis because the size of the cracks are those expected in clinical failures. The results here and from Quinn et al. suggest that the fractographic technique may be used to determine differences in manufacturing techniques as well as differences in particle loading. Further research in this area should be pursued.

The unbiased Weibull modulus was 4 for this specific material, which is less than the value of 8 found by Quinn et al. for their material [16]. Of course, the Weibull modulus is just an indication of the distribution of the values of strength obtained. This distribution is related to the uniformity of the flaws in the material which, in turn, is related to manufacturing procedures and handling. Thus, both values found in the two studies are relatively low, indicating a wide spread of flaw sizes and locations. As observed in the Weibull graph, there does not appear to be an effect of the location of flaws as to the strength of the material. The characteristic strength was 26 ± 2 MPa. Since the fracture initiating flaws were "natural", they were not controlled except by the fabrication and finishing procedure. The sizes should be comparable to those observed in clinical procedures. Better control of the fabrication procedures could result in greater toughness values, but most likely not greater than ~ 1 MPa$\sqrt{m}$, and thus, in greater strengths for the same size flaws.

The method used to determine the elastic modulus in this work is relatively straightforward and unique for resin composites. Since the value agrees with the value provided by the manufacturer for flexural modulus, we think this is encouraging in that this presents

an easy method to obtain values for elastic moduli measurements in resin composites.

5. Conclusions

Quantitative fractographic analysis offers a different method to evaluate the toughness of direct resin composites. The advantage of this technique is that it occurs with the strength measurements. No additional testing is necessary. The other advantage of this technique to measure fracture toughness is that the flaws causing failure are of the size expected with the handling and finishing procedure used in clinical practice. More research is needed using the quantitative fractographic technique with resin composites to determine the effect of particle size and volume fraction as well as manufacturing techniques on the mechanical properties. The Knoop hardness technique to measure the elastic modulus offers a relatively easy technique to use for resin composites.

Author contributions

Equal contribution to the paper.

Acknowledgments

The authors thank Dr. Nancy Ruzycki at the University of Florida for use of the SEM during the investigation and Mr. Jack Wannamaker for hardness measurements. We also want to thank and acknowledge Ivoclar Vivadent for providing the raw materials used in this study.

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Questions

1. The fracture toughness of the resin composites was measured using:

❑a. Single edge notch test;
❑b. Compact tension test;
❑c. Quantitative fractography;
❑d. Double torsion test.

2. The elastic modulus was calculated using:

❑a. The slope of the stress-strain curve;
❑b. The sonic modulus technique;
❑c. Knoop indentation;
❑d. Vickers indentation.

3. The value for the fracture toughness found was:

❑a. In agreement with comparable studies;
❑b. Lower than values found in comparable studies;
❑c. Greater than values found in comparable studies;
❑d. Not compared to values found in other studies.

4. Quantitative fractography uses what measurements to calculate fracture toughness?

❑a. Crack size and stress at failure;
❑b. Crack size and elastic modulus;
❑c. Elastic modulus and stress at failure;
❑d. Stress at failure and Vickers hardness.

Original Article

ASSOCIATION BETWEEN SERUM RESISTIN LEVEL AND PERIODONTAL CONDITION CHANGE AMONG ELDERLY PEOPLE

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DOI: 10.25241/stomaeduj.2018.5(1).art.2

ABSTRACT

Aim: This study aimed to compare periodontal condition in four years of Japanese elderly between high and low serum resistin levels.
Materials and methods: One hundred and thirty-two dentate community-dwelling participants enrolled in this cohort study. At baseline, blood sample were drawn for serum resistin and other adipokines/cytokines measurements. The participants were then divided into 2 groups; low resistin (LR, resistin < 5.3 ng/mL) group (n = 84) and high resistin (HR, resistin ≥ 5.3 ng/mL) group (n = 48). At baseline and after four years, all participants were subjected to periodontal examination (assessment pocket depth; PD and bleeding on probing; BOP). Annual general/oral health questionnaires were also performed. Intergroup comparisons of periodontal parameters and categorical variables were accomplished by t-test and Chi-square test, respectively. Association between baseline serum resistin level and periodontal condition alteration after four years in each group were analyzed by a multiple linear regression analysis.
Results: At baseline, HR group had more sites with PD ≥ 4 mm concomitant BOP than those of LR group (5.8±9.0 vs. 2.8±4.8 sites). High serum resistin concentration and number of tooth loss markedly associated with reduction of sites with PD ≥ 4 mm and PD ≥ 4 mm concomitant BOP.
Conclusion: High serum resistin level might negatively be associated to periodontal disease progression.
Keywords: adipokine, elderly, inflammation, periodontitis, resistin.

Peer-Reviewed Article

Citation: Ogawa H, Damrongrungruang T, Furugen R, Hayashida H, Saito T, Yoshihara A, Miyazaki H. Association between serum resistin level and periodontal condition change among elderly people. Stoma Edu J. 2018;5(1):24-30.

Academic Editor: Poul Erik Petersen, DDS, Dr Odont, BA, MSc, Professor, WHO Senior Consultant, University of Copenhagen, Copenhagen, Denmark

Received: January 26, 2018
Revised: February 02, 2018
Acccepted: February 28, 2018
Published: March 02, 2018

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1. Introduction

Adipose tissue, in current view, is not only an inert organ for energy storage, but it is able to mediate signals to play important roles in a number of physiological responses, for instance activation of secretory process from endocrine and reproductive system, modulation of bone metabolism and controlling inflammatory processes [1]. It is well established knowledge in recent years that increase in metabolic overload relates to more frequent obesity and is closely associated with higher systemic inflammations [1]. Adipocytes produce a number of adipokine such as adiponectin, resistin and leptin as well as cytokine including tumor necrosis factor alpha (TNF-α) and interleukin-6 (IL-6). These factors play a pivotal role in inflammation and immune reaction [1,2]. TNF-α and IL-6, two major inflammatory cytokines, were shown to overexpress in adipose tissue of obese mice and human, which clearly showed the link between obesity, diabetes and chronic inflammation [3-5]. Additionally, soluble molecules from adipocytes played a complex interaction with the immune cells [6]. Adiponectin, one of a well-studied adipokines, acts as an anti-inflammatory factor due to it inhibited TNF-α-induced adhesion molecule expression [7] and induced anti-inflammatory cytokine IL-10 and IL1R in human leukocytes [8]. Furthermore, its level is slightly decreased in periodontitis [9].

Resistin is an 144-amino-acid adipokine which was previously said to be predominantly expressed in adipocytes [10-11]. However, recent evidence demonstrated that resistin expressed mainly from macrophages and bone marrow cells and is linked to the inflammatory cascade [12] as well as an immune response [1]. It was found that lipopolysaccharides from pathogenic bacteria in human volunteers stimulated secretion of circulating serum resistin levels [13]. On the contrary, the NF-κB inhibitor could counteract the pro-inflammatory properties of resistin, thus demonstrating the interplay of the NF-κB in the resistin–induced modulation of the inflammatory cascades [14]. Previous reports found that resistin was positively correlated with obesity and insulin resistance and glucose-lowering therapies reduced resistin gene expression [15].

Periodontitis, a multifactor chronic inflammatory disease caused mainly by intraoral pathogens, is strongly linked to the immune system [16,17]. Obesity has also been suggested to be linked to periodontitis in the way that periodontitis was exacerbated by some

conditions associated with obesity e.g. insulin resistance [18]. It was suggested that increased serum resistin levels were correlated with developed periodontitis in elderly Japanese [9]. Furthermore, non-surgical periodontal treatment slightly decreased circulating resistin level [19]. Bleeding on probing is generally known parameter that directly reflects inflammatory condition and is considered as a predictor of periodontal disease progression in elderly [20]. We hypothesized that serum resistin level but not adiponectin might relate to the progression of periodontitis by the changing of bleeding on probing sites. However, this hypothesis has never been proved yet.

Even several lines of evidence support the higher level of serum resistin in periodontitis patients, but recent reports concluded that there were almost no differences of serum resistin levels between normal VS periodontitis patients [21-22]. Whether they influence the alteration of periodontal conditions in a long-term period still has not yet been reported. The aim of the present study was to investigate whether serum resistin levels associate to the long term periodontal condition alteration.

2. Materials and Methods

2.1. Study design and participants

The present cohort, parallel design study was performed as part of the Niigata elderly study. A total of 161 Japanese elderly residing in Niigata, Japan and aged 76 at baseline participated during the entire period of the present study. Our inclusion criteria were healthy individuals and the exclusion criteria included any severe systemic disease(s) or disability condition(s). Ethical approval was obtained from the Niigata University Review Board (21-R13-09-08) and all procedures were undergone in the Niigata University Hospital. After the participants signed the informed consent, they were asked to answer the general/oral health questionnaires. The diagnosis of periodontitis was based on the criteria as designed by the American Academy of Periodontology in 1999 [23].

2.2. Periodontal Examination

Four trained dentists were involved in this study and were calibrated for periodontal examination until the kappa value for probing pocket depth ≥0.8 was reached. All remaining teeth were subjected to 6 sites/tooth examination. The measurements of the probing pocket depth (PD) were based on nearest millimeter intervals and all sites with bleeding on probing (BOP) were also recorded. Periodontal examinations were conducted at baseline and at the 4th-year follow-up examinations. Analyses were performed by another dentist who was not involved in the patient clinical outcome measurements.

2.3. Biological measurement

Blood samples were taken and kept at -70°C until subsequent measurements of HbA1c, adiponectin, resistin, IL-6 and TNF-α by KHP0041, KHP0051, KHC0064 and KHC3014 ELISA kits (Biosource International Inc., CA, USA), respectively. Before measurements, the validation of the method was performed by fabrication of standard curve following the instruction from the manufacturer. All serological parameters were measured once at the baseline period.

Table 1. Basic characteristics, HbA1c and periodontal characteristics of the study participants at baseline

Characteristics	Overall	Resistin	
		LR (<5.3 ng/mL) N = 84	HR (≥5.3 ng/mL) N = 48
General characteristics			
Male/female	64/68	40/44	24/24
Number of present teeth	20.53 ± 5.87	20.36 ± 5.67	20.83 ± 6.21
Alcoohol drinking (%)	64.12	64.29	63.83
Smocking (%)	44.70	46.43	41.67
HbA1c (%)	5.22 ± 0.70	5.27 ± 0.81	5.13 ± 0.46
BMI (kg/m^2)	22.69 ± 2.62	22.75 ± 2.69	22.59 ± 2.51
Serological parameters			
Adiponectin (μg/mL)	11.09 ± 4.82	11.17 ± 4.80	10.97 ± 4.88
TNF-α (pg/mL)	0.97 ± 1.59	0.94 ± 1.80	1.03 ± 1.14
IL-6 (pg/mL)	0.75 ± 1.89	0.75 ± 1.97	0.76 ± 1.75

Data expressed as mean ± standard deviation

BMI = body mass index, HbA1c = glycated hemoglobin, HR = high serum resistin, IL-6 = interleukin-6. LR = low serum resitin, TNF-α = tumor necrosis factor alpha

2.4. Health Status Interview

At baseline and at 4th-year, the participants were asked to participate in an annual health examination which includes a general health check-up and the oral health questionnaires. We included the questions about receiving dental (including periodontal) treatment and recent tooth loss in the questionnaires as well in order to evaluate the oral health maintenance manner of subjects.

2.5. Statistical Analysis

For continuous variables, the t-test was used for intergroup comparisons. Categorical variables comparisons between groups were conducted using Chi-square test. For association between baseline serum resistin level and periodontal condition after 4 years, multiple linear regression models were used to predict changes of sites with PD≥4 mm and sites with PD≥4 mm concomitant BOP by the influence of serum resistin, adiponectin, IL-6, TNF-α level and number of tooth loss. The P-value<0.05 was determined as statistically significant. All statistical analyses were conducted using the STATA software package (Stata Corp., www.stata.com).

3. Results

A total of 132 participants (64 male and 68 female) were included in the present study because 29 participants were totally edentulous individuals. Almost all participants were non-diabetic because the average HbA1c at baseline was 5.22 ± 0.70%. Only 5 participants (3.8%) had HbA1c level more than 6.7% (a cut-off point of increased risk of hypoglycemia according to the Japanese Diabetes Diagnostic Criteria (1999) [24]. Of these, 84 participants were classified into a low resistin group (LR), (with an

individual having a serum resistin level <5.3 ng/mL, and 48 participants were in a high resistin group (HR), or who had serum resistin from 5.3 ng/mL. This categorization was according to a previous study [9].

Table 1 shows the characteristic of the participants at baseline. Based on general data, 44.7 % (59 out of 132) of participants were smokers. With respect to the drinking habit, one participant who was in the HR group refused to answer the questionnaire so we excluded this participant in the analysis of the drinking habit and we found that 64.1 % (84 out of 131) of participants drank alcohol. There was no difference regarding the number of drinkers or smokers between the groups. The distribution of serum resistin ranged from 1.2 to 17.9 ng/mL with an average of 5.38 ± 3.24 ng/mL. The average BMI of participants in the present study were in the normal weight range based on the WHO classification for Asians [25]. Six participants (5 in LR and 1 in HR group, data not shown) were classified as obese (BMI ≥ 27.5). With respect to the adipokine/cytokines data at baseline, there were no differences between the groups in all these parameters (Table 1).

Intergroup comparisons of periodontal parameters are shown in Table 2. At baseline, the HR group had sites with PD≥4 mm, and sites with PD≥4 mm concomitant BOP 1.58. This was 2 times higher than those of the LR group, respectively.

There were statistically significant differences at p = 0.026 and 0.016, respectively. Interestingly, after 4 years all these parameters were improved in all participants. Alteration of above parameters were markedly detected in the HR group for both sites with PD ≥ 4 mm and sites with PD ≥ 4 mm concomitant BOP which were reduced by 54.2% and 92.5% after 4 years, respectively while in the LR group, these parameters decreased only by 28.3% and 87.2%, respectively from baseline. No significant difference was found between groups regarding PD ≥ 6 mm, and PD ≥ 6 mm concomitant BOP. The average number of tooth loss was only 1.1 teeth (5.0% loss from baseline) in the LR group, and 1.62 teeth (7.8% loss from baseline) in the HR group.

Multiple linear regression analyses (Table 3 and 4) were performed using alteration in the number of sites with PD≥4 mm, and these sites concomitant BOP during 4 years as a dependent variable, and all adipokines/cytokines level at baseline as well as the number of tooth loss in 4 years as independent variables. It was found that serum resistin levels had a significant contribution effect on the improvement of sites with PD ≥ 4 mm (correlation coefficient = -0.49; p = 0.080), and also inflammation shown by the reduction of sites with PD ≥ 4 mm concomitant BOP (correlation coefficient = -0.41, p = 0.009). The other cytokines and adipokine, however, appeared to have no such relationship. Additionally, the number of teeth lost during the 4-year period also had a significantly positive effect on the reduction of sites with PD ≥ 4 mm and sites with PD ≥ 4 mm concomitant BOP (correlation coefficient = -2.48; p = 0.000 and correlation coefficient = -0.78; p = 0.001, respectively).

Most of participants received periodontal treatment during the study period. Table 5 shows the numbers of participants who received scaling and scaling with root planning which were 109 (82.6%) and 56 (42.4%) individuals, respectively. When we compared the groups, there were no statistically significant differences between groups in participants who received scaling or those who received scaling with root planning (p = 0.862 and p = 0.894, respectively).

Table 2. Comparison of periodontal conditions between low (LR) and high (HR) serum resistin

Characteristics	Resistin		*p* value
	LR (<5.3 ng/mL) N = 84	HR (≥5.3 ng/mL) N = 48	
Periodontal conditions (Baseline)			
Sites with PD ≥ 4 mm	9.91 ± 11.98	15.62 ± 17.02	0.026
Sites with PD ≥ 6 mm	1.69 ± 3.11	2.75 ± 5.17	0.144
Sites with PD ≥ 4 mm concomitant BOP	2.82 ± 4.84	5.75 ± 8.97	0.016
Sites with PD ≥ 6 mm concomitant BOP	0.60 ± 1.69	1.02 ± 2.07	0.216
Number of present teeth	20.36 ± 5.67	20.83 ± 6.25	0.664
Periodontal conditions (4 years follow-up)			
Sites with PD ≥ 4 mm	7.11 ± 12.08	7.16 ± 8.10	0.980
Sites with PD ≥ 6 mm	0.89 ± 0.30	0.87 ± 1.23	0.969
Sites with PD ≥ 4 mm concomitant BOP	0.36 ± 0.48	0.43 ± 0.50	0.442
Sites with PD ≥ 6 mm concomitant BOP	0.21 ± 0.85	0.22 ± 0.55	0.913
Number of present teeth	19.09 ± 6.56	19.02 ± 6.68	0.950
Periodontal conditions (alteration)			
Sites with PD ≥ 4 mm	-2.79 ± 11.02	-8.45 ± 12.44	0.000
Sites with PD ≥ 6 mm	-0.79 ± 4.06	-1.87 ± 4.72	0.170
Sites with PD ≥ 4 mm concomitant BOP	-1.15 ± 4.98	-4.27 ± 7.34	0.004
Sites with PD ≥ 6 mm concomitant BOP	-0.39 ± 1.86	-0.79 ± 1.97	0.250
Number of present teeth	1.10 ± 2.17	1.62 ± 2.60	0.224

Data expressed as mean ± standard deviation

HbA1c = glycated hemoglobin, PD = probing pocket depth, BOP = bleeding on probing

t test was used to analysed

4. Discussion

To our knowledge, this is the first longitudinal observational study to compare the potential of low and high serum resistin level at baseline to predict the periodontal condition alteration of community-dwelling elderly in a 4-year period. The primary outcome variable was the association between the baseline serum resistin level and the alteration

Table 3. Multiple linear regression analysis and associated *p*-value using change in sites with PD ≥ 4 mm as a dependent variable

Independent variables	Dependent variable: changes in sites with PD ≥ 4 mm				
	Coefficient	S.E.	t	95% CI	*p*-value
Resisitin (ng/mL)	-0.49	0.28	-1.76	-1.05 – 0.06	0.080
Adiponectin (µg/mL)	-0.01	0.19	-0.04	-0.38 – 0.36	0.967
TNF-α (pg/mL)	0.39	0.56	0.70	-0.72 – 1.52	0.487
IL-6 (pg/mL)	-0.05	0.48	0.11	-0.90 – 1.00	0.915
Number of tooth loss	-2.48	0.39	-6.23	-3.27 – 1.69	0.000
Constant	0.70	2.93	0.24	-5.09 – 6.51	0.240

R-square = 0.281, PD = probing pocket depth, S.E. = standard error, t = t test statistic, CI = confidence interval, TNF-α = tumor necrosis factor alpha, IL-6 = interleukin-6

Table 4. Multiple linear regression analysis and associated *p*-value using change in sites with PD ≥ 4 mm concomitant BOP as a dependent variable

Independent variables	Dependent variable: changes in sites with PD ≥ 4 mm, concomitant BOP				
	Coefficient	S.E.	t	95% CI	*p*-value
Resisitin (ng/mL)	-0.41	0.15	-2.66	-0.72 – 0.10	0.009
Adiponectin (µg/mL)	-0.02	0.10	-0.28	-0.23 – 0.17	0.777
TNF-α (pg/mL)	0.31	0.31	0.99	-0.30 – 0.93	0.323
IL-6 (pg/mL)	-0.01	0.26	-0.07	-0.54 – 0.50	0.945
Number of tooth loss	-0.78	0.21	-3.55	-1.21 – -0.34	0.001
Constant	1.00	1.61	0.62	-2.19 – 4.20	0.536

R-square = 0.281, PD = probing pocket depth, S.E. = standard error, t = t test statistic, CI = confidence interval, TNF-α = tumor necrosis factor alpha, IL-6 = interleukin-6

Table 5. Comparison of number and percentages of participants who received periodontal treatment between low and high serum resistin group during study period

Type of periodontal treatment received	Resistin		*p* value
	LR (<5.3 ng/mL) N = 84	HR (≥5.3 ng/mL) N = 48	
Scaling only (%)	69 (82.14)	40 (83.33)	0.862
Scaling and root planing (%)	36 (42.86)	20 (41.67)	0.894

The *p*-values were calculated by Chi-square test

of inflammatory-related periodontal parameters. We demonstrated that the high serum resistin levels seemed more sensitive to contribute to the other factors-mediated improved periodontal condition more than those in the low resistin counterpart. The association between the other serological parameters at baseline as well as the number of teeth lost in 4 years, and the alteration of the periodontal condition were the secondary outcome variables.

The participants in the present study were in a relatively good periodontal condition (at baseline average sites with PD≥4 mm, and those concomitant BOP were 11.99 sites and 3.88 sites, respectively). Basically, periodontal disease activity can be measured by many parameters such as probing pocket depth, clinical attachment level, radiographic bone level, and bleeding on probing. Among these parameters, bleeding on probing is a reliable indicator that can be used to monitor periodontal disease activity in clinical situation [26], especially when focusing on inflammation as a primary outcome. This is the reason why we emphasized the analysis of the sites with periodontal pocket depth ≥ 4mm concomitant BOP in our study. Our results indicated that the periodontal disease activity in our participants were much lower than in the previous report [20].

Two meta-analyses [27,28] have demonstrated that individuals who were obese or had high body mass index (BMI) seemed susceptible to periodontitis more than normal weight individuals. And the high resistin levels were observed in obese individuals with periodontitis. The participants in the precedent study had normal BMI, but in individuals with relatively high BMI or the obese ones we did not observe this tendency suggesting that obesity modulates resistin independent of periodontitis.

A previous cross-sectional study by Furugen et al. [9] indicated that serum resistin levels were significantly correlated with BOP, and leukocyte counts, but weakly correlated with average PD. The present study also similarly found a significant correlation of sites with PD≥4 mm as well as sites with PD≥4 mm concomitant BOP at baseline with serum resistin level. These results support the previous report that resistin play an important role in inflammation [12]. But since all previous studies were cross-sectional studies; causality-effect relationship could not be obtained. It is noteworthy that for long term association of serum resistin level and periodontal parameters, high serum resistin level at baseline appeared to influence more profoundly the effect of the periodontal condition alteration. The possible explanation of these findings is based on the fact that all participants were aware of their periodontal condition mainly because they were subjected to periodontal examination and oral hygiene instruction. These led most of the participants to receive extensive periodontal treatment by themselves elsewhere over the period of the present study. However, the percentages of participants who received periodontal treatment in both groups are almost the same (Table 5). Nonetheless, the periodontal conditions of the high resistin group remained more improved than the low resistin group. These results were probably due to resistin significantly correlated only to severe systemic inflammation condition such as in angina patient [29], but in case of mild or localized inflammation such as stable angina and mild periodontitis, which is not severe enough to sense signaling to activate resistin, resulting in almost no positive relationship between the serum resistin level and the periodontal condition [14,19,30]. Our results were somehow different from these studies because we demonstrated the inverse association between serum resistin level and long-term periodontitis progression in a fashion that the higher the serum resistin levels the better the sensitivity to periodontal treatment effectiveness. Moreover, resistin plays a role not only in the peripheral area, but it also functions in a central nervous system. It was found that resistin inhibits dopamine and norepinerphrine in rat hypothalamus [31]. Furthermore, an increase in

serum resistin levels is related to the inhibition of the parasympathetic nervous system [32]. To date, there is still a lack of promising data in humans. This is because there is a striking difference in terms of biological responses between humans and rodents. Hence, we postulated that high serum resistin at baseline in our subjects might be a signaling factor to activate the central nervous system regulating an extensive amelioration of the local inflammation. In contrast, a low serum resistin level might not provide an adequate signal to stimulate the reduction of the peripheral inflammation. The exact mechanism to explain this finding, however, has not yet been fully elucidate.

Furthermore, resistin may respond differently depending on the age of the patients because it was found that resistin levels in children had no correlation with metabolic parameters. However, they correlated only with the onset of pubertal development [33]. Thus, resistin in the elderly probably exerts different effects than in the adults. Additionally, the serum resistin level is also affected by many other factors such as lipopolysaccharides form oral pathogens [13], insulin level [10,34], cardiovascular disease condition [35], and chronic kidney disease [36]. All these factors might exert an effect on serum resistin levels more than local inflammation occurring in mild/moderate periodontitis.

Conversely to the effect of serum resistin on the alteration of the periodontal condition, serum IL-6 and adiponectin level were hardly associated with the change of the periodontal condition (data not shown). For IL-6, the results are somewhat supported by the previous reports [37-39] in which these molecules were produced mainly only during the early inflammation event and were probably synthesized only in low level in elderly. Therefore, in the long-term observation and with a relatively low level of localized inflammation such as in the present study, we could not observe any effect of IL-6 on the periodontal condition changes. For adiponectin, previous studies suggested that periodontal treatment had minimally influenced the serum adiponectin level [9,39-42]. The present study added up this relationship, in which serum adiponectin level was relatively minimally influenced by the alteration of the periodontal condition. Indeed, adiponectin is said to be an anti-inflammatory molecule that can be impaired by resistin [43]. Regarding TNF-α, we demonstrated that the TNF-α level at baseline slightly positively affected periodontal disease progression (regression coefficient of 0.39 and 0.31 for change of sites with PD ≥ 4 mm, and sites with PD ≥ 4 mm concomitant BOP, respectively). TNF-α is a well-recognized cytokine related to the inflammatory process, and this molecule could be secreted by adipocytes [44], and immune cells [45]. Some studies have shown the positive association between serum TNF-α and periodontitis [46,47]. Our study is in line with these studies and contributes to the establishment of the role of the TNF-α in inflammatory enhancement.

Regarding the number of tooth loss which had a strong association with the reduction of the sites with PD ≥ 4 mm in 4 years, it is a common phenomenon that teeth which had been diagnosed on the basis of periodontal etiology/criteria, as having a poor prognosis in the elderly, on the basis of periodontal etiology/criteria, were the main sources of multiple, and relatively deep periodontal pockets. Based on theoretical and clinical knowledge such teeth would be extracted. The data of the present study showed that approximately 5.1 – 7.8% of teeth were lost during the 4 years in LR and HR group, respectively. This was considered an important factor that dramatically reduced the sites with PD ≥ 4 mm and these sites PO ≥ 4 concomitant BOP, which collectively improved the periodontal condition as shown in the study population.

Additionally, it is useful to include other age groups, the leukocyte related parameters e.g. leukocyte count, and genetic information to clarify the general resistin function. Especially from a genetic point of view, although there is no clear association, some Finnish [48] and Japanese [49] study subjects suggested that single nucleotides polymorphism (SNP) in the promoter region of the resistin gene (RETN -420C>G, rs1862513) associated with obesity and diabetes, which may be a link to the increase of the inflammatory reaction. Based on the fact that all participants were non-diabetic and almost classified into normal BMI individuals, the majority of our subjects probably might not have this SNP locus.

The present study has some limitations that should be carefully taken into consideration when interpreting the results. First, because of the observational nature of our study, we could not discourage individuals from receiving periodontal treatment, thus improving of individual periodontal condition. This might have in part contributed to the observed effect of the periodontal treatment they received. Furthermore, as aforementioned almost all participants were relatively in a good periodontal condition from the beginning of the study, therefore detecting the association between severe periodontitis and the serum resistin level could not be achieved. Finally, we had no data on the serum resistin level as well as the other serological parameters at the follow-up period to re-evaluate the relationship of serum resistin level and other adipokines/cytokines, and periodontal condition in a low inflammatory state. Monitoring the level of adipokines/cytokines at the end of study should be included in the future studies.

5. Conclusion

The present results provide evidence that high serum resistin levels are associated with a dramatic improvement in the long-term periodontal condition especially when considering bleeding on probing in the Japanese elderly. There was also a finding that resistin plays an important role in inflammation.

Author contributions

Conceptualization: HO. Methodology: HO and TD. Investigation: HO, RF and HH. Writing: HO and TD. Funding: TS and HM. Resources: AY.

Acknowledgement

We would like to thank all study participants for their kind co-operation. This study was supported by Grant-in-Aids from the Japan Society for the Promotion of Science (09470469) from the Ministry of Education, Culture, Sports, Science and Technology of Japan.

The author declares no conflict of interest related to this

study. There are no conflicts of interest and no financial interests to be disclosed.

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His major interest is global oral health promotion in public health perspective and also clinical research to strengthen evidence for the integration of oral and general health.

Questions

1. What is the major inflammatory cytokine shown to overexpress in adipose tissue?

❑a. Adiponectine;
❑b. Resistin;
❑c. TNF-alpha;
❑d. Leptin.

2. Individuals with impaired fasting glucose and diabetes mellitus,

❑a. often have degrees of periodontal inflammation;
❑b. often have degrees of oral carcinoma;
❑c. often have degrees of root caries;
❑d. often have degrees of dysphagia.

3. Periodontal disease could be described as,

❑a. non-multifactor chronic inflammatory disease;
❑b. integrated to immune system;
❑c. caused only by intraoral pathogen;
❑d. caused mainly by undernutrition.

4. Level of adipokine could be influenced by,

❑a. fluoride gel application;
❑b. intake of Vitamin supplement;
❑c. professional mechanical tooth cleaning;
❑d. smoking habit.

MANIFESTATION OF SLEEP BRUXISM ACCORDING TO THE AGE OF PATIENTS

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DOI: 10.25241/stomaeduj.2018.5(1).art.3

ABSTRACT

Introduction: Bruxism is a widespread condition, affecting up to 85-90% of the general population, and in 5% of these individuals, the grinding evolves into a clinical condition. In many cases, sleep bruxism is latent, the disorder may be identified by its consequences (dental wear, etc.). This ascertains the need to develop diagnostic methods that may be able to identify bruxism at the initial stages of the disorder.
Aim of the study: to determine the peculiarities of the clinical manifestation of primary sleep bruxism (SB) based on the age of the patients.
Methodology: One hundred patients with primary SB (70 patients aged between 18-35 and 30 patients aged between 35-50) were investigated. The clinical features of SB (algic syndrome, myogenic disorders, temporomandibular disorders, dental wear, psychoemotional disorders, sleep quality alterations) were also investigated.
Results: The expression of emotional stress in patients of various ages was almost identical. The highest clenching frequency and duration, as well as a higher clinical expression of sleep bruxism was observed in patients under 35. The components of the algic syndrome show a varied expression for different age groups – patients under 35 had more severe disorders of the nocturnal episodes and myogenic-spastic events; older patients (35-50) were characterized by a prevalence of local and diffuse myogenic structural disorders, arthrogenic pain and severe sleep disturbances.
Conclusion: Electromyography and ultrasonography can reveal important morpho-functional peculiarities of the masticatory muscles that are associated with the severity of SB in patients from different age groups.

Keywords: bruxism, electromyography, ultrasonography, temporomandibular disorders, diagnostics.

Peer-Reviewed Article

Citation: Romaniuc D, Fala V, Lăcustă V, Bordeniuc G, Fala P. Manifestation of sleep bruxism according to the age of patients. Stoma Edu J. 2018;5(1):31-37.

Academic Editor: Sever Toma Popa, DDS, PhD, Professor, "Iuliu Haţieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania

Received: November 22, 2017
Revised: January 23, 2018
Acccepted: February 26, 2018
Published: March 01, 2018

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1. Introduction

Bruxism is a parafunctional activity, characterized by repetitive jaw-muscle clenches, tooth grinding, bracing/thrusting of the jaw, occurring either during sleep (SB – sleep bruxism) or during wakefulness (AB – awake bruxism) [1]. Bruxism is a widespread condition – around 85-90% of the general population grinds their teeth in certain periods of their life, and in 5% of these people, the grinding evolves into a clinical condition [2,3]. The prevalence of bruxism varies greatly from 5% to 96%, which highlights that a varied range of criteria and methods for diagnosing this condition are being used [5,6]. An important aspect to this problem is the age of the patients. The highest frequency of bruxism is observed in the age group between 19-44, without any essential gender- based differences [7]. Bruxism may be observed in children starting approximately from the age of one [8] and it occurs in 7-15% of cases [9]. The condition has its onset during childhood in 6.4% of cases, during school years in 2.5% of cases and during the period of professional activity in 26.8% of cases [10]. The prevalence of bruxism in children varies from 6.5% to 28% in various countries [11,12]. The authors, based on the analysis of various scientific literature data, have established a linear trend of decrease in the prevalence of bruxism in relation to age: 19% at the age of 3-10, 13% in adolescents and youngsters, 3% in adults after the age of 60 [11]. Some researchers consider that bruxism first identified in childhood may continue to persist with aging [13], others have established that bruxism diminishes and disappears during adulthood [14]. The incidence of bruxism in 18-29 year-olds is 18.9% – awake bruxism in 10.4% of cases, sleep bruxism in 2.4% of cases and mixed bruxism in 6.1% of cases. It has been established that patients aged between 20-29 show signs of bruxism most frequently (41.8%) [15]. An analysis of 2,000 people showed that bruxism is present in 18-year-olds in 13% of cases, and after 65 years of age in only 3% at an approximately equal frequency in men and women [16]. After the age of 65, the prevalence of bruxism is about 10% with a dramatic decrease with aging. The prevalence of bruxism in individuals aged between 35-44 is twice as high as the prevalence in 18-year-olds, respectively 4.12 ± 0.79% vs. 2.73 ± 0.65%. Currently, there are no specific factors that are deemed responsible for the etiology of bruxism [4]. It is being assumed that one of the causes of the higher prevalence of night bruxism in young people is the presence of a higher level of anxiety and stress [11]. With aging, the microstructure of the masticatory muscles essentially changes; signs of osteoporosis that are associated with the changes in the masticatory

muscles occur [17]. The thickness and hypertrophy of the masticatory muscles also depend on the age of the patients [18, 19, 20]. Based on the age factor, the degree of severity is also various for the manifestations of sleep bruxism. It is being assumed that the peculiarities of bruxism based on the age factor are manifested under the influence of cofactors (alcohol, caffeine, nicotine, etc.), professional activity, and especially stressful professions [6,12]. Currently, there are no sufficient studies on the peculiarities of SB manifestation based on the age of the patients, while the etiopathogenetic causes of this phenomenon are not yet clear. A clinical-neurophysiological study of bruxism at various periods of life will allow the development of a diagnostic and a treatment algorithm based on the age of the patients.

Clinical signs and the subjective symptoms of sleep bruxism are considered to be neither always present, nor evident [4]. In many cases, sleep bruxism is latent (subclinical), without being revealed during common dental exam. In the subclinical variants of sleep bruxism, the disorder is identified when various complications arise (dental abrasion, root fractures, etc.). This ascertains the need of developing diagnostic methods that may be able to identify bruxism in patients of various ages at the initial stages of the disorder, using pathogenetically argumented methods.

Purpose of the study – highlighting the peculiarities of the clinical manifestations of primary sleep bruxism according to the age of the patients.

2. Materials and methods

The study has been approved by the Committee of Research Ethics of the „Nicolae Testemițanu" State University of Medicine and Pharmacy, Chișinău, Republic of Moldova (minutes no. 37/04.04.2016).

One hundred patients with primary sleep bruxism were investigated (Table 1).

The diagnosis of SB was performed following the current international criteria, including: 1) medical history, 2) application of clinical questionnaires, 3) dental clinical examination (intraoral and extraoral), 4) EMG assessment for a period of several days, 5) recording of the SB nocturnal episodes for a period of several nights, 6) ultrasonographic examination of the masticatory muscles.

Inclusion criteria: a positive clinical diagnosis of primary sleep bruxism, confirmed by an objective recording of the nocturnal episodes; occlusal type – Angle Class I; age of patients between 18-50; presence of the patient's consent to participate in the research; cooperating patients.

Exclusion criteria: age was not within the established limits; other clinical forms of bruxism (disorders of the nervous system – epilepsy, parkinsonism, etc.); the presence of anomalies and inflammatory signs in the stomatognathic system; the presence of signs of organic damage with the decompensation of the masticatory activity (EMG values during relaxation less than 30 μV); various acute and chronic diseases in the period of exacerbation, parasitosis; alcoholism, drug addiction, toxicomania, mental illness; ongoing treatment with psychotropic, anticonvulsant or miorelaxant drugs; lack of the patient consent for participating in the research; non-cooperating patients.

Table 1. The age of the patients with primary sleep bruxism according to their gender.

Researched groups	Mean age of the group, yrs.	Mean age, yrs.	
		Individuals under 35	Individuals over 35
Whole group	33.2 ± 1.15	26.6 ± 0.99	39.8 ± 1.07
Women	30.4 ± 1.34	23.5 ± 1.02	37.3 ± 1.16
Men	36.0 ± 1.12	29.7 ± 1.25	42.3 ± 2.13

The study regarding the influence of stressogenic professions on the degree of sleep bruxism manifestations was performed according to the criteria proposed by Nishimura [21].

We have applied questionnaires for the quantitative assessment of SB manifestations [22-25]: clinical questionnaire, Fonseca questionnaire, multifactorial questionnaire for bruxism associated pain, sleep quality questionnaire. For the quantitative assessment of the emotional subjective feelings, we have used the Visual Analogue Scale (VAS).

The *dental abrasion degree* was assessed, according to the following score [22]: 0 – no abrasion; 1 – dental abrasion within enamel boundaries; 2 – dental abrasion with crown destruction less than one-third; 3 – dental abrasion with crown destruction more than one third.

In order to record the nocturnal motor episode, we have applied the portable device *SleepGuard* SG_5 (Hollistic Inc., USA). It is used for five consecutive nights in order to assess the average values of the motor indices: *total clench time* (TCT) during sleep and their number (TNC – *total number of clenches*).

We have determined the thickness of the masseter muscle following the recommendations in the scientific literature [18,19] by applying the *Envisor C* (Philips, Japan) equipment and a 7.5 MHz linear transducer. The *masseter muscle thickness gradient* (MTG) was calculated according to the formula:

$$MTG = \frac{Ga - Gr}{Ga} \times 100\%$$

where: *Gr* - masseter muscle thickness during relaxation (mm); *Ga* - masseter muscle thickness during maximum jaw engagement (mm).

We have determined the echo-structure of the masseter muscle by analyzing the local and diffuse echogenic features. Normally, the muscle is visualized as hyperechogenic strips parallel to the long axis of the muscle. Muscle fascicles have a connective tissue coating that creates an ultrasonographic picture of hyperechogenic bands. Any pathological change in muscles, fascia, and connective tissue manifests itself through local and/or diffuse modifications of echogenicity. The trigger points are manifested by the occurrence of local pathological echogenicity, and the pathological changes in the masseter muscle can be manifested through diffuse ecogenic zones that increase, consequent to the increase in muscle hypertrophy/hypotrophy, increase in the processes of fibrosis, etc. For the quantitative assessment of the echogenic features, we have determined the total score: normal echogenicity in the projection of the masseter muscle – 0 points; local pathological echogenicity – 1

Table 2. Clinical manifestations of primary sleep bruxism vs. the age of patients vs. indices observed in healthy subjects.

Indices	Healthy (n = 30)	Primary sleep bruxism			P_{1-2}	P_{3-4}
		Entire group (n = 100)	Age ≤35 (n = 70)	Age >35 (n = 30)		
Bruxism questionnaire, points	0.10 ± 0.05	4.85 ± 0.28	5.41 ± 0.32	4.25 ± 0.24	< 0.001	< 0.05
Pain questionnaire, points	1.18 ± 0.16	4.71 ± 0.25	5.09 ± 0.36	4.33 ± 0.31	< 0.001	NS
Fonseca questionnaire, points	1.16 ± 0.39	52.02± 4.13	59.43 ± 4.42	44.61 ± 3.75	< 0.001	< 0.05
Ultrasound, MTG index, %	25.0 ± 0.45	28.4 ± 0.52	25.5 ± 0.55	31.3 ± 0.58	< 0.001	< 0.001
Ultrasound, echogenicity, units	0.23 ± 0.07	1.35 ± 0.10	1.10 ± 0.11	1.60 ± 0.10	< 0.001	< 0.01
Dental wear, units	0.26 ± 0.11	1.93 ± 0.19	1.87 ± 0.22	1.99 ± 0.15	< 0.001	NS

Note: NS – no statistical significance.

point; diffuse pathological echogenicity – 2 points.
The results obtained were processed using the *Statistics for Windows v.11.0* (StatSoft Inc., USA) specialized software package for statistical analysis.

3. Results

In healthy people, highly stressful professions accounted for 30% of cases; VAS-stress expression of 3.80 ± 0.35 points. In patients with SB, but from various age groups (18-50 years, n = 100), highly stressful occupations accounted for 24% of cases; VAS-stress – 5.71 ± 0.31 points. In SB patients under 35, high stress professions accounted for 21.4% of cases; VAS-stress – 5.99 ± 0.28 points. In SB patients over 35, highly stressful occupations accounted for 30% of cases; VAS-Stress – 5.43 ± 0.35 points.
This analysis revealed non-essential differences ($p > 0.05$) between healthy individuals and SB patients of various age. Statistical differences of VAS-stress scores among healthy individuals vs. patients with SB (n = 100) were significant ($p < 0.01$), and the differences between groups of patients with SB of various age were not significant ($p > 0.05$) with tendencies of more severe stress manifestation in patients under 35.
TNC indices in healthy individuals were 3.4 ± 0.95; in patients with SB (n = 100) – 50.4 ± 5.96; in patients with SB under 35 – 65.4 ± 5.26; in patients with SB over 35 – 35.4 ± 6.44. The highest frequency of clenching was observed in younger patients.
TCT indices in healthy subjects constituted 3.6 ± 0.68; in patients with SB (n = 100) – 86.5 ± 7.93; in patients with SB under 35 – 110.5 ± 8.22; in patients with SB over 35 – 61.5 ± 6.91. In a similar way, the highest clench duration was observed in younger patients.
The length and quality of night sleep were closely related to the intensity of the psycho-emotional state. Sleep duration in patients under 35 (18-35 years of age, n = 70) showed statistically significant differences in comparison to the values observed in older patients (35-50 years, n = 30), respectively: 7.9 ± 0.52 hours vs. 6.2 ± 0.41 hours ($p < 0.05$).
The quality of nighttime sleep in patients with SB, based on the self-assessment scores, was as follows (statistically significant differences between values observed in patients under 35 years of age in comparison to older patients):

- normal sleep quality – 20 patients (28.6%)/4 patients (13.3%), $p > 0.05$;
- borderline disorders – 38 patients (54.3%)/8 patients (26.7%), $p < 0.01$;
- pathological sleep – 12 patients (17.1%)/18 patients (60.0%), $p < 0.001$.

The analysis of the clinical manifestations of SB, based on the clinical questionnaire has shown a higher value of the clinical SB expression in patients under 35, when compared to older patients (Table 2). The frequency of the positive responses, based on the SB questionnaire (which reflected the condition of the patients in the last 6 months) was the following (the percentages of clinical signs for patients under 35 are indicated in a decreasing order, as compared to data from older patients):

- Tooth grinding during sleep, observed by life partners – 100% vs. 100%.
- Tooth grinding during sleep (self-assessed by patients) – 97.1% vs. 93.3% ($p > 0.05$).
- Pain and fatigue in masticatory muscles, after awakening – 60.0% vs. 36.7% ($p < 0.05$).
- Sensations of jaw tension or difficulties during mouth opening, after awakening – 54.3% vs.
- 30% ($p < 0.05$).
- Pain felt in the temple region, after awakening – 50.0% vs. 26.7% ($p < 0.05$).
- Teeth clenched together, after awakening – 44.3% vs. 23.3% ($p < 0.05$).
- Dental or gingival pain, after awakening – 22.9% vs. 10.0% ($p > 0.05$).
- Dental mobility, after awakening – 18.6 % vs. 13.3% ($p > 0.05$).

In patients with SB under 35, ulcerations of the tongue were detected in 7.1% of cases vs. 6.7% in patients

aged over 35.

According to the multifactorial pain test developed by the authors, the smallest values in healthy individuals have the following scales: scale I – arthrogenic factor (0.10 ± 0.05), autonomous factor, scale IV (0.10 ± 0.15), circadian factor, scale VI (0.10 ± 0.05) and the pain duration factor, scale VIII (0.10 ± 0.05). In healthy individuals, the highest values are presented by the myogenous factor – scale II (0.27 ± 0.26) and the by the psychoemotional factor – scale V (0.28 ± 0.06). Scale III (locoregional irradiation factor) and VII (pain intensity factor) have an intermediate position, due to their degree of expression (0.13 ± 0.06).

The components of the algic syndrome in patients with SB aged under 35 showed a pronounced expression for the following factors (in a decreasing order): myogenous (1.14 ± 0.12), circadian (0.99 ± 0.11), psychoemotional (0.92 ± 0.11), pain duration (0.58 ± 0.08); a moderate expression for the following factors: pain intensity (0.58 ± 0.08), arthrogenic (0.33 ± 0.06); poor expression for the following factors: autonomous (0.18 ± 0.03), loco-regional irradiation (0.16 ± 0.05).

For the patients aged 35 years or older, the expression of the algic syndrome was characterized by pronounced psychoemotional manifestations (0.83 ± 0.13), circadian (0.82 ± 0.12), myogenous (0.71 ± 0.13), a longer duration (0.66 ± 0.11) and arthrogenic manifestations (0.65 ± 0.11); moderate for pain intensity (0.32 ± 0.02); poor expression for pain irradiation (0.18 ± 0.04) and autonomous manifestations (0.16 ± 0.05).

The analysis of the masseter muscle thickness was conducted based on the gender of the patients, because it was established that the differences of these indices are statistically significant between men and women [18,19]. During the state of relaxation, the masseter muscle thickness was 9.75 ± 0.27 mm for women under 35 and of 9.82 ± 0.26 mm for older women ($p > 0.05$). During jaw clenching, the values of masseter thickness were: 13.12 ± 0.29 mm for younger women (< 35 years, n = 50), and for the ones over 35 (n = 18) – 14.75 ± 0.28 mm ($p < 0.001$). With aging, the increase of the masseter muscle thickness was also evident.

In men, during relaxation, the thickness of the masseter muscle was 10.71 ± 0.23 mm at the age of under 35 (n = 20) and of 11.45 ± 0.22 mm – over 35 (n = 12, $p < 0.05$); during jaw clenching, the thickness of the muscle was of 14.52 ± 0.24 mm for individuals under 35 and of 16.21 ± 0.28 mm for patients over 35 ($p < 0.001$).

As it may be observed from Table 2, the thickness gradient (relaxation-engagement) had a higher statistical significance in patients with SB, which are over 35.

4. Discussion

According to the proposed objectives, we have studied the clinical peculiarities of SB, according to the age of the patients – under 35 and older. This division was made based on multiple literature data that reflects that the period of 35-40 years of age is the one where the prevalence of bruxism shows a considerable reduction [12].

Taking into account the fact that increased stress activity contributes to the occurrence of many SB disorders [26] and that people with SB have a much higher level of stress-sensitivity [27], we have analyzed the level of emotional stress (VAS) and the professions of the patients, according to the stress level.

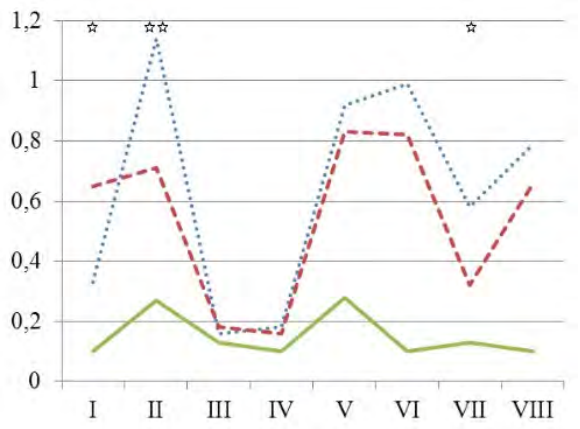

Figure 1. Bruxism-associated pain intensity in patients with primary sleep bruxism, according to the age of the patients.
Note: the scales (factors) of the bruxism-associated pain: I – arthrogenic; II – myogenous; III – loco-regional irradiation; IV – autonomous; V – psychoemotional; VI – circadian; VII – pain intensity; VIII – pain duration; statistical significant differences between sleep bruxism patients under 35 vs. patients over 35 (* - $p < 0.05$, ** - $p < 0.01$). Blue dots – Sleep bruxism patients, under 35; Red dots – Sleep bruxism patients, over 35; Green line – Healthy subjects.

We have observed that the level of emotional stress is an important index that is fundamentally different in healthy people and in patients with SB, but this index does not reflect the differences regarding the age of the investigated subjects, and some tendencies of increased stress levels in younger individuals can be observed.

With aging, there is an increase in the quantitative and qualitative sleep disruptions. The interpretation of these data is difficult due to the fact that, as it has been established that in healthy people, there are significant changes in the sleep quality associated with aging, especially after the age of 30-35 – a longer period of time is needed to get asleep, sleep is far more fragmented, with more frequent awakening episodes, the duration is shorter. These features are particularly greatly increased in patients with SB.

Pain in the masticatory muscles and in the temporomandibular joint is one of the main causes of dental visits [29]. For these reasons, a more precise clinical diagnosis of the algic syndrome will contribute to more effective monitoring and treatment.

The phenomenon of tongue ulcerations can be partially explained by the fact that the pressure exerted by the bruxer's tongue towards the teeth is much higher compared to the one found in non-bruxers [28].

It has been established that the bioelectric activity of the masticatory muscles may be associated with muscle pain but may also present as a disorder that is independent of the presence of pain and its intensity [29]. The relationship between pain and sleep bruxism is still a matter of controversy, especially in regard to whether a painful condition may affect the EMG activity during sleep [2]. Due to a massive nociceptive affinity from the structures of the stomatognathic

system towards the somatosensory cortex, there occur various reflex activities, due to modifications of muscle tone and onset of myogenous pain. However, the correlations between reflex activity and pain expression are not yet studied deeply.

According to several research projects, there are no statistically significant differences in the EMG indices in patients, which feel pain in the masticatory muscles compared to those with no pain [12,29]. The authors state that this phenomenon is due to central neuronal adaptation mechanisms, modifications of the pain modulation mechanisms and because of central sensitization phenomena.

It should be taken into account that various poorly expressed algic manifestations may be present for a short term in healthy individuals as well.

It is to be noted that myogenous pain in younger patients is more pronounced than in older patients. This phenomenon was also observed by other researchers [8,9,12,30,31], who explain it through the processes of adaptation to chronic pain observed in older people.

The results demonstrate that the psychoemotional factor (scale V), myogenous (scale II), circadian (scale VI), and pain duration (scale VIII) are quite pronounced in SB patients, that are either under or over 35. The pain pattern in patients under 35 may be characterized as a psycho-emotionalmyogenous circadian pain and for the older patients as a psycho-emotional-myogenous-arthrogenic circadian pain.

The data obtained confirm the results from the scientific literature – consequent to aging (until 61 years); an increase of the masseter muscle thickness can be observed [32].

There are several hypotheses regarding this problem: the increase of the masseter muscle thickness may occur as a result to muscle edema, fat accumulation, deficiency of protein metabolism, effects of psychoactive substances (alcohol, nicotine, etc.). Under the influence of previous inflammatory processes, the thickness of the muscle increases by approximately 4.3 mm [32].

Patients with SB show areas of muscle hypertonus (trigger zones) in which ultrasonographic examination shows changes in the echo-structure, left/right asymmetry and modification of the masseter muscle thickness.

In patients with SB under 35, the presence of local pathological echogenics is more frequent, which in most cases corresponds to the localization of the algic areas during palpation of the masseter muscles. In patients with SB over 35, besides the local pathological echogenicity, quite frequently a diffuse pathological echogenicity was observed. In the scientific literature, these aspects are being debated – it has been established that during the first stages of the disorders of the masseter muscle activity, local hypo-echogenic areas appear, which afterwards, due to the aggravation of the disturbances, transform into diffuse hyperechogenic zones [18].

An important dental index for SB is the presence of dental abrasion. Surprisingly, there was no statistically significant correlations observed between the EMG activity of the muscles and the degree of dental abrasion [33]. Some researchers consider that currently, there is an overemphasis on SB as a causative factor in tooth wear [4]. No valid correlations were found between dental wear and the age of patients, the occlusal factors and the degree of temporo-mandibular joint dysfunction. These data demonstrate that wear is associated with various factors, including cerebral factors. Moreover, a specific study has not revealed any statistically significant differences in the bioelectric activity of masticatory muscles during sleep between patients with and without signs of dental wear [31]. While assessing dental abrasion as a diagnostic sign of SB, it is necessary to highlight other etiopathogenic factors; dental abrasion is not the main criterion in the diagnosis of SB, because it can occur in other pathologies as well (acid reflux, long-term consumption of acidic juices, etc.) [30,31].

In summary, the following SB manifestations occur with a higher severity in patients under 35 years of age (statistically significant), when compared to older patients – $p < 0.05$):

- clinical signs of bruxism, assessed by means of the clinical questionnaire ($p < 0,05$);
- dysfunction of the temporomandibular joint, assessed by means of Fonseca questionnaire ($p < 0.05$),
- total number of clenches (TNC) ($p < 0.001$),
- total duration of clenches (TCT) ($p < 0.001$).

The following SB manifestations occur with a higher severity in patients over 35 years of age (statistically significant), when compared to younger patients – $p < 0.05$):

- pathological thickness of the masseter muscle (MM), determined by ultrasound ($p < 0.001$),
- pathological echogenicity of the MM, determined by ultrasound ($p < 0.01$),
- shorter sleep duration ($p < 0.05$), pathological quality of sleep ($p < 0.001$).

The results obtained show that there are important peculiarities of the clinical manifestations of primary sleep bruxism according to the age of the patients, which can be detected by the application of clinical and paraclinical diagnostic methods, mainly by using technologies able to continuously monitor the bioelectric activity of the masticatory muscles and the morpho-functional status of the stomatognathic system through ultrasonography.

5. Conclusions

1. The expression of primary sleep bruxism is influenced by the age of the patients: the younger patients (18-35 years of age) are characterized by having more severe disorders regarding the episodes of sleep bruxism, with more pronounced myogenous-spastic manifestations; older patients (35-50 years of age) are characterized by the predominance of local and diffuse myogenic-structural disturbances, with more pronounced arthrogenic pains, with more severe quantitative and qualitative disturbances of nighttime sleep.
2. The expression of the emotional stress and the quantitative manifestations of dental abrasion are not essentially different in patients with primary sleep bruxism based on the age factor.

3. The nighttime electromyography diagnosis via the application of portable devices and the ultrasound diagnosis can reveal important peculiarities of the activity of the masticatory muscles, regarding their local and diffuse thickness and echogenicity, associated with the severity of the primary sleep bruxism in patients of various age.

Author Contributions

Equal contribution to the paper.

Acknowledgments

Not applicable. The study was self-funded.

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Questions

1. Based on epidemiological data, what percentage of the general population is affected by bruxism?

❑a. Up to 85-90%;
❑b. Less than 0.1%;
❑c. Up to 20-30%;
❑d. Approximately 40%.

2. What age group is affected by bruxism?

❑a. Only adults;
❑b. Mainly children;
❑c. Only the geriatric population;
❑d. All the age groups.

3. Which of the following is not one of the bruxism cofactors?

❑a. Alcohol;
❑b. Caffeine;
❑c. Sleep;
❑d. Nicotine.

4. After the age of 65, the prevalence of bruxism is:

❑a. Up to 1%;
❑b. Up to 60%, regardless of gender;
❑c. The highest among the general population;
❑d. Around 10% with a tendency to decrease in relation to age.

Original Article

ARE DENTAL MEASUREMENTS TAKEN ON PLASTER CASTS COMPARABLE TO THOSE TAKEN FROM CBCT IMAGES AND LASER SCANNED SURFACES?

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DOI: 10.25241/stomaeduj.2018.5(1).art.4

ABSTRACT

Introduction: Intraoral scanning techniques, laser scans and cone-beam computed tomography (CBCT) are becoming widely diffused in dental practice. These instruments can replace dental plaster casts with digital models; recent investigations have found that measurements taken on digital models do not differ clinically from those obtained on CBCT scans and physical models, but only intra-examiner reliability has been assessed. In the current study we tested both intra- and inter-examiner variations, together with inter-techniques reliability.

Methodology: Data from six adult subjects were retrospectively obtained. Twelve dental distances were measured on dental plaster casts using a digital calliper; on digital 3D CBCT images using inVivoDental software (Anatomage, San Jose, CA); and on laser scanned surfaces using Mirror Vectra Software (Canfield Scientific, Fairfield, NJ). Two different operators performed all measurements twice. Bland-Altman analysis, Kruskal-Wallis and Wilcoxon tests were used for comparisons.

Results: The intra- and inter-operator biases range was 0-0.34 mm. The reproducibility range was 72-99%. The three different techniques gave very similar measurements, with biases between ±0.1 mm. Reproducibility ranged between 90 and 100%; the best reproducibility coefficients were found between plaster and digital casts, and only three differences were larger than 0.5 mm. Calliper measurements slightly overestimated digital casts values. Only the mesiodistal distance of tooth 24 (p=0.002) was significantly different among techniques.

Conclusion: Measurements on digital dental models and CBCT reconstructions of the dental arches seem clinically reliable as direct calliper measurements. The inter- and intra-operator reliabilities were acceptable, some more care may be needed for CBCT measurements.

Keywords: teeth, laser scan, cone beam computerised tomography.

Peer-Reviewed Article

Citation: Pisoni L, Codari M, Galli S, Rusconi FME, Tartaglia GM, Pucciarelli V, Sforza C. Are dental measurements taken on plaster casts comparable to those taken from CBCT images and laser scanned surfaces? Stoma Edu J. 2018;5(1):38-42.

Academic Editor: Lidia Boboc, DDS, PhD, Associate Professor, "Carol Davila" University of Medicine and Pharmacy Bucharest, Romania

Received: December 23, 2017
Revised: February 09, 2018
Accepted: March 01, 2018
Published: March 03, 2018

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1. Introduction

New technologies like scanning techniques, cone-beam computerised tomography (CBCT) and three dimensional imaging are becoming more and more used in all branches of dental practice (conservative, prosthodontics, surgery and orthodontics). Among the other applications, these devices can replace dental plaster casts with digital models possessing several advantages: easy storage, no necessary physical space, no damages during handling, and easy data share with other professionals [1-9].

CBCT, in particular, gives a 3D representation of the cranio-facial and dental structures and has already several indications in clinical routine: oral and maxillofacial surgery (orthognathic surgery, treatment of traumas and malignancies, nerve tracing in cases of third molar extraction and implant placement), endodontics (root fracture detection), orthodontics (diagnosis and treatment planning) [6, 10-15]. In this last field, several studies have successfully compared the accuracy of craniofacial measurements taken using landmarks identified on CBCT scans with those taken directly on skulls with conventional digital callipers [16, 17].

Safety, accuracy and reliability of measurements taken with new instruments must be evaluated and compared with those obtained with traditional methods also for dental landmarks: data obtained from both the digital and traditional plaster casts models must match in order to allow using the new technologies in clinical practice [2, 8, 18].

In general, recent investigations found that measurements taken on digital models do not differ clinically from those obtained on CBCT scans and physical models [4, 5]. Unfortunately, while reporting intra-examiner reliability, no inter-examiner variations were presented [6-8]. Indeed, the assessment of inter-operator variations seems to be of relevance in the current scenario where dental technicians often work in centralised locations at distance from clinical offices, and several of them may be involved in the evaluation of the same dental reproductions.

In the current study, we compared measurements taken on digital models obtained from CBCT images and laser scanned surfaces with direct measurements

obtained on dental plaster casts. Both intra- and inter-operator reliabilities were assessed.

2. Material and methods

Data from six adult Caucasian subjects with full dentition, no implant surgery, dental fillings, prostheses or caries that could affect the morphology of teeth were obtained. The absence of implants and metal fillings was selected as inclusion criterion to reduce the presence of metal artefacts that can alter the measurement process.

All patients were retrospectively selected from a clinical database and underwent CBCT examination for clinical reasons uncorrelated with this study. Their plaster casts poured from alginate impressions, cast in gypsum and conventionally trimmed, were collected as well. They reproduced the full arches with no surface damage. The casts were imaged by a laser scan (iSeries, Dental Wings, Montreal, Canada), and their 3D digital models obtained [1]. The work described was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). Informed consent was obtained from all patients, and their privacy rights observed. Considering the retrospective nature of the study, no ethical approval was required. No clinical information was retrieved from the database.

Twelve dental distances (Fig. 1) were measured on dental plaster casts using a digital calliper; on digital 3D CBCT images using inVivoDental software (Anatomage, San Jose, CA); and on laser scanned surfaces using Mirror® Vectra Software (Canfield Scientific, Fairfield, NJ).

Two different operators performed all measurements twice. A previous calibration session was performed: each operator made the whole set of measurements on a dental plaster cast and on its digital reproduction, as well as on the CBCT images of a patient not included in the study. The results were discussed until a consensus about landmark location was obtained.

Intra- and inter-operator reliability was assessed by Bland-Altman analysis, and for each comparison both the reproducibility coefficient and the bias (difference between measurements divided by the mean value) were calculated [7, 18].

The mean values were computed separately for tooth and measurement (mesiodistal and vestibulopalatal or vestibulolingual crown diameters). The three different techniques were compared by Bland-Altman analysis and Kruskal-Wallis test, with the Wilcoxon test for post-hoc comparisons.

For all tests, the statistical significance level was set to $p < 0.01$, with the Bonferroni correction for post-hoc comparisons.

3. Results

The intra- and inter-operator biases ranged between 0 and 0.34 mm, and only 3/72 biases were equal to larger than |0.3| mm (Table 1). These biases were observed for the vestibulopalatal diameters of teeth 24 and 26 (intra-operator analysis), and the vestibulopalatal diameter of tooth 26 (inter-operator analysis). Reproducibility ranged between 72 and 99%, the worst coefficients were found for CBCT measurements (18/24 were lower than 90%),

Figure 1. Dental crown distances chosen for the study in the right side mandibular arch. The corresponding distances were selected also in the left side maxillary arch: a) Mesiodistal distance of tooth 41; b) Mesiodistal distance of tooth 43; c) Mesiodistal distance of tooth 44; d) Mesiodistal distance of tooth 46; e) Distance from vestibular to lingual cusp of tooth 44; f) Distance from mesial-vestibular to mesial-lingual cusp of tooth 46.

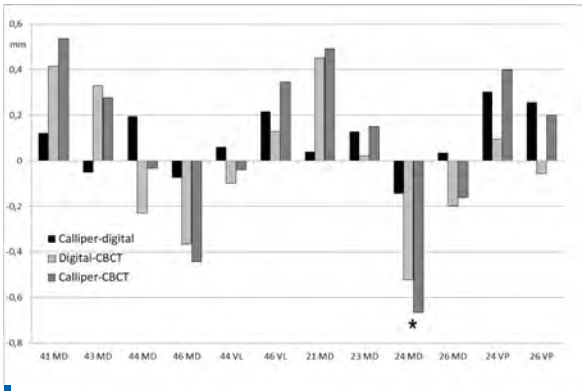

Figure 2. Mean differences between measurement methods. MD: Mesiodistal distance; VL or VP: vestibulolingual or vestibulopalatal distance. *: P = 0.002, Kruskal-Wallis test.

the best for plaster casts (all larger than 93%). The intra- and inter-operator reliabilities were comparable.

The three different techniques gave very similar measurements, with biases smaller than ±0.1 mm, except the calliper-CBCT comparisons of the mesiodistal diameters of teeth 41 and 24 (Table 2). Reproducibility ranged between 90 and 100%; the comparisons between plaster and digital casts had the best reproducibility coefficients (all larger than 97%).

The mean differences (± 1 SD) for calliper-digital, digital-CBCT and calliper-CBCT measurements were respectively 0.09±0.14, 0±0.3, 0.09±0.37 mm (Fig. 2).

Only three differences were larger than 0.5 mm, which represents the threshold for clinical acceptability [7, 18]: calliper-CBCT for teeth 41 and 24, and digital-CBCT for tooth 24 (all mesiodistal crown diameter). Calliper measurements slightly overestimated digital cast values, while the other differences were more scattered. Only the mesiodistal distance of tooth 24 (Kruskal-Wallis test, $p = 0.002$) was significantly different among techniques (Table 3).

4. Discussion

In the present investigation, we compared dental

Table 1. Intra- and inter-operator repeatability (Bland-Altman analysis).

		Intraoperator						Interoperators					
		Central incisor	Canine	First premolar	First molar	First premolar	First molar	Central incisor	Canine	First premolar	First molar	First premolar	First molar
Hemiarch		Mesiodistal				Vestibulopalatal/ Vestibulolingual		Mesiodistal				Vestibulopalatal/ Vestibulolingual	
Left maxillary													
Calliper	Bias	0.07	0.02	0.04	0.01	0.01	0.07	0.03	0.02	0.03	0.03	0.04	0.03
	Reproducibility	96	95	95	99	95	97	98	99	97	99	98	95
Digital	Bias	0.03	0.13	0.14	0.05	0.00	0.23	0.04	0.06	0.20	0.16	0.16	0.21
	Reproducibility	96	95	95	93	94	95	98	94	95	98	94	97
CBCT	Bias	0.06	0.22	0.21	0.16	0.30	0.30	0.05	0.12	0.19	0.12	0.03	0.34
	Reproducibility	91	87	83	87	78	78	91	90	94	80	75	72
Right mandibular													
Calliper	Bias	0.02	0.00	0.04	0.06	0.03	0.04	0.05	0.03	0.06	0.05	0.04	0.07
	Reproducibility	96	97	98	96	93	95	96	98	97	98	97	94
Digital	Bias	0.08	0.28	0.06	0.14	0.02	0.13	0.00	0.26	0.28	0.08	0.25	0.01
	Reproducibility	98	88	93	96	90	81	97	94	89	94	94	89
CBCT	Bias	0.10	0.06	0.04	0.20	0.04	0.21	0.10	0.25	0.24	0.04	0.09	0.10
	Reproducibility	87	93	86	89	87	75	72	94	90	94	82	82

Bias values (absolute values) are in mm, reproducibility coefficients are in %

Table 2. Bland-Altman analysis for the three measurement methods.

		Central incisor	Canine	First premolar	First molar	First premolar	First molar
Hemiarch		Mesiodistal				Vestibulopalatal/Vestibulolingual	
Left maxillary							
Calliper - Digital	Bias	0.00	0.02	-0.02	0.00	0.05	0.04
	Reproducibility	100	100	99	100	99	99
Digital – CBCT	Bias	0.05	0.00	-0.08	-0.02	0.02	-0.01
	Reproducibility	99	99	99	99	98	95
Calliper - CBCT	Bias	0.06	0.02	-0.10	-0.02	0.07	0.03
	Reproducibility	99	99	99	99	98	95
Right mandibular							
Calliper - Digital	Bias	0.02	-0.01	0.03	-0.01	0.01	0.04
	Reproducibility	99	99	99	100	98	98
Digital – CBCT	Bias	0.08	0.05	-0.03	-0.03	-0.02	0.02
	Reproducibility	97	98	98	99	91	97
Calliper - CBCT	Bias	0.10	0.04	0.00	-0.04	-0.01	0.06
	Reproducibility	97	98	98	99	90	96

Bias values (absolute values) are in mm, reproducibility coefficients are in %

linear distances (crown dimensions) taken with three different techniques. Overall, differences among the measurements were limited, and their reproducibility very high, ranging between 90 and 100%. Together with the comparison among methods, we investigated the variability inherent to each measurement protocol, namely the effect of repeated measurements made by the same and different operators. We found limited intra- and inter-operator variabilities. Indeed, the quantification of inter-operator reliability is necessary whenever multiple operators contribute to the analysis of the same dental reproductions. The good agreement between our two operators may be an effect of their prior calibration, which should be included in all measurement protocols [12].

Apparently, this is the first study that reported inter-

operator differences: for instance, both White et al. [19] and El-Zanaty et al. [20] assessed only intra-examiner bias. Indeed, two or three different operators were involved in other studies, but only intra-operator variability was reported [6]. Similarly, Wiranto et al. [8] assessed the variability from three different operators, but did not report the actual inter-operator data, quoting a previous investigation.

The excellent reproducibility of the three different measurement techniques is in line with the current literature reports. For instance, De Luca Canto et al. [2] made an extensive review to study the validity of measurements obtained from digital dental models produced from laser scanning against those directly made on the original physical dental models. The authors concluded that the current scientific evidence supports the validity of digital measurements.

White et al. [19] tested the accuracy of the digital reproductions of dental models made by using CBCT scans, and found satisfactory values for intra-arch measurements but inaccurate inter-arch relationships. El-Zanaty et al. [20] compared linear distances obtained on plaster casts and from CT head scans; the two techniques had excellent agreement. More recent studies reported that both intraoral scanning and CBCT scanning of alginate impressions of the dental arches gave valid, reliable, and reproducible dental measurements for diagnostic purposes.

Wiranto et al. [8] compared traditional plaster scans, scans obtained from intraoral scans, and CBCT scans of alginate impressions, and found that the digital reproduction of dental arches can be usefully employed for diagnostic purposes.

In the current study, the worst coefficients of reproducibility were found for CBCT measurements, while the best were those obtained for plaster casts. For CBCT, similar data were reported by Kim et al. [4, 5]. Literature is not in agreement about the technique with the best reproducibility: both digital models [4, 5, 7], and plaster models [16] had the best scores in different studies.

Overall, only three mesiodistal crown diameters had differences larger than 0.5 mm, which is considered the threshold for clinical acceptability [7, 18]. This corresponds to 8% of the analysed dental distances (3 out of 12 distances x 3 techniques values), a value larger than that reported by Tarazona-Álvarez et al. [6] who found only 5% of significant differences when comparing 20 linear distances obtained directly on dried mandibles and on their CBCT scans. Additionally, the current results well confirm that measurements involving the premolars are more variable than the other ones [4].

In general, the overestimation of calliper measurements vs. digital casts data is in line with the literature reports [18], while the comparison with CBCT data is more scattered. For instance, on dry mandibles, most of CBCT measurements were significantly smaller than those obtained by using the calliper [6].

5. Conclusion

In conclusion, measurements on digital dental models and CBCT reconstructions of the dental arches seem clinically reliable as direct measurements performed on dental plaster casts. Inter- and intra-operator reliability were acceptable, while more care may be needed for CBCT measurements, as also underlined by previous studies [3, 4].

The results are promising, nevertheless further evaluations on a larger sample are advised.

Table 3. *P* values from Kruskal-Wallis test.

	Central incisor	Canine	First premolar	First molar	First premolar	First molar
Hemiarch			**Mesiodistal**		**Vestibulopalatal**	
Left maxillary	0.09	0.93	0.002*	0.93	0.18	0.47
Right mandibular	0.05	0.55	0.86	0.36	0.93	0.44

*Significant difference $p < 0.01$. For significant values, post hoc Wilcoxon tests: Calliper – CBCT: $p = 0.002$; Digital - CBCT: $p = 0.03$.

Author Contributions

LP: design of the study, data collection and interpretation, drafting the MS, final approval of the MS; MC: design of the study, data elaboration, drafting the MS, final approval of the MS; SG: data collection, critical review of the MS, final approval of the MS; FMER: data collection and elaboration, critical review of the MS, final approval of the MS; GMT: design of the study, data elaboration and interpretation, critical review of the MS, final approval of the MS; VP: design of the study, data collection, drafting the MS, final approval of the MS; CS: design of the study, data interpretation, critical review of the MS, final approval of the MS.

Acknowledgments

Not applicable. The study was self-funded. There are no conflicts of interest and no financial interests to be disclosed.

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Luca Pisoni, DDS, PhD, is currently a member of the research staff in the Laboratory of Functional Anatomy of the Stomatognathic System - LAFAS, Department of Biomedical Sciences for Health at the University of Milan, Milan, Italy. His fields of research are the morphological and metrical assessment of anatomical characteristics of craniofacial structures, dental arches, and teeth, including their modifications with age, sex and pathology. He authored/co-authored some papers published in international, peer reviewed Journals. He is also in private practice in Legnano (Milan, Italy).

Questions

1. Which instruments can be used to obtain a 3D virtual model of dental arches?

❑a. Bite wing radiographs;
❑b. Ultrasounds;
❑c. Laser scans;
❑d. Conventional orthopantomographs.

2. Which instruments can be used to obtain a 3D virtual model of dental roots?

❑a. Laser scans;
❑b. Cone Beam Computerized Tomography (CBCT);
❑c. Teleradiographs;
❑d. Surface EMG.

3. In the current study we assessed

❑a. Three different methods to measure dental diameters;
❑b. The effect of operator experience in making dental measurements;
❑c. The use of Magnetic Resonance to measure dental diameters;
❑d. Dental arch diameters in fully edentulous patients.

4. In the current study, we found that

❑a. Intra-operator error was larger than 20%;
❑b. Measurements on the ultrasound reconstructions of the dental arches were clinically useful;
❑c. Measurements on the laser scanned reconstructions of the dental arches were too prone to error;
❑d. Measurements on the CBCT reconstructions of the dental arches were clinically reliable.

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Review Article

BLOOD LOSS AND TRANSFUSION NEED IN ORTHOGNATHIC SURGERY: REVIEW OF LITERATURE

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DOI: 10.25241/stomaeduj.2018.5(1).art.5

ABSTRACT

Background: Blood loss during orthognathic surgery has gained renewed interest due to the omission of surgical final splints in bimaxillary surgery, which increased operative time, while orthognathic surgery is increasingly indicated for the treatment of the obstructive sleep apnea syndrome (OSAS). OSAS subjects are usually older with more medical comorbidity which requires blood transfusion.
Objective: To review (reported) blood loss and transfusion practice in orthognathic surgery in the literature published between 1976 and 2012 and to compare these data with more recent developments. The relationship between the duration of the surgery and the related blood loss and/or transfusion was examined.
Data Sources: The 1976-2012 orthognathic literature was searched to determine the relationship between the duration of the surgery and the related blood loss and/or transfusion.
Study Selection: Articles containing clear information on the operation time, blood loss, transfusion, and orthognathic surgery were included.
Data Extraction: Information on the operation time, blood loss, transfusion, and orthognathic surgery was extracted.
Data Synthesis: Different descriptions of procedures and techniques are grouped together in a concise and coherent way, resulting in a number of categories per label. Using this grouping various targeted questions are exploited and answered.
Keywords: orthognathic surgery, blood loss, operation time, blood transfusion.

Peer-Reviewed Article

Citation: Politis C, Agbaje JO, Lambrichts I. Bloodloss and transfusion need in orthognathic surgery: review of literature. Stoma Edu J. 2018;5(1):44-51.

Academic Editor: Heinz Kniha, DDS, MD, PhD, Associate Professor, Ludwig-Maximilians- München University, München, Germany

Received: January 03, 2018
Revised: February 05, 2018
Acccepted: February 23, 2018
Published: February 26, 2018

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1. Introduction

Blood loss during orthognathic surgery has gained renewed interest for several reasons. A first reason is found in a recent school of thought that advocates the omission of surgical final splints in bimaxillary surgery but insists on the perioperative achievement of an excellent interdigitation, which in many cases can be achieved only by multisegmenting the Le Fort I osteotomy at the cost of increased operative time. Because orthognathic surgery is increasingly used to enhance facial aesthetics, many concomitant procedures have been reported [1], all of them influencing the duration of the operative procedure and blood loss. Orthognathic patients used to be generally young adults without major comorbidities. That scope is changing because orthognathic surgery is increasingly indicated for the treatment of the obstructive sleep apnea syndrome (OSAS). OSAS subjects undergoing maxillomandibular advancement surgery are likely older with more medical comorbidity [2], influencing the limit below which blood transfusion is indicated. Blood loss during surgery requiring blood transfusion is viewed as an important operative complication, designated as a grade II complication in the Clavien-Dindo complication classification system, which is becoming widely accepted for surgical complications, even in oral and maxillofacial surgery [3]. Although a Cochrane review recommends adherence to a restrictive transfusion strategy (7 to 8 g/dL) [4] in hospitalized stable patients, a remarkable tendency to preoperative autologous blood donation is seen even in surgical procedures – such as single-jaw SSO – that nowadays are considered low risk for blood loss [5].
The aim of the present contribution is to review (reported) blood loss and transfusion practice in orthognathic surgery in the literature published between 1976 and 2012. The relationship between the duration of the surgery and the related blood loss and/or transfusion was examined.

2. Methods

2.1. Research questions

The relevant clinical questions that should be answered are as follows:

- Is the operation time a predictor for blood loss and/or blood transfusion?
- Are concomitant procedures (segmentation, genioplasty, rhinoplasty, iliac crest grafts) predictors for blood loss and/or blood transfusion?
- Is the practice of preoperative autologous blood donation a predictor for blood loss and/or blood transfusion?
- What are the measures taken to minimise blood

loss during orthognathic surgery?
- Is operating time correlated to blood loss and/or blood transfusion?
- Is blood loss related to blood transfusion?
- Is an evolution in time detectable concerning duration of operations and/or blood loss?
- The methodological questions that need to be answered are as follows:
- How is blood loss defined or measured?
- How is operation time defined?
- How is hypotension/normotension defined?
- How is mean arterial pressure (MAP) measured and reported?

2.2. Literature review: selection criteria

Table 1 summarizes the entries that were introduced in PubMed, Scopus and LIMO.

No limits were set for language, year, field. A manual search for articles containing information on the operation time, blood loss, transfusion, and orthognathic surgery was performed in the following journals until 1976:
- British Journal of Oral and Maxillofacial Surgery
- International Journal of Oral and Maxillofacial Surgery
- Journal of Craniofacial Surgery
- Journal of Cranio-Maxillo-Facial Surgery
- Journal of Oral and Maxillofacial Surgery
- Oral & Maxillofacial Surgery Clinics of North America
- Oral and Maxillofacial Surgery
- Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics
- Plastic and Reconstructive Surgery
- Revue de Stomatologie et de Chirurgie Maxillo-faciale

An additional manual search was done to retrieve theses on the subject of blood transfusion in orthognathic surgery. Two theses were included [6,7], both in German.

2.2.1. Inclusion criteria

The criterion for retention for further processing was a clear allocation of the operation time AND/OR blood loss AND/OR transfusion to one of following operations:
1. SSO (advancement or set-back)
2. Le Fort I osteotomy one-piece without concomitant procedures
3. Le Fort I osteotomy multisegmental or with additional operations
4. Bimaxillary surgery without concomitant procedures
5. Bimaxillary surgery with simultaneous other procedures (e.g., iliac bone graft, cranial bone graft, genioplasty, liposuction, septoplasty, rhinoplasty inferior turbinate reduction, and removal of third molars).

These operations needed to be the predominant operation if a certain group was correlated with the duration of the operation and/or blood loss. If the predominancy of any of these types of operations could not be established, the group was discarded for further analysis.

2.2.2. Exclusion criteria

Exclusion criteria were craniofacial surgery in children; articles where blood loss, operation time, or transfusion could not be clearly attributed to one of the categories mentioned; case reports on syndromes; and case reports or reviews on major postoperative hemorrhagic events. In addition, retrospective reports on large numbers of procedures were often not suitable for inclusion because they did not separate the different categories needed. No minimal number of patients was required to be included.

Table 1. Summary of the entries that were introduced in PubMed, Scopus and LIMO.

Entry	Medline	Scopus	Limo
Blood loss and orthognathic	121	6	80
Transfusion and orthognathic	62	6	26
Operative time and orthognathic	35	10	157
Hypotension and orthognathic	50	5	18
Blood transfusion and orthognathic surgery	62	2	25

3. Results

3.1. Search results

In total, 51 papers and 2 theses were retained that contained valuable subgroups with information. Both retrospective and prospective studies were accepted, no matter if the procedures were done in normotension, mild hypotension, controlled hypotension, or any other tension reported (see Appendix 1)

3.2. Meta-analysis or systematic review

Meta-analysis was not the approach used because there was no control group for comparison. Control groups were used to compare the effect of different medications that influence the depth of controlled hypotension or to compare the effect of certain antifibrinolytic agents such as aprotinin, aminocaproic acid, and tranexamic acid to stabilise clot formation. Because the levels of reduced blood loss of these measures are considered below clinical relevance compared to the type of surgical procedure selected [8], aggregation of data is needed. Therefore, the following differences have been neglected:
- different methods to realise anaesthesia (gas, iv medication);
- different methods to reach mild, moderate, or deep hypotension; and
- different or no use of antifibrinolytic agents.

3.2.1. Aggregation of data

Many different descriptions of procedures and techniques needed to be united in a concise and coherent way, leading to a number of categories per label, allowing focus on the targeted questions. These characteristics were defined as seen in Appendix 2.

3.3. Measurement of blood loss

To compare blood loss in comparable surgical procedures (BSSO, Le Fort I, bimaxillary surgery), measurement of blood loss has to be comparable. In that respect, we found that in 22 out of 51 papers, the method of measuring estimated blood loss was missing [9-30].

In 18 out of 51 papers, the estimated blood loss was measured by deducting the volume of saline used from the total volume in the suction unit and by weighing the sponges [31-48], others 10 mL [43].

In 6 out of 51 papers, losses in sponges were not included

in the estimated blood loss, but the irrigation fluid and the fluid collected in suction devices was [8,49-53].
In 5 papers/theses, the calculation was based on a comparison of preoperative and postoperative hematocrit level [6,42,54,55] or blood volume [56]. The problem with estimation of preoperative and postoperative hemoglobin and/or hematocrit is that the timing between the preoperative and postoperative measurements differed between studies. It varied between 6 hours postoperatively [38] and 1 week postoperatively [46]. Ueki et al [46], however, did include the perioperative blood loss estimation. Hemodilution may be a problem when measuring the postoperative hemoglobin level, and the rise in hemoglobin level will differ according to individual body size.
The postoperative blood loss was not estimated, and the blood lost in drapes and gowns was not measured. The blood lost postoperatively in drains or swallowed by the patient all contribute to the ultimate blood loss that may affect the decision for blood transfusion. Also, blood lost in sinuses or tissue spaces was not accounted for [44].
The intraoperative blood loss estimation is always less than the calculated blood loss [6], but the estimation accuracy worsens with the amount of blood lost. Böttger calculated a linear regression where the estimated blood loss=0.4115 × Calculated blood loss + 406.8. In this calculation, a 1000 mL estimated blood loss appears to correlate with 1462 mL calculated blood loss, and a 2000 mL estimated blood loss appeared to correlate with 4250 mL calculated blood loss [6]. The deviation between estimation and calculation increases as the volume increases. The underestimation between the estimated blood loss and the calculated blood loss also was observed by Schaberg et al [45] in a radioisotope study of red blood cells.

3.4. Measurement of duration of surgery

To know the duration of surgery, all papers that define and measure the duration of surgery in the same manner are valid candidates to be included if the duration can be clearly attributed to a specified orthognathic procedure. The operation time is defined as 'missing' if the starting point of the measurement and the endpoint of the measurement were not defined. In contrast to 'age', 'weight', and 'length', operation time allows variable interpretations.
Out of the 51 papers retained for data acquisition, 44 did not mention at all how the duration of surgery was measured; 2 stated that the duration was recorded or documented; 2 clearly stated that the operating time was calculated from the first incision to the last suture [42,55]; one counted from the beginning of the BSSO incisions to the last suture [29], and one started from the injection of the local anesthetic to the last suture [47]. Clearly, no uniform definition of operation time exists. Using operation time as a predictive variable, in the absence of the knowledge about which two points were used to measure it, creates an important bias when comparing studies.

3.5. Duration of surgery and blood loss

One would assume that the longer the operation lasts, the more blood is lost. In bimaxillary surgery, Böttger [6] indeed found a linear correlation between calculated blood loss and operation time, but this correlation was weak for 82 bimaxillary procedures: Spearman correlation coefficient r = 0.325. Chen et al [31] found a weak Spearman rank correlation between operation time and blood loss in 30 mandibular surgery patients (IVRO set-back and genioplasty). Rummasak et al [43], in a retrospective review of 208 patients with bimaxillary orthognathic surgery, reported the following correlation between blood loss and operative time: blood loss = (2.64 * operative time) + 82.35. They reported a "significant" relationship because the p value was < 0.001 for R2 = 0.15. However, we should be cautious: R2 = 0.15 signifies R = 0.387; when attempting to predict one measure from another, coefficients below 0.40 do not yield a guess even 10% better than chance [57]. Further, the chart seems to include all data points, indicating that the whole population rather than a sample was reported. As a result, p value reporting would not make sense.
A confusing presentation of blood loss versus operative time is found in Ueki et al [46]. In regression analysis, y is what we want to predict or to understand and is sometimes called the dependent variable. X is called the independent variable or a predictor. In the equation, we want to predict blood loss on the basis of operative time. So, operative time needs to be on the x-axis, as most authors have placed it [22,29,31,43,55,58]. Because blood loss is a continuous variable, linear regression was used [59].
Four papers [15,17,20,48] provide data of overall 163 individual patients concerning the peroperative bloodloss and the duration of surgery (Table 2).
Based on these studies it was possible to estimate the amount of bloodloss for every minute of surgery: per minute of operation time the estimated bloodloss is 2.151 mL (= SE 1.124 mL; p = 0.056) (Table 3).
Several articles [6,22,29,31,43,46,58] do find a linear correlation between blood loss and the duration of surgery but these data could not be integrated due to the lack of necessary information. Besides the linear regression coefficient, both the standard error of the alfa- and beta-coefficient should be known as well as the total number of patients.

Table 2. Summary of the entries that were introduced in PubMed, Scopus and LIMO.

Study	Estimate	Standard Error
Golia et al [15]	-0.37310	0.3161034
Kasahara et al [17]	3.65315	0.7732564
Landes et al [20]	1.46156	0.6044895
Zelllin et al [48]	4.43946	1.1349279

Table 3. Relation bloodloss versus duration of surgery.

Evaluation between-study heterogeneity				Random Effects Analysis		
I^2	Q	Df	P-value	Estimate	SE	p-value
92.210	38.510	3	<.0001	2.151	1.124	0.056

I^2 = percentage of variation in study estimates due to heterogeneity; Q = Cochrans Q statistic. If Q is smaller than the number of degrees of freedom, then the estimated heterogeneity equals zero (I^2 = 0%); Df = Degrees of Freedom for heterogeneity test; Random Effects Analysis: DerSimonian and Laird method; SE = standard error

3.6. Hypotension

There is no accepted single definition for intraoperative

hypotension. Bijker et al [60] in a literature review found more than 50 different definitions of intraoperative hypotension used in the recent anaesthesia literature. When it comes to controlled hypotension in the orthognathic literature, again no consensus is found as to what constitutes controlled hypotension and how it would differ from intraoperative hypotension. Bijker et al [61] found that patient and surgical characteristics, notably age and duration of surgery and duration of low blood pressure, influence the relationship between intraoperative hypotension and adverse outcome. Controlled hypotension is an anesthesiological technique to lower the mean arterial blood pressure of the patient in orthognathic surgery on the presumption that a lower blood pressure correlates with less blood loss and a better quality of the operation field. In the orthognathic literature, hypotension has not been related to adverse effects except for patients with pre-existing hypofunction. In these cases, cerebral damage or neurological deficit, stroke, dysrhythmia, cardiac arrest, or even death have been reported [32].

The absence of a common definition of hypotension, the different ways of measurement of arterial pressure, the different attitudes towards the intraoperative duration of hypotension, the timing to reverse hypotensive anaesthesia to discover and address undetected arterial hemorrhage [29], and the different means to achieve hypotension render comparisons between study groups difficult. An entire range encompassing aggressive attitudes (MAP 50–55 mm Hg), cautious attitudes (blood pressure 20%– 30% below mean preoperative level), and no deliberate hypotension is reported with orthognathic surgery.

Measurement of mean arterial pressure was mostly done with the aid of measurements from a radial artery catheter. [45] calculated mean arterial pressure with the formula: systolic pressure × 2/5 + diastolic pressure × 3/5. No other mean arterial pressure measurement formula was found in the 50 other retained articles. Contemporary monitors measuring mean arterial pressure use the following formula: (diastolic pressure × 2) + systolic pressure) / 3.

3.6.1. Advantages of controlled hypotension

Controlled hypotension has advocates and opponents. Arguments raised in favour of controlled hypotension are a shorter operation time, a better quality of the operation field, diminished blood loss, and lower blood transfusion. Others question the advantages of controlled hypotension [6]. Choi and Samman [32] studied that controversy with a systematic review and concluded in support of hypotensive anaesthesia, with three studies reporting a significant decrease of blood loss in patients receiving hypotensive anaesthesia, two studies reporting a significant decrease in transfusion rate, and two other studies demonstrating an improved surgical field and significant reduction in operation time. Their conclusion was that hypotensive anaesthesia is most valuable in operations of long duration when a large amount of blood loss and consequent blood transfusion are to be expected.

3.6.2. Minimizing perioperative bleeding

Both surgeon and anesthesiologist have means at their disposal to affect coagulation, blood loss, and the quality of the surgical field.

- Anesthesiologist:
- normovolemic hemodilution
- application of Cell Saver Systems
- carefully controlled body temperature
- use of tranexamic acid (antifibrinolytic agent) as a clot stabiliser
- use of aprotinin (serine protease inhibitor)
- use of desmopressin, increasing coagulant activity
- hypotensive anesthetic techniques
- optimised tissue perfusion by administration of 500 mL of hydroxyethyl starch 6%/200/0.5 before segmentation of the maxilla [55]
- atraumatic nasal intubation with heated nasal tubes
- avoidance of trauma at adenoid fossa during intubation
- preoperative injection of human recombinant erythropoietin (not routine in OMFS)
- preoperative exclusion of bleeding disorders
- maintaining hypocapnia

- Surgeon:
- avoiding perioperative vascular injury
- bipolar electrocoagulation; cutting diathermy
- use of an electrocautery unit to make incisions
- skilled surgeons to perform the operation instead of residents
- surgical vigilance
- administration of local anaesthesia with vasoconstrictor immediately after intubation
- timely administration of local anaesthesia in Le Fort I
- fluid injection with vasoconstrictor subperiosteally at nasal floor
- cocainisation of the nasal mucosa prior to maxillary surgery
- vasoconstriction of intranasal lining with cottonoid sponges soaked in nasal decongestant
- placement of the patient in a reverse Trendelenburg position
- incisions that are cleanly made through the periosteum
- packing of open surgical sites with gauze
- local hemostatics like oxidised regenerated cellulose (Surgicel®, Ethicon Inc, Johnson&Johnson Company, Somerville, NJ, USA)
- piezosurgical osteotome
- endoscopic assistance for a controlled dissection of nasal mucosa [62]
- hemostats and hemoclips
- short duration of operation
- instrumentation that allows suction with built-in light system
- avoiding venous obstruction

3.7. Excessive blood loss

Reports concerning the need for blood transfusion also give some insight into the occurrence of excessive blood loss, either directly by explicit mention or by observation of the range of blood loss. Kok-Leng Yeow and Por [19] report 3 excessive bleedings in 102 orthognathic patients, occurring from the facial artery, maxillary artery, and pterygoid plexus separately in three patients. When we observe the reported ranges of the subgroups, we see an upper limit of the range at 3000 mL and one upper limit of 6000 mL of perioperative blood loss. Martini et al [22], in a graph depicting the linear correlation between

blood loss and operation time, show two outliers of blood loss, one close to 2900 mL and one at 5000 mL, in an orthognathic surgery group containing 27 Le Fort I operations and 52 bimaxillary cases. Choi et al [58], in a reported graph with the relationship between total blood loss and operation time in 61 patients, show 4 cases of blood loss in excess of 3000 mL. The mean blood loss in 11 patients who received blood transfusion included one group of 7 patients (2,291±831.7 mL) and one group of 4 patients (1,732±856.8 mL). Rummasak et al [43] reported retrospectively on 208 bimaxillary orthognathic osteotomies, and their graph depicting the regression analysis between blood loss and operative time shows one case with 2750 mL and one case with 3400 mL of estimated blood loss. Samman et al [44] reported on 291 bimaxillary and 69 single-jaw surgical cases with a range of blood loss between 50 mL and 5000 mL and 5 hemorrhagic perioperative incidents. They reported that 4% of the 291 bimaxillary surgical cases required a transfusion greater than 2 units of blood. In the range of blood loss reported by Ash [9], we find a value of 3400 mL, which occurred in a bimaxillary osteotomy case. In the series of Böttger [6], an upper limit of 3400 mL is reported.

3.8. Criteria for transfusion

The updated Cochrane review on transfusion thresholds [4] concludes that, for most patients, giving less blood is safe and blood transfusion is probably not essential until hemoglobin levels drop below 7.0 to 8.0 g/dL. In the orthognathic literature, no consensus exists regarding what constitutes a blood transfusion 'trigger'. Fenner et al [13] performed 105 consecutive bimaxillary osteotomies without any need for transfusion and argued that in young healthy adults, hemoglobin concentrations as low as 50 g/L can be sustained. In contrast, Zellin et al [4] gave blood transfusion when arterial hemoglobin was below 100 g/L. Flood et al [63] reported overtransfusion in bimaxillary osteotomies where the postoperative hemoglobin increased after homologous transfusion. Obviously, the high rate of blood transfusion in the series of Flood et al [63] could have been avoided by more strict criteria for transfusion. The general condition of the patient and underlying diseases are taken into account when deciding on the need for blood cell transfusion, and hemoglobin concentration is one of the criteria [39,64] used the criterion of allowable blood loss. The allowable blood loss was defined as 20% of the estimated blood volume (male 70 mL/kg, female 65 mL/kg), and once this was reached, a unit of packed red cells was transfused.

3.9. Risk of transfusion

The authors report that the risk for viral transmission is very low in developed countries. An example is Canada, where the residual risk of transmission through transfusion of HIV, HCV, and HBV is estimated to be 1 per 7.8 million donations, 1 per 2.3 million donations, and 1 per 153,000 donations, respectively [4]. This reduction in risk should lead to the abandonment of the practice of autologous blood transfusion because the most important reason for an autologous blood donation is the greatly reduced risk of disease transmission. It has been reported that the availability of autologous blood increased the rate of autologous blood transfusion [22,37]. In case strict criteria are used to 'trigger' blood transfusion, the availability of autologous blood did not seem to increase the rate of blood transfusion [25].

4. Preoperative donation of autologous blood

Preoperative autologous blood donation has several disadvantages. It is not risk free, and human error and the administration of the wrong unit of blood still can occur. It leads to anemia and hypovolemia [6] and is more expensive than homologous blood donation. Patients waste time from work to donate. Autologous blood that is not used is discarded and constitutes waste [26]. Iwase et al [5] further reported increased intraoperative blood loss to be associated with total withdrawn blood before the operation. Retransfused autologous blood has a lower hemoglobin concentration and the erythrocyte function diminishes by 10% per week in unused autologous blood [22].

While avoiding the risk of transfusion of homologous blood is an advantage of transfusion of autologous blood, Moennig et al [51] reported that 3 out of 4 patients needing a transfusion received the available units of autologous and additional units of homologous blood to compensate the loss. These four patients had an average estimated blood loss of 975 mL [51]. Thus, the donation of autologous blood does not entirely exclude the risk of needing a homologous blood transfusion.

Meta-analyses on preoperative autologous blood donation have shown that this practice indeed reduces the use of allogeneic blood transfusion by 63%, but at the same time increases overall red blood cell transfusions (ie, allogeneic and autologous red blood cell units) by 30% and causes a decline in patient hemoglobin concentration by more than 1 g/dL from before commencing preoperative autologous blood donation to immediately prior to surgery [65].

The German recommendation for autologous blood donation states: "The so-called 'liberal' transfusion indication for autologous blood products stands in contrast to the strict indication parameters for the therapeutic use of blood products laid down in the present guidelines and should be rejected because it is for all practical purposes equivalent to a blood transfusion without indication" [66].

Donors of autologous blood will more likely receive a transfusion because their initial hemoglobin value has been lowered by the autologous blood donation and because the availability of autologous blood influences the decision of transfusion. Puelacher [26] reports that the mean hemoglobin level of 121 patients prior to donation was 14.2 g/dL and fell to 12.7 g/dL after a mean donation of 2.3 units per patient. If then the criterion for transfusion is a certain hemoglobin level, patients with autodonation will sooner reach that level than patients without donation.

Nath and Pogrel [24] report on 260 orthognathic surgery cases in which 126 patients chose autodonation and 134 patients preferred no autodonation. The transfusion rate was respectively 26/126 and 3/134 patients, indicating that the availability of autologous blood influenced the decision to use it. Obviously, 'a perceived benefit' must accompany this decision, which probably is influenced by the information given to the patient. Puelacher et al

[26] evaluated 127 questionnaires about autologous donation of blood in patients who underwent orthognathic surgery; 65 patients (51%) reported that autologous blood donation was decisive for the agreement to operate and that 12 patients (9%) would have refused the operation without the possibility of autologous blood donation.

It should be recommended that the decision to offer the possibility of preoperative autologous blood donation should not be done as a gain-framed or loss-framed persuasive message. A loss-framed persuasive appeal emphasises the disadvantages of failing to comply with the communicator's recommendation; in contrast, the gain-framed appeal will emphasise the advantages of compliance. Both are well-known techniques in patient communication [67]. Obviously, legal recommendations [66] and court rules in Germany [22] and in the United States [24] do not facilitate the information task towards the patient [26], because the patients need to be informed about the risks of homologous transfusion and the possibility of autologous blood transfusion as an alternative. Blau et al [49] reported that based on the perceived safety of reinfusion of autologous blood, the transfusion decision was made even before knowledge of the postoperative hemoglobin level.

5. Discussion and Conclusions

Considering the risk factors for blood transfusion after orthognathic surgery, a great deal of attention has been focused in the past both on the relationship with the duration of the surgery and the blood loss during surgery and in the postoperative period. Blood loss and duration of surgery are only weakly related to each other. The most significant factor in deciding when to transfuse is one's attitude towards transfusion and the related 'trigger' criterion for transfusion. Although the contemporary limit of 7 g/dL is a safe margin for healthy persons, the measurable increase in cardiac output needs to be observed.

It is important to know that Hb drop could be overestimated due to hemodilution, which in return may influence the decision of blood transfusion [68]. The estimated blood loss might be a good guide, especially in cases that received large amounts of i.v. fluids. According to Al-Sebaei et al [69], blood loss does not consistently increase over time. The majority of intra-operative blood loss is expected to occur in the beginning of the procedure during the performance of the osteotomies [69].

On the other hand, it has been shown that predonation of autologous blood both increases the necessity and the opportunity to use it. Nevertheless, any blood transfusion is graded as a grade II complication in the Clavien-Dindo complication classification system.

Minimising perioperative blood loss seems to be a multidisciplinary task in which both the anesthesiologist and the surgeon share a common responsibility. The timely adaptation of legal guidelines to adopting a nontransfusion default position when there is no evidence for potential benefit is the wise approach.

Author contributions

CP was the principle investigator who initiated, designed and prepared the protocol. CP, JOA and IL were involved in the analysis of data and the writing of the manuscript. All authors read and approved the final manuscript.

Acknowledgment

Not applicable. The study was self-funded. There are no conflicts of interest and no financial interests to be disclosed.

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Questions

1. The relation between the duration of orthognathic surgery and bloodloss is:

❑a. Linear;
❑b. Exponential;
❑c. Asymptote function;
❑d. Depends on type of surgical procedure.

2. Which of following measures does not help in minimizing peri-operative bleeding:

❑a. Anti-Trendelenburg position of the patient;
❑b. Timely administration of local anaesthesia in Le Fort I;
❑c. Replacing the saw by piezo-tome;
❑d. Control of body temperature.

3. The overestimation of the hemoglobin drop measured after orthognathic surgery can be due to:

❑a. Hemodilution;
❑b. Weight of the patient;
❑c. Body temperature;
❑d. Hypertension.

4. The risk of blood transfusion includes transmission of all of following agents but one:

❑a. Hepatitis B;
❑b. Hepatitis C;
❑c. HIV;
❑d. Syphilis.

Case Report

NON SYNDROMIC FAMILIAL HYPODONTIA - A CASE SERIES

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DOI: 10.25241/stomaeduj.2018.5(1).art.6

ABSTRACT

Aim: The aim of this case report is to discuss the features of non-syndromic familial hypodontia, which was noted in three siblings who had an unremarkable medical history.
Summary: Congenital absence of teeth is a common dental anomaly referring to teeth that fail to erupt in the oral cavity and remain invisible in radiographs. Congenital tooth agenesis is defined by the number of missing teeth, excluding the third molars; hypodontia refers to the absence of less than six teeth, while oligodontia is the absence of six or more teeth.
Tooth agenesis can occur as part of a genetic syndrome such as the cleft lip and palate, ectodermal dysplasia and Trisomy 21 (syndromic hypodontia) or an isolated trait (nonsyndromic hypodontia). Non-syndromic hypodontia is the most common form and can be familial or sporadic. The most supported etiological theory suggests that tooth agenesis may be due to a combination of genetic and environmental factors, which lead to disturbances in the tooth germ during the initial formation stages.
This case series reports bilateral agenesis of the maxillary canines in siblings, which is quite rare in occurrence. The management of these anomalies involves a multidisciplinary approach in order to restore esthetics and function. An early diagnosis can lead to effective treatment planning and satisfactory results.
Key learning points: The clinical manifestations as well as the short and long term management of this condition are discussed.
Keywords: hypodontia, congenital, nonsyndromic, management.

Peer-Reviewed Article

Citation: Binladen H, Mahmoud A, Chandwani N, El-Halabi M. Non syndromic familial hypodontia - a case series. Stoma Edu J. 2018;5(1):52-57.

Academic Editor: Rodica Luca, DDS, PhD, Professor, "Carol Davila" University of Medicine and Pharmacy Bucharest, Bucharest, Romania

Received: January 31, 2018
Revised: February 26, 2018
Acccepted: March 20, 2018
Published: March 26, 2018

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1. Introduction

Hypodontia is a very common dental anomaly that occurs mainly in the induction and proliferation stage of tooth development, leading to tooth agenesis, posing a significant clinical problem.
It can occur in both the primary and permanent dentition and its classification is based on the number of missing teeth, excluding the third molars [1]. Anodontia is defined as the complete absence of teeth either in one or both arches [1,2]. Oligodontia is a severe and rare form of tooth agenesis which is defined as the absence of six or more teeth, while the congenital absence of less than six teeth is referred to as hypodontia.
Hypodontia can be inherited as an isolated trait or is usually associated with several syndromes such as ectodermal dysplasia, Down Syndrome and cleft lip and palate [2,3].
Non-syndromic hypodontia is more common, with varying numbers of teeth that can be involved; however, the incisor-premolar type predominates [3].
Various studies report that hypodontia is more commonly seen in the maxillary arch and the permanent dentition is much more affected than the primary dentition [3,4].
A review of the literature indicates that the etiology of hypodontia is multifactorial and has been reported to be due to genetic as well as environmental factors [5].
Recent studies indicate the role of the genes in the tooth morphogenesis from the initiation, patterning and histogenesis of dental tissues. Mutations in some of these genes, mainly MSX1, PAX9 and AXIN1 may result in tooth agenesis, although the exact mechanism is not known [6-9]. The environmental factors implicated in tooth agenesis include trauma to the dental region, chemotherapy or radiotherapy and maternal infections during tooth development [6,7].
Prevalence of hypodontia in the permanent dentition, excluding the third molars, is about 4.5 – 7.4% in Caucasians; while including the third molars is about 9-30% [2,4].
A 2016 systematic review and meta-analysis found that there was no difference between the prevalence of hypodontia among the different ethnic groups with each affected Negroid, Mongoloid, and Caucasian having 1.871, 1.900, and 1.889 missing teeth respectively [10].
The most frequently affected teeth are the mandibular second premolar and the maxillary lateral incisor [4]. The congenital absence of canines in the permanent dentition is reportedly a very rare occurrence with prevalence rates varying from 0.06% to 0.18% [11].
The present cases report familial non-syndromic hypodontia in three siblings, of which two cases show bilateral maxillary canine agenesis.

2. Case report

2.1. Case 1

A 7.9-year-old girl (ZA) presented with her father at the department of pediatric dentistry for an initial dental

Figure 1. Intraoral frontal view, ZA.

Figure 2. Upper occlusal view, ZA.

Figure 3. Lower occlusal view, ZA.

Figure 4. Right buccal view, ZA.

Figure 5. Left buccal view, ZA.

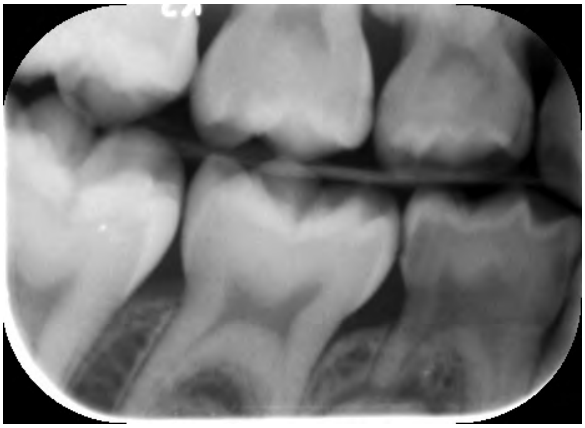

Figure 6. Right bitewing, ZA.

Figure 7. Left bitewing, ZA.

Figure 8. Orthopantomogram, ZA.

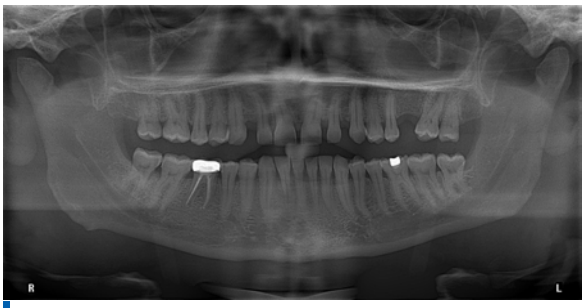

Figure 9. Orthopantomogram, father.

visit with no chief complaints. Her medical history was unremarkable with no systemic conditions or syndromes.

Dental History: An extra-oral examination revealed a convex profile with an increased over-jet (5 mm) and the patient's skin and hair were found to be normal in texture and appearance. The intraoral examination showed the child to be in the mixed dentition stage (Fig. 1-5). Multiple teeth, namely 55, 54, 53, 63, 64, 65, 73, 84 (FDI Notation system) had proximal carious lesions which were detected clinically and confirmed by the initial bitewing radiographs (Fig. 6, 7). Tooth 74 was noted to be non-restorable.

A comprehensive dental treatment plan was formulated and discussed with the parent, which included restoration of the carious teeth with composite restorations and extraction of tooth 74. The patient however did not return back for any treatment for almost one year, despite repeated attempts to contact them.

Upon the child's return for treatment at 9 years of age, a new dental assessment was conducted which included an orthodontic consultation due to the Class II malocclusion with the increased over-jet.

A routine panoramic radiograph was thus taken which revealed agenesis of teeth 13, 12, 22, 23 and 32 (Fig. 8).

The corresponding primary teeth (53, 52, 62, 63) were retained with no radiographic evidence of tooth resorption or mobility. Tooth 72 had exfoliated and teeth 31, 41 and 42 were present.

Based on the history and clinical findings, a diagnosis of non-syndromic hypodontia was made.

A comprehensive treatment plan using a multidisciplinary approach was formulated in order to restore both esthetics and function and discussed with the father.

The short-term plan included restoration of the carious teeth and maintaining the retained primary teeth (53, 52, 62 63) until they showed clinical or radiographic signs of exfoliation on routine follow up appointments. The long term orthodontic plan would then be initiated which would involve extraction of all the retained primary teeth, moving the maxillary premolar teeth (14 and 24) into the respective canine spaces and reshaping them to resemble the maxillary canines (13 and 23).

The space for the missing maxillary lateral teeth would be preserved. Once orthodontic treatment was completed, a resin retained bridge would be fabricated to replace 12 and 22 as a temporary measure until implants could be placed once the child turns 18 years of age.

Due to the diagnosis of the hypodontia, a detailed medical history was obtained from the parent which revealed a non-consanguineous marriage, with no history of genetic conditions in both parents. The child was the third oldest among four children. The

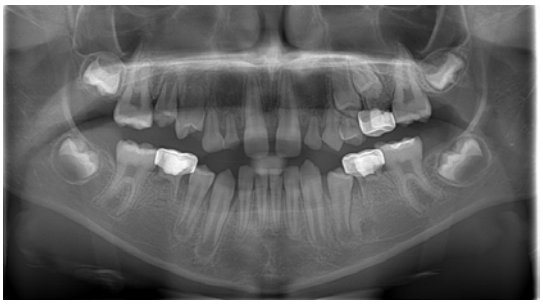

Figure 10. Orthopantomogram, AA.

Figure 11. Intraoral frontal view post-op, AA.

Figure 12. Upper occlusal view post-op, AA.

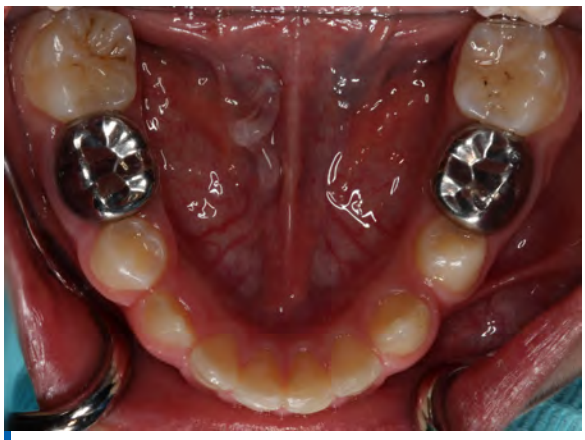

Figure 13. Lower occlusal view post-op, AA.

father agreed to a panoramic radiographic evaluation of himself and was advised to bring in the remaining children for a thorough dental evaluation to detect familial hypodontia.

The father's radiograph showed spacing in the upper arch, no congenitally missing teeth and a history of extraction of tooth 26 (Fig. 9).

The two older children (Cases 2 and 3) however had congenitally missing teeth. The youngest child was 2

years of age and hence no radiographic evaluation was conducted.

2.2. Case 2

AA was 10 years of age with an unremarkable medical history. The panoramic radiograph revealed oligodontia with teeth 13, 12 22, 23, 45, and 55 congenitally missing (Fig. 10).

AA presented with a Class II malocclusion and a 7mm anterior overjet (Fig. 11, 12, 13). A similar short term and long term orthodontic plan was devised to correct the missing teeth, where in teeth 14 and 24 would be positioned in the place of the permanent canines and the space for the lateral incisors, 12 and 22, would be preserved for future implants, once the child turns 18 years of age.

Teeth 75 and 85 would also be extracted and the space would be closed orthodontically.

2.3. Case 3

OA was 12 years of age with an unremarkable medical history and presented with tooth 45 congenitally missing and peg shaped upper lateral incisors (12 and 22) (Fig. 14).

The treatment plan included orthodontics to correct the crowding and retaining the space of tooth 45 for a future implant and reshaping the peg shaped maxillary lateral incisors.

The timing of the diagnosis of hypodontia is important so as to choose an appropriate treatment plan which requires good patient and parent cooperation in order to achieve optimum long-term results.

3. Discussion

Non-syndromic hypodontia is the most common form of congenitally missing teeth and can be familial or sporadic and usually occurs as an isolated trait. It can be inherited in an autosomal dominant, autosomal recessive or an X linked pattern.

The etiology of congenitally missing teeth is reported to be a combination of genetic and environmental factors which can cause disturbances to the tooth germ during the initial formation stages [5,6].

The present cases represent a sporadic, non-syndromic familial form of hypodontia. There was no known history of any genetic syndromes in all three cases.

Congenital missing teeth are defined as those that fail to erupt in the oral cavity and are not visible in radiographs. The diagnosis of tooth agenesis should be made after the 6 years of age excluding the third molar, and after 10 years if evaluating the third molar [13]. A panoramic radiograph is the best means to diagnose the number of missing teeth.

Agenesis of the teeth in our case report was evident in the panoramic X rays and confirmed the diagnosis of hypodontia.

The prevalence of hypodontia ranges from 1.6% to 36.5%, depending on the population studied.

A 2014 systematic review found the overall global prevalence of hypodontia to be 6.4%. Different continents displayed different prevalence values with Africa being the highest at 13.4%, followed by Europe at 7%, Asia and Australia both 6.3%, North America 5% and Latin America and the Caribbean displaying the lowest

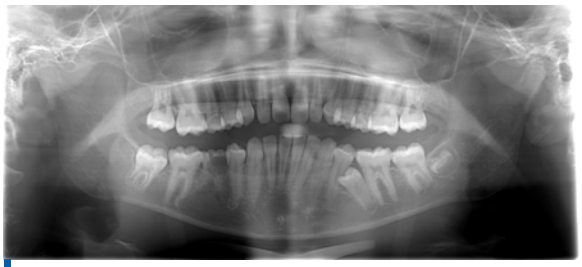

Figure 14. Orthopantomogram, OA.

prevalence values at 4.4%. Most individuals had only one or two teeth missing [3].

Mandibular second premolars are the most commonly affected and account for 29.9% of all congenitally missing teeth, followed by maxillary lateral incisors (24.3%). Maxillary canines on the other hand made up only 2.5% of all congenitally missing teeth [3].

Our case series showed three siblings with variable expressions of hypodontia. Case 1 and 2had congenitally missing maxillary canines in addition to maxillary lateral incisors. The occurrence of bilateral congenitally missing canines is very rare with prevalence rates reported to be as low as 0.14% by Lombardo et al [14].

Hypodontia is often associated with other dental anomalies such as interdental spacing, microdontia, delayed tooth formation, over retained primary teeth, and reduced development of the alveolar bone and taurodontism [15]. Some studies however indicate that the agenesis of permanent teeth shows a strong correlation to the absence of the corresponding primary predecessors, while others indicate that the absence of a permanent successor causes a delay in the root resorption of the corresponding primary teeth [4,12].

Cases 1, 2 and 3 all showed interdental spacing and retained primary teeth where the permanent successors were congenitally missing. Additionally, Case 3 also showed microdontia in the form of maxillary peg shaped laterals.

The treatment approach for hypodontia is specific to each case and is dependent on many factors such as the number of teeth missing, the condition and longevity of the primary predecessor, size and number of teeth remaining in both arches, the occlusal status, facial growth patterns, patient and parent preferences including the financial aspect of the treatment options offered [4,16,17].

A multidisciplinary approach is highly recommended which helps in the short and long-term treatment planning. The various specialists usually involved in the care of individuals with hypodontia include pediatric dentists, orthodontists, prosthodontists and oral surgeons.

In the present cases, initial consultations were done with the orthodontist and prosthodontist. The treatment plan was discussed in detail with the parents and the patient preferences were also taken into consideration.

In cases of hypodontia, the treatment options usually include the timely extraction of the over retained primary teeth that do not have a permanent successor to allow spontaneous orthodontic space closure with or without orthodontic alignment or placement of a prosthetic restoration to replace the missing tooth/teeth. In some cases, the primary tooth is retained to allow growth and impede resorption of the alveolar bone which will help

preserve the volume of the bone. This will facilitate the future placement of an implant in favorable locations, with a reduced need for bone grafting [4,14,16,17].

Cases 1 and 2 displayed little or no resorption of retained maxillary primary canines at the time of diagnosis. The short-term plan included retaining all the primary teeth (53, 52, 62, 63) with the missing permanent successors (13, 12, 22 and 23) as long as possible until they showed signs of tooth resorption. This would allow for alveolar bone growth which would help maintain bone height for future implant placement.

According to GunaShekhar et al [4], the survival rate of primary canines without permanent successors might be long and would provide a functional advantage to patients with hypodontia or oligodontia.

In cases with permanent maxillary canine agenesis, the treatment options include:

Orthodontic movement of a premolar into the canine space and reshaping it to resemble the canine, esthetically and functionally; creating or retaining the adequate space in the area of the canine tooth and placing a prosthetic appliance such as temporary cemented bridges, resin bonded artificial teeth, or removable appliances with acrylic teeth to serve as space maintainers and to improve the patient's appearance. In some of these cases, an implant may be placed in the available space once the child reaches the appropriate age at the end of the facial growth period [18].

In both Case 1 and 2, the maxillary premolar teeth (14 and 24) were orthodontically moved to the missing canine (13 and 23) space and reshaped to resemble maxillary canines. The long-term plan also included preserving the space for the maxillary lateral incisors (12 and 22), placing a temporary resin cemented bridge followed by implant placement in the region once the facial growth period is completed at approximately 18 years of age.

In Case 3, the space for missing tooth 45 was also retained for a future implant and the peg shaped maxillary lateral incisors were built up cosmetically.

The diagnosis of hypodontia should thus be made early which will help making the patients and parents aware of the existing condition as well as help in the treatment planning.

4. Conclusion

Hypodontia is a multifactorial dental anomaly which may occur in isolation or as part of a genetic syndrome. The number of missing teeth varies among individuals and negatively affects esthetics and function. The most commonly missing teeth are the mandibular second premolars and maxillary lateral incisors. The management of this condition is multifactorial and an early diagnosis can lead to effective treatment planning.

Author contributions

Equal contribution to the paper.

Acknowledgements

We would like to thank all of the study subjects for their participation in our research especially Dr. Neeta Chandawani for her help and support.

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She is currently a specialist pediatric dentist at Mohammed Bin Rashid University (MBRU) where she treats pediatric patients including those with special health care needs, with a core focus on behavior management and prevention of dental caries.

Questions

1. Oligodontia is defined as the agenesis of how many tooth/teeth?

❑a. One permanent tooth;
❑b. One primary tooth;
❑c. Six or more permanent teeth;
❑d. Six or more primary teeth.

2. Which are the most commonly congenitally missing teeth?

❑a. Mandibular first premolar and maxillary central incisor;
❑b. Mandibular second premolar and maxillary lateral incisor;
❑c. Maxillary first premolar and mandibular central incisor;
❑d. Maxillary second premolar and mandibular lateral incisor.

3. Which dental anomaly is usually associated with hypodontia?

❑a. Interdental spacing;
❑b. Over retained primary teeth;
❑c. Taurodontism;
❑d. All of the above.

4. What is the treatment approach for hypodontia dependent upon?

❑a. Number of missing teeth;
❑b. Size of the remaining teeth;
❑c. Occlusal status of the patient;
❑d. All of the above.

Biomimetics Pascal Magne Master Class

Date: 06 - 08 April 2018

Location: Madrid, Spain

Event types: Conference, Workshop, Exhibition

Visit event website: https://www.facebook.com/events/141563926526067/

ITI Congress Japan

Date: 07 - 08 April 2018

Location: Kyoto, Japan

Event types: Conference, Exhibition

Visit event website: www.iti.org/ITI-National-Congresses

The Art and Science of Equilibration Dentistry Course

Date: 09 - 11 April 2018

Location: Saint Petersburg, USA

Event types: Conference, Workshop

Visit event website: http://www.dentaleventscalendar.com/event/the-art-and-science-of-equilibration-dentistry-course/

Dental Education 2018 - International Conference

Date: 10 - 11 April 2018

Location: Amsterdam, Netherlands

Event types: Conference, Exhibition

Visit event website: www.dentaleducation.dentalcongress.com

5th Conference of Polish Academy of Paediatric Dentistry

Friday, 13 - 14 April 2018

Location: Warsaw, Poland

Event types: Conference, Exhibition

Visit event website: http://www.dentaleventscalendar.com/event/5th-conference-of-polish-academy-of-paediatric-dentistry/

3rd International Conference on Prosthodontics & Restorative Dentistry

Date: 13 - 14 April 2018

Location: Hawaii, USA

Event types: Conference, Hands-on, Exhibition

Visit event website: http://prosthodontics.conferenceseries.com/scientific-program

3rd International Conference on Prosthodontics & Restorative Dentistry

Date: 16 - 17 April 2018

Location: Las Vegas, USA

Event types: Conference, Exhibition

Visit event website: http://americandentistry.conferenceseries.com/scientific-program

FDI Middle Eastern Regional Congress

Date: 17 - 20 April 2018

Location: Tehran, Iran

Event types: Conference, Exhibition

Visit event website: https://www.fdiworlddental.org/news/20171130/fdi-regional-congress-in-tehran-will-focus-on-contemporary-clinical-practice

Megagen Days 2018 - Anniversary Edition

Date: 03 - 05 May 2018

Location: Bucharest, Romania

Event types: Conference, Workshops, Exhibition

Visit event website: http://www.dentaleventscalendar.com/event/megagen-days-2018-anniversary-edition/

40th Asia Pacific Dental Congress

Date: 07 - 11 May 2018

Location: Manila, Philippines

Event types: Conference, Lectures, Exhibition

Visit event website: https://apdc2018.org/scientific-information/scientific-program

World Health Professions Regulations Conference

Date: 19 - 20 May 2018

Location: Geneva, Switzerland

Event types: Conference, Exhibition

Visit event website: https://www.fdiworlddental.org/news/20171024/attend-the-leading-conference-on-health-professional-regulation

24thAmerican Dental Research & Future Dentistry

Date: 25 - 26 May 2018

Location: New York, USA

Event types: Conference, Exhibition

Visit event website: https://futuredentistry.conferenceseries.com/scientific-program

1st International Dental Photography Congress

Date: 08 - 09 June 2018

Location: Berlin, Germany

Event types: Conference, Exhibition

Visit event website: https://www.quintessenz.de/events.php?ide=10635

24th Global Dentists and Pediatric Dentistry Annual Meeting

Date: 11 - 12 June 2018

Location: London, UK

Event types: Conference, Exhibition

Visit event website: http://annualmeeting.conferenceseries.com/dentists/

Telemedicine in dentistry as the gold standard of improving access to oral health care

Technology in the form of a smartphone and electronic media has penetrated into our lives no matter whether we live, in the country side or the city. There are numerous isolated villages and communities that do not have access to specialized medical care, the more so to dental care and prevention. Today, technology proposes a paradigm shift towards better interprofessional communication that helps both physicians and patients. Teledentistry is a combination of telecommunications and dentistry involving the exchange of clinical information and images over large distances for dental consultation and treatment planning.

Teledentistry is pertains to Telemedicine. Tele in Greek means distance and medicine in Latin means to heal. Teledentistry has been introduced in many branches of dentistry such as: endodontics, oral surgery, pedodontics, prosthetics, orthodontics, radiology, oral pathology.

After the 2001 report on US telemedicine activity: the Association of Telehealth Service Providers has been highlighted by the yearly 2-fold increase in the number of active telemedicine programs. This is justified by the development of telecommunications over the Internet [1].

Teledentistry was established in 1989 at the Westinghouse electronics system group conference in Baltimore; to be more specific, the birth of teledentistry as a specialist field of telemedicine could be linked to 1994 and a military project of the United States Army (US Army's Total Dental Access Project) [2].

In August 1996, Norway was the first European country to implement an official telemedicine levy program so that these services became reimbursable by the national health insurer [3].

Teledentistry has the role to eliminate the differences between oral health care in the urban and rural communities. by being quick, low cost and able to bring together specialists from different corners of the world in a very short time.

Teledentistry, also known as telemedicine in dentistry, will be included in the ADA's Code on Dental Procedures and Nomenclature CDT Code) for the first time in 2018 [4].

E-Oral Health technology that could address the participants's oral health needs in terms of education, consultation, screening, diagnosis, treatment, support or any other type of application in the field of dental medicine [2]. No limitation in terms of the duration of the intervention and the type of stakeholders that are involved in the interventions will be imposed.Teleconsultation through teledentistry can take place in either of the following ways – "Real-Time Consultation" and "Store-and Forward Method" [5].

Real-Time Consultation involves a videoconference in which dental professionals and their patients, at different locations, may see, hear, and communicate with one another.

Store-and-Forward Method involves the exchange of clinical information and static images collected and stored by the dental practitioner, who forwards them for consultation and treatment planning.

Teledentistry develops the ability to establish links between dental professionals to reduce the isolation phenomenon of rural and isolated areas in setting up a personalized treatment plan.

In the US, a software that facilitates teledentistry has been implemented. TeleDent by MouthWatch provides an easy, cost-effective, secure way to facilitate your health. It is designed to easily import x-ray pictures and digital scans for clinicians performing off-site dental examinations and to connect dental patients to imaging technology and clinical expertise at the point of care. It also tracks current CDT billing codes. With the advent of the new CDT 2018 codes, documentation will become even easier.

Despite being the only platform specifically designed for teledentistry, MouthWatch TeleDent is easy to implement and surprisingly affordable. The TeleDent subscription is available at an annual price of $ 299 per provider for unlimited use [6].

Beside the software, implementing a teledentistry program requires adequate communication infrastructure, portable dental equipment, a source of sustainable funding, and a capable workforce trained to effectively use the equipment.

Teledentistry is also an educational tool that provides continuing education and training to dental professionals and others in dental schools and residency programs and in the clinics where it is used. The use of technology and teledentistry in education provides new opportunities for case learning and for the interactive participation in treatment planning and consultation from distant locations.

In a few years, most likely there will be legislation in each country that will support teledentistry. Awareness of teledentistry among health professionals should be increased and included in their day to day practice because it is a way to expand their practice, which can help in proper diagnosis and treatment plan accurately.

Recently, the UCLA School of Dentistry received a $ 1.5 million grant from the largest dentistry provider to support the launch of a community-based clinical education program. The award will help UCLA student dentists to take care of the most vulnerable patients, as in California there is an uneven distribution of providers, underfunded public health programs, lack of understanding of the importance of oral health, and the difficulty of identifying available resources.

In honor of the World Oral Health Day (WOHD), FDI and Dentsply Sirona have signed a new partnership on endodontics. This collaboration will create a White Paper on endodontics and a Chairside Guide for dentists to be launched at the 2019 World Congress in San Francisco.

To improve the quality of medical care of the readers of Stoma Edu J the use of teledentistry is strongly recommended.

Florin - Eugen Constantinescu
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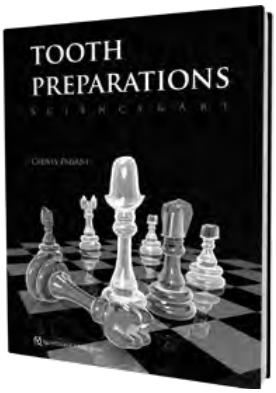
DOI: 10.25241/stomaeduj.2018.5(1).prodnews.1

Tooth Preparations: Science & Art



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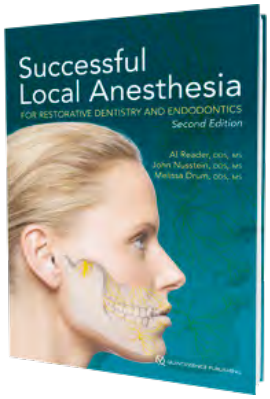
Author: Clovis Pagani
Publisher: Quintessence Publishing, Germany
Language: English
ISBN: 978-1-78698-001-4
Edition: 1/e
Publish Year: 2017
Pages: 312, illustrated
Price: 98.00 €

It is known that most of the current work carried out by a dental practitioner goes into the preparation of the teeth for various dental restorations. Green Vardiman Black's general principles on the cavity preparation are maintained, but a number of changes have been brought to them due to new materials and restorative techniques introduced in current practice.
In the book entitled "Tooth Preparations: Science & Art", Professor Clovis Pagani and colleagues, teach the principles of tooth preparation for highly biologic indirect restorations for the dental support structure. The book is divided into 8 chapters. The first chapter, Introduction to Indirect Restorations, presents the pre-established operative sequence of steps. Restorative planning involves the application of rehabilitation concepts adapted to the needs and expectations of the patient, which are developed in Chapter 2. Chapter 3 speaks about the mechanical (retention, stability and resistance), biological (preservation of dental pulp), and aesthetic principles, and the cervical finish line of teeth preparation. The various types of intra- and extra- coronary dental preparations are addressed in Chapters 4 and 5. The necessary tools for the preparation and types of metallic and non-metallic restorations are the examples in point. Conservative preparations are described in Chapter 6, exemplifying the different types of veneer preparation. Chapter 7 deals with the preparation of endodontically compromised teeth. The chapter presents the methods used for their restoration with cast and ceramic dowel, prefabricated metal, carbon fiber and glass fiber posts, including the necessary tools and the different working steps. The last chapter treats milled adhesive restoration adapted for: inlay, onlay, crown and intraradicular crown.
This book clearly presents the objectives of preparing the teeth for a multitude of clinical situations. Through its rich illustrations, through the over 800 images of excellent quality, it is an invaluable guide to be added to the personal library of any practitioner, but especially of those just beginning their careers

DOI: 10.25241/stomaeduj.2018.5(1).bookreview.1

Successful Local Anesthesia for Restorative Dentistry and Endodontics



Authors: Al Reader / John Nusstein / Melissa Drum
Publisher: Quintessence Publishing, USA
Language: English
ISBN: 978-0-86715-743-7
Edition: 2/e
Publish Year: 2017
Pages: 240, illustrated
Price: 88.00 €

It is known that besides the fear of pain, which is the main factor that makes patients delay the visit to the dentist one should add also the fact that 90% of the dentists encounter some difficulties while performing anesthesia during restorative dental procedures. For the success of local anesthesia in dental and endodontic restorations, the endodontic team of College of Dentistry's Division at The Ohio State University, Columbus, Ohio, has offered practitioners this book to ensure patient anesthesia by using the latest medicines and techniques. The book is divided in seven chapters. The first chapter discusses the clinical factors of dental anesthesia such as: confirming pulpal anesthesia in non-painful vital teeth, clinical local anesthesia, anxiety and pain, use of vasoconstrictors, characterize of injection pain, use of topical anesthetic alternative mode of reducing injection pain and alternative modes. Mandibular anesthesia is the subject of the second chapter, which tackles the inferior alveolar nerve block (IANB), anesthetic solution for IANB, mandibular injection locations, attempts to increase success of IANB in asymptomatic patients, mechanism of failure with the IANB, why asymptomatic patients do not achieve pulpal anesthesia with the IANB and methods to increase the success of mandibular anesthesia. The third chapter presents maxillary anesthesia by infiltration injection, it lists alternative anesthetic solutions, increasing the duration of pulpal anesthesia for infiltrations and discribes alternate injections techniques. Supplemental anesthesia is the subject of Chapter 4, which describes supplemental infiltration, intraligamentar and intraosseous injections, indication and success rates. The fifth chapter talks about the clinical tips for the management of routine restorative procedures and provides information on anesthetic success for molars, premolars and anterior teeth, mandibular and maxillary. Endodontic anesthesia is presented in Chapter 6, detailing the clinical factors and methods related to confirming pulpal anesthesia, factors related to pain, the success of local anesthesia in irreversible pulpitis, postoperative pain reduction in irreversible pulpitis, the use of supplemental intraligamentary, intraosseous, intraseptal and intrapulpar injection. The last chapter describes some clinical tips for the management of specific endododntic situations, describing how to successfully anesthetize and defines some considerations regarding endodontic anesthesia. The book is accompanied by an index and each chapter benefits from abundant references. The book guides the practitioner on how to make a successful anesthesia using the latest techniques and drugs; the book is a guide that should not be missing from the library of every practitioner who is aiming at dental and endodontic high-quality restorations.

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DOI: 10.25241/stomaeduj.2018.5(1).bookreview.2

The Books Review is drafted in the reviewer's sole wording and illustrates his opinions.

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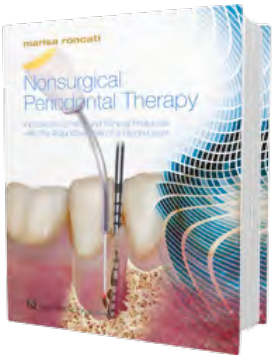
Keep It Simple: Concept Porcelain Book

Author: Paulo Battistella
Publisher: Quintessence Publishing, Germany
Language: English
ISBN: 978-85-7889-092-6
Edition: 1/e
Publish Year: 2017
Pages: 236, illustrated
Price: 150.00 €

Biomimicry has been introduced as a term for innovations inspired by nature and the author of this book applies this concept when performing dental restorations. The book has four chapters and clearly describes the technique for layering restorative materials to more accurately recreate the esthetic qualities found in natural teeth while being abundantly illustrated. The author presents the concept of dentin layering and preparing the structure to receive the enamel effects in their places. After the layer of dentin, he covers it with a layer simulating the dentinoenamel junction (DEJ) followed by the final layer, a thin layer of enamel sealing the tooth for canine lateral and central teeth porcelain restoration. The author presents the proper stratification technique by starting from the alveolar model by Willi Geller; the technique is described in detail throughout an entire chapter. Next, he describes the rehabilitation plan from the extra- and intra- oral photos protocol, wax-up protocol, the interocclusal records in light curing resin and the mock-up. The last part is used by the author to describe 11 clinical cases which illustrate his method of restoration, which highlights the ideal case of biomimicry. Paulo Battistella's book is accompanied by over 500 exceptional photographs taken by a professional photographer and is a true guide to dental materials stratification techniques to make ceramic restorations with exceptional aesthetic qualities. Each ceramist should consult this book in order to perfect his technique and to make restorations as natural as possible.

DOI: 10.25241/stomaeduj.2018.5(1).bookreview.3

Nonsurgical Periodontal Therapy
Indications, Limits and Clinical Protocols with the Adjunctive Use of Diode Laser



Author: Marisa Roncati
Publisher: Quintessence Publishing, Italy
Language: English
ISBN: 978-88-7492-045-7
Edition: 1/e
Publish Year: 2017
Pages: 416, illustrated
Price: 120.00 €

Periodontal disease is one of the most common affection of the oral cavity seen in daily practice. The goals of the periodontal therapy are to preserve, improve and maintain the natural dentition, dental implants, periodontium and peri-implant tissues in order to achieve health, aesthetics and function. The book "Nonsurgical Periodontal Therapy" by Dr. Marisa Roncati shows how to manage and resolve inflammatory periodontal diseases and how to maintain stable results over time. This book has six chapters. It starts with the main goal in periodontal therapy, long-term clinical stability. Periodontal patient management is approached in chapter two presenting modus operandi, initial clinical phase, initial therapy, protocols, consequences of aggressive periodontal instrumentation, cause related therapy reevaluation. The most significant factor in achieving a satisfactory result and maintaining in the long term is the patients' home care skills which are clearly presented in chapter three along with non-surgical periodontal instrumentation. There are descriptions of calculus detection, mechanical and ultrasonic therapy, step-by-step operating techniques, classification of manual instruments and correct movement types and clinical protocol in complex cases. Significant attention is paid to diode laser treatment in chapter four as an adjuvant to nonsurgical treatment giving details about indications, limits, and protocols. Considering that cases of peri-implantitis are increasing Dr. Roncati dedicates a whole chapter (5) to this affection, describing numerous protocols for dealing peri-implantitis and mucositis. The last chapter is dedicated to periodontal maintenance and strategies in dealing with clinical instability. This book provides in a clear and concise manner how to manage and resolve inflammatory periodontal diseases and how to maintain stable results over time. The book is exceptionally illustrated with more than 1.390 images that make it easier to understand. Every periodontist, young or experienced should read this book because it is a great educational tool, helping to master therapy protocols adapted to today's technology.

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DOI: 10.25241/stomaeduj.2018.5(1).bookreview.4

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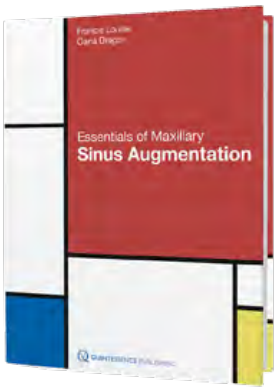
Essentials of Maxillary Sinus Augmentation



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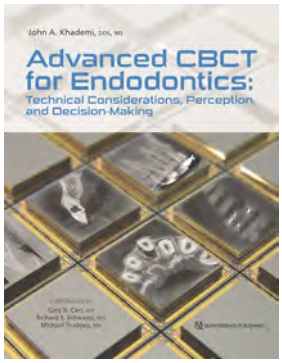
Authors: Francis Louise / Oana Dragan
Publisher: Quintessence Publishing, Germany
Language: English
ISBN: 978-1-78698-018-2
Edition: 1/e
Publish Year: 2017
Pages: 128, illustrated
Price: 78.00 €

It is known that most of the current work carried out by a dental practitioner goes into the preparation of the teeth for various Lately, sinus augmentation has become a current procedure in oral implantology to increase the height of the edentulous atrophied posterior maxilla. Professor Francis Louise of Aix-Marseille University, Marseille, France together with Dr. Oana Dragan of the University of Medicine and Pharmacy, Cluj-Napoca, Romania and contributors have drafted a new book to help implantologists support edentulous atrophied posterior maxilla. The book is divided in six chapters. After presenting the general considerations regarding sinus augmentation by lateral or crestal approach, the authors develop the preoperative evaluation by highlighting the necessary anatomical landmarks that the implantologist needs to know in detail. A separate chapter is dedicated to instruments and biomaterials used in oral implantology. It presents both the instruments used for the mechanical technique as well as those used for the ultrasonic one, including the effects of biomaterials on the healing of the grafted sinus. Preoperative care and procedures, surgical techniques and clinical cases are described and illustrated for the lateral and crestal techniques. At the end of the book preoperative risk assessment and postoperative care are presented. This book is updated to the currently existing knowledge, it is well illustrated with over 360 images, being a clinical guide for the implantologist to be able to plan treatment in cases with severe posterior maxillary atrophy.

DOI: 10.25241/stomaeduj.2018.5(1).bookreview.5

Advanced CBCT for Endodontics:
Technical Considerations, Perception, and Decision-Making



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Author: John Khademi
Publisher: Quintessence Publishing, USA
Language: English
ISBN: 978-0-86715-720-8
Edition: 1/e
Publish Year: 2017
Pages: 352, illustrated
Price: 148.00 €

The book entitled "Advanced CBCT for Endodontics" by Dr. John A. Khademi and contributors aims to encourage endodontist doctors to use cone beam computer tomography (CBCT) in daily practice to establish a diagnosis, a treatment plan, to assist in the decision-making process and how to assess treatment outcomes. This book is divided into five chapters. After introducing us to the CBCT issue the authors present technical considerations on the acquisition process and the difference between two-dimensional and three-dimensional radiography. Chapter three talks about occult perceptual and cognitive issues that can influence both the interpretation and the confidence in the interpretation of CBCT imaging studies. Restore consideration and balance into the decision making in the diagnostic, treatment planning and treatment process is the objective of the chapter four. These first chapters are the "know what" chapters, while the last chapter is the "know-how" chapter showing how to implement CBCT in clinical practice. As the author says, this book is not easy to read. It will require multiple readings and additional study. The topic tackled in the book is made clearer through the over 700 images. Reading this book is an opportunity to become an expert endodontist and leader on CBCT technology.

DOI: 10.25241/stomaeduj.2018.5(1).bookreview.6

The Books Review is drafted in the reviewer's sole wording and illustrates his opinions.

1. Submitting the Article

The journal publishes articles written in English. All articles will be accompanied by the signed copyright form which can be returned by e-mail, fax (as scanned documents). All the responsibility for the originality of the material sent belongs to the author(s) alone. Each article will be evaluated by the peer-review committee composed of two independent peer-reviewers, in a blinded fashion, according to the peer-review protocol. All articles will be sent to the editor-in-chief at the following e-mail address: stomatology.edu@gmail.com. The articles will also be sent at the e-mail address of the co-editors-in-chief from your area (Americas, Europe, Asia-Pacific).

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- case reports;
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A. The title of the manuscript will have a maximum of 100 characters without spaces, written in title case, centered capitals, and in 12 point bold Times New Roman font at the top of page. Abbreviations should be avoided within the title.

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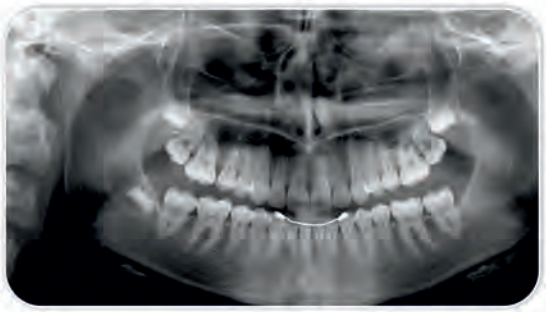

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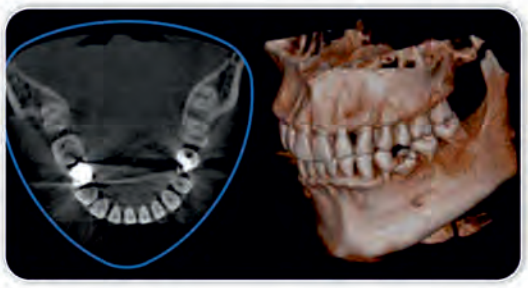

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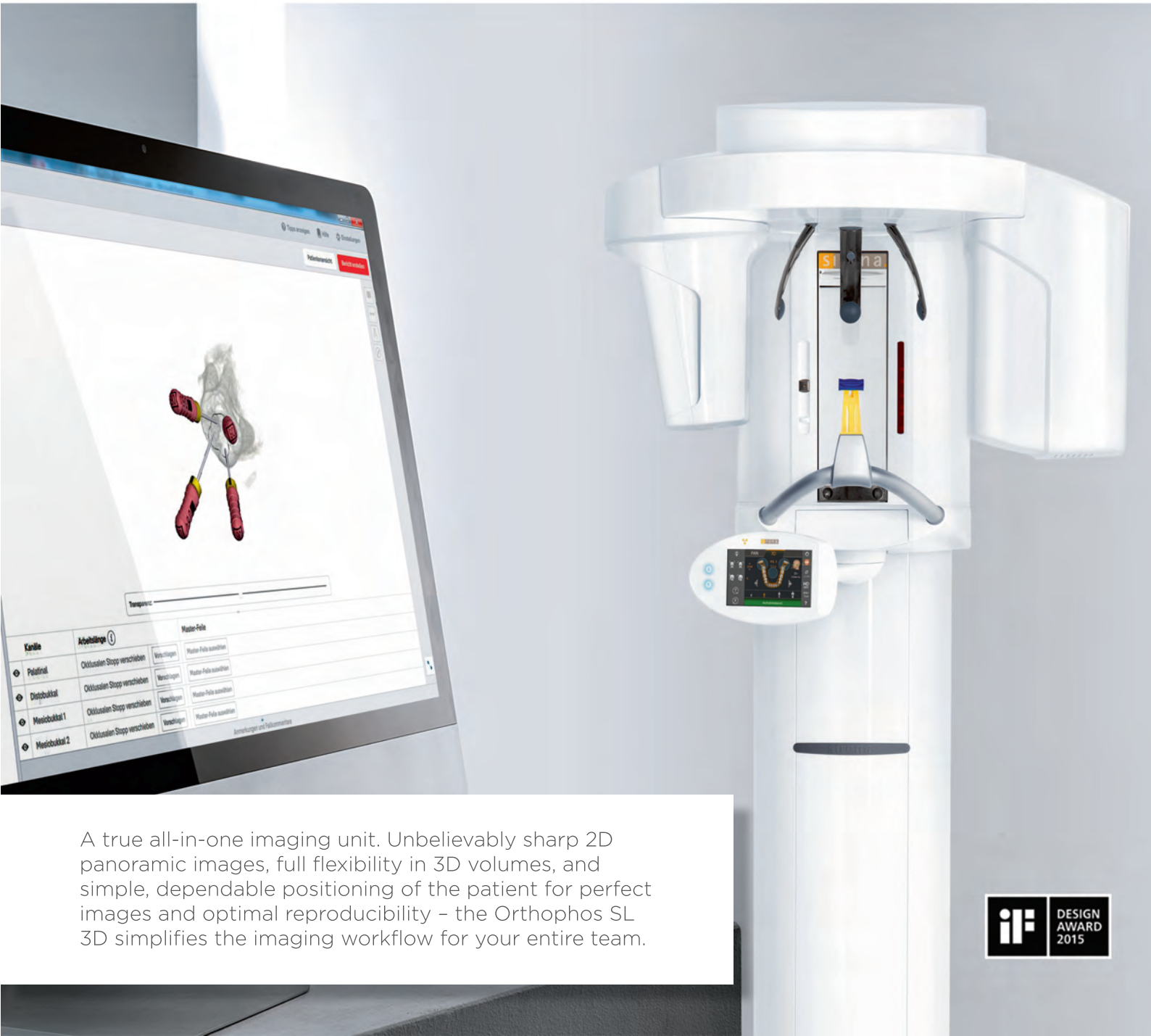

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