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2020

CE PROGRAM FAQs



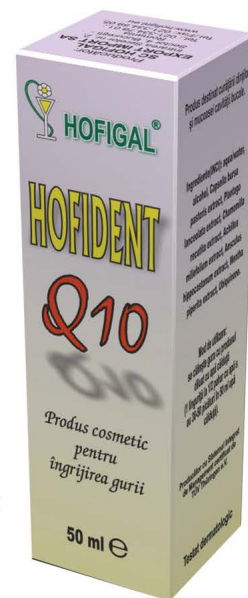
Hofident Q₁₀

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 action, it acts as a antioxidant, detoxifier, deodorant. It is strongly recommended in gingivitis, stomatitis, thrush, compression pain caused by 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 antileukemic 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 millefolium*, *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).

More and more dentists worldwide admit:

I

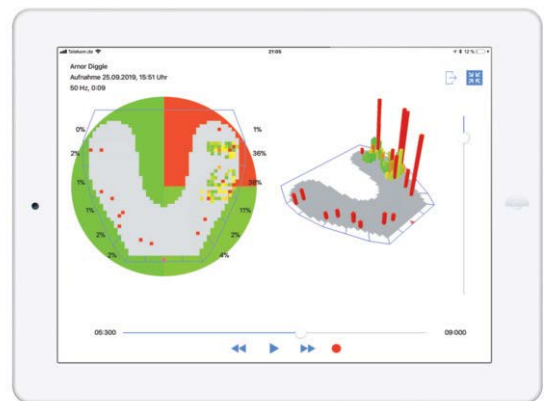


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EDITORIALS

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Suggestions for a quick safely recovered daily routine
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- 83** Entry-level survival in a post-crisis world
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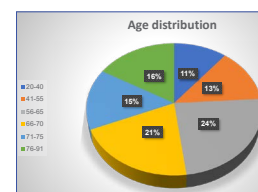
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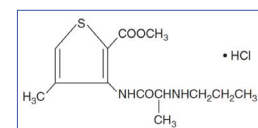
Dental wear	Total N = 74	Type I n = 25	Type II n = 24	Type IV n = 25	p-value
Prevalence of OI persons with dental wear					
Normal	63.5	55.6	69.6	63.6	0.652
Moderate/severe	36.5	44.4	30.4	36.4	
Mean percentage of teeth showing wear in dentition					
Normal	90.4	89.7	93.5	87.9	0.647
Moderate/severe	9.6	10.3	6.5	12.1	

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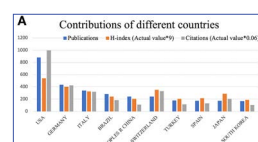
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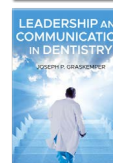


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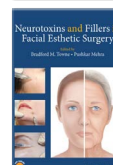
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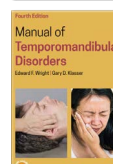
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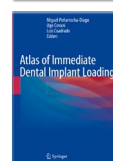
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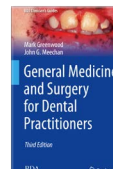
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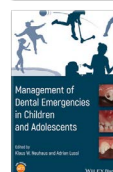
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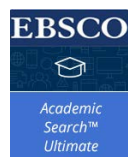
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Dental team engagement and motivation in Post-Covid-19 time

Suggestions for a quick safely recovered daily routine



Mario R. Cappellin, DDS, MBE
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Dear readers,

According to guidelines and specific national conditions, dentists are getting ready to restart their clinical activities; everybody has updated safety protocols to protect ourselves, our teams and obviously our patients from contagion risk and cross infections.

However we have to face an underestimated risk and this could undermine all our efforts: the correct implementation of every protocol, especially if safety-related, requires a global care and an high level of mental focus by the professionals involved.

If our teams had been inactive for these months, their psychological state couldn't be the best for a safe restart of clinical routine; in particular fear, anxiety and negativity (maybe due to the grief of a relative's death by Covid-19) could strongly impact the effectiveness of our workers.

Supporting our employees and collaborators in recovering confidence and trust is a crucial task to avoid any risk of errors and demotivation, which could decrease the quality of our services and even our clinical outcomes.

Early symptoms could be a lack of concentration, oversights and a general sense of melancholy; while someone is struggling to retrieve psychophysical equilibrium, the other members of the team can be easily influenced by this negativity, because in this peculiar circumstance people are more impressionable, due to the global dark mood shown by the mass-media, the social-media and above all by the deprivation of social contacts.

Everyone in our team deals with worries and uncertainty, maybe someone is experiencing financial difficulties too: as leaders of our company, first at all we have to reestablish a positive environment and hold up morale in order to ensure the safety of our patients and the best quality of our services.

The main reason of fear and worries could be related to apprehension, because it is possible to come into contact with asymptomatic patients infected by Covid-19; it is mandatory to deeply inform about the additional safety procedures, available individual protections, implemented technologies and investments made by the company to safeguard health of operators and patients.

We strongly suggest that you promote virtual meetings (ZOOM, Skype or similar), to discuss safety issues in order to involve the whole team in drafting and developing up to date protocols. It might seem obvious, but "feeling safe" is the first and most powerful motivation in any human behavior and if someone feels "threatened" by a danger or risk, due to a lack of effective communication or even just out of ignorance, he/she will tend to flee: if it cannot be done physically, it will be done psychologically for sure and it is more dangerous and insidious because it could cause errors, sometime irreparable ones.

As a second task, you should analyze how you have maintained personal contact with the members of your team. During lockdown, operational meetings and distance learning — both of which are a very important opportunity to maintain a work contact — were an unrepeatable chance to train your team and develop skills, especially the ones involved in communication.

Before restarting the clinical activity, you can prevent big personal issues in your team with individual meetings (virtually) to recognize any kind of stress or discomfort at the very beginning; except for rare cases, this should be sufficient to demonstrate your sincere carefulness to each team member, increasing your leadership; if you have too many workers, you can identify a small number of people whom you fully trust and appoint them as "tutors" for a small group of colleagues, empowering them to carry out the individual discussions. These meetings can help to intercept doubts, fears and uncertainties, identifying the causes and planning the needed actions to properly support your team.

As a third step, it is very important to clearly communicate strategies and objectives you are planning to restart, reinforce and further develop in your business. Declaring your policy about job security is a crucial point, because the team deserve to know if you are planning staff reduction and which kind of scenario could lead to this extreme choice.


Obviously, the best option is to avoid any staff reduction, because this can keep your team strongly motivated; probably you will have to face some economic efforts (even increasing your debts level), but you can maintain your resources and professional skills developed in many years and of course it will come in handy, especially in hard times.


If you have to dismiss some workers, we strongly suggest that you be transparent, however presenting this as the last option, in desperate cases: you should indicate clearly which kind of employee you cannot afford to keep in the company (for example, we demand big improvements in communication skills after the e-learning course we organized in these months AND we ask the members of our team to control interpersonal conflicts absolutely abstaining from creating tensions and discontent in the company, because we cannot afford communication errors and negativity; of course we hope that it will encourage people to follow our requests, we really wouldn't remove anybody from our team).

Finally, we suggest that you assume three scenarios for the future of your business: fast recovery, slow recovery or downsizing, so that you can plan how you can deal with these scenarios and above all what are the strategies that lead your team to fall into the first two hypotheses and to avoid the third. Strong communication is the key to engaging the whole team in achieving the shared targets and to reaching long term success.

Your team looks at you as the leader who can make them feel safe: you know your business and your team better than anyone else and as a physician you have to guarantee the integral health and welfare both of your patients and your team; I wish these simple suggestions can help you to react against this crisis and grant you full professional success and personal fulfilment.

Sincerely yours,

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Entry-level survival in a post-crisis world



Constantinus Politis
 MD, DDS, MM, MHA, PhD
 Professor & Chairperson
 Editor-in-Chief

Dear readers,

Every major crisis is an opportunity to either perish or be successful. Not in the least for medical and dental journals. Journals see their advertising revenues plummeting. At the same time digitization offers relief. Zoom meetings replace physical meetings and are an excellent opportunity for a journal editorial board to have regular meetings despite their international membership. Now that even top-journals have accepted to pre-publish manuscripts before peer-review and to allow all peers publicly scrutinize the submission an irreversible new way of peer-reviewing has entered the scene: crowd-reviewing by peers. This has led to the withdrawal of many manuscripts. The international community of scientists is in need of open access papers of high quality since subscription fees for most universities and individual medical doctors and dentists are no longer affordable. Leaving printed issues in favor of open access electronic journals would benefit all readers.


A worrying trend is the surge in number of predator journals accepting any submission in return for a submission fee. Seducing journal names hide their real intent. The ones suffering are not top journals or top scientists but entry level journals and beginning scholars and researchers. There is a definite need for journals accepting work of junior members of a staff. Writing is a skill and as any skill positive feedback is needed to motivate young people to aspire to a next level.

As the name says the Stomatology Edu Journal (*Stoma Edu J*) has the ambition to Educate. Education is not for the readership only, but also for those submitting. The advantage of an entry level journal is that no 'big data' are needed, that no complicated statistics are required to accept a submission. Reviewers are well aware of the standards that need to be fulfilled to present a paper to the peers. As soon as a paper with a decent content has been submitted and accepted, its open access publication will motivate juniors to pursue an academic career and to produce submissions for a next level journal.

Globalization of economic progress has increased competition among universities and the increase of manuscripts has led to major rejection figures in many journals. This rises the standards that can be achieved, but at the same time the Europe suffers from lack of funding for medical and dental research at University level. The presence and survival of continental journals is worthwhile to serve the European academic world. This journal therefore needs to do whatever is needed to meet the requirements set for entering InCites Journal Citation Reports of Clarivate Analytics. A good way to start are zoom-meetings to discuss concerns of any kind and promote initiatives which progressively enhance the level of submissions.

Sincerely yours,

C. Politis 
 Editor-in-Chief

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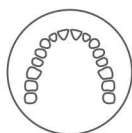
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Alan H. Gluskin, Gordon Lai, Christine I. Peters, Ove A. Peters

THE DOUBLE-EDGED SWORD OF CALCIUM HYDROXIDE IN ENDODONTICS

J Am Dent Assoc. 2020 May 151 (5): 317–326. Doi: 10.1016/j.adaj.2020.01.026

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PREVOTELLA SPECIES – THE MOST PREVALENT BLACK-PIGMENTED ANAEROBIC BACTERIA AMONG OROPHARYNGEAL ISOLATES OBTAINED FROM A SAMPLE OF HEALTHY YOUNG ADULTS

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ABSTRACT

 [https://doi.org/10.25241/stomaedu.2020.7\(2\).art.1](https://doi.org/10.25241/stomaedu.2020.7(2).art.1)

Introduction The black-pigmented *Prevotella* - *Porphyromonas* group comprises members of the normal flora of the oral cavity, oropharyngeal, intestinal and genitourinary tract, but may be associated with various infections too. The purpose of this study was to identify the species of this anaerobic group which frequently colonize the oropharynx in clinically healthy young adults.

Methodology The microbiological investigation was carried out on a strain collection of 93 dark-pigmented anaerobic isolates originated from the oropharynx of healthy dental students, at the Department of Microbiology, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy - Bucharest, Romania. All isolates of Gram-negative bacilli were identified at the genus and species level by conventional methods, MASTRING ID (MAST Group Ltd., U.K.) and Rapid ID 32 A system (BioMérieux, France), while the isolates of anaerobic cocci were tested only by MASTRING ID.

Results The microscopy of the Gram-stained smears and the results of the MASTRING ID test performed with the 93 black-pigmented anaerobic isolates indicated that 77 strains were Gram-negative bacilli and/or coccobacilli, while 16 strains were Gram-positive cocci. The identification of the Gram-negative bacilli at the species level concluded that 57 strains belonged to *Prevotella denticola*, 18 strains to *Prevotella melaninogenica* and 2 strains to *Prevotella intermedia*.

Conclusion *P. denticola* and *P. melaninogenica* might be considered the main species of the black-pigmented *Prevotella*-*Porphyromonas* group which colonize the oropharynx in healthy young adults. These species are usually beta-lactamase producers and their high rate of oropharyngeal colonization should be considered when antibiotics are needed in oral infections therapy.

KEYWORDS

Oropharynx, Microbiota, Anaerobes, Black-Pigmented Bacteria, *Prevotella*.

1. INTRODUCTION

The oropharynx comprises the palatine tonsils, tongue base, soft palate and posterior pharyngeal wall and is lined by a nonkeratinized stratified squamous epithelium [1]. The oropharynx mucosa comes in contact with saliva and nasopharyngeal

secretion. The oropharynx microbiota is complex and comprises hundreds of microbial species [2,3], most of them organized in biofilms associated with the respective microenvironment [4]. About 80% of the local normal flora is represented by the viridans streptococci and commensal species of *Haemophilus* and *Neisseria* [5,6]. Besides different



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species of *Mycoplasma*, *Corynebacterium* and staphylococci, the oropharynx may harbor also pathogenic or potentially pathogenic bacteria like: *Streptococcus pyogenes*, *Streptococcus agalactiae*, *Streptococcus dysgalactiae subsp. equisimilis*, *S. pneumoniae*, *Neisseria meningitidis*, *Haemophilus influenzae* or *Moraxella catarrhalis* [6-14]. Some studies reported that the dominant bacteria of the normal oropharyngeal flora are the anaerobes [15]. The persistence of anaerobic bacteria is favored by the anaerobic conditions found into the depth of the biofilm covering the oropharyngeal mucosa, mainly due to the oxygen consumption by aerobic and facultative anaerobic bacteria. The mucosal convolutions and especially the tonsils crypts may be considered important anaerobic microhabitats. At these sites, the strictly anaerobes are found in high proportion with *Prevotella* being the most frequently isolated species [16,17]. Most Gram-negative anaerobic bacteria colonizing the oropharynx in healthy adults belong to the following genera: *Prevotella*, *Fusobacterium*, *Leptotrichia* and *Veillonella* [2,18-22]. Some researchers also found *Porphyromonas* at this site, but except for *Prevotella* spp., the other anaerobes were isolated in much smaller percentages than the facultative anaerobes, such as: streptococci, staphylococci and diptheromorphs [16]. The conclusion of a Norwegian-American research team that applied cultural-independent molecular techniques to determine the microbial diversity of the oral flora was that there is a distinctive dominant oral flora in healthy subjects, with site-specificity and high diversity [23]. The same team found an unexpected high diversity at tonsils level (more than 50 different species) with high variation between subjects [23]. Thus, *Prevotella* and *Porphyromonas* spp. were isolated from some subjects, but were missing in others who were harboring mostly bacteria belonging to the phylum *Firmicutes* [23].

Some bacterial community analysis indicated that the main group associated with the throat microbiota comprises: species belonging to *Streptococcus* and other genera of *Firmicutes*, species belonging to the family of *Pasteurellaceae*, *Fusobacterium* spp. and *Actinomyces* spp., while the main group associated with the tonsils includes species of *Streptococcus*, *Mogibacterium* and other *Firmicutes*, *Fusobacterium* spp., *Prevotella* spp. and members of the family *Pasteurellaceae* [24]. In healthy persons, the core microbiome plays a major role in homeostasis [25]. In children, an oropharyngeal microbiome similar to that of adults was described, but richer in *Prevotella*, *Neisseria*, *Granulicatella*, *Porphyromonas* and *Fusobacterium* [26]. At present high efforts are required for advanced research of normal flora of the oral cavity and oropharynx, estimating that future findings may substantially contribute to understanding the role played by the microorganisms with oral or oropharyngeal habitat

in human pathology [23]. The present study intended to contribute to the investigation of black-pigmented Gram-negative anaerobic bacilli, since the anaerobic bacteria are not commonly cultivated by many microbiology laboratories. Thus, the aim of this study was to identify the species belonging to this bacterial category which colonize the oropharynx in healthy young adults most frequently.

2. METHODOLOGY

The microbiological investigation was performed on a collection of 93 black-pigmented anaerobic bacterial strains stored at -70°C, at the laboratory of the Department of Microbiology, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy (CDUMP) Bucharest. The respective strains originated from oropharyngeal swab samples collected from 29 male dental students and 64 female dental students, aged 20-34 years, at the same Microbiology department, in April 2018. They were second-year students, were clinically healthy and had not taken antibiotics in the last 6 months. Twenty-four of them were smokers: 7 male subjects and 17 female subjects. Prior to the present study, cultures from the 93 oropharyngeal swab samples were performed on Schaedler agar with 5% sheep blood (BioMérieux, France), which were incubated in GENbox, with GENbox anaer sachet and *Anaer* indicator (BioMérieux, France), at 35°C, for 10 days, with examination every 48h. All isolates that developed black pigment and showed negative results in the aerotolerance test were stored in cryobiles, at -70°C and constituted the collection of strains used in the present study. At the beginning of this study conducted in the second semester of 2018, the black-pigmented anaerobic strains belonging to the above mentioned collection were checked for their morphotinctorial characteristics by microscopic examination of Gram-stained smear. All Gram-negative bacilli strains were further identified by the conventional methods, MAST ID MID8 ANAEROBE ID RING/MASTRING ID (MAST Group Ltd., U.K.) and Rapid ID 32 A system (BioMérieux, France). The presumptive identification of the Gram-negative bacilli strains was performed by testing their ability to grow in the presence of 20% bile (by streaking them on *Bacteroides* bile-esculin agar, BBE) and by testing their susceptibility to: vancomycin (5 µg), kanamycin (1000 µg), colistin sulphate (10 µg), erythromycin (60 µg), penicillin G (2 units) and rifampicin (15 µg) by applying the MASTRING ID on blood agar plates (BioMérieux, France) seeded with bacterial inoculum adjusted to the turbidity of 2 McFarland standard. The plates were incubated in anaerobic atmosphere, at 35°C, for 48h. *Bacteroides fragilis* ATCC 25285 was used as quality control. These tests were interpreted based on the indication mentioned in the textbooks of diagnostic microbiology [27], completed with the recommendation given by the MASTRING ID



Figure 1. MASTRING ID test applied on a strain of black-pigmented Gram-negative anaerobic bacilli.

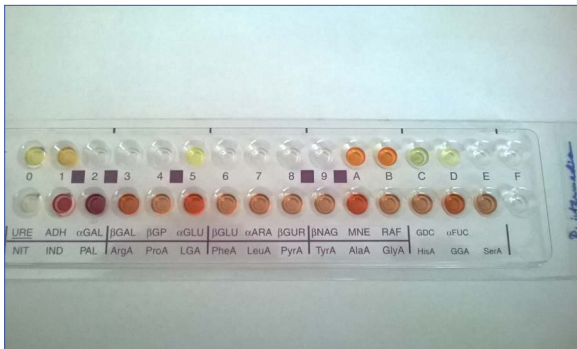


Figure 3. *P. intermedia* strain identified by the Rapid ID 32 A system.

producer. In addition, the MASTRING ID test was also applied to the coccus-shaped anaerobic isolates. The Fisher exact test was used to find any statistically significant association between smoking (data on this habit being received from students prior to this study, when oropharyngeal swab samples were collected) and oropharynx colonization with black-pigmented Gram-negative anaerobic bacilli species. The chosen significance level was $p \leq 0.05$.

3. RESULTS

The microscopic examination of the Gram-stained smears from the culture of dark-pigmented anaerobic strains indicated that 77 of the 93 isolates were Gram-negative bacilli and/or coccobacilli. The microscopy showed that the other 16 strains were Gram-positive cocci (arranged mainly in irregular clusters) and this was in complete agreement with the results of the MASTRING ID. Figure 1 illustrates the result of the MASTRING ID test applied to a strain of black-pigmented Gram-negative anaerobic bacilli (Fig. 1). The microbiological investigation carried out on the dark-pigmented Gram-negative anaerobic bacilli and/or coccobacilli isolates showed that all of them were susceptible to 20% bile, rifampicin and erythromycin, but resistant to kanamycin and vancomycin. The results concerning the susceptibility to colistin and penicillin G varied, 45 strains being found susceptible and 32 strains resistant to colistin, while only 19 strains were

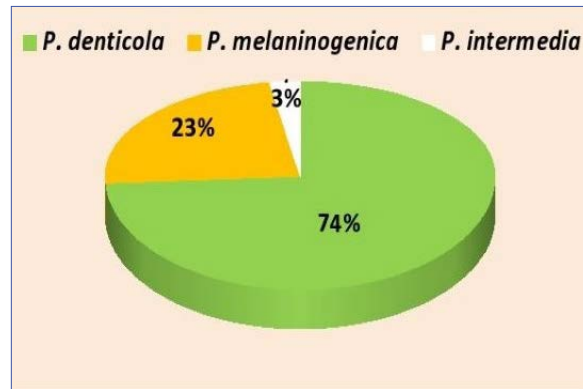


Figure 2. The distribution of the 77 strains of black-pigmented Gram-negative anaerobic bacilli by species.

found susceptible to penicillin. The interpretation of the tests according to the textbook of diagnostic microbiology [27] and MASTRING ID producer indicated that all these bacilli strains belonged to the genus *Prevotella*. The Rapid ID 32 A system indicated that 57 strains were *Prevotella denticola*, 18 strains were *Prevotella melaninogenica* and 2 strains were *Prevotella intermedia* (Fig. 2). In 5 subjects, pairs of *P. denticola* - *P. melaninogenica* were isolated. Twenty of the 72 students with black-pigmented *Prevotella* oropharyngeal colonization were smokers. Figure 3 presents the biochemical profile of a *P. intermedia* strain obtained with the Rapid ID 32 A gallery (Fig. 3). A p -value of 0.5737 was found when applying the Fisher exact test, indicating no statistically significant correlation between smoking and colonization of the oropharynx with black-pigmented Gram-negative anaerobic bacilli.

4. DISCUSSION

The normal oropharyngeal flora may show variability among healthy individuals due to external factors and ecological relationship. The investigation of the microbial relationship may contribute to clarifying many underlying aspects [28]. Anaerobic bacteria are not currently investigated by many laboratories due to the laborious and expensive work required. *Porphyromonas* and *Prevotella* (previously belonging to the genus *Bacteroides*) also include, besides non-pigmented species, dark-pigmented species like: *Porphyromonas gingivalis*, *Porphyromonas endodontalis*, *Porphyromonas asaccharolytica*, and *Prevotella intermedia*, *Prevotella nigrescens*, *Prevotella melaninogenica*, *Prevotella loescheii*, *Prevotella denticola* and *Prevotella corporis*, respectively [29]. This study focused on the investigation of the oropharynx colonization by dark-pigmented *Prevotella* and *Porphyromonas* species. The culture method allowed the isolation of the black-pigmented anaerobic strains. Because the development of dark-pigment is usually a delayed process, primary cultures (which were obtained prior to this study) were checked throughout the incubation period. The present study began with the selection of

the bacilli strains among the 93 black-pigmented anaerobic isolates and continued with the species identification, based on both conventional and rapid methods. *P. denticola*, *P. melaninogenica* and *P. intermedia* were the only black-pigmented anaerobic bacilli species isolated from the oropharynx in this group of 93 healthy young dental students. The results obtained with the Rapid ID 32 A system showed very good to excellent identification for all but 6 strains. The identification at species level of the 6 strains mentioned above indicated *P. denticola* as the first choice and *Prevotella oralis* as the second choice. These isolates were considered to belong to *P. denticola* because *P. oralis* is known to not produce colonies with dark pigment. Atypical phenotypic characteristics of isolates can sometimes lead to misidentification of species. Therefore, the culture-independent methods are highly recommended for the detection of anaerobic species. However, both culture-based method and detection by molecular techniques also have advantages and limitations. Previous studies performed in adults and children reported *P. melaninogenica* in a higher percentage in patients with tonsillar crypts who suffer from recurrent tonsillitis, compared to healthy subjects with adenotonsillar hyperplasia [17]. Recent studies reported that *P. melaninogenica* colonizes the tonsils in large quantities [30]. Isolates of this species are usually beta-lactamase producers [31] and this may explain the failure of penicillin treatment in recurrent tonsillitis [32]. The bacteria that produce enzymes that destroy the beta-lactam ring of penicillin indirectly protect penicillin-sensitive bacteria such as *S. pyogenes* [33]. Changes in the oropharyngeal ecology can variably affect the oropharyngeal microbiota. Smoking is one of the main external factors that can directly influence the composition of the upper airway microbiota [2]. Both active and passive smoking can contribute to colonization of the upper respiratory tract with pathogenic microorganisms [34,35] by impairing the immune response and favoring bacterial colonization, either by stimulating microbial adhesion to the epithelium or by other means [36,37]. *Prevotella* comprises commensal species from the human microbiota, which usually protect the upper respiratory tract against colonization of pathogenic bacteria [24,35]. Some studies have reported that nasopharynx in smokers frequently hosts *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Moraxella catarrhalis*, while *Prevotella* is absent [24,35]. It has been observed that the oral cavity and the nasopharynx became colonized again with the normal resident flora when smoking was abandoned [38,39]. Recent research using univariate analysis and machine learning approaches has concluded that smokers compared to non-smokers are colonized with a

greater number of species belonging to the genera: *Megasphaera*, *Streptococcus*, *Veillonella*, *Atopobium*, *Eggerthella*, *Dorea*, *Anaerovorax*, *Eubacterium* and to the family *Erysipelotrichaceae* [24]. Many of these bacteria can also be involved in oral infections. Some researchers found that significant changes occurring in the resident microbial population from oral and nasopharyngeal microbiota in smokers are correlated with higher frequencies of infections than in non-smokers [40]. Oropharyngeal flora varies due to many other factors, such as age and health status. In most studies focusing on the upper respiratory tract flora, mainly oral and nasopharyngeal flora have been investigated in children, the elderly and patients suffering from various diseases [41-47]. However, updated data on changes in oropharynx flora in healthy young adults are also needed. Influenced by data from recent specialty literature, special attention was paid in the present research to analyze the association between smoking and colonization of oropharynx with black-pigmented Gram-negative anaerobic bacilli in the group of healthy young adults from whom the strains were isolated. Although the findings showed no statistically significant correlation, for a more accurate interpretation of the results, this study should be continued on a larger sample size. It is important to understand that maintaining a normal oropharyngeal and nasopharyngeal microbiota is an important step in maintaining good health.

5. CONCLUSIONS

The findings of this study indicated *P. denticola* and *P. melaninogenica* as the main species of black-pigmented Gram-negative anaerobic bacilli that colonize oropharynx in healthy young adults. The well-known beta-lactamase activity of these bacteria should be strongly considered when antibiotics are needed in oral infection therapy.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

All authors had equal contribution to the paper.

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Questions

1. Prevotella originated from the genus?

- ☐ a. *Bacteroides*;
- ☐ b. *Fusobacterium*;
- ☐ c. *Tannerella*;
- ☐ d. *Porphyromonas*.

2. Prevotella comprises species of?

- ☐ a. Gram-positive anaerobic bacilli;
- ☐ b. Gram-negative anaerobic bacilli;
- ☐ c. Gram-negative anaerobic cocci;
- ☐ d. Gram-negative aerobic bacilli.

3. Examples of black-pigmented anaerobic species?

- ☐ a. *Prevotella melaninogenica*, *Prevotella oralis* and *Prevotella nigrescens*;
- ☐ b. *Porphyromonas gingivalis*, *Porphyromonas endodontalis* and *Prevotella oralis*;
- ☐ c. *Prevotella melaninogenica*, *Prevotella intermedia* and *Prevotella nigrescens*;
- ☐ d. *Prevotella intermedia*, *Porphyromonas gingivalis* and *Prevotella oralis*.

4. The beta-lactamase?

- ☐ a. Is never produced by black-pigmented anaerobic strains;
- ☐ b. Enhances the penicillin effect against anaerobic bacteria;
- ☐ c. Enhances the penicillin effect against aerobic bacteria;
- ☐ d. Cleaves the beta-lactam ring of beta-lactam antibiotics.



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DENTAL FINDINGS OF PERSONS WITH OSTEOPENIA IMPERFECTA IN VIETNAM

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ABSTRACT

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Background Osteogenesis imperfecta (OI) is the collective term for a heterogeneous group of connective tissue syndromes. The aim of the current study is to describe dental characteristics, including dentinogenesis imperfecta (DGI), dental wear, occlusal features, and dental caries experience of Vietnamese persons with OI.

Methods The sample consisted of 74 individuals with OI classified into type I (n=25), type III (n=24), and type IV (n=25). All participants were examined for DGI through the evaluation of intrinsic color variation, dental wear using Hooper's index, occlusal features (including Angle's classification, overjet, overbite, crossbite) and dental caries experience by using the dmft/DMFT index.

Results DGI was found in 62.2% of the sample and was significantly related to OI type III and type IV (p=0.019). Dental wear occurred in 36.5% and was equivalent among OI types. Angle Class III malocclusion was more prevalent in type III (66.7%) and type IV (54.5%) than in type I (37.5%). High prevalence of reverse overjet (60.3%), posterior crossbite (32.2%), and missing teeth (23.3%) were found in the OI sample. The mean dmft/DMFT score was 3.0/2.2. The dental findings related to dental wear, occlusal features, and dental caries did not show significant differences among type I, III, and IV.

Conclusion There was a high prevalence of DGI and dental wear in the Vietnamese OI sample. Occlusal features were related to a high prevalence of class III malocclusion, overjet, open bite, posterior crossbite, and missing teeth. Dental caries experience of persons with OI was at a moderate level.

KEYWORDS

Dental Care for Disabled; Dentinogenesis Imperfecta; Dental Occlusion; Osteogenesis Imperfecta.



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1. INTRODUCTION

Osteogenesis imperfecta (OI) is the collective term for a heterogeneous group of connective tissue syndromes. Seventeen mutated genes have been found related to OI syndromes [1,2]. The mutation incidence varies in different populations from 1/20,000 to 1/10,000 OI cases [3–5].

The clinical classification of OI includes five types (type I–V) [2,6]. Type I is a mild phenotype with dominantly inherited OI and blue sclerae; type II is related to perinatal lethality; type III results in progressive deformity throughout the lifespan; type IV is similar to type I, but sclerae are normal; and type V has mesh-like bone appearance due to calcification in inter-osseous membranes. In clinical studies, types I, III and IV are often mentioned to describe the clinical features of living individuals with OI syndrome. Collagen mutation may influence the dental-facial structures of individuals with OI. Previous studies indicated that more than 50% of individuals with OI had class III malocclusions [7–9]. The OI syndromes cause not only maxillary deficiencies but also hypodontia [8,10]. Dentinogenesis imperfecta (DGI) and dental abnormalities are also observed in intra-oral and radiologic examination of persons with OI, such alterations may result in premature wear of dental structure [10–13]. This suggests that OI has an impact on many oral conditions. Because it is a rare disease, many OI studies focus on finding genetic mutations and on the treatment of bone fractures. There are still gaps in the scientific literature about the dental health of individuals with OI. In Vietnam although OI has been assessed medically [14], to the authors' knowledge, the dental aspects of OI types have not been reported. Therefore, the aim of the current study is to investigate the dental characteristics of persons with OI, including dentinogenesis imperfecta, dental wear, dental caries experience, and malocclusion.

2. MATERIALS AND METHODS

2.1. Study sample

This is a cross-sectional study and the total sample consisted of 74 OI persons aged 2–37 years (mean age = 10.6 ± 7.1 , median age = 9.0) from 34 healthcare centers across Vietnam. The OI diagnosis was based on Sillence's classification [5] and was confirmed by two orthopedic experts. OI participants or their legal representatives signed informed consent forms. The Danang University of Medical Technology and Pharmacy (No. 523/CN-DHKTYDDN) approved this study. All procedures were performed according to the World Medical Association Declaration of Helsinki.

2.2. Examination of dentinogenesis imperfecta

DGI was clinically diagnosed according to the Shields' classification [13]. The clinical examination of DGI

was based on evaluating color variation, including lightness level, saturation, and hue of teeth, using the Vita System 3D-Master.

The system consists of six lightness level groups from 0 to 5 (0=lightest, 5=darkest), five grades of color saturation (chroma) with a given score of 1, 1.5, 2, 2.5 and 3, and three levels of hue (L=yellowish, M=intermediate hue, R=reddish). In the current study, the lightness level was divided into grades of lightness (score 0–2) and darkness (score 3–5); chroma was grouped into low saturation (score 1–2) and high saturation (score 2.5–3).

Tooth shades were determined in daylight in 5–7 seconds. In our study, DGI was confirmed by intrinsic color variation with teeth that were darker, had high color saturation and displayed a reddish hue.

2.3. Measurement of dental wear

A dental impression was taken for pouring a dental cast to measure tooth wear using a millimeter probe. Tooth wear was evaluated based on Hopper's index [15]. A six-point scale (0=no wear, 5=the most severe) was used to identify a tooth as having incisal/cuspal wear. The level of tooth wear was grouped into no/mild and moderate/severe levels.

2.4. Examination of dental caries

The dental caries experience of persons with OI was recorded using the Decayed, Missing and Filled Teeth index for permanent teeth (DMFT) and for primary teeth (dmft). A decayed tooth was registered as presenting primary caries or secondary caries next to a filling. A missing tooth was a tooth that was extracted due to caries. A filled tooth was a tooth with restoration but without additional caries. The dmft/DMFT score was the sum of decayed, missing and filled teeth.

2.5. Analysis of occlusion

Occlusal variables of OI dentition consisted of 10 variables including overbite, overjet, open bite, posterior crossbite, contact point displacement, midline diastema, molar Angle classification, incisal segment crowding, and incisal segment spacing.

2.6. Calibration procedure

The dental status of an OI person was examined twice on the same day by the first author (MSN) at local healthcare centers to ensuring reliability between the interval examination and inter-examiner. The Kappa value of 0.92 and 0.87 indicated high reliability of the clinical examination. The first author also conducted an analysis of occlusion and dental wear on dental casts. The calculated Kappa values were above 0.85, indicating a high degree of intra-examiner and inter-analysis reliability.

2.7. Statistical analysis

Data entry and analyses were performed with the Statistical Package for the Social Sciences software

Table 1. Prevalence of dentinogenesis imperfecta and tooth discoloration in persons with osteogenesis imperfecta.

Variable	Total N = 74	OI classification			p-value ^a	
		Type I	Type III	Type IV		
		n = 25	n = 24	n = 25		
Dentinogenesis imperfecta						
	No	37.8	60.0	25.0	28.0	0.019*
	Yes	62.2	40.0	75.0	72.0	
Tooth coloration						
Lightness level						
	0-2	12.2	28.0	0	8.0	0.008 ^b
	3-5	87.8	72.0	100	92.0	
Saturation (Chroma)						
	Low	75.7	72.0	79.2	76.0	0.842
	High	24.3	28.0	20.8	24.0	
Hue						
	Yellowish (L)	10.8	4.0	8.3	20.0	0.418
	Intermediate hue (M)	79.7	88.0	79.2	72.0	
	Reddish (R)	9.5	8.0	12.5	8.0	

^aChi-square test; ^bFisher's test

*Significant.

Table 2. Prevalence of dental wear in persons with osteogenesis imperfecta.

Dental wear	Total N = 74	OI classification			p-value	
		Type I	Type III	Type IV		
		n = 25	n = 24	n = 25		
Prevalence of OI persons with dental wear						
No/mild	63.5	55.6	69.6	63.6	0.652 ^a	
Moderate/severe	36.5	44.4	30.4	36.4		
Mean percentage of teeth showing wear in dentition						
No/mild	90.4	89.7	93.5	87.9	0.647 ^b	
Moderate/severe	9.6	10.3	6.5	12.1		

^aChi-square test; ^bANOVA test.

version 17.0 (SPSS Inc., Chicago, IL, USA).

The Chi-square test and ANOVA test were used to identify the differences related to DGI, dental wear, occlusal features, and dmft/DMFT score among OI types I, III, and IV. An interval confidence level of 95% and a two-sided p-value of .05 were set for significant difference.

3. RESULTS

The study included 74 persons with OI aged 2–37 years (50% females and 50% males). The distribution of clinical diagnoses was 33.8% type I (n=25), 32.4% type III (n=24), and 33.8% type IV (n=25). Primary dentition was accounted for in 31.1% of the sample, mixed dentition was in 37.8%, and permanent dentition was 31.1%. Dentinogenesis imperfecta was found in 62.2% of the total sample. Prevalence of DGI was statistically more frequent in type III (75%) and

color variation, 72% dentition of type I, 92% of type IV, and 100% of type III were graded in darkness levels. Prevalence of high saturation was fairly equivalent among type I (28.0%), type III (20.8%), and type IV (24.0%, p=0.842). The hue component of the total dentitions was 10.8% of yellowish, 79.7% of intermediate hue, and 9.5% of reddish.

There were no differences in hue components among OI types (p = 0.418) (Table 1). Dental wear occurred in 36.5% of OI individuals, of which 44.4% presented in type I, 30.4% in type III, and 36.4% in type IV. The mean percentage of the amount of tooth wear in dentition was found in 12.1% of type IV, 10.5% of type I, and 6.5% of type III. However, there were no differences in the distribution of tooth wear among three types of OI (p>0.05, Table 2). Table 3 shows the characteristics of dentition associated with each type of OI. According to Angle's classification, class III was more prevalent in type III (66.7%) and type

Table 3. Prevalence of occlusal features in persons with osteogenesis imperfecta.

Variable	Total N = 74	OI classification			p-value	
		Type I n = 25	Type III n = 24	Type IV n = 25		
Angle's classification						
Class I	27.1	43.8	23.8	18.2	0.231	
Class II	18.6	18.8	9.5	27.3		
Class III	54.2	37.5	66.7	54.5		
Overbite >3.5mm						
No	80.7	64.3	90.5	81.8	0.155	
Yes	19.3	35.7	9.5	18.2		
Increased overjet > 3.5 mm						
No	100	100	100	100	-	
Yes	0	0	0	0		
Reverse overjet						
No	39.7	60.0	33.3	31.8	0.173	
Yes	60.3	40.0	66.7	62.8		
Posterior crossbite						
No	67.8	75.0	57.1	72.7	0.424	
Yes	32.2	25.0	42.9	27.3		
Open bite						
No	82.5	100	75.0	77.3	0.133	
Yes	17.5	0	25.0	22.7		
Diastema						
No	86.4	87.5	90.5	81.8	0.702	
Yes	13.6	12.5	9.5	18.2		
Displacement > 2mm						
No	66.1	75.0	52.4	72.7	0.251	
Yes	33.9	25.0	47.6	27.3		
Incisal segment crowding						
No	53.4	75.0	42.9	47.6	0.121	
Yes	46.7	25.0	57.1	52.4		
Incisal segment spacing						
No	66.1	62.5	76.2	59.1	0.466	
Yes	33.9	37.5	23.8	40.9		
Missing teeth						
No	76.7	76.5	76.2	77.3	0.996	
Yes	23.3	23.5	23.8	22.7		

Chi-square test; *Significant.

IV (54.5%) than in type I (37.5%). No OI persons had an increased overjet (>3.5mm), but 60.3% of individuals had reverse overjet. Posterior crossbite occurred in 32.2% of the total OI sample, of which 42.9% presented in type III, 27.3% in type IV, and 25.0% in type I. High prevalence of incisal segment crowding (46.7%), incisal segment spacing (33.9%), displacement of tooth>2mm (33.9%), missing teeth (23.3%), open bite (19.3%) and diastema (13.6%) were also found in the total sample, but no significant differences were observed among type I, III and IV ($p>0.05$). Table 4 indicates dental caries experience within the OI sample; the mean of the dmft and

DMFT score was 3.0 ± 4.1 and 2.2 ± 4.6 respectively. The dmft and DMFT scores were equivalent among types of OI ($p>0.05$). None of the persons with OI received restorative treatment for decayed teeth, and none of the permanent teeth in type III and IV were extracted due to caries.

4. DISCUSSION

4.1. General information about Vietnamese persons with OI. This is a preliminary study conducted in Vietnam to collect the dental characteristics of persons who suffer from OI. The total sample of our

Table 4. Mean score of dental caries components of primary and permanent teeth in osteogenesis imperfecta patients.

Dental caries experience	Total N = 74	OI classification			p-value
		Type I	Type III	Type IV	
		n = 25	n = 24	n = 25	
Primary teeth					
dt	1.8 ± 3.2	0.9 ± 2.0	3.2 ± 4.3	1.7 ± 3.1	0.111
mt	1.3 ± 2.4	1.1 ± 2.8	1.6 ± 2.3	1.2 ± 2.0	0.771
ft	0	0	0	0	-
dmft	3.0 ± 4.1	1.9 ± 3.4	4.9 ± 4.4	2.8 ± 4.4	0.119
Permanent teeth					
DT	1.7 ± 2.4	1.0 ± 1.6	2.3 ± 2.9	1.6 ± 2.3	0.295
MT	0.3 ± 1.8	0.9 ± 3.5	0	0	0.272
FT	0	0	0	0	-
DMFT	2.2 ± 4.6	2.9 ± 7.9	2.3 ± 2.8	1.6 ± 2.3	0.753

ANOVA test

dt/DT: decayed teeth; mt/MT = missing teeth; ft/FT = filled teeth.

study was 74 OI persons from thirty-four provinces that are home to approximately 60 million of the total population of Vietnam, meaning that the prevalence of OI in Vietnam is estimated at 1/480,000. Our prevalence might be lower compared to the prevalence of 1/25,000-1/10,000 reported in other countries [3-5]. Our study lacked information about OI in the newborn infant group, and OI's mild type might be undiagnosed in the general population; in addition, OI type II was excluded from the present study. Nonetheless, the distribution of OI types in our study approached a range distribution of 39-79% for type I, 9-24% for type III, and 13-40% for type IV, as reported in previous studies [10,11,16,17]. Bisphosphonate therapy has good results in increasing the bone mineral density; however, most of our participants could not follow bisphosphonate therapy due to inaccessibility of adequate medical care, sustainment or counseling from the medical professionals.

4.2. Dentinogenesis imperfecta and dental wear

A high prevalence of DGI was found in Vietnamese with OI. Our results were in accordance with a study by Majorana et al. [12] that indicated that 62.5% of an Italian OI sample had DGI. Conversely, Malgrem [11] and Saeves [10] found that the prevalence of DGI in OI samples in Sweden and Norway was 41.5% and 19.0%, respectively. Concerning DGI related to types of OI, our study is consistent with previous studies in showing DGI to be more prevalent in OI type III than in type I and IV [10,18], indicating that DGI is related to the severity of OI. DGI is a disorder of dentin formation causing deposition of dentine, obliteration of the pulp chamber and intrinsic discoloration. This could explain the finding that up to 80% of dentition in our OI sample were graded as having a dark lightness level and yellow-

red intermediate to reddish color. Our study found that 36.5% of OI persons had dental wear. This is in line with previous investigations that found the prevalence of dental wear ranging from 37.5% to 66.5% in OI samples [11,12]. Dental wear occurring in OI person could be from DGI. Among DGI types of Shields' classification, DGI type I is associated with OI because of the inherited disorders of collagen metabolism; whereas, DGI type II and III are mutations affecting the dentin sialophosphoprotein gene [13]. The mutations in COL1A1 and COL1A2 genes would cause DGI type I that teeth easily expose the abnormal dentine and were typically worn. Approximately 10% of teeth in both dentitions were showed a severely worn condition in the current study. Preventive and restorative care of DGI and dental wear are important for Vietnamese OI persons. The treatment considerations are preservation of occlusal height, maintenance of oral function and esthetic needs. Nonetheless, most of OI persons might not receive dental treatment because of the family economic hardship; thus, there is a need for more effective support for OI persons to approach treatment to restore the harmony of the oral functions.

4.3. Occlusal features

OI mutation not only has an impact on dental structure but also on dental occlusion. The findings of our study indicate that class III malocclusion presented in 54.2% of the sample, which was similar to 60-80% of class III malocclusion in investigations in Taiwan and Canada [7,9]. In the current study, class III malocclusion was more prevalent in OI type III compared to type IV and I. An individual with OI type III is described as having a triangular face, and this feature might be associated with class III malocclusion. High prevalence of class III in

the Vietnamese OI sample corresponded with the prevalence of OI persons having reverse overjet. Reverse overjet is a manifestation of disharmony between the maxilla and the mandible. In the current study, OI persons were likely to have deficient growth of the maxilla. The evidence was that a posterior crossbite presented in 25.0-42.9% of OI types, with no OI persons having an overjet > 3.5mm, a parameter indicating a protrusive maxilla. Our study was strongly supported by previous studies. Chang et al. [7] reported a shorter upper facial length in an OI sample as compared to a healthy sample. By using the discrepancy index in orthodontic treatment, Rizkalla et al. [9] found OI to be related with anterior and posterior crossbite. Scalia et al. [19] concluded that malocclusion of OI was associated with a retrognathic maxilla. The impairment of maxilla growth could be from a lack of type I collagen due to mutation. In addition, the symptom of loose joints could be observed in severe cases of OI. When occurring in the temporomandibular joint, it can stretch more than normal and lead to abnormal jaw relations. The deficiency of maxillary length might also lead to teeth crowding. Our study found that both the prevalence of displacement of tooth > 2mm and incisal segment crowding gradually increased from OI type I to type IV and type III. According to Sillence's classification for living OI patients, type I is the mildest form, whereas type III is the most severe form. Such severe deformities of OI type III and IV influenced the defective growth of the maxilla and might also be associated with disharmony of growth between the two jaws.

The evidence was that over 20% of people with OI type III and IV had an open bite in contrast with 0% of type I. Waltimo-Siren et al. [17] indicated that the gonial angle of OI type I was 124.6 degrees, which was lower compared to the 126.3 degrees of OI type III/IV. Similarly, Chang et al. [7] found a clockwise rotation of the mandible of OI patients as compared to the control group. Such alterations in the mandible might be associated with an open-bite of occlusion in OI patients.

The mutations of COL1A1 and COL1A2 in persons with OI might prohibit tooth formation and development. In the current study, the prevalence of missing teeth was equivalent among OI types, and it ranged from 22.7-23.8%; that was much higher compared to 0.5-11.0% of missing teeth in the general population [20]. The findings related to missing teeth in our study are reinforced by previous OI studies. Tooth agenesis was found in 17% of the OI sample, including 11% hypodontia and 6% oligodontia [18].

Approximately 14% of individuals with OI type III had congenital missing teeth [21], and in our study, missing teeth accounted for 23.8% of OI type III. The odds of having missing teeth among persons with OI was more 2.0-4.7 times compared to the general population [8,10].

4.4. Dental caries experience

Dental caries is a major concern for persons with OI because of difficulties with physical activity for oral hygiene. The mean score dmft/DMFT of 3.0/2.2 indicated a moderate level of dental caries experience in OI sample. Our findings were in accordance with previous studies that highlighted oral problems among the OI population. Saeves et al. [10] described that although OI patients in Norway had regular dental visits and daily oral health habits, their oral status was not as good as compared to the general population. Differently from the findings of Saeves in Norway, none of the Vietnamese individuals with OI received any restorative treatment for decayed teeth. The physical disability of persons with OI might influence their ability to visit a dentist for dental treatment; in addition, most of them were from healthcare centers that only focused on rehabilitation of OI patients. The dental issues and lack of dental visits could accelerate caries development in OI persons; however, the number of decayed teeth of Vietnamese people with OI was lower compared to the general population in Vietnam [22]. This is possibly related to DGI presenting in persons with OI. In DGI dentition, the presence of obliterated dentinal tubules and pulp chamber can prevent penetration of harmful bacteria, although enamel has chipped away. This might explain that the missing teeth component in our study (mt/MT=1.3/0.3) resulted from hypodontia as aforementioned, not by the impact of caries. The shortcoming of our study is an absence the control group to compare with the OI sample in evaluation the risk of oral problems. In addition, radiographic examination was not carried out for OI participants to determine the reasons for missing teeth due to impacted teeth or hypodontia.

5. CONCLUSION

There was a high prevalence of dentinogenesis imperfecta and dental wear in the Vietnamese OI sample, especially in OI type III and IV. The occlusal features of OI persons were determined with a high prevalence of class III, malocclusion, overjet, open bite, posterior crossbite, and missing teeth. The dental caries experience of persons with OI was at a moderate level, and none of the study's subjects had received any dental restorations.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

MSN: performed clinical studies, data acquisition, statistical analysis, and manuscripts writing, MS: analysis results, proofreading, BH: data acquisition, KM: data acquisition and interpretation of the results, SK: interpretation of the results, AM: data acquisition, TT: data acquisition and manuscript literature search, TJ: protocol, proofreading.

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Questions**1. Osteogenesis imperfecta is a genetic mutation affecting**

- ☐ a. Connective tissue;
- ☐ b. Bone;
- ☐ c. Eyes;
- ☐ d. Dentition.

2. Which type of osteogenesis imperfecta cannot be observed in living persons?

- ☐ a. Type I;
- ☐ b. Type II;
- ☐ c. Type III;
- ☐ d. Type IV.

3. The high prevalence of malocclusion that can be observed in persons with OI is related to

- ☐ a. Angle's class I;
- ☐ b. Angle's class II, division I;
- ☐ c. Angle's class II, division II;
- ☐ d. Angle's class III.

4. Which type of dentinogenesis imperfecta is associated with osteogenesis imperfecta?

- ☐ a. Only DGI type I;
- ☐ b. DGI type I and type II;
- ☐ c. DGI type I and type III;
- ☐ d. DGI type II and type III.

IS THERE AN AGE LIMIT FOR IMPLANT DENTISTRY?

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ABSTRACT

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Introduction Aging may impede implant survival due to compromised wound healing. The present study assessed, retrospectively, whether there is an age limit for implant dentistry.

Methodology All patients treated with a single implant brand in a single medical center were included. Early implant failure (EIF) was recorded. The cohort was divided to a younger (20 to 65) and an older (≥ 65) group. The comparison between groups was based on: (1) gender (2) physical status (3) implant location (4) implant dimensions (5) number of implants placed per patient and (6) bone grafting.

Results Out of 121 patients, the younger group comprised 57 and the older 64. The younger cohort received 192 implants (mean: 3.25 ± 3.68 , range: 1 to 16 implants per patient) vs. 171 (mean 2.78 ± 1.91 , range: 1 to 11 implants per patient) in the older group. The older did not differ significantly ($p > 0.05$) from the younger in any of the parameters evaluated. EIF on implant and patient level was 1.0 and 3.5%, respectively in the younger vs. 1.1 and 3.1%, respectively in the older. Seven patients were ≥ 80 years. EIF at implant and patient level was 8.3 % and 14.3% respectively.

Conclusions Elderly patients ≥ 65 years old presented a similarly low EIF rate as younger patients 20 to 65 years old, while patients ≥ 80 years old may have a slight tendency for a higher EIF rate. Hence, there seems to be no age limit for implant dentistry.

KEYWORDS

Early Implant Failure; Osseointegration; Older Population; Dental Implant; Aging.

1. INTRODUCTION

The growing numbers of population ≥ 65 years [1] offer an important challenge for the dental profession. Implant dentistry has a major contribution to improving life quality [2-4]. Aging may compromise implant survival due to compromised wound healing [5,6]. The proliferative phase of healing is prolonged due to reduced numbers of stem cells [6]. A study in a rat model demonstrated that the younger group achieved good bone contact faster than the older one. The results suggested that the rate and volume of new bone formation around implants decrease with age [7]. Other studies on implant treatment

suggested that age may be associated with a higher implant failure rate [8,9]. Bone quality and quantity are related to initial stability and longitudinal success [10,11]. Both are theoretically compromised by aging. After the age of 50 a marked increase in bone porosity and decrease in bone mass, were demonstrated [12]. Implant success can thus be compromised [10]. Bone volume may be reduced requiring grafting before or with implant placement. Bone augmentation success is age-related [13]. The decrease in the number of pluripotent cells within the bone marrow [14,15] and the reduced numbers of osteogenic cells at recipient sites combined with low vascularity [16] are suggested factors that might

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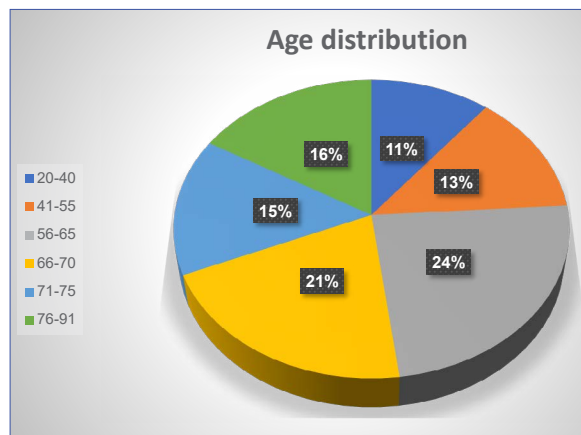


Figure 1. Patient distribution according to age.

compromise bone grafting in the elderly. Implant failures can be divided into early and late [17] according to timing of failure - abutment connection [18,19]; loading [20]; several weeks after placement of the final prosthesis [21]; 12 months after loading [22,23]. Late failures are associated with moderate to severe bone loss, a larger number of failed implants per patient, a higher incidence in men, and mostly in posterior areas. Early failures are associated with minimal bone loss, occur more in women, and in most cases the implants were intended to support single crowns [17]. There are studies indicating that increasing age alone is not a contraindication for implant treatment [24-28]. However, there is still lack of information on early implant failure (EIF) in the elderly (implant loss up to 12 months post loading). Therefore, the aim of the present study was to assess, retrospectively, EIF rate in an older (≥ 66 years old) patient cohort up to one year after prosthetic delivery, and to compare it with a younger (20 to 65 years old at time-point of implant installation) one.

2. MATERIALS AND METHODS

The present retrospective, cohort study is based on dental records of the Department of Oral and Maxillofacial Surgery, Rabin Medical Center, Campus Beilinson, Israel, which were selected automatically (electronically) based on information from the dental implant records, from 01/2017–12/2018. All treatments were performed by experienced oral and maxillofacial surgeons and the only implant type installed was molecular precision implant (MPI™), endosseous, conical, sand-blasted and acid-etched surfacing (Ditron Dental, Ashkelon, Israel). The study protocol was approved by the ethics committee of the Rabin Medical Center, Campus Beilinson, Israel (0674-19mc). The present manuscript complies with the STROBE guidelines.

2.1. Patient population

The dental records of all patients who had received an MPI™ (Ditron Dental, Ashkelon, Israel). Dental implant between 01/2017 and 12/2018, were

extracted and manually screened twice by 2 examiners (DM and GC).

Inclusion criteria – Complete documentation; minimum follow-up – 12 months following prosthetic delivery.

Exclusion criteria – history of head and neck cancer and/or immune deficiency due to immunosuppressant medication, uncontrolled systemic diseases, heavy smokers, untreated periodontal disease.

The following parameters were recorded:

- age
- gender
- physical status according to American Society for Anesthesiology (ASA)
- implant location
- implant dimensions (length, diameter)
- bone augmentation prior to or simultaneously with implant installation (yes/no)
- number of implants placed
- early implant failure (EIF) – lack of osseointegration up to 12 months after prosthesis delivery and occlusal loading (yes/no; primary outcome variable).

2.2. Statistical Analysis

The descriptive statistics were calculated for patient- and implant-related characteristics. The cohort was classified into 2 age sub-cohorts: (1) 20-65 years old at time-point of implant installation) and (2) ≥ 66 years old at time-point of implant installation. The Fishers' exact test or chi-squared test was used to assess any potential differences regarding the various categorical parameters (gender; ASA status; implant location; implant dimensions; bone augmentation; number of implants placed; number of EIF). Patient specific parameters have been compared at patient level, while implant specific parameters at implant level. A statistical analysis was performed using SPSS Version 24.0 (SPSS Inc., Chicago, IL, USA) and p-values < 0.05 were considered as statistically significant.

3. RESULTS

3.1. Patient population

Most of the patients were between 56-70 years old (45%) (Fig. 1). Out of 121 patients, the younger group comprised 57 and the older 64. Mean age was: 50.5 ± 0.53 years (range: 20-65 years; 61.4% females) vs. 73.1 ± 5.65 years (range: 66-91 years; 65.6% females) respectively.

3.2. ASA status

All patients had physical status either I or II. No statistically significant differences between the groups ($p > 0.05$).

3.3. Implant data

The younger patient cohort received 192 implants (mean: 3.25 ± 3.68 , range: 1 to 16 implants per patient) vs. 171 (mean 2.78 ± 1.91 , range: 1 to 11 implants per patient) in the older group. Data on

Table 1. Implant number and dimensions (diameter & length) according to location.

			Diameter (mm)					Length (mm)			
			Number	Mean	Min.	Max.	Median	Mean	Min.	Max.	Median
Maxilla			163								
Anterior	Young	33	3.70	3.3	3.75	3.75	11.90	8	13	11.5	
	Old	32	3.83	3.3	4.2	3.75	11.97	10	13	13	
Premolar	Young	34	3.86	3.75	4.2	3.75	11.67	8	13	11.5	
	Old	21	3.85	3.75	5	3.75	12.40	8	13	13	
Molar	Young	24	4.18	3.75	5	4.2	11.375	8	13	11.5	
	Old	19	4.16	3.75	5	4.2	11.5	10	13	11.5	
Mandible			200								
Anterior	Young	35	3.76	3.75	5	3.75	11.56	10	13	11.5	
	Old	38	3.74	3.3	4.2	3.75	11.32	8	16	11.5	
Premolar	Young	37	3.71	3.3	4.2	3.75	9.97	8	13	10	
	Old	34	3.74	3.3	4.2	3.75	10.15	8	13	10	
Molar	Young	29	3.98	3.3	5	3.75	9.29	6	11.5	10	
	Old	27	3.99	3.3	5	3.75	9.26	8	11.5	10	

implant locations- number of implants per jaw area and implant dimensions (length and diameter) per area are presented in Table 1. The older group did not differ significantly ($p>0.05$) from the younger group in any of the parameters. Bone grafting was performed in 14/57 (24.6%) of the patients in the younger group vs. 18/64 (28.1%) of the older group. Mean follow-up was 27.3 ± 8.4 months in the younger group vs. 24.9 ± 6.2 months on the older one.

3.4. Early Implant Failure (EIF)

In the younger patient group, 2 patients had one EIF each. EIF on implant and patient level was 1.0 and 3.5%, respectively. In the older patient group 2 patients had one EIF each. EIF on implant and patient level was 1.1 and 3.1%, respectively.

3.5. Patients ≥ 80 years old

A special attention was given to 7 patients (3 females and 4 males) ≥ 80 years old (Table 2). A total of 12 implants were placed (1-3 per patient). The locations varied. Bone augmentation was not performed in any of the cases. One implant failed in the oldest patient (91 years old). EIF at implant and patient level was 8.3 % and 14.3% respectively. We speculated that the extremely poor-quality soft bone of the posterior maxilla could be the failing reason.

4. DISCUSSION

In the present study EIF were not more frequent in older (≥ 65 years old) vs. younger patients (20-55 years old), and in general rare (around 1% on implant and between 3 to 4% at patient level). This corresponds with the existing literature on implant therapy in the elderly. A review on implants in older patients reported implant survival rates of 98% at 1 year and 91% at 10 years [29]. Another review on implant failure in older vs. younger patients, reported

no significant differences of implant survival (94 vs. 95%, respectively) [30]. The failure of osseointegration was suggested as the main reason for EIF [31]. Contributing factors may be patient-related [18,19], surgeon-related [22], and biomaterial-related [32].

These studies used many implant systems with different designs, which could have greatly affected the results. Consequently, we concentrated on a single implant from a single implant system in the present study. The group comparison accounted for 5 factors, i.e., gender, ASA status, jaw site, implant characteristics (number and dimensions), and need of bone grafting, while some other factors were controlled through inclusion criteria - choosing the same type of implant (i.e., MPI / Ditron™ Dental) and implant insertion by experienced oral and maxillo-facial surgeons.

A review points out 65 years of age has been as the cut-off to define "older" in several studies [29]. That is the reason for choosing this age as cut-off in the present study. The age of 7 patients was ≥ 80 years old, contributing 12 implants. Bone augmentation was not performed in any of those patients and the number of implants did not exceed 3 implants.

Those facts emphasize the desire to keep implant dentistry at age ≥ 80 years simple and with minimum potential morbidity. EIF at implant and patient level was 8.3 % and 14.3%, compared with the entire older (≥ 66 years old) patient group, in the present study, which resulted in EIF of 1.1% and 3.1%, respectively. Nevertheless, it should not be forgotten that these fractions still represent only one EIF case. This EIF is compatible with previously reported risk factors for EIF – women and implants intended to support single crowns [17]. Correspondingly, other studies reported higher EIF in patients ≥ 80 years old [33, 34]. Specifically, 4.5% at implant level [33], or 9.7% at patient level [34]. Still, 6/7 patients aged ≥ 80 years

Table 2. Implant characteristics for patients ≥ 80 years old.

Age (years)		80	80	80	83	84	90	91
Gender		Female	Male	Male	Male	Female	Male	Female
Number of implants		1	1	1	2	3	2	2
Follow up (months)		20	28	22	24	38	23	26
1 st Implant	Location	27	23	21	35	42	42	15
	Dimensions (mm)	4.2/13	3.75/11.5	3.75/13	4.2/11.5	3.75/10	3.75/11.5	3.75/11.5
2 nd implant	Location				41	43	43	26
	Dimensions (mm)				4.2/11.5	3.75/10	4.2/11.5	3.3/11.5
3 rd implant	Location					44		
	Dimensions (mm)					3.75/10		
Bone augmentation		No	No	No	No	No	No	No
Failure		No	No	No	No	No	No	1

old in the present study showed successful primary osseointegration and received final prosthetic restoration.

Considering the limitations that the present study is retrospective, the physical status of both elderly and younger patient groups was good, the operators were experienced oral and maxillofacial surgeons, and only few EIF were observed, it is still reasonable to conclude, that there is no age limit for implant dentistry.

5. CONCLUSIONS

Elderly patients ≥ 65 years old presented a similarly low EIF rate as younger patients 20 to 65 years old, while patients ≥ 80 years old may have a slight tendency for a higher EIF rate. Hence, there seems to be no age limit for implant dentistry.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

DM: conception and design of the study, acquisition of data, analysis and interpretation of data, drafting the article, final approval of the version to be submitted; LC: conception and design of the study, analysis and interpretation of data, drafting the article, final approval of the version to be submitted; JN: conception and design of the study, analysis and interpretation of data, drafting the article, final approval of the version to be submitted; SAN: conception and design of the study, analysis and interpretation of data, drafting the article, final approval of the version to be submitted; GC: conception and design of the study, acquisition of data, analysis and interpretation of data, drafting the article, final approval of the version to be submitted.

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Questions

1. Timing of early implant failure in the present study?

- ☐ a. At surgery;
- ☐ b. At 2nd stage surgery;
- ☐ c. Up to one year after loading;
- ☐ d. Up to 6 weeks after loading.

2. EIF rate for patients ≥ 80 years old?

- ☐ a. Was similar to younger group;
- ☐ b. Was similar to older group;
- ☐ c. Had a slight higher tendency;
- ☐ d. Was better than younger group.

3. The main wound healing problem in the older?

- ☐ a. Lack of myofibroblasts;
- ☐ b. Reduced numbers of stem cells;
- ☐ c. Lack of osseointegration;
- ☐ d. Lack of ossification.

4. Implant dimensions in the older were?

- ☐ a. Similar;
- ☐ b. Higher;
- ☐ c. Lower;
- ☐ d. Not recorded.



The poster features a black background with a large, stylized logo on the left consisting of a heart shape formed by two interlocking 'S' and 'D' letters in pink and blue. To the right of the logo, the text '13th INTERNATIONAL Sofia Dental Meeting' is written in white. Below this, the phrase 'Patient Wellness' is written in a large, elegant, white cursive script. On the right side, the dates '01-03 OCTOBER 2020' are displayed in large, bold, pink letters. To the right of the dates, the location 'SOFIA • BULGARIA' is written vertically in white. At the bottom right, the website 'www.sofiadentalmeeting.com' is written in white.

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UNCLARITIES ABOUT ARTICAIN: CONTRAINDICATIONS

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ABSTRACT

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Background Articaine is one of the most widely used local anesthetics in dentistry. It is formulated with epinephrine in a 1:100,000 or 1:200,000 concentration as a vasoconstrictor. The addition of epinephrine gives the drug an extensive list of formal contraindications.

Objective To review the literature on the chemistry and safety of articaine with epinephrine, and to review the validity of each of the contraindications.

Data sources The base knowledge was the result of reading a handbook on local anesthesia. Afterward, a literature search was made for publications between 1990 and 2019 concerning contraindications to articaine and dental epinephrine. Some articles about the pharmacological properties of articaine were also used. Finally, what was used was the list of contraindications in the package leaflet of articaine in Belgium as stated on 11/11/2019.

Study selection Articles of good quality and with clear information discussing and explaining these contraindications were included.

Data extraction Information about which contraindications, which drug interactions, and what physiological reasoning is behind them was extracted.

Data synthesis This information was synthesized in an extensive overview. First, the profile, safety and pharmacological properties of articaine with epinephrine were reviewed. Afterwards, an overview of the contraindications and drug interactions was given as stated in the package leaflet and each of them was explained.

KEYWORDS

Articaine; Epinephrine; Pharmacology; Contraindications; Pregnancy.

1. INTRODUCTION

Articaine is a dental local anesthetic of the amide group. It is the only anesthetic specifically developed for use in dentistry. It was first synthesized in 1969 when it was still referred to as carticaine. Its name changed to articaine in 1976 when it reached the markets in Germany [1]. In the following years, articaine got approval for clinical use around the world and has steadily become increasingly popular.

It is the second most used dental local anesthetic in the United States with a market share of 39,3% in 2018 (the most popular still being lidocaine, the golden standard in local anesthetics) [1]. In Germany, it is even more popular, accounting for 97% of local anesthetic use by dentists in 2018 [2].


The package insert of articaine in Belgium (Septanest by Septodont) contains a lot of contraindications to articaine itself as well as to the added vasoconstrictor,

epinephrine. While most contraindications theoretically make sense, the majority of them do not elicit a clinically significant hazard.

This paper is aimed to review the clinical characteristics of articaine and to analyze the validity of the contraindications to this drug as mentioned in the package insert.

2. MATERIALS AND METHODS

For the preparation of this review and introduction to this subject in general, Malamed's Handbook of Local Anesthesia (seventh edition) was read. After that PubMed, Trip database and Limo were searched for the different aspects of articaine discussed in this paper. For articaine, a search was conducted on different keywords for safety, clinical characteristics, interactions, and contraindications. The same was done for epinephrine in dental use and pregnancy, cardio-

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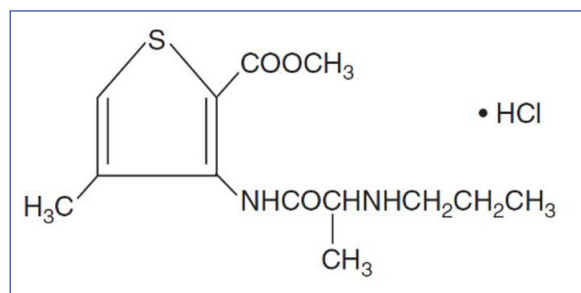


Figure 1. The chemical structure of articaine.

Malamed SF. *Handbook of Local Anesthesia*. 7th ed. St Louis: Mosby; 2019, Fig. p72

vascular effects, safety in cardiovascular compromised patients, contraindications and interactions. The most relevant articles were selected to create a narrative review, portraying an overall picture of the current ambiguities about articaine.

3. CLINICAL CHARACTERISTICS

In Belgium, Articaine cartridges are currently available in two formulations: Articaine hydrochloride 4% with epinephrine 1:200.000 (Septanest Normal®) and 1:100.000 (Septanest Special®).

3.1. Articaine Hydrochloride 4%

3.1.1. Structure

Articaine (or 4-methyl-3-[2-(propylamino) propion-amido-2-thiophenecarboxylic acid methyl ester] is classified as an amide local anesthetic, although it is a unique entity within the amide local anesthetics (see Fig. 1). It is the only one containing an aromatic ring rather than a benzene ring [2]. This thiophene ring ensures greater lipid solubility which makes it great for penetrating tissue and would ensure better bone penetration, thereby increasing potency [1]. Furthermore, the structure contains an ester-linkage which makes it susceptible to hydrolyzation by plasma esterases. Articaine also has a higher degree of protein binding (95%) than the other amide anesthetics [2]. It exerts its pharmacodynamic action by reversibly binding and inhibiting the alpha-unit of the voltage-gated sodium channels, which prevents the propagation of action potentials in neurons [3].

3.1.2. Pharmacokinetics

The ester-linkage embedded in the amide structure makes articaine a hybrid molecule. This gives it a unique pattern of metabolism. As soon as the drug reaches the plasma, the carboxylic acid ester groups are hydrolyzed by plasma esterases producing a primary inactive metabolite: articainic acid [2]. About 90% of the drug undergoes this rapid process and this would contribute to the lower systemic toxicity of the drug. Further metabolism of the amide linkage happens by microsomal enzymes in the liver just like the other amide anesthetics. This turns articainic acid into articainic acid glucuronide, which is in turn excreted through the kidneys. Approximately 5-10% is excreted unchanged [3].

3.1.3. Duration of action and elimination half-life

Articaine is an intermediate-acting local anesthetic providing pulpal anesthesia for approximately 60 minutes and soft tissue anesthesia for 3 to 5 hours [2]. Because of the rapid plasma hydrolysis, articaine has a significantly shorter elimination half-life (27 minutes) than the other amide anesthetics like lidocaine (90 minutes) [1]. This half-life is not related to the duration of clinical action but is a measure for how long it takes for the drug to be eliminated from the circulation. This fast elimination means it is clinically advantageous when treating pregnant, lactating or pediatric patients because there is less exposure time to the drug [2].

3.1.4. Maximum dosage

Articaine has a maximum recommended dose (MRD) of 7.0 mg/kg to prevent the occurrence of an overdose reaction [1]. Although local anesthetics are safe drugs, an overdose is possible as with any drug, so there are a few things to keep in mind. Hepatic and renal dysfunction will lead to increased anesthetic blood levels [1]. Liver dysfunction is not an absolute contraindication to local anesthetics, but they should be used thoughtfully as their half-life will increase and blood levels will be higher. In this case, articaine could be the anesthetic of choice because of its partial metabolism in blood plasma. Moreover, some patients have atypical serum pseudocholinesterase, which occurs in approximately 1 in 2820 individuals [1]. To prevent overdose reactions, there are injection techniques that should be respected. Before injecting the drug, the practitioner should always carefully aspirate the syringe to avoid intravascular injections. Furthermore, the injection rate appears to be one of the most important factors for overdose: a rapid intravenous injection (<15 seconds) of a cartridge lidocaine 2% gives highly elevated blood levels, which can cause an overdose reaction [1]. Therefore, it is recommended to administer the cartridge slowly (>60 seconds) so the blood levels will not be as high and the risk of overdose reactions will be significantly reduced [1].

Finally, the maximum dosage of 7.0 mg/kg is of utmost importance. A 1.8 ml cartridge of 4% articaine contains 72 mg of articaine, meaning a healthy adult weighing 72 kg can receive a maximum of 7 cartridges (504 mg). However, it is unlikely these maximum numbers would be achieved during routine dental care since there is rarely a need for more than three to four cartridges in one appointment [1].

Obtaining anesthesia of the complete adult mouth is possible with only six cartridges using regional block anesthesia, and only two cartridges in the primary dentition.

Nonetheless, the use of excessive volumes is the most frequent cause of overdose reactions [1]. As a dentist or oral surgeon, you should always calculate the maximum recommended dose for your patient, especially in risk populations (pregnant women, children, cardiac patients).

3.2. Epinephrine

Epinephrine, a vasoconstrictor, is added to the local anesthetic solution for several reasons. Its vasoconstrictor effect delays the absorption of the local anesthetic, reducing systemic toxicity. It increases the depth and duration of anesthesia, the dose of anesthetic can be reduced, and it provides good hemostasis [1].

3.2.1. Implications

Epinephrine has a direct effect on the myocardium and on the vascular tone that can result in hypertension or even ventricular fibrillation. Especially in cardiac patients, who do not have as much reserve as healthy patients, this could potentially be a problem. That is why the addition of epinephrine to a local anesthetic cartridge comes with a lot of clinical implications. A lot of the contraindications listed in the package leaflet of articaine formulations (like Septanest) are actually contraindications to the administration of epinephrine, which will be discussed later.

3.2.2. Cardiovascular effect

There are a few considerations to be made on the dental epinephrine use in cardiovascular patients. Pain and fear induce endogenous catecholamine release which emphasizes the importance of adequate pain control, especially in cardiac patients [1]. Effective pain control is less likely to be achieved when a vasoconstrictor is excluded from the local anesthetic solution. Even when using precautions (careful aspiration, slow injection), using the vasoconstrictor can cause an elevation of epinephrine blood levels and can result in a moderate increase in the cardiac output and stroke volume. Blood pressure and heart rate are minimally affected at these low dosages [1]. It should be noted that the dosages in the cartridges are minimal (a 1.8 mL cartridge of epinephrine 1:200 000 contains only 0.009 mg of epinephrine). By comparison, when other clinicians use epinephrine, it is usually intramuscular/intravascular in an emergency setting (anaphylaxis, cardiac arrest) and the dose is considerably higher (0.3 to 1 mg). In the small quantities used in dentistry, the cardiovascular effects of the systemically absorbed epinephrine are modest [1]. There are of course several situations where vasoconstrictors in local anesthetics should be avoided because the risk is too great. However, most of these circumstances (like uncontrollable hypertension, uncontrollable arrhythmias, ...) are actually contraindications to elective dental care altogether [1].

3.2.3. Maximum Dosage

In this context the New York Heart Association recommended a maximal dose of 0.2 mg for cardiac patients back in 1955 [1]. Later, Bennett recommended a maximum dose of epinephrine in cardiac risk patients (ASA 2 or 3) of 0.04 mg or roughly 4 cartridges of a 1:200 000 epinephrine solution [4]. Malamed also states that a smaller dose of 0.04 mg appears to be tolerated in cardiac patients [1]. This 40 µg can be administered safely to cardiovascular compromised patients [5].

A recent systematic review confirmed the safe use of ≤ 4 cartridges of the higher concentrated lidocaine with 1:100,000 epinephrine in cardiac patients [6]. Although this is a useful guideline, it should not create a false sense of security. The practitioner should always proceed with caution and be aware of possible side effects. In any case, for cardiac patients the lowest concentrated articaine formulation (1:200 000) seems to be the anesthetic of choice given the lower epinephrine load.

4. CONTRAINDICATIONS AND PRECAUTIONARY CIRCUMSTANCES

As with all medications, there is a package insert with contraindications (either absolute or relative), conditions that require extra caution, possible drug interactions (see Fig. 2) [7]. As mentioned above, a lot of these contraindications are included because of the presence of epinephrine. Several of these contraindications or precautions are historic in nature and more of a formality. There are numerous comments to be made on the package leaflet that are contrary to everyday clinical practice. This makes it a debatable subject in the context of possible litigation. A general rule can be applied in most of the following instances, as explained by Malamed: if the patient is deemed healthy enough to undergo elective dental treatment, the use of proper anesthesia is indicated [1]. When using a vasoconstrictor in your local anesthesia, the maximum recommended dose should be calculated and in some cases, it could be necessary to restrict the dose. Always use as minimal vasoconstrictor as possible.

4.1. Contraindications

4.1.1. Allergy

Historically, with the use of ester anesthetics, although still rare, an allergic reaction occasionally happened. With the rise of the amide anesthetics however, this changed for the better. Articaine has low immunogenicity and it does not have the allergen p-aminobenzoic acid as a metabolite (contrary to ester local anesthetics) [2]. The sulfur contained in the thiophene ring will also not provoke allergic reactions as it is embedded in the ring and cannot be seen by our immune system [2]. Although the incidence of 'alleged' allergy is rather high, true documented allergy to an amide local anesthetic is extremely low but it has been reported [8]. However, the cartridge solution contains 0.15 to 2.0 mg/ml sodium metabisulfite, an antioxidant added to prevent the oxidation of epinephrine thus increasing preservability, but also a known allergen [2,9]. Adverse reactions to the ingestion of alimentary sulfites can cause a severe and prolonged asthmatic crisis or even anaphylactic shock [9]. However, the dose in a typical meal after which such reactions occur appears to be a lot higher (25 to 200 mg of sulfites) than those used in dentistry [9]. If a true allergy to the amide local anesthetics or

SEPTANEST NORMAL (Articaine 4% with epinephrine 1:200,000)	
When shouldn't you use this drug	
-	Allergy tot his or a similar drug or one of the compounds
-	Severe arrhythmias and you don't have a device
-	Refractory epilepsy
-	Porphyria
-	Child < 4 years old
-	Disease by overproduction of thyroid hormones
-	Diabetes mellitus
When should you be extra careful with this product	
-	Cardiovascular disorders (arrhythmias, hypotension, coronary insufficiency, arterial hypertension)
-	Neurological disorders
-	Asthma
-	Treatment wit antidepressants and suffers from muscle fatigue
-	Severe hepatic disorder
-	Do not use it in infected or inflamed area's because the efficacy will decrease
Drug-drug interactions	
-	Guanethidine and analogues
-	Halogenated inhalation anesthesia
-	TCA and SNRI
-	MAO-I

Figure 2. Contraindications and precautionary circumstances in the package insert of Septanest normal in Belgium (articaine 4% with 1:200,000 articaine), consulted on 10/10/2019 (translated in English).

sulfites exists, it is an absolute contraindication for its use. The actual incidence of an allergy to either articaine or to metabisulfite is unknown, but a clinically relevant reaction remains extremely rare.

4.1.2. Severe arrhythmias without a device

Severe arrhythmias like ventricular tachycardia or ventricular fibrillation are life-threatening types of arrhythmias with the risk of sudden death [10]. Logically, patients with severe arrhythmias that are not under control by medication or do not have a device (like an implantable cardioverter-defibrillator (ICD) or a pacemaker) should not receive a local anesthetic with a vasoconstrictor [10]. On the other hand, such a condition is considered a contraindication to elective dental care whatsoever [1].

4.1.3. Refractory epilepsy

Overdose reactions caused by the toxicity of local anesthetics include possible seizures, which is why local anesthetics should not be used if a patient's epilepsy is not under control with medication [1].

4.1.4. Porphyria

There were historical reports of local anesthetics causing methemoglobinemia, a cyanosis-like state with decreased oxygen-carrying capacity of the blood [1]. These reports concerned prilocaine (not articaine) and being only a relative contraindication for prilocaine, methemoglobinemia should not develop in a healthy ambulatory dental patient [1]. In the database of drugs for use in porphyria from Sweden and the UK, articaine is listed as "safe" and "probably not porphyrinogenic" [11,12].

4.1.5. Children younger than 4 years of age

The greatest concern in this population is the risk of overdose: a rapid (<15 seconds) intravenous injection of a full cartridge would likely induce a rapid onset of severe seizure activity [1,2]. Proper techniques like aspiration and slow injection are of utmost importance in the pediatric population [1,2].

As most of the local anesthetic overdoses develop as a result of an overadministration, articaine (with its short elimination half-life) is the least likely to induce an overdose [1]. However, two concerns should always be considered. First, because of the smaller weight, children are more susceptible to an overdose reaction [1]. Second, prolonged anesthesia can possibly lead to self-inflicted injury by biting the lip or tongue after the procedure [1].

The MRD should always be calculated according to their weight. It should be noted that the entire primary dentition can be anesthetized using approximately only two cartridges. This means that for dental treatment, usually less than one cartridge is needed [1]. The package insert states that articaine should not be used on children under four years of age given the lack of data about the safety in this population [7]. However, a survey of 373 American dentists showed that 21% had used articaine in the age group of 2-3 year-olds [13]. A retrospective study that dates back to 1989 found data on 211 children under the age of four years of age receiving 240 doses of articaine [14]. There were no adverse reactions known to the clinicians or noted in the medical file [13].

Limited data suggest the use of articaine in children under four years of age appears to be safe as long as the clinician keeps to the maximum dose restrictions, but more research is needed to fully establish the safety in this population. A study about safety in children under four years of age is now in progress [15].

4.1.6. Disease by overproduction of thyroid hormones

The thyroid hormone has a direct effect on the myocardium, which is why we see a lot of hypertension, atrial tachydysrhythmias and cardiac insufficiency in patients with hyperthyroidism [9].

A life-threatening complication concerning the thyroid is thyrotoxic crisis [9]. Because of the resemblance of the cardiac effects of thyroid hormone to those of catecholamines, it has been suggested that a synergistic effect might occur between the two [9]. The possible potentiation of the vascular effect of thyroid hormone by a vasoconstrictor would plead for a formal contraindication for the use of vasoconstrictors in such patients [9]. However, studies testing this possible hypersensitivity to catecholamines show inconsistent results [9].

In the case of thyrotoxicosis, elective dental care altogether is absolutely contraindicated [9].

If a patient's hyperthyroidism is under control, proper local anesthetic use with vasoconstrictor is indicated [1]. In patients with clinically overt hyperthyroidism (also bearing in mind the often-associated subclinical cardiac disease), there would be a higher risk to

hyperrespond on these epinephrine doses (tachycardia, elevated blood pressure) [9].

In these cases, vital signs should be monitored when using vasoconstrictors [1].

4.1.7. Diabetes mellitus

This contraindication has been based on a warning concerning the use of large quantities of epinephrine (like for the treatment of allergic reactions or regional anesthesia) [9]. Epinephrine opposes the action of insulin, making it a hyperglycemic hormone [9]. Chances of complications vary within the population: For example, insulin-dependent diabetics or uncontrolled diabetics are at greater risk for complications such as acid ketosis and hyperglycemic coma, although this is very unlikely to happen at the low dosages used in dentistry [9]. Another possible problem with (insulin-dependent) diabetics is that they usually defer eating for a few hours after a dentist appointment because of the residual anesthetic effect [1]. This can alter their normal diet with a risk of hypoglycemia, which is why a diabetic should modify their insulin doses in advance if needed [1].

Vasoconstrictors can be used safely for the majority of diabetic patients as long as their condition and diet are under control [9]. As with all risk populations, to minimize the risk the lowest possible dose should be used [9]. However, we must detect patients with uncontrolled diabetes as they could pose an increased risk for complications [9].

4.2. When should you be extra careful with this drug?

4.2.1. Cardiovascular disorders (arrhythmias, hypotension, coronary insufficiency, arterial hypertension)

Some other cardiovascular disorders also present a contraindication to elective dental care: unstable angina, 6 months after coronary artery bypass surgery or myocardial infarction or hypertension in excess of 200 mmHg systolic or 115 mmHg diastolic [1].

Each of these cases is a medical emergency and requires treatment to stabilize the situation. Obviously, these should be taken care of before going to the dentist. If the patient is deemed healthy enough to receive dental care, correct local anesthesia is indicated [1].

The safe use of vasoconstrictors in cardiac patients is the subject of a huge debate. The dose restriction, recommended by Malamed and Bennett, of 0.04 mg of epinephrine appears to be safe and beneficial in cardiac patients who have stable disease [1,4].

4.2.2. Asthma

A few papers in the 1980s warned dentists to avoid local anesthetics with vasoconstrictors in asthmatic patients because allegedly a substantial proportion of asthmatics are potentially sensitive to sulfite [9]. Pérusse addressed this matter already in 1989 and explained that this recommendation should at least be restricted to steroid-dependent asthma patients [9]. Given this concern, there was a study reporting an alleged sulfite sensitivity threshold of 0.6 to 0.9 mg [9]. However, a later investigation documented that only

a minority of sulfite-sensitive patients would react to a challenge test smaller than 10 mg/ml (a multitude of the dose normally used in local anesthetics) [9].

It should be noted that most of these papers date from before 1990 and are not up to date. For the last 20 years, there are only limited data like case reports or reviews on reactions to local anesthetics in asthmatic patients.

Given the high prevalence of asthmatic disease and the absence of reported cases in the literature, this contraindication could be disputed.

4.2.3. Severe hepatic disorder

Severe hepatic disease would logically suggest a relative contraindication as amide anesthetics are metabolized in the liver [1].

Hepatic disease would decrease the elimination of the drug, increasing possible toxicity [1]. However, given the ability of articaine to be rapidly hydrolyzed for 90% by plasma esterases into an inactive compound, articaine is the preferred option in patients with hepatic dysfunction [1].

4.2.4. Do not use it in infected or inflamed areas because the efficacy will decrease

The increased acidity in an inflamed or infected area results in less effective and profound anesthesia as this disturbs the mechanism of action [1]. However, stating that in this case this drug should not be used is a bit curious as you will obviously need the best anesthesia possible when providing dental care in an already inflamed or infected area.

4.2.5. Pseudocholinesterase deficiency

Another ambiguous point is the clinical significance of a pseudocholinesterase deficiency. As it turns out 1 in 2820 individuals have an atypical serum pseudocholinesterase, a genetic trait resulting in a relative pseudocholinesterase deficiency [1].

This results in a decreased metabolism of ester anesthetics and it presents a relative contraindication to their use. Haas states that little clinical effect would be expected unless the dose would be very high [16]. Malamed states that amide local anesthetics do not present an increased risk of high blood levels in these patients given their hepatic metabolism [1].

For articaine, however, as a hybrid molecule classified as an amide local anesthetic, the clinical significance is unclear as it is still metabolized by the liver.

Given this dual metabolism, the clinical impact of this trait in a patient would be small. However, the practitioner should still be cautious for possible overdose reactions as articaine blood levels could be somewhat increased.

4.3. Drug-drug interactions

4.3.1. Guanethidine and analogues

Guanethidine is an adrenergic neuronal blocker inhibiting the release of norepinephrine from sympathetic nerve terminals [17]. Long-term use could result in postsynaptic receptor upregulation increasing the responsiveness to adrenergic

vasoconstrictors [17]. Another possible mechanism of potentiation is the competitive inhibition of the adrenergic reuptake transporter [17]. This interaction received a 4 rating (just like thyroid hormone) as a reaction is "possible" [17]. The same recommendation as for TCAs apply [17].

4.3.2. Halogenated inhalation anesthesia

The use of halogenated inhalation anesthetics like halothane could potentiate the arrhythmogenic effect of epinephrine and result in a cardiac dysrhythmia [17]. The treating anesthesiologist should be aware of this possible interaction.

4.3.3. TCA and SNRI

Tricyclic antidepressants (TCAs) are mainly used in the treatment of depression. TCAs act the same as SNRIs by inhibiting serotonin (SERT) and norepinephrine (NERT) transporters thus blocking the reuptake of neurotransmitters in the synaptic cleft [18]. This way, they could enhance the cardiovascular actions of exogenously administered vasopressors. This enhancement appears to be fivefold to tenfold for levonordefrin and norepinephrine, two rarely used vasoconstrictors [18]. For epinephrine, this potentiation is approximately twofold [18].

Whether or not this potentiation results in a clinically significant adverse reaction with the dosages used in dentistry is debatable [18]. Reports of this interaction resulting in a series of hypertensive crises in patients, of which one patient died, contributed to the fear of using vasoconstrictors in patients taking TCAs [19]. These cases are referred to a lot in the literature. However, this needs some rectification as Boakes et al were misquoted: the patient who died was not taking a TCA [20]. The other patients with adverse reactions appeared to experience these reactions because of the use of norepinephrine as a vasoconstrictor (instead of epinephrine) [20]. Patients taking TCAs may also have different electrocardiographic changes. While antiarrhythmogenic in low doses they are arrhythmogenic in overdose, making it a hazard for serious arrhythmias in combination with a local anesthetic [18]. Yagiela et al recommend limiting the dose of epinephrine to one-third of the normal maximum dose for patients taking TCAs [17]. This should preserve the patient for any problem arising because of interactions [17].

4.3.4. MAO-I

Mono-amine-oxidase inhibitors (MAO-I) could theoretically potentiate the actions of vasopressors by inhibiting their biodegradation by monoamine oxidase in the presynaptic neuron [1].

This could result in a hypertensive crisis, which can be seen with phenylephrine, a vasoconstrictor currently no longer used [1]. However, research on this subject is unified on the fact that there is no clinically significant interaction taking place with epinephrine [17,18]. This is partially due to the fact that this exogenously administered epinephrine is preferably metabolized by catechol O-methyltransferase [17].

Yagiela states that "the continued listing of this interaction in the package insert for local anesthetics with vasoconstrictors is simply a testament to the bureaucracy of the U.S. FDA" [17].

4.4. Pregnancy and lactation

All local anesthetics can cross the placenta and enter the system of a developing fetus [1]. In general, dental treatment should optimally be avoided in the first 10 weeks because this is when the teratogenic risk is the greatest [21]. Elective dental treatment is usually planned in the second trimester [21]. Although articaine is classified as a class C drug, Malamed prefers the use of articaine because of the shorter exposure time as the elimination half-life is only 27 minutes compared to the 90 minutes of lidocaine [2]. A formulation with a vasoconstrictor is indicated as they reduce systemic toxicity and will not affect uterine blood flow in the low dosages used in dentistry [22]. A prospective study following 210 women that underwent local anesthetic exposure during pregnancy found no significant difference in gestational age or median birth weight [23]. Within the study limitations (small sample size, heterogeneous nature of birth anomalies) that permit detection of a 2.65-fold increase, no associated increased risk was found for major anomalies [23]. Amide local anesthetics are considered safe to use during pregnancy if administered with the proper aspiration technique. Lidocaine is the drug with the most experience and data in pregnant women and is categorized as a class B drug. Because of the lack of data, articaine is categorized as a class C drug. For breastfeeding, lidocaine is the only "S" local anesthetic. Articaine is considered "S?" (safety in nursing infants unknown) [2]. The current recommendation is to use the "pump & discard" method: following exposure of the drug to a nursing woman, she should pump and discard for a 4-hour period (covering six elimination half-lives) to minimize infant gestation [2].

5. DISCUSSION

There are some comments to be made about the package insert of articaine. There should be no unfounded statements about the possible contraindications or interactions concerning articaine with epinephrine. A restricted dose of 40 µg epinephrine (4 cartridges of 1:200,000) is tolerated in cardiac patients whose disease is under control. Some other contraindications are too generalized (diabetics, asthmatic patients, ...). Interaction of epinephrine with TCAs and general anesthetics is well-documented and should be prevented by using a dose restriction [17]. The interaction with thyroid hormones and guanethidines is much less compelling, meaning a vasoconstrictor can be used safely within the normal dosages [17]. For MAO-I's there is absolutely no scientific evidence of a significant interaction [17]. Something to keep in mind concerning the drug-drug interac-

tions is the tendency for receptor down-regulation after repeated exposure to a certain compound [17,18]. This phenomenon, which would apply to a patient taking TCA's for a longer time or a patient with hyperthyroidism, would reduce the possible risk of a damaging effect as a result of an interaction [20]. There exist a lot of other interactions and contraindications, but with a dose restriction in some cases if necessary, articaine can be administered safely without or with minimally increased risk. The relevance of these contraindications could be argued in case of litigation. To summarize the debate on the contraindications, Malamed states that if a patient is deemed healthy enough to undergo elective dental treatment, local anesthetics are indicated [1].

6. CONCLUSION

Because of its unique properties (plasma hydrolyzation) and its lower epinephrine concentration compared to the lidocaine formulation, articaine is the better choice in certain clinical situations (like hepatic dysfunction, patients with cardiovascular morbidity or cases where the clinician wants to be prudent for possible interactions). In the package insert of articaine, there are a lot of contraindication (either abso-

lute or relative) that are open to debate.

Theoretically, a lot of interactions with either diseases or other drugs are possible. In the current literature, however, there are not many cases that demonstrate these interactions. In clinical practice the relevance of most of the possible interactions is modest. Most of the adverse reactions are caused by the overadministration of the drug. Adverse reactions can be prevented by being aware of the maximum recommended dose and by using proper injection techniques (aspiration and slow injection). The contraindications in the package leaflet are mainly too broad and should be better defined for use in everyday clinical practice.

CONFLICT OF INTEREST

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CV

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Questions

1. What is the current maximum recommended dose of epinephrine in dental cartridges for patients with cardiovascular disease per dental appointment?

- ☐ a. 9 µg;
- ☐ b. 40 µg;
- ☐ c. 200 µg;
- ☐ d. There is no dose restriction.

2. In which case is articaine absolutely contraindicated?

- ☐ a. Allergy to amide anesthetics;
- ☐ b. Patients taking MAO-I;
- ☐ c. Patients with (controlled) hyperthyroidism;
- ☐ d. Patient with diabetes.

3. What would ensure a greater bone penetration capacity of articaine compared to other local anesthetics?

- ☐ a. Thiophene ring;
- ☐ b. Ester-linkage;
- ☐ c. High protein binding;
- ☐ d. Primary metabolite (articainic acid).

4. Which positive effect is not attributed to the addition of epinephrine to articaine?

- ☐ a. Less blood loss and better vision;
- ☐ b. Longer and more profound anesthesia;
- ☐ c. Less systemic absorption;
- ☐ d. Faster time of onset.

STRESS AND INFLAMMATION IN PERIODONTAL DISEASE: A REVIEW OF THE BASIC BIOLOGICAL MECHANISMS

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ABSTRACT

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Background Periodontitis is a multifactorial infectious disease influenced by a myriad of other conditions and factors amongst which, psychosocial stress has emerged as a potential risk indicator. In order to establish this link in a generally accepted theory, we need to better understand the physiological pathways of stress on immune response with implications in the periodontal disease.

Objective This article aims at synthesizing the current knowledge on the effect of the psychological factors on the periodontal disease and to provide an insight into the bidirectional links between stress-related disorders and periodontitis via psychoneuroimmunology studies.

Data sources A search was performed in 2 databases - PubMed and Google Scholar, supplemented by a manual search in peer-reviewed journals and cross-referenced with the articles accessed. The key terms used were: periodontal disease, periodontitis, stress, psychosocial stress, inflammation.

Study selection The inclusion criteria were all published potentially relevant articles on relationship between stress, inflammation and periodontitis on human and animal models. The exclusion criteria were articles with non-available full text and articles that were not written in English.

Data extraction Two reviewers extracted information regarding the quality and study characteristics independently. The studies were assessed for their methodology, statistical analysis, characteristics of the periodontal outcome measures, and psychological measurements.

Data synthesis Considerable evidence documents the link between psychosocial stress and periodontitis. This should redirect the attention of researchers and clinicians towards a multidisciplinary approach to periodontitis where psychosocial disturbances might be a key component into the rebus of disease progression and treatment results.

KEYWORDS

Periodontitis; Stress; Psychosocial Stress; Inflammation; Glucocorticoids.

1. INTRODUCTION

Periodontitis is a chronic inflammatory condition affecting the supporting tissues of the teeth, which results in loss of connective tissue and bone support and is a major cause of tooth loss in adults [1]. The advanced form of the disease affects a smaller part of the adult population, around 7% to 15% [2] while milder to moderate forms of the disease are found in approximately 50% of the population [3].

Its etiopathogenicity is complex with many factors interplaying, and due to this dynamic interrelated

play, no isolated factor could solely explain the tissue destruction phenomenon [4]. The concepts of periodontal disease etiology have evolved towards understanding the role of the immune system and the inflammatory reaction in defining the host response. Those components do play an important role in the progression of the periodontal disease, which is further influenced by genetic and environmental risk factors [5]. Some of the genetic disorders may alter the host immune response which could predispose individuals to severe periodontal destruction. They might affect the production or function of polymor-

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phonuclears (PMN), which are known to play a pivotal role in the defense against bacteria. As a result, individuals suffering from neutropenia, agranulocytosis, Chédiak–Higashi syndrome exhibit more severe forms of periodontitis due to impaired immune response. In leukocyte adhesion deficiency (LAD) syndromes, neutrophils lack specific proteins which allow them to adhere to vessel walls and effectively migrate to the infection site. As a consequence, periodontal tissue destruction advances due to an impaired immune defense [6]. While this is clear evidence of how a deficient host response might affect periodontal disease, other conditions associated with exaggerated immune response are thought to also affect the disease.

In this light, psychosocial stress has emerged as a risk indicator with several studies documenting a positive relationship between psychosocial stress and forms of the periodontal disease [7].

As the scientific evidence is now unequivocal on the effects of psychological stress on immune systems and other systemic conditions through a network of pathways, it would be reasonable to also explore periodontitis and its relations to stress under this paradigm.

2. MATERIALS AND METHODS

A literature search was conducted for relevant studies addressing the issue of the relationship between stress, inflammation and periodontitis undertaken on human and animal models. *Data sources:* A search was performed in 2 databases- PubMed and Google Scholar, supplemented by a manual search in peer-reviewed journals and cross-referenced with the articles accessed. The key terms used were: periodontal disease, periodontitis, stress, psychosocial stress, inflammation. *Study selection:* *The inclusion criteria* were all published potentially relevant articles on relationship between stress, inflammation and periodontitis conducted on human and animal models. *The exclusion criteria* were articles with non-available full text and articles that were not written in English. Studies published in dental and medical journals were included together with a selection of studies from psychology literature. The studies were assessed for their methodology, statistical analysis, characteristics of the periodontal outcome measures, and psychological measurements.

The psychoneuroimmunology (PNI) studies were classified into intervention studies which evaluate the immune response after exposure to intervention (e.g. relaxation or hypnosis) and vulnerability studies which assess the functioning of the immune system in association with psychological vulnerability. These studies used inflammatory mediators or markers of inflammation to assess the immune response to stress, including mainly natural killer cell activity, cytokine production, glucocorticoid levels and catecholamine

levels. The studies served to provide evidence on the association between immune response and stress components in a cellular and molecular level. The periodontology clinical studies were assessed based on the criteria used to define periodontal disease, adjustment for confounding factors, psychometric instruments, and the stress markers that were used to evaluate the stress component.

The articles included used parameters to define the periodontal disease, such as bleeding on probing, probing depth, recession level, attachment loss, alveolar bone loss and missing teeth.

The stress component was evaluated through psychometric instruments such as questionnaires or stress biomarkers such as salivary cortisol levels, crevicular interleukin levels, or urine corticosteroid levels.

3. RESULTS

The review identified the following noteworthy aspects related to stress, inflammation and periodontitis visible on human and animal models:

3.1. Stress and periodontium

Stress, can be defined as a set of emotions, triggered by an actual or perceived threat, giving rise to physiological and psychological changes [8]. As the psychological aspects get reflected in a set of behavioral reactions that redefine one's priorities, the oral hygiene habits change for the worse, new patterns of avoidance emerge together with substance abusive behaviors such as smoking and alcohol consumption [9-10]. On the other hand, physiological response that the body compiles in reaction to stressful stimuli which are perceived as threats, affects the immune system and alters the host defense as a consequence. Stress association to periodontal disease has been suggested for more than 50 years and the evidence in favor of this putative relation has been growing with different studies.

Necrotizing ulcerative gingivitis (NUG) was the first disease to be investigated in relation to stress, for its acute infectious etiology caused by bacteria that are non-pathogenic under normal oral conditions. Under these circumstances it would be reasonable to search for host defense alterations that would cause the outbreak [11].

In a study exploring the effect of stress on NUG, by measuring the corticosteroid levels in the patient's urine, the NUG cases did exhibit higher levels of the stress marker in the urine samples, yielding a positive correlation as hypothesized [12].

Earlier studies looking for a correlation between psychological stressful periods such as exam seasons in college students and the rate of NUG also showed a higher incidence of the disease in the sample [13]. The literature has provided robust evidence supporting the hypothesis of stress being a predisposing factor in NUG, through immunological mechanisms.

3.2. Periodontium and other systemic conditions

Periodontitis as an oral inflammatory disease, can induce minor systemic inflammation through markers of inflammation like interleukin 6 (IL-6) and C-reactive protein and the spread of lipopolysaccharide (LPS) and flagellin from its causing bacteria into systemic circulation [5]. There is growing evidence that periodontitis induced inflammation can further lead to neuro-inflammation through the activation of microglia, which are brain immune cells [14].

The results of a recent clinical study conducted on over 60000 participants, support the theory of elevated systemic inflammation being associated with stress related disorders such as depression. The study revealed a significantly higher incidence rate of subsequent depression on periodontitis patients compared to the control group, suggesting that periodontitis may increase the risk of subsequent depression and can be considered an independent risk factor regardless of sex, age, and most comorbidities [15]. Furthermore, new clinical data support the evidence that increased systemic inflammation is associated with stress-disorders including depression. In a recent study, the authors measured the activity of microglia brain cells and showed that patients had increased levels of neuro-inflammation during depressive episodes when compared to a healthy control group. They concluded that there is incentive to evaluate anti-inflammatory therapies in major depressive disorder [16]. Besides this, studies conducted from a psychosocial perspective suggest that periodontitis could be contributing to stress related disorders through the psychosocial effects of halitosis, poor oral hygiene and edentulism. These could impact the patient's quality of life by inducing shame, social isolation and depression [17-18]. Alongside periodontitis putative effects on depression, there is significant longstanding evidence that it imposes a greater risk on systemic conditions such as cardiovascular disease or preterm delivery [19].

However, the link between periodontal disease and other systemic conditions seems to be bidirectional, as it is well documented that diabetes and osteoporosis increase the risk for periodontitis [20].

Analyzing these links, a common denominator has caught the attention of researchers. Considering the well-accepted fact that stress is related to cardiovascular disease, diabetes mellitus, preterm delivery, osteoporosis, rheumatoid arthritis, inflammatory bowel disease, and systemic lupus erythematosus through physiological or behavioral responses, this could point to stress as a common risk indicator for these conditions and periodontitis [9].

3.3. Pathophysiology of stress- biological mechanisms

Stress is one of the adaptive mechanisms that helps individuals navigate through challenges of all natures, making it compatible with survival forms of organisms. However, when there is a mismatch

between the actual or perceived stimuli and one's stress response, neuroendocrine and biochemical changes that follow can lead to adverse effects on the proper functioning of the immune system [21-22]. In trying to understand the pathways through which stressors translate into a physiological response from the immune system, endocrine and nervous system, a growing body of evidence has been mounted through studies and experiments in the field of psychoneuro-immunology.

A synthesis of the main theories deriving from this work is presented below, aiming at elucidating the link with implications in periodontal disease.

According to a theoretical study by G. Slavich [23] "Two physiological pathways are responsible for converting social-environmental adversity into broad pro-inflammatory transcriptional programs. The first pathway involves the sympathetic nervous system (SNS), and the second pathway involves the hypothalamic-pituitary-adrenal (HPA) axis" [24].

3.4. Sympathetic nervous system

Stressful stimuli elicit a response from the autonomic nervous system, in the form of catecholamine secretion. The sympathetic branch of ANS responds by releasing norepinephrine into lymphoid organs and vasculature and perivascular tissues, altering the pro-inflammatory cytokine levels. The neurotransmitter then, reacts directly on the β -adrenergic receptors and provokes the due changes on the immune system components through signaling transcriptional messages on inflammation related genes [24-25].

In the presence of norepinephrine there is an increase in transcriptional activity on genes that are related to the production of interleukin 1 (IL1), tumor necrosis factor (TNF) and IL6 [26] with systemic pro-inflammatory effects. The role of the above mentioned cytokines in periodontitis has been studied and reviews concluded on their pro-inflammatory role and bone resorption activity in the presence of an infection [27]. Focusing on the periodontium, the catecholamine secretion in response to these stressful stimuli, as proposed on the SNS pathway, can have an influence on proteolytic enzymes with a tissue destructive potential, such as matrix metalloproteinases MMP [28].

3.5. Hypothalamic-pituitary-adrenal axis

A stressful stimuli of a less acute type is perceived by the brain and signals the hypothalamic/pituitary/adrenal (HPA) axis to release corticotrophic-releasing hormone (CRH) from the hypothalamus which induces the release of adrenocorticotrophic hormone (ACTH) from the pituitary gland and consecutively glucocorticoids from the adrenal cortex [29]. Glucocorticoids suppress the immune system functions by a number of mechanisms. They decrease the number of circulating lymphocytes, monocytes, and eosinophils; inhibit the functions of inflammatory cells through a myriad of actions such

as lowering the production of cytokines (interleukin [IL] IL-1, IL-2, IL-3, IL-6, tumor necrosis factor (TNF), interferon gamma. The cascade of the inflammation is further hindered due to an impeding of macrophage-antigen presentation and lack of lymphocyte differentiation into more specialized cells such as T-helper lymphocytes, B cells, cytotoxic lymphocytes and NK cells [30]. Glucocorticoids can further suppress the immune responses by impeding the functions of secretory IgA and IgG, and neutrophils all of which are important factors that build the host response towards infections by pathogenic bacteria. Under this altered defense response, periodontal infection can occur which may lead to tissue destruction by factors such as IL-1 and MMP and the direct effects of pathogenic periodontal microorganisms [9]. There is yet another mechanism that could be involved in elevated levels of inflammation that are related to HPA-axis response to stress.

3.6. Increased inflammation via glucocorticoid resistance - HPA-axis related

When a persistent secretion of glucocorticoids occurs, immune cells in response lower their sensitivity to it, developing what is known as glucocorticoid resistance [31]. In response to this phenomenon, HPA axis that is responsible for providing the "fight or flight" reaction to threatening stimuli of a social-environmental nature, can mount an abnormally high inflammatory response, when triggered frequently or chronically. Under conditions of prolonged actual or perceived threat, or possibly during acute stressors indicating social threat or physical danger, glucocorticoid resistance can develop, leading to excessive inflammation that increases a person's risk for several disorders [23]. A few other disorders such as anxiety, posttraumatic stress disorder, asthma, rheumatoid arthritis, cardiovascular disease, inflammatory bowel disease, autoimmune diseases, and some cancers, also show evidence of glucocorticoid resistance [32-34]. This, together with the growing body of evidence that periodontal disease is linked to the abovementioned conditions through several physiopathological processes, might suggest that glucocorticoid insensitivity happening under stressful environmental stimuli could be involved in the progression of periodontitis. Another pathway by which stress induced physiologic response modulates the immune system is the sensoric peptidergic nervous pathway, also known as "neurogenic inflammation" in which neuropeptides are released from sensory nerve fibers while stimulated by external stimuli [35 -36]. Research has provided evidence that the peripheral release of neuropeptides may promote various inflammatory processes [36].

4. DISCUSSION

Literature contains various studies conducted on humans aiming at evaluating the association

between stress-driven behavioral changes and periodontal conditions, as presented below. It is now widely accepted that one of the mechanism through which stress is thought to exert its putative effect on the periodontal condition is the behavioral change in general, with stressful individuals inclined towards adopting harmful health behaviors including oral hygiene neglecting, smoking and poor compliance with dental care [9]. In a study conducted by Deinzer et al. [37] assessing the effect of academic stress on gingival inflammation, the crevicular levels of interleukin-beta were higher and the oral hygiene levels were poorer compared to the control group, indicating that academic stress was a risk factor for gingivitis. Emotional conditions that generate higher stress levels are also thought to affect the choice of a diet with an inclination towards softer foods with a high content of sugars and fat which facilitate the faster formation of plaque and enhance its adhering capacity to the teeth, affecting the periodontal health [38]. During periods of elevated stress individuals tend to increase smoking or even start it as a new habit. The harmful effects of smoking on oral health and particularly that of the periodontium, are well studied and established beyond doubts [39].

5. CONCLUSIONS

The present body of knowledge emerging from periodontology and psychoneuroimmunology interdisciplinary field has yielded strong evidence on the relation of stress and periodontitis.

The intriguing evidence of the effects of stress on the inflammatory conditions and periodontitis should guide researchers to explore its implications on the possible preventive measures, as well as treatment modalities.

Informed clinicians can then make better informed decisions and design treatment plans on patients that might include addressing psychological disturbances and referring them to specialists for an integrated care plan.

In a multifactorial disease such as periodontitis, there is a necessity for multidisciplinary attention and collaboration in considering the psychological status of the individual along other well-established etiological factors.

This approach would yield multiple benefits for the patient, with general health to be seen as a good balance between body and mind.

CONFLICT OF INTEREST

Authors declare no conflict of interest related to this manuscript.

AUTHORS CONTRIBUTION

OM: Data gathering, Data analysis, Data Interpretation, Manuscript drafting, RB: Data interpretation, Manuscript revision, BR: Data gathering, Data analysis.

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CV

Oriola Madhi studied dentistry at the Faculty of Dental Medicine, University of Medical Sciences in Tirana, Albania where she earned her DDS degree. Afterwards she was accepted into a residency program in Dental Therapy in the same faculty. She went on to advance her academic education by enrolling into a PhD program in the field of Periodontology and is close to the completion of the program. She has been teaching at the Faculty of Dental Medicine for 8 years and she is also a practicing dentist and clinical instructor at the University Dental Clinic. Her teaching areas include conservative dentistry and periodontology.

Questions

1. The advanced forms of periodontitis affect?

- ☐ a. Over 50% of the world population;
- ☐ b. More individuals than the milder forms of periodontitis;
- ☐ c. Less than 15% of the world population;
- ☐ d. Only immunocompromised patients.

2. In a study exploring the effect of stress on NUG, by measuring the corticosteroid levels in the patient's urine, NUG patients compared to the control group exhibited?

- ☐ a. Lower levels of corticosteroids in their urine;
- ☐ b. Higher levels of corticosteroid in their urine;
- ☐ c. Same levels of corticosteroid in their urine;
- ☐ d. No statistical difference between groups.

3. Glucocorticoids, suppress the immune system functions by?

- ☐ a. Inhibiting the functions of inflammatory cells;
- ☐ b. Increasing the production of cytokines;
- ☐ c. Increasing the production of secretory IgA and IgG;
- ☐ d. Increasing the number of NK cells.

4. In a study exploring the effects of academic stress on gingival inflammation, it was observed?

- ☐ a. An increase in the crevicular levels of interleukin β ;
- ☐ b. A decrease in the crevicular levels of interleukin β ;
- ☐ c. An improvement on oral hygiene;
- ☐ d. No difference on inflammation markers between groups.

TREND OF SCIENTIFIC PRODUCTION ON DIGITAL IMPLANT DENTISTRY (1990-2019): A BIBLIOMETRIC STUDY

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ABSTRACT

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Background and Objective Digital implantology has become a hot topic in dentistry. The purpose of this paper was to present trends regarding the interests of this field using bibliometric indicators.

Data sources On the basis of articles in the Web of Science database, we performed a quantitative analysis of publications in 1990-2019 on digital implant dentistry.

Data Extraction and Synthesis Excel and VOSviewer were applied to assess the publication trend. A total number of 3680 publications with 57,930 citations up to February 8, 2020, were obtained. More than half (2013; 54.70%) of the articles were published in the last five years (2015–2019). The United States was in the leading position, with the highest H-index (60), 23.91% of the publications, and 28.74% of the total citations. Among the top 10 active authors, eight were from Europe, and the other two were from the United States. The University of Bern (Switzerland) (101; 2.745%) was the most productive institution, followed by the University of Sao Paulo (Brazil) (89; 2.418%), and the University of Michigan (United States) (84; 2.283%). The most active journal in publishing articles related to digital implantology was the Clinical Oral Implant Research (336; 9.13%), together with the International Journal of Oral & Maxillofacial Implants (336; 9.13%). Three of the top 15 funding agencies were well-known implant companies. Digital workflow, digital impression, and 3D printing are becoming popular research topics. In conclusion, there was a noticeable growth in scientific publications in digital implant dentistry, and most key bibliometric indicators demonstrated its upward trends.

KEYWORDS

Bibliometrics; Dental Implants; Digital Technologies; Evidence-Based Dentistry; Dental Research.

1. INTRODUCTION

Compared to the era of the introduction of dental implants in the 1960s, implant therapy is now highly predictable and has become a widely used treatment modality to replace missing dentition [1]. Along with the continuous technological progress in the treatment planning software, computer-aided design (CAD), and computer-assisted manufacturing technology (CAM), a strong digitalization trend in implant dental medicine is noticed in clinical practice [2]. Evolving from being a merely “surgically driven”

to a “restoration-driven” treatment, the concept of implant therapy currently turns to “computer-assisted” implant placement and even a completely digital workflow [3,4]. Together with the increasing use of digital technologies in implant dentistry, research on this topic has grown at an exponential rate, producing increasing numbers of scientific publications every year [5]. The research topics range from pre-clinical to clinical, from surgical to prosthetic related fields. In addition, novel digital equipment such as cone-beam computed tomography (CBCT) [6], optical scanner [7,8], magnetic resonance imaging (MRI) [9],

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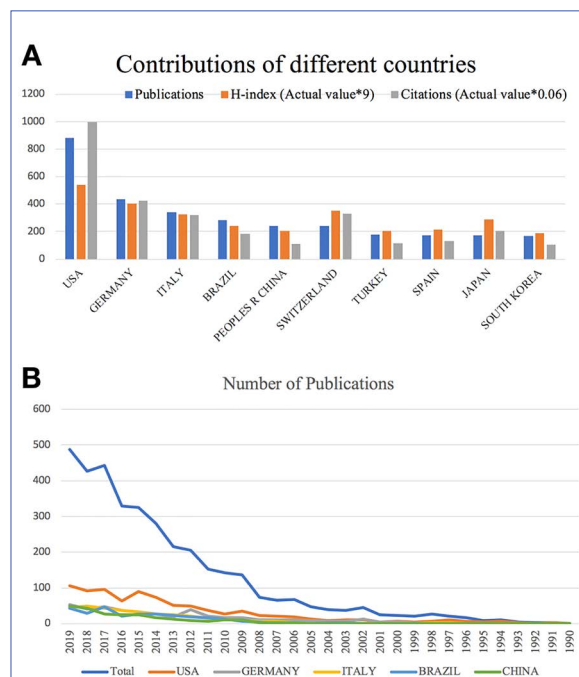


Figure 1. Number of Publications. (A) The number of publications of the top 10 countries and regions; (B) Annual evolution of the scientific production on digital implant dentistry.

and ultrasonography [10,11], are increasingly being tested in research for the assessment of implant treatment outcome. Knowing the trend of the industry is essential for dental practitioners and researchers in this field. With the rapid growth of publications in digital implant dentistry, it is necessary to quantify both results of scientific activity and its impact on the research trend [12,13]. In this context, bibliometrics is a useful and objective tool [14].

Bibliometrics is a method of analyzing data from citation indexes. It traces relationships amongst academic journal citations and assesses the trend of a specific field as well as its international scientific impact.

Yet, to our knowledge, the progress of digital implantology so far has not been extensively studied. Therefore, the aim of our study was to present all-around insights on the current state of digital-related implant dentistry.

The distribution of the research publications, affiliations, keywords, and authorships were analyzed to discover the popular topics and to better understand the global trend of research in this field. It is hypothesized that the upward trends in digital implant dentistry will be reflected in the production of quality articles and popular topics.

2. METHODOLOGY

2.1. Literature search strategy

The literature search was performed in the core collection of Thomson Reuter's Web of Science database, with the manuscript type restricted to articles. The Web of Science is considered the

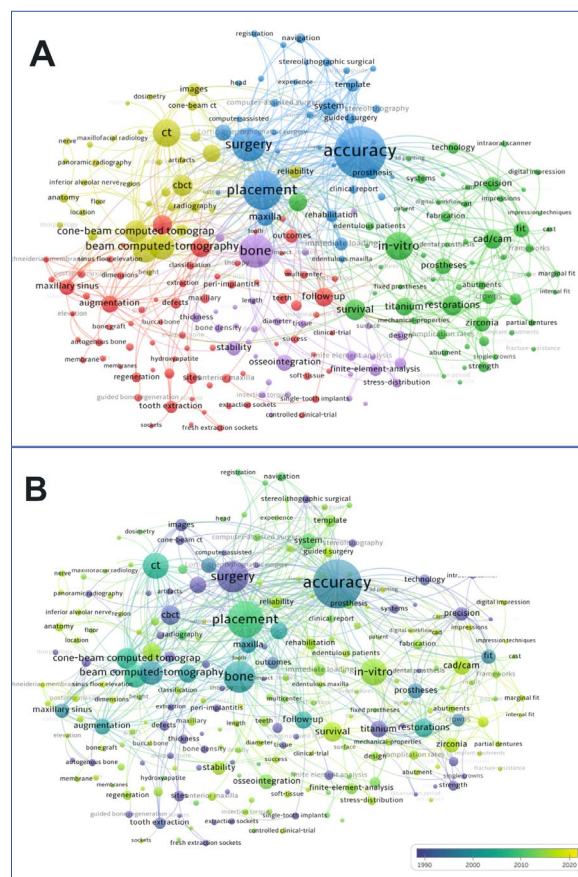


Figure 2. The analysis of keywords (with the occurrence more than 20 times). (A) Based on different clusters; (B) Based on its different average appearing year.

optimum database to perform bibliometric analysis, and it has been applied in many published studies [12-15]. All screenings took place on a single day, February 8, 2020, with an attempt to eliminate any change in the number of publications and citations. The search strategy was: ((TS=(dental implant* OR implant dentistry* OR dental implantology OR oral implant) AND TS=(digital* OR digital technologies OR digital workflow OR computer OR computer-guided OR computer-aided OR computer-assisted OR CAD/CAM OR intraoral scan OR intraoral scanner OR cone beam OR CBCT)) AND LANGUAGE: (English), and timespan for publication was set as 1990–2019.

2.2. Data collection

The basic characteristics of selected publications were obtained from the Web of Science by its intrinsic tool Clarivate Analytics.

Data related to publication years, countries/regions, authors, institutions, journals, funding agencies, and citations were exported as Excel files for tabulation. All journals' impact factor (IF) were retrieved from the Journal Citation Reports of 2019.

In an attempt to evaluate both the productivity and citations of the publications, the H-index was used, which indicates that a scholar (or country or organization) has published H papers and each of which has been cited in other publications at least H times [16].

Table 1. The most productive authors (top 10) with the publications related to digital implant dentistry.

Author	Country	Affiliation	Docs	% of 3680	Citations	H-index
Jacobs R.	Belgium	Catholic University of Leuven	60	1.630	2245	25
Wang HL.	United States	University of Michigan	54	1.467	940	19
Bornstein MM.	Switzerland	University of Bern	33	0.897	984	16
Wismeijer D.	Netherlands	Academisch Centrum Tandheelkunde Amsterdam (ACTA)	33	0.897	981	18
Quirynen M.	Belgium	Catholic University of Leuven	32	0.870	1207	17
Hammerle CHF.	Switzerland	University of Zurich	29	0.788	869	16
Buser D.	Switzerland	University of Bern	26	0.707	1441	17
Chan HL.	United States	University of Michigan	26	0.707	388	12
Jung RE.	Switzerland	University of Zurich	25	0.679	769	12
Bragger U.	Switzerland	University of Bern	24	0.652	666	16

Table 2. Top 10 organizations with the most publications related to digital implant dentistry.

Organization	Country	Docs	% of 3680	Citations	H-index
University of Bern	Switzerland	101	2.745	36	4504
University of Sao Paulo	Brazil	89	2.418	17	1319
University of Michigan	United States	84	2.283	20	1550
University of Zurich	Switzerland	79	2.147	21	1673
Catholic University of Leuven	Belgium	59	1.603	22	1976
King Saud University	Saudi Arabia	55	1.495	11	390
Harvard University	United States	48	1.304	23	1356
Seoul National University	Korean	44	1.196	14	512
Yonsei University	Korean	42	1.141	10	339
University of Geneva	Switzerland	41	1.114	16	687

2.3. Statistical analysis

The data were imported into a java program VOSviewer (version 1.6.8; Leiden University, Leiden, Netherlands). This software was used to visualize a term map analyzing keywords from the extracted data. The data were then analyzed by using the "Create Map" function.

The type of analysis was chosen as "Co-occurrence" and the unit of analysis was set as "All keywords". Only keywords that had the occurrence number more than 20 were displayed. Redundant keywords like "dental implant" and "dentistry" were removed.

Thereafter, a keyword map was generated by the software. For each keyword, the size of the node indicates its frequency of occurrence in the included publications, and larger size represents a higher frequency of occurrence.

In network visualization mode, keywords that frequently occurred together were marked as the same color.

In overlay visualization mode, different colors were used to mark the average publication year of the keywords. [17].

3. RESULTS

3.1. Growth of publications

In total, 3680 documents published between 1990-2019 were included. The highest number of articles was published in 2019 with a total number of 448 (13.26%). More than half (2013, 54.70%) of the papers were published in the last five years (2015-2019). The total trend and the annual number of documents are shown in Fig. 1. The United States was the most productive country with 880 (23.91%) publications, followed by Germany (434; 11.79%) and Italy (342; 9.29%).

3.2. Distribution of most productive organizations, journals and funding agencies

Articles from top 10 organizations accounted for 17.45% of all publications in this field. The University of Bern published the highest number of studies with a total number of 101 (2.745% of all publications). In the list of the top 10 organizations, three were from Switzerland, two were from the United States, two were from Korea, the rest three were from Brazil,

Table 3. The most productive journals on digital implant dentistry.

Journals	Country	IF 2018	Docs	% of 679
Clinical Oral Implants Research	Denmark	3.825	336	9.130
International Journal of Oral & Maxillofacial Implants	United States	1.734	336	9.130
Journal of Prosthetic Dentistry	United States	2.787	190	5.163
Clinical Implant Dentistry and Related Research	United States	3.212	181	4.918
Journal of Oral and Maxillofacial Surgery	United States	1.781	146	3.967
Implant Dentistry	United States	1.214	108	2.935
Dentomaxillofacial Radiology	England	1.525	84	2.283
Journal of Oral Implantology	United States	1.062	83	2.255
International Journal of Periodontal and Restorative Dentistry	United States	1.228	74	2.011

Belgium, and Saudi Arabia (Table 2). The top 10 journals publishing the most articles are shown in Table 3. There were 1611 papers published in these journals (43.78% of all publications). Clinical Oral Implants Research (IF=3.825, 2018; 336 articles) and International Journal of Oral & Maxillofacial Implants (IF=1.734, 2018; 336 articles) ranked first, followed by the Journal of Prosthetic Dentistry (IF=2.787, 2018; 190 articles). Among these studies, 1109 out of 3680 (30.14%) were supported by funding agencies. The top 15 funding agencies are presented in Table 4, with four based in the United States, four in Switzerland, and three in Brazil. NIH in the United States endorsed 81 studies (ranked 1st, 2.201%), followed by National Natural Science Foundation in China (68 studies, 1.848%), and Coordination for the Improvement of Higher Education Personnel (CAPES) in Brazil (48 studies, 1.304%). Furthermore, implant companies showed great contributions to the development of digital implant dentistry and occupied three of the top 15 funding agencies.

3.3. Highly contributive authors publishing digital implant dentistry research

The 3680 documents were authored by 10,598 different authors. The 10 most productive authors are listed in Table 1. The most productive was Jacobs R. (n=60, citations=2245) from the Catholic University of Leuven (Belgium), followed by Wang HL. (n=54, citations=1467) from the University of Michigan (United States), and Bornstein MM. (n=33, citations=984) from the University of Bern (Switzerland). Five of the top 10 productive authors came from Switzerland, followed by two from the United States, two from Belgium, and one from the Netherlands.

3.4. Hotspot analysis

All keywords were extracted from the title/abstract of 3680 articles and then analyzed by VOSviewer software. Keywords, with an occurrence of more than 20 times, were included in the map (Fig. 2) and were stratified into five clusters: cluster 1 (treatment

outcome; Fig. 2A, left, in red), cluster 2 (accuracy of digital technology; Fig. 2A, right, in green), cluster 3 (implant planning and placement; Fig. 2A, up, in blue), and cluster 4 (radiograph and anatomy; Fig. 2A, left, in yellow), and cluster 5 (implant stability and biomechanics; Fig. 2A, middle, in purple). In the cluster 1, the frequently used keywords were "reconstruction" (162 times), and "implant placement" (161 times), and "follow-up" (152 times). The most frequent keywords in the second cluster were, "in-vitro" (264 times), "restorations" (166 times), and "CAD/CAM" (147 times). In cluster 3, "accuracy" (586 times), "placement" (400 times), and "surgery" (332 times) were the most frequent keywords. "CT" (251 times), and "cone beam computed tomography" (221 times) were the most frequent keywords in cluster 4. In cluster 5, "bone" (329 times), "osseointegration" (126 times), and "stability" (113 times) were the top 3 frequently used keywords. Based on its different average appearing year, VOSviewer marked each keyword with different colors (Fig. 2B). Keywords in yellow appeared later than those in green and blue. In cluster 1, the newest keywords were "Schneiderian membrane" (34 times) which has an average publication year of 2016, "dimensions" (51 times, 2016), and "floor elevation" (36 times, 2016). In cluster 2, the new focus of "accuracy of digital technology" were "3d printing" (29 times, 2017), "digital impression" (36 times, 2017), and "digital workflow" (26 times, 2017). As for the third cluster, the new focus of "implant planning and placement" was "guided surgery" (74 times) with an average publication year of 2015. In the fourth cluster, the newest keyword was "mental foramen" (32 times, 2015), "inferior alveolar nerve" (45 times, 2015), and "location" (44 times, 2015). In the fifth cluster, "stability" (113 times, 2015) was a relatively new keyword.

3.5. Characteristics of top 10 articles in digital implant dentistry

Among all 3680 publications (57,980 citations), top 10 cited articles (Table 5) have 2,378 citations (22.19%). The paper "Bone healing and soft tissue contour

Table 4. The top 15 funding-related agencies in digital implantology.

Funding agency	Country	N	% of 3680
National Institutes of Health (NIH)	United States	81	2.201
National Natural Science Foundation of China	China	68	1.848
Coordination for the Improvement of Higher Education Personnel (CAPES)	Brazil	48	1.304
The Department of Health and Human Services (HHS)	United States	46	1.250
Sao Paulo Research Foundation (FAPESP)	Brazil	43	1.168
The Brazilian National Council for Scientific and Technological Development (CNPq)	Brazil	41	1.114
Dentsply	United States	34	0.924
Noble Biotech	Switzerland	32	0.870
ITI Foundation	Switzerland	32	0.870
Ministry Education, Culture, Sports, Science Technology (MEXT) in Japan	Japan	31	0.842
University of Michigan	United States	30	0.815
Institute Straumann AG	Switzerland	28	0.761
King Saud University	Saudi Arabia	28	0.761
Japan Society for the Promotion of Science (JSPS)	Japan	25	0.679
University of Zurich	Switzerland	22	0.598

changes following single-tooth extraction: A clinical and radiographic 12-month prospective study.” [18] in International Journal of Periodontics & Restorative Dentistry received the highest citations (924 times) with an average citation of 51.33 times per year.

4. DISCUSSION

The present study assessed scientific publications pertaining to digital implantology in the last 30-year period (1990–2019). Upward trends in this field were demonstrated by most bibliometric indicators. These findings could provide a self-evaluation for the dental community and be valuable to editors and publishers of implant-related journals. Regarding the countries, around 73% of the articles (2672) in this field came from these top 10 productive countries. The United States and Germany were the most productive countries in this field, which is in agreement with a similar bibliometric study for the whole of implantology [14]. Besides the quantity of publications in a country, the total citations and H-index may represent its quality of publications as well as academic impact. The United States and Germany also ranked 1st and 2nd. Switzerland was 6th when ranked according to the quantity of publications, but 3th for citations and 3th for H-index. The most active authors are renowned specialists in implant dentistry linked to universities. On the list of the top 10 scholars, five of the top 10 productive authors came from Switzerland, followed by two from the United States, two from Belgium, and one from the Netherlands. Jacobs R. from the Catholic University of Leuven was the most productive author; also, this institution was a leader in this field. Three out of 10 top organizations were from Switzerland, two were from the United States, two were from Korea,

the rest three were from Brazil, Belgium, Saudi Arabia. This shows that digital implantology is a subject of interest in many different countries. The University of Bern was the leading organization in digital implant dentistry research concerning the quantity of publications, citations, and H-index. Unlike other medical areas where most of the studies were supported by the government, digital implant dentistry research was also supported by commercial organizations, and four of the top 15 active funding agencies were well-known dental implant companies and institutes. In this field, research teams worked closely with an industrial partner as they needed the expertise of engineering and precise manufacturing. At the same time, companies need researchers to test new digital products for marketing and sales. Top researchers from the top institutions can be good candidates for partnerships and may also have the priority for more investments and grants.

When it came to the analysis by journal, the articles included in this study were published in 151 journals. Around half of the articles were published in the top 10 journals, and eight of which are based in the United States. *Clinical Oral Implants Research*, *The International Journal of Oral & Maxillofacial Implants*, *Journal of Prosthetic Dentistry*, and *Clinical Implant Dentistry and Related Research* published most studies on digital implantology. Future discoveries in digital implant dentistry are likely to be published in the aforementioned journals. Subsequently, researchers may pay more attention to studies reported by these journals. Regarding the keywords in this field, the topics can be mainly divided into five groups. In the cluster related to the accuracy of digital technology, the paper “Digital vs. conventional implant impressions: efficiency outcomes” [19] was most cited with 125

Table 5. Top 10 cited articles in digital implantology.

Title	Authors	Journal	Year	Total Citations	Citations per year
Bone healing and soft tissue contour changes following single-tooth extraction: A clinical and radiographic 12-month prospective study.	Schropp L, Wenzel A, Kostopoulos L, et al.	<i>Int J Periodontics Restorative Dent.</i>	2003	924	51.33
A new volumetric CT machine for dental imaging based on the cone-beam technique: preliminary results.	Mozzo P, Procacci C, Tacconi A, et al.	<i>Eur Radiol.</i>	1998	635	27.61
Clinical applications of cone-beam computed tomography in dental practice.	Scarfe WC, Farman AG, Sukovic P.	<i>J Can Dent Assoc.</i>	2006	593	39.53
Cone-beam computerized tomography (CBCT) imaging of the oral and maxillofacial region: A systematic review of the literature.	De Vos W, Casselman J, Swennen GRJ.	<i>J Oral Maxillofac Surg.</i>	2009	397	33.08
Bone augmentation techniques.	McAllister BS, Haghighat K.	<i>J Periodontol.</i>	2007	376	26.86
The future of dental devices is digital.	van Noort R.	<i>Dent Mater.</i>	2012	367	40.78
Crestal bone changes around titanium implants. A radiographic evaluation of unloaded nonsubmerged and submerged implants in the canine mandible.	Hermann JS, Cochran DL, Nummikoski PV, et al.	<i>J Periodontol.</i>	1997	317	13.21
Analysis of the accuracy of linear measurements obtained by cone beam computed tomography (CBCT-NewTom).	Lascala C, Panella J, Marques MM.	<i>Dentomaxillofac. Radiol.</i>	2004	305	17.94
Accuracy of implant placement with a stereolithographic surgical guide.	Sarment DP, Sukovic P, Clinthorne N.	<i>Int J Oral Maxillofac Implants.</i>	2003	273	15.17
Bone classification: an objective scale of bone density using the computerized tomography scan.	Norton MR, Gamble C.	<i>Clin Oral Implants Res.</i>	2001	250	12.50

citations. For treatment outcome, "Bone healing and soft tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study" [18] with 924 citations was the most cited one. In this study, cast and model scanner were used to evaluate the change of soft tissue contour. Recently, clinical studies using intraoral scanner to capture tissue contour were more often published [20]. In the third cluster of implant planning and placement, the most cited paper with 593 citations was "Clinical applications of cone-beam computed tomography in dental practice" [21], which reinforced that CBCT played a vital role in the progress of digital implant dentistry. For implant stability and biomechanics, "Influence of cortical bone thickness and implant length on implant stability at the time of surgery-clinical, prospective, biomechanical, and imaging study" [22] had 179 citations. Regarding the trend of research topics, the most frequently used keywords in digital implantology research papers and their main year when they were published were: digital subtraction radiography,

diagnosis, panoramic radiography (before 2010), CT, osseointegration, bone, resonance frequency analysis (2011), placement, surgery, surgical guide, in-vitro, biomechanics (2012), accuracy, follow-up, interface, finite-element-analysis, restorations (2013), augmentation, soft tissue, (2014), CAD/CAM, intraoral impression, abutment, fixed dental prostheses, zirconia, guided surgery (2015), floor elevation (2016), digital workflow, 3D printing, digital impression (2017). This suggests that the emphasis of digital implant dentistry research responds to the prosthetic field and digital workflow that is very new to researchers. Supplementary large-scale clinical studies on different digital systems and different digital workflows will be vital to better utilize these processes and/or understand the potential of the digital technology.

Limitations

The publications included in this study were screened and selected from the Web of Science database, and the analysis was relatively objective

and comprehensive. However, it should be noted that studies published in 2020 were not included in the present study and digital technologies are a very dynamic area in implant dentistry. Therefore, future research may soon become necessary with the latest published studies.

Besides, in the Web of Science, the number of publications for each author was counted regardless of the position of the author.

For example, a document with five authors is counted once for each author.

Therefore, a potential overlap in the number of publications assigned for each author may happen. The same applies to data regarding the most active countries and organizations.

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5. CONCLUSION

The present study showed significant growth in the literature regarding digital implantology research in the last decade. The United States was in the leading position. Digital workflow, digital impression, and 3D printing are the latest popular topics.

CONFLICT OF INTEREST

Authors declare no conflict of interest related to this manuscript.

AUTHOR CONTRIBUTIONS

ZC, JL, and HLW: contributed to the conception of the work. ZC and JL: collected and analyzed the data, wrote the manuscript. CYL and HLW: critically revised the manuscript.

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Questions

1. The following are considered as the latest popular topics in digital implant dentistry, with one exception?

- ☐ a. Digital workflow;
- ☐ b. Digital impression;
- ☐ c. 3D printing;
- ☐ d. Resonance frequency analysis.

2. Which of the following is increasingly being tested in research for the assessment of implant treatment outcome?

- ☐ a. CBCT;
- ☐ b. Optical scanner;
- ☐ c. Ultrasonography;
- ☐ d. All above.

3. Which of the following is a bibliometric indicator?

- ☐ a. Number of publications;
- ☐ b. Number of citations;
- ☐ c. H-index;
- ☐ d. All above.

4. Which one indicates that a scholar (or country or organization) has published H papers and each of which has been cited in other publications at least H times?

- ☐ a. Impact factor (IF);
- ☐ b. H-index;
- ☐ c. Citation index;
- ☐ d. Hotspot analysis.

BARRIERS TO GOOD ORAL HEALTH FOR NURSING HOME RESIDENTS: A LITERATURE REVIEW

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ABSTRACT

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Background Oral health in older adults who live in nursing homes is generally poor, with high rates of mainly preventable oral conditions.

Objective The aim of this review was to present an overview of the barriers to good oral health for older nursing home residents.

Data sources Electronic databases were used (PubMed, Google Scholar, ScienceDirect). Reference lists from relevant studies and cited papers were also investigated.

Study selection The review included reports from national surveys and full papers of any study design, systematic reviews and guidelines published in peer-reviewed journals in English published until February 2019.

Data extraction The recorded barriers to good oral health were allocated to the main categories described in the socioecological model of health promotion.

Data synthesis The identified barriers to oral health of nursing home residents were allocated into intrapersonal, interpersonal, organizational and public health policy issues. The main intrapersonal barriers included the residents' physical and mental disease, resistance to care, poor oral health literacy and difficulties in accessing dental care. Interpersonal factors included inadequate knowledge and training of caregivers and health professionals on oral health and care for frail older people, as well as negative attitudes of caregivers and family members towards oral hygiene provision in nursing homes. Organizational factors included low priority of oral health in nursing homes, limitations in time and number of staff and limited collaboration with dental professionals. Ineffective oral health policies included lack of priority for oral health and unsupportive oral care systems.

KEYWORDS

Barriers; Oral Health; Oral Hygiene; Nursing Homes; Older Adults.

1. INTRODUCTION

Oral diseases are a major global public health problem affecting individuals, communities, and the society as a whole, as over 3,5 billion people face chronic and progressive oral diseases [1]. Older adults who reside in nursing homes are a particularly vulnerable part of the population with high rates of oral diseases.

Neglected oral health has severe consequences for the residents' general health and quality of life and has been associated with increased risk for aspiration

pneumonia, diabetes mellitus, cardiovascular diseases and malnutrition [2-9].

Poor oral health has a considerable impact on the health care systems raising the health care costs [10-13]. In addition, poor oral health may have a negative impact on social relationships due to altered speech, aesthetics, and oral comfort [13-16].

Oral care for nursing home residents does not often meet best practice standards [17] and several factors seem to act as barriers. The aim of this review was to offer an overview of the barriers to good oral health in older adults residing in nursing homes.

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2. MATERIALS AND METHODS

A literature search in PubMed, Google Scholar, ScienceDirect and Scopus electronic databases was performed. The following keywords were used: (barriers) AND (oral health OR oral care) AND (nursing home residents OR dependent older adults). Moreover, reference lists from relevant studies and cited papers were also investigated. The titles and the abstracts of the retrieved articles were screened to decide whether full-text reading was required, and full texts were retrieved for the selected articles. The review included reports from national surveys and full papers of any study design, as well as guidelines, published in peer-reviewed journals in English. Articles published until February 2019 were included. According to the socioecological model of health promotion, poor oral health of residents in care units can be attributed to intrapersonal, interpersonal, organizational and public health policy issues. Therefore, the main barriers identified in the study were allocated to these specific categories.

3. RESULTS

The review has identified the following barriers to good oral health in nursing homes:

3.1. Intrapersonal factors

A number of barriers to oral health of nursing home residents are related to the residents themselves. Intrapersonal issues include physical illness, cognitive impairment and mobility problems leading to progressive self-care limitations and, subsequently, to difficulties in performing oral hygiene and accessing dental care [17-21]. Lower use of dental services may lead to the fast progression of oral diseases, delayed diagnosis and, as a result, to poor prognosis [22].

Studies in care units revealed poorer oral hygiene in functionally dependent older adults compared to residents with better self-care capacity [23,24,25]. Apart from the level of care dependency, increasing age, as well as communication and behavioral problems comprised additional barriers [8,26,27].

Polypharmacy is a major barrier to good oral health. In particular, cholinesterase inhibitors, atypical antipsychotics and antidepressants have significant oral side effects such as xerostomia or sialorrhea, stomatitis and dysgeusia. In addition, donepezil, galantamine, and risperidone interact with medications often administered by the dentist, such as erythromycin, clarithromycin and ketoconazole [28-30]. Individual factors also include unhealthy dietary habits, and smoking, as well as the social determinants of health such as low educational level and limited income [31-33]. The presence of natural teeth and dental implants have also been characterized as barriers to good oral health, because of the complexity of oral hygiene procedures compared to dentures. However, poor retention and stability, and poor hygiene of

the dentures may also negatively affect oral health causing denture-related stomatitis oral lesions [17,27,34-36].

3.2. Interpersonal factors

Caregivers should examine the oral health status of the residents and provide or supervise the implementation of oral hygiene at least once a day [37,38,39]. However, the oral health of nursing homes residents does not receive the necessary attention and oral care neglect is more frequently observed compared to community dwelling elders [40]. The role of formal caregivers in nursing homes is crucial for the everyday general and oral care of frail and functionally dependent residents. Inadequate theoretical and practical education of nursing home staff in oral health and care has been well documented [34,41-45].

Caregivers have poor knowledge and skills on oral hygiene advice and assistance [18,25]. Moreover, they do not have adequate knowledge in detecting common oral pathologies such as caries, periodontitis and stomatitis, and in the correct procedures for oral hygiene implementation [42,46]. Furthermore, they do not use the available educational resources on oral care. Some caregivers, also, do not understand the need for certain oral care activities and they think that the implementation of oral hygiene is based on their preexisting knowledge [19]. According to the caregivers' perceptions, a major barrier to oral hygiene provision is the residents' negative responsive behaviors and resistance (i.e. not opening their mouth, biting the toothbrush or the caregivers' hands, shouting, etc.). However, the caregivers' close relationships with the residents and a person-centered approach can play a key role in preventing or managing responsive behaviors of older adults with dementia. Nevertheless, care providers are deprived of proper education in overcoming care resistant behaviors and are unaware that aggressive behaviors of residents with dementia may express pain, fear or resentment [8,47-51]. Furthermore, caregivers believe that the residents experience oral hygiene as intimate or painful. The poor cooperation among caregivers may also cause communication problems [8,21,35,52-54]. Caregivers also consider oral care of low priority and believe that it is not included in their job responsibilities [19,20,43,55,56]. Oral care and removal of dentures is considered as an unpleasant and repulsive process, mainly due to oral halitosis and bacteria prevalence [20,25,34,57]. For some caregivers, oral care is considered as more unpleasant compared to general care (feeding, washing or changing diapers) and they feel exhausted after applying oral hygiene [44,58]. Other reported barriers include the lack of empathy, laziness and belief that residents can manage oral care themselves [44,59]. Lack of professional support is also associated with the insecurity of the dentists to provide oral care in medically compromised older people, particularly

in domiciliary settings [39,60,67], as well as the limited knowledge of physicians to integrate oral health into the general medical assessment [39]. Interpersonal factors also include barriers related to the residents' family members. Family members' oral health literacy is often inadequate [20,61,62] and there is lack of understanding of the need to improve the quality of oral health and care [63]. They often do not support the formal caregivers in the provision of oral hygiene to the older family members [60,61,63], and do not purchase oral care supplies for their relatives, due to their high cost or perceived low priority of oral care [8].

3.3. Organizational factors

Barriers to oral health associated with the organization of nursing home services include lack of oral care routines and instructions, and unclear rationale for implementing oral care recommendations [20,21,41,54,64]. The lack of a nursing team leader and of proper supervision, monitoring, enforcing and rewarding the caregivers' oral hygiene practices are important determinants of proper oral hygiene implementation [8,21,65]. On the other hand, common findings in the care units are the low numbers of nursing staff and the limited time assigned to oral hygiene provision [19,20,25,34,35,52,53,62,65]. Caregivers face high workloads and are frequently interrupted while providing care to the residents [46,63,65]. Therefore, the number of residents in long-term care institutions seemed to have a negative impact on oral hygiene practices [26]. Despite the nursing staff's willingness to improve the oral health of the residents, their increased workload posed significant difficulties in integrating oral care into the daily care routine [17,37]. The above factors may lead to the low caregivers' satisfaction with their work, burn-out and, consequently, to a low quality of care [8,46,63,65]. Moreover, the caregivers' rush to provide timely daily care may trigger the residents' aggressive behavior, especially those with dementia [47,51]. Additional barriers are the lack of financial resources to buy the necessary oral hygiene supplies [17,18,34,35], the lack of dentures' labelling [34] and the absence of a dental chair at the nursing homes' premises [66]. It should also be noticed that a significant barrier to good oral health in nursing homes is the lack of integration of oral health assessment into the general health examination provided by the unit's physician and the limited collaboration with a dental professional who will regularly assess the oral health of the residents and manage any urgent and routine oral problems [39].

3.4. Public policy issues

The lack of appropriate oral health policies is well documented. Public dental care coverage is limited in most countries, socio-economic inequalities reduce access to dental care and oral health literacy of the public is poor [39,67]. Finally, there is poor availability of domiciliary dental services and lack of appropriate legislation to support oral care for the

older adults living in care units or being confined at home [37,39,67].

4. DISCUSSION

This review has identified several barriers to good oral health in nursing home residents related to intrapersonal, interpersonal, organizational and public policy issues. The caregivers' lack of oral health education and increased workload, along with limited access to dental care for the residents were the dominant barriers.

Older residents face a rapid oral health deterioration due to several risk factors which include general health factors, oral conditions and lack of social and institutional support [68]. Poor oral hygiene implementation has been associated with the caregivers' inadequate knowledge, training and skills for oral hygiene assessment and provision, the limitations in the number of staff and their time availability for oral care, the poor communication with the residents, the residents' low interest or even their resistance to oral care [8,17,19,21,25,34,35,52,53,69]. The main barriers regarding the provision of dental treatment are the limited collaboration of nursing homes with dental practitioners, the lack of suitable facilities for treatment on site, the difficulties in the transportation of the residents to the dental offices, their refusal to receive dental care, the limited preparedness of dentists to manage frail and care-dependent older people, the poor oral health policies including the lack of oral health integration into public health care coverage, and the limited provision of domiciliary care [39, 69].

The study of Hilton, et al. (2016) describes findings from a focus group of nurses and residential care workers identifying large discrepancies between the existing recommendations for oral care in nursing homes and their actual implementation [17]. The results revealed the caregivers' substantial gaps in oral care training, the limited access to appropriate equipment and professional support, the residents' resisting behaviors to oral hygiene, the inadequate staffing and the staff's negative attitudes towards the provision of oral care [17]. Difficulties in oral care provision regarding dysphagia, dementia and poor fit of the dentures are common and it is of utmost importance to be addressed [17]. Interestingly, the members of the focus group suggested that lack of time should not be a barrier in converting the daily implementation of oral health practices in residential care settings to a priority [17]. This study highlights the need for the implementation of appropriate oral health education programmes for nursing homes' staff and of the necessary organizational interventions based on the existing recommendations by the European College of Gerodontology (ECG) and the European Geriatric Medicine Society (EUGMS) [39]. These recommendations include a compulsory oral health assessment together with the medical entry

assessment, daily oral hygiene provision, oral health education for the caregivers, availability of oral care products, accessibility to emergency and routine oral care, regular oral screenings and a healthy diet [39]. However, there is lack of robust evidence on the prevalence, predictors and consequences of the various barriers and facilitators to oral health in nursing homes [8,69]. Because of the specific characteristics of the nursing home population with high levels of cognitive impairment, the implementation and testing of effective oral hygiene protocols raise significant difficulties and demand adapted procedures [70]. Based on systematic reviews' findings, most of the related studies generally have a low methodological quality and a high risk of bias especially in terms of sample size, research tools and assessment of confounding factors, while most studies were mainly conducted in high-income countries and, therefore, generalization of the findings is limited [8,68]. Future research should include studies on the existing and novel oral health practices in nursing homes to thoroughly determine the barriers to the residents' oral care [17]. The development of appropriate strategies to prevent and manage the residents' negative attitudes and behaviors and enhance the caregivers' oral care knowledge and attitudes is also crucial [8,39,71]. Moreover, appropriate legislation and policies for

oral health prevention and promotion in institutional settings according to the recommendations of the European College of Gerodontology (ECG) and the European Geriatric Medicine Society (EUGMS) should be implemented [39].

5. CONCLUSIONS

Several barriers in oral health prevention and promotion for nursing home residents have been reported at an individual, interpersonal, organizational and public policy level. A more rigorous research and a thorough understanding of these barriers will lead to the design and implementation of effective oral health promotion strategies for the vulnerable older population.

CONFLICT OF INTEREST

We declare no conflict of interest of any kind.

AUTHORS CONTRIBUTIONS

KK: protocol, data gathering, data analysis, authoring the draft. AK: concept, protocol, critically revising the manuscript. HK, GP: critically revising the manuscript.

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Kalliopi KONSTANTOPOULOU

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CV

Kalliopi Konstantopoulou graduated from the School of Dentistry of the National and Kapodistrian University of Athens, Greece in 2016. In 2019, she obtained her master's degree in Health Promotion and Education from the Medical School of the National and Kapodistrian University of Athens and became a postgraduate student at the Department of Prosthodontics (School of Dentistry, National and Kapodistrian University of Athens, Athens, Greece).

Questions

1. According to the socioecological model in health promotion, which of the following factors may deteriorate oral health of older nursing home residents?

- ☐ a. Factors associated with the residents themselves;
- ☐ b. Interpersonal factors;
- ☐ c. Organizational and public policy issues;
- ☐ d. All of the aforementioned.

2. A common side effect of polypharmacy is?

- ☐ a. Gingivitis;
- ☐ b. Periodontitis;
- ☐ c. Xerostomia;
- ☐ d. Teeth discoloration.

3. According to caregivers' perceptions, which is the major barrier to oral care provision?

- ☐ a. Lack of oral care supplies;
- ☐ b. Residents' responsive behaviors and resistance;
- ☐ c. Lack of support by residents' family members;
- ☐ d. Poor cooperation among caregivers.

4. The lack of appropriate oral health policies is related to?

- ☐ a. Poor availability of domiciliary dental services;
- ☐ b. Lack of oral health integration into public health care coverage;
- ☐ c. Poor oral health literacy of the public;
- ☐ d. All of the aforementioned.

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YOUR RELIABLE SUPPORT IN ORAL SURGERY: PIEZOSURGERY® TOUCH BY MECTRON

The experience gained in using a piezosurgery device for several interventions on rabbits in a research study for the University of Hadassah in Jerusalem, Israel, makes me come back to you on piezosurgery.

I have decided to present to you a new piezosurgery device, produced by the well-known company Mectron S.P.A. (via Loreto 15 / A, 16042 Carasco (Ge), Italy), which in 2001 introduced a revolutionary technology for bone surgery, namely piezosurgery.

Piezosurgery provides a number of clinical benefits:

- provides micrometric cuts for minimally invasive surgery, with maximum surgical accuracy and intraoperative tactile sensation
- ensures selective cuts with protection of soft tissues (nerves, vessels and membranes)
- creates a bloodless surgical site with maximum intraoperative visibility through the cavitation effect
- provides maximum safety during bone cutting for both surgeons and patients.

The new device, PIEZOSURGERY touch, has a number of benefits for the patient, due to the technical advantages it furnishes, its precision, safety, ergonomics as well as quality for surgeon.

PIEZOSURGERY® touch has a number of benefits for the patient:

- soft tissue protection
- the risk of perforation is reduced by over 80% in lateral sinus lift surgery
- reduced post-surgical edema
- faster bone integration after preparation of the implant site
- faster and less traumatic post-operative recovery.

Here are the technical advantages of PIEZOSURGERY® touch:

Digital screen:

- all-glass touch screen
- easy to clean
- irrigation and power rate chosen by digital control
- protection of the screen from dirt, scratches or fingerprints by sterile protection foils.

Automatic protection control (APC):

- recognizes deviations from standard operation automatically
- stops power and fluid in less than 0.1 seconds
- shows the cause of the interruption on the touch screen.

Feedback system:

- constant and optimal adjustment of the insert movement
- automatic power detection and consecutive adjustment
- simplified user intervention by depressing the foot pedal.

Working efficiency:

- provides optimal power-to-safety ratio



The PIEZOSURGERY® touch device (Mectron s.p.a. (via Loreto 15 / A, 16042 Carasco (Ge), Italy)

<https://dental.mectron.com/products/piezosurgeryr/units/piezosurgeryr-touch/>

- the intelligent electronic feedback system ensures maximum power and cutting efficiency
- ensures the efficiency, safety and success of each surgery.

Unique handpiece system:

- fully sterilizable handpiece cord system and LED-handpiece
- sterilizable internal irrigation line
- handpiece cord coupling protected against mishandling.

LED-handpiece:

- swivel LED light directed to the insert tip
- choice between automatic, and permanent light or off
- flexible position adaptable to the sterilizable handpiece holder (4 positions).

Flexible irrigation system:

- the irrigation system works with standard parts
- the peristaltic pump tube is reusable
- standard connections for piping
- liquid line integrated in the handpiece cord.

Automatic cleaning function:

- cleaning cycle for the main irrigation tubes of the device
- control provided by the foot pedal.

Foot pedal

- 360° foot pedal control function
- high weight for fix positioning
- easy movement with the U-bolt.

Due to the technical advantages presented above, the PIEZOSURGERY touch device ensures precision, safety, ergonomics and quality for the following categories of surgery: sinus lift technique - crestal and lateral approach, implant and mini dental implant site preparation, extractions / explantation, ridge expansion, corticotomy techniques, bone block grafting, bone chip grafting, bone modeling, endodontics, osteotomy close to nerves, periodontal surgery, and implant cleaning. Due to its main technical specifications and its very clear qualities, the PIEZOSURGERY® touch device is positioned as a reliable support in oral surgery.

Florin - Eugen Constantinescu

DMD, PhD Student

Editorial Director, Product News

[https://doi.org/10.25241/stomaeduj.2020.7\(2\).prodnews.1](https://doi.org/10.25241/stomaeduj.2020.7(2).prodnews.1)

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Basal Implantology

Editor: Gérard M. Scortecchi
 Publisher: Springer Nature, Switzerland
 Language: English
 ISBN: 978-3-319-44873-2
 Edition: 1/e
 Publish Year: 2019
 Pages: 398, illustrated
 Price: € 117,69



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Books Review

Dr. Scortecchi, inventor of Diskimplant and holder of several associated patents, together with his 16 collaborators, drafted a book entitled **Basal Implantology** which explains the principles that underlie the use of basal implants. Diskimplants have been used in oral implantology for over 30 years as an alternative to more invasive procedures in desperate clinical situations and may represent a last chance for an oral invalid to have fixed teeth once again. This book is a guide to the practical application of biological, mechanical, and prosthetic principles of basal implantology and osseointegration (BIO concept), from simple solutions to complex clinical situations without the need for prior bone grafting.


The book is divided into three parts with fifteen chapters.

Part I, *Fundamental Basis*, has five chapters and explains the basic principles, biological aspects, biomechanics, evidence-based basal implantology and initial bone bed activation.

Part II, *Step-by-Step Basal Implantology*, has a more practical approach and in four chapters explains the indications and contraindications, how to establish treatment planning, surgery procedures and prosthetic stages. Finally, *Clinical Applications and Complications*, in six chapters exemplifies single-tooth replacement in the esthetic zone and posterior sectors, how to approach partial edentulism, completely edentulous, atrophic jaws and extreme clinical situations, presents multicenter clinical applications, complications and postimplantation neuropathies.

The book is a practical guide for implant surgeons and helps them find simple solutions to complex and highly demanding clinical situations. To facilitate understanding it is abundantly illustrated with pictures from clinical cases, CT's and radiographs.

Basal Implantology was written to support implantologists to successfully perform oral rehabilitation without more invasive procedures.

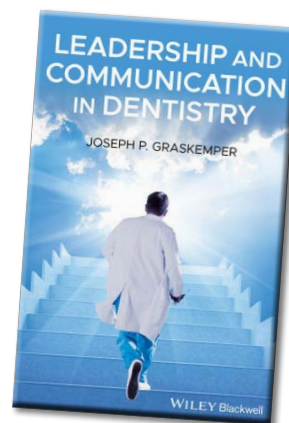
 [http://www.stomaeduj.com 10.25241/stomaeduj.2020.7\(2\).bookreview.1](http://www.stomaeduj.com 10.25241/stomaeduj.2020.7(2).bookreview.1)

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

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Leadership and Communication in Dentistry

Author: Joseph P. Graskemper
 Publisher: Wiley-Blackwell, Hoboken, NJ, USA
 Language: English
 ISBN: 978-1-119-55721-0
 Edition: 1/e
 Publish Year: 2020
 Pages: 176
 Price: € 69.40



Good communication can ensure the success of management in the current dental practice. Dr. Joseph P. Graskemper of the Stony Brook School of Dental Medicine, Stony Brook, NY, USA, has formulated a practical guide addressed to practice, patients and dentists, entitled **Leadership and Communication in Dentistry**.

The book is divided into three sections comprising twelve chapters and an index.

Section 1, *Leadership and Success in Communication with Dental Insurance Companies* covers ways to approach insurance companies, insurance negotiations, preferred provider organization and contractual issues, estimation of benefits problems, appeals letters and leadership to interface with your community.

Section 2, *Leadership, Communications, and Success for Your Practice*, includes communicating with patients, addressing how to listen and motivate both them and the staff and how to institute office policies.

Section 3, *Leadership, Communication, and Success for Your Self*, makes us understand how to use leadership and what are the communication skills necessary to improve one's dental practice.

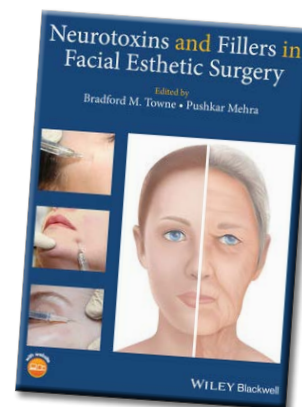
The book is rich in True Case/Examples to better illustrate the issues discussed.

Leadership and Communication in Dentistry is a real guide for any dentist or dental student to learn good communication skills in his activity.

<http://www.stomaeduj.com> 10.25241/stomaeduj.2020.7(2).bookreview.2

Neurotoxins and Fillers in Facial Esthetic Surgery

Editors: Bradford M. Towne, Pushkar Mehra
 Publisher: Wiley-Blackwell, Hoboken, NJ, USA
 Language: English
 ISBN: 978-1-119-29427-6
 Edition: 1/e
 Publish Year: 2019
 Pages: 136, illustrated
 Price: € 112.80



Dental practitioners are increasingly required by their patients to complete their dental aesthetic treatment be completed with common facial cosmetic procedures.

Professor Bradford M. Towne and Professor Pushkar Mehra provide a practical guide that incorporates minimally invasive cosmetic surgery in the book entitled **Neurotoxins and Fillers in Facial Aesthetic Surgery**.

The book has seven chapters, accompanied by an index.

After an accurate description of the facial anatomy and evaluating the patient's characteristics, we are presented with the neurotoxins: cosmetic use of Botulinum Toxin A, cosmetic fillers, Hyaluronic Acid dermal fillers, Radiesse™ Calcium Hydroxylapatite injectable filler, pearls and pitfalls of neurotoxins and facial fillers.

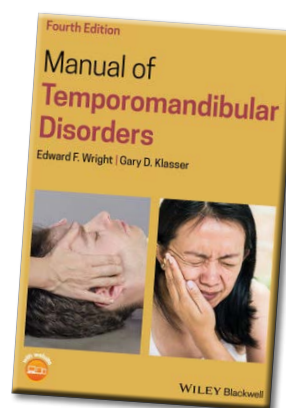
The last chapter synthesizes convincing tools for the introduction of minimally invasive cosmetic surgery in clinical practice. The book is accompanied by a companion website, where the authors present a whole series of clarifying videos. The book is clearly written, exemplified with convincing images, being a useful reference for any oral and maxillofacial surgeon or general dentist, who intends to expand the range of medical services by adding minimally invasive cosmetic surgery.

<http://www.stomaeduj.com> 10.25241/stomaeduj.2020.7(2).bookreview.3

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

Manual of Temporomandibular Disorders

Authors: Edward F. Wright, Gary D. Klasser
 Publisher: Wiley-Blackwell, Hoboken, NJ, USA
 Language: English
 ISBN: 978-1-119-54884-3
 Edition: 4/e
 Publish Year: 2019
 Pages: 416, illustrated
 Price: € 111.10



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Books Review

Lately, clinicians have faced various forms of TMDs. Additional proof to that is the **Manual of Temporomandibular Disorders**, 4th edition by professors Edward F. Wright, University of Texas, USA and Gary D. Klasser, Louisiana State University, USA.

The manual has 6 parts, accompanied by a glossary of terms and an index.

The introduction defines the cardinal signs and symptoms of TMD, stating that approximately 33% of the population has at least one TMD symptom, while 3.67% have severe TMD which causes patients to seek care. Part I, *Initial Evaluation*, presents a patient interview, a review of the "Initial Patient Questionnaire", clinical examination, imaging, TMD diagnostic categories, contributing factors.

Part II, *Common Acute TMD Conditions and Therapies*, describes TMD secondary to trauma, TMD secondary to dental treatment, lateral Pterygoid spasm, intermittent and continuous forms of TMJ disc displacement without reduction with limited opening and TMJ subluxation and luxation.

Part III, *Occlusal Appliance Therapy*, describes and exemplifies stabilization appliance and anterior positioning appliance.


Part IV, *Multidisciplinary Management Approach*, addresses self-management therapy, physical medicine, cognitive-behavioral intervention, pharmacological management, other dental procedures, integrating multidisciplinary therapies.

Part V, *Case Scenarios*, presents 20 clinical cases, from the simplest, symptomatic irreversible pulpitis mimicking TMD symptoms, to the most complex, appliance that positioned condyles into their "proper position".

Part VI, *Fundamentals of Clinical Studies*, synthesizes study designs, from case reports to Randomized Controlled Trial (RCT) and other types of publications.

Each chapter is accompanied by an explicit iconography, but also by the last references on the approached subject. To better understand the book, the authors developed a companion website on patient handouts, examples and additional TMD information.

The book is a good source of information on the field, very clearly written, targeting general dentists, dental students, residents and other practitioners, tempted to effectively address TMD patients.

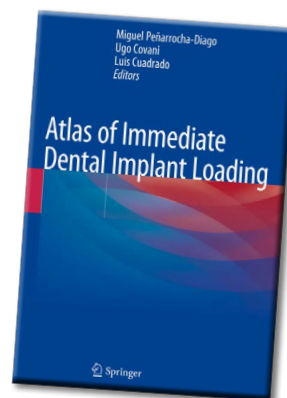
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The Books Review is drafted in the reviewer's sole wording and illustrates his opinions.

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Atlas of Immediate Dental Implant Loading

Editors: Miguel Peñarrocha-Diago, Ugo Covani, Luis Cuadrado
Publisher: Springer Nature, Switzerland
Language: English
ISBN: 978-3-030-05546-2
Edition: 1/e
Publish Year: 2019
Pages: 383, illustrated
Price: € 160,49



Atlas of Immediate Dental Implant Loading by Miguel Peñarrocha-Diago, Ugo Covani, and Luis Cuadrado is a book which shows newly introduced early loading and immediate loading protocols to reduce the total treatment time and to accommodate new patient needs.

The book has 17 chapters and 4 parts.


The Part I, *Biological Principles of Immediate Loading*, presents information about bone biology healing during osseointegration of titanium dental implants, histological evaluation of early and immediately loaded implants retrieved from human jaws and biomechanics and occlusion in immediate loading.

Part II, *Clinical Considerations for Diagnosis During Treatment Planning*, explains how to do general diagnosis and medical evaluation, diagnosis, and planning in immediate loading: implant selection, prosthetic diagnosis, and surgical diagnosis.

The Part III, *Immediate Restoration*, seeks to provide a concise description of the importance and types of provisional restorations available when following an immediate provisionalization approach and also includes a series of cases described in a step-by-step manner. It presents single- and partial multiple-unit provisional, fixed full-arch prosthesis in the edentulous patient, immediate loading in atrophic jaws: zygomatic implants, in all-on-four and of mandibular overdentures.

The Part IV, *Digital Workflow Approaches for Immediate Loading*, explains how to use software and digital workflows to plan and manufacture a surgical guide, and how provisional prosthesis can be inserted immediately after the implant surgery step.

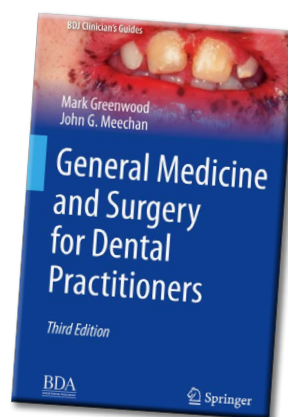
Given that both doctor and patient want stable and aesthetic results over time, this book helps us acquire new knowledge and tools that will ensure the success of our treatments, involving not only new physical elements (intraoral scanner, Osstell, etc.) but also a few strict protocols that will guarantee the best results in our daily practice.

 [http://www.stomaedu.com 10.25241/stomaedu.2020.7\(2\).bookreview.5](http://www.stomaedu.com 10.25241/stomaedu.2020.7(2).bookreview.5)

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

General Medicine and Surgery for Dental Practitioners

Authors: Mark Greenwood, John G. Meechan
 Publisher: Springer Nature, Switzerland
 Language: English
 ISBN: 978-3-319-97737-9
 Edition: 3/e
 Publish Year: 2019
 Pages: 253, illustrated
 Price: € 96,29



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Books Review

The third edition of **General Medicine and Surgery for Dental Practitioners** by Mark Greenwood and John G. Meechan provides a detailed overview of the medical and surgical conditions that affect patients seen in daily dental practice. The book has twenty chapters and ends with an index..

The first chapter focuses on the holistic patient assessment and main components of a medical history. The next nine chapters address the nine types of body systems and their conditions. They explain how to clinically recognize some general conditions, which is the protocol of dental treatment in certain conditions, in which cases the dental treatment can be done in the dental offices and when to be treated in hospital. The most common are cardiovascular, respiratory and gastrointestinal system, neurological disorders, liver disease, endocrine system, renal disorders, musculoskeletal system, hematology and patients with bleeding problems. The following two chapters specifically talk about the pediatric patient and the older patient management in daily dental practice. The keys to successful treatment with this type of patient are: accurate medical history, good examination, rigorous preventive programs, dental intervention at times appropriate to medical care and regular follow-up.


Metabolic disorders, skin disorders, psychiatry, cancer, radiotherapy and chemotherapy and dental practice are the topics of the next four chapters.

Knowledge of all of these disorders will highlight patients who need special precautions to facilitate safe treatment. It is important that dental practitioners are aware of the most common disorders and their potential implications as they are likely to encounter them in clinical practice.

The next chapter presents the currently recommended contents of the emergency drug box as well as the equipment and basic management principles.

The following chapter discusses treatment for specific emergencies, teaches us how to recognize signs and symptoms of relevant medical emergencies and what medicines to administer. The subsequent chapter presents and underlines principles behind maintaining a safe working environment. The last chapter provides an overview of clinical immunology and how it interfaces with dentistry.

General Medicine and Surgery for Dental Practitioners is a book useful to all practitioners, helping them to better recognize and treat patients with certain conditions that can lead to true complications in combination with dental treatments. It is written in an easy way and is accompanied by numerous images to facilitate understanding.

 <http://www.stomaedu.com> 10.25241/stomaedu.2020.7(2).bookreview.6

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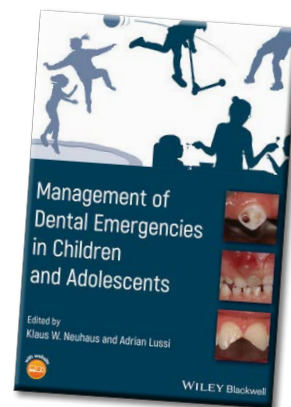
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Management of Dental Emergencies in Children and Adolescents

Editors: Klaus W. Neuhaus, Adrian Lussi
Publisher: Wiley-Blackwell, Hoboken, NJ, USA
Language: English
ISBN: 978-1-119-37264-6
Edition: 1/e
Publish Year: 2019
Pages: 320, illustrated
Price: € 67.80



In order to provide effective and adequate dental care to children and adolescents, general practitioners, pedodontists and non-pediatric specialists must always be up-to-date with novel treatment protocols.

Dr. Klaus W. Neuhaus and Prof. Adrian Lussi present the first edition of the book entitled **Management of Dental Emergencies in Children and Adolescents** based on the Swiss school experience in pediatric dental emergencies.

This book is divided into seven units including twenty-four chapters.

Unit 1, *General Considerations for Emergency Management in Children and Adolescents* recapitulates the main features of tooth development and pulp biology, offers guidelines for the correct indication for antibiotic therapy, behavioural management besides some basic considerations of conscious sedation and management of radiographic needs.

Unit 2, *Management of Tooth Substance Loss* presents methods for managing the deep carious lesion, biological foundation, diagnostic approaches and appropriate treatment modalities for root-fractured teeth, crown and crown-root fractures.

Unit 3, *Management of Open Pulp in Permanent Teeth* describes the pulpotomy protocol after trauma, how to perform pulpectomy with open apex and a step-by-step treatment protocol reflecting regenerative endodontics.


Unit 4, *Management of Open Pulp in Deciduous Teeth* explains methods to carry out a full coronal pulpotomy, the clinical procedure and the outcome of pulpectomy and tooth extractions indication.

Unit 5 develops extensively aspects of *Management of Missing Teeth* such as resin-bonded restorations, treatment protocol of an avulsed permanent tooth, ankylosis and external root resorption after trauma and orthodontic treatment aspects at various ages.

Unit 6, *Management of Oral Health Conditions*, focuses on the most common viral diseases affecting the oral mucosa, with special emphasis on children, non-infective swellings and oral problems in patients undergoing haematology or oncology treatment.

Unit 7, *Management of Non-infective Dental Conditions* covers molar – incisor hypomineralisation (MIH) treatment, clinical management of dentin hypersensitivity (DH) and cracked tooth syndrome (CTS) treatment.

This book is a unique manual for general practitioners, non-pediatric specialists and pedodontists, accompanied by a companion website and has numerous images, graphs, radiographs and also clinical cases. This book will help you manage potentially stressful situations with children and adolescents while improving your competence in a wide range of urgent pediatric situations.

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The Stomatology Edu Journal (Stoma Edu J) is a quarterly international journal, double blind peer-reviewed, open access journal to be database indexed, which accepts original articles for publication in all aspects of dental development and research. It addresses those interested in oral and maxillofacial sciences including students, graduates, postgraduates, educators, researchers, dental practitioners, those involved in dental industry and policy-makers relevant to the practice of dentistry.

1. Submission Instructions

The Stomatology Edu Journal (Stoma Edu J) publishes articles written only in English. All articles will be accompanied by the signed copyright form which can be returned by e-mail, fax (as scanned documents). All the responsibility for the originality of the material sent belongs to the author(s) alone. Each article will be evaluated by the peer-review committee composed of two independent peer-reviewers, in a blinded fashion, according to the peer-review protocol. All manuscripts must be original and exclusive. The Stomatology Edu Journal Editor will consider only articles that are original, have not been published elsewhere and have been submitted exclusively to the Stomatology Edu Journal. The manuscripts should be submitted online at www.ManuscriptManager.net/stom.

2. Ethics in publishing

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3. Articles sent for publishing

The Stomatology Edu Journal (Stoma Edu J) publishes: original articles; reviews; case reports; technical procedures; consensus declaration coming from an association or from a group of specialists; letters to the editor. All articles must be up to 3,000 and 5,000 words for meta-analysis (the word count is for the manuscript text only). Letters to the editor must not exceed 400 words of text and have no more than 3 authors. Letters to the editor can be related to an article already published in the journal or it can represent original scientific contributions or events news/presentations etc. of interest for the reader.

4. Permissions and Ethics

For citations, tables, figures etc. which are not original, these must be accompanied by the written permission for their use and the full reference must be provided. Photographs of identifiable persons must be sent alongside the written permission of the person(s) and all regions that may allow the identification of the subject must be covered. The author must have obtained, for all studies including human subjects, the permission of the subjects to be part of the study whilst keeping their anonymity. By sending the article, the author declares that

he obtained this permission from all his subjects. All studies must respect the Helsinki Declaration (1975). For human and animal studies, the authors must have obtained the approval of the ethics committee from the University/Institute/etc. where the study was done. Consent for publication is required for studies involving human subjects - ALL case reports, letters that describe cases and some original articles. Cohort studies are exempt; instead evidence of IRB approval (name of IRB, date of approval and approval code/reference number) must be provided.

5. Manuscript preparation

The article must be written in conformity with the general recommendations of the International Committee of Medical Journal Editors. <http://www.icmje.org/icmje-recommendations.pdf>

The Stomatology Edu Journal (Stoma Edu J) uses double-blind review, which means that both the reviewer and author name(s) are not allowed to be revealed to one another for a manuscript under review. The identities of the authors are concealed from the reviewers, and vice versa. To facilitate this, please include the following separately:

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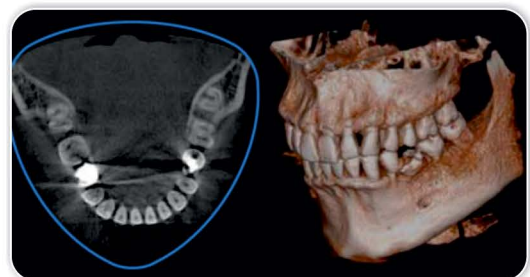
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