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Clinical application of individualized 3D-Printed templates in the treatment of Condylar Osteochondroma

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Background: Osteochondroma (OC) is one of the most common benign tumors of the long bones, but it rarely occurs in the maxillofacial skeleton. However, mandibular condylar OC often leads to severe facial deformity in affected patients, including facial asymmetry, deviation of the chin and malocclusion. This study aimed to explore the clinical application of individualized 3D-printed templates to accurately and effectively treat condylar OC. Methods: A total of 8 patients with mandibular condylar OC were treated from July 2015 to August 2021. The enrolled patients (5 women and 3 men) had a median age of 27 years (range: 21–32 years). All patients exhibited symptoms of facial asymmetry and occlusal disorders preoperatively. The digital software used to virtually design the process consisted of three-dimensional reconstruction, 3D-cephalometry analysis, virtual surgery, individualized templates and postoperative facial soft-tissue prediction. A set of 3D-printed templates (DOS and DOT) were used in all cases to stabilize the occlusion and guide the osteotomy. Then, pre- and post-operative complications, mouth opening, clinical signs and the accuracy of the CT imaging analysis were all evaluated. All the measurement data were presented as means ± SD; Bonferroni and Tamhane T2 multiple comparison tests were used to examine the differences between the groups. Results: All patients healed uneventfully. None of the patients exhibited facial nerve injury at follow-up. In comparing the condylar segments with T0p and T1, the average deviation of the condylar segments was 0.5796 mm, indicating that the post-operative reconstructed condyles showed a high degree of similarity to the reconstruction results of the virtual surgical plan. Conclusions: Individualized 3D-printed templates simplified surgical procedures and improved surgical accuracy, proving to be an effective method for the treatment of patients with slight asymmetric deformities secondary to condylar OC.

Recent publications

1. Ma, W.; Niu, S.; Wang, L.; Peng, C.; Fu, S.; Zhang, C.; Cui, Q.; Wang, S.; Li, M.; Xu, Y. Clinical Application of Individualized 3D-Printed Templates in the Treatment of Condylar Osteochondroma. Healthcare 2022, 10, 2163.
2. Wang L#, Ma W#, Fu S, Zhang C, Cui Q, Peng C, Li M*; Design and manufacture of dental-supported surgical guide for genioplasty. Journal of Dental Sciences. 2021;16(1):417-423.
3. W. Ma; L.D. Wang; Y. Liang□M. Li*□Application of a digital guide in the removal of foreign body from the maxillofacial region. British Journal of Oral and Maxillofacial Surgery. 2019;57(7):708-709.

Biography

Ma Wen is an oral and maxillofacial surgeon from KunMing medical university in China and the research areas include application of biomedical materials, digital technology in stomatology. The treatment is the combination of digital methods and medical ways which contains removal foreign body, TMJ ankyloses and orthognathic surgery. From these years, the digital technology is improving in oral and maxillofacial surgery which help surgeons shorten operation time and improve surgical accuracy. We hope that our work can help other doctors in the future.

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Genetic approach to orthodontic external root resorption

Damla Cardak
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External apical root resorption (EARR) is one of the most frequent iatrogenic effects of orthodontic treatment, resulting in loss of the dental structure of the root apex that mainly affects the maxillary incisors. EARR was first reported by Ottolenghi in 1914 as a complication of orthodontic treatment. The first comprehensive study on EARR was made by Ketcham in 1927. Harris et al. reported the hypothesis of genetic influence on EARR using the sib-pair model with high heritability about 70% in 1977.

Al-Qawasmi et al who investigated the relationship between the polymorphism in interleukin IL-1 (IL-1A and IL-1B) genes and external apical root resorption, stated that the force applied by orthodontic treatment alone or the appliance type was not responsible for root resorption.

Another candidate gene for orthodontic forces-induced root resorption is tissue non-specific alkaline phosphatase (TNSALP), which encodes a protein that has an important function in the cement formation and root mineralization process.

Following studies in this area also show that it is essential to develop a robust and well- structured genetic predisposition database that can be used in orthodontic practice to ensure that 'high-risk' individuals are identified based on their genetic information before initiating orthodontic treatment.

Recent publications

1. Hartsfield JK Jr, Everett ET, AL-Qawasmi RA. Genetic factors in external apical root resorption and orthodontic treatment. Crit Rev Oral Biol Med 2004;15:115–122.
2. Ottolenghi R. The physiological and pathological resorption of tooth roots. Dent. Items Int. 1914;36:332–355.
3. Ketcham AH. A preliminary report of an investigation of apical root resorption of permanent teeth. Int J Orthod Oral Surg Radiograph 1927;13:97-127.

Biography

She graduated from Vefa High School in 2008. She completed her undergraduate education at Istanbul university faculty of Dentistry in 2015. Later, she increased her clinical experience in general dentistry. She started associate degree education in Anadolu University Open education faculty management of Healthcare organizations and finished in 2022. In 2021, she started her doctorate education at Izmir Katip Celebi University, Institute of Health Sciences, Department of Orthodontics.

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Who manages tooth movement in orthodontics? mechanics versus histology?

Ozkan Buyuk
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Tooth movements occur systematically, thanks to the regular responses of the tissues, in order to maintain the balance against biological and mechanical stimuli. The most important factor affecting the amount of tooth movement is remodeling in the alveolar bone. Different methods to move teeth faster have been tried for years.

The teeth are moved with brackets and wires in the bracket slot. In the mesiodistal movement of the tooth, a friction occurs between the bracket and the wire, as happens in all mechanics in nature. 40-50% of approximate force applied for tooth movement is used to overcome the friction resistance. It is not applicable to apply too much force to the teeth in order to overcome the friction force. Very heavy forces cause undesirable movements or immobility of the teeth, pain and loss of anchorage.

Although a limited number of cells in the affected area are activated as a result of cellular activation provided by mechanical appliances, it has been suggested that all or most of the cells in the area are activated by chemical and physical applications. In this respect, studies on the benefits of locally applied agents in orthodontic treatment have been increased.

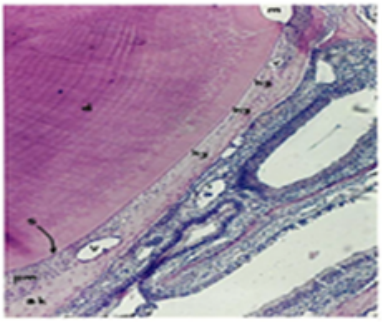

Figure 1: In Karadede's study examining experimental orthodontic tooth movement in rats using low-dose aspirin, the hyalinization area in the pressure region of the upper medial region of the periodontal membrane (Harris Hematoxylin-Eosin x 30).

(m) enamel
(d) dentin
(s) cementum
(v) blood vessel
(ak) alveolar bone
(hy) hyalinization
(pm) periodontal membrane

Recent publications

1. Davidovitch Z., Krishnan V., Role of basic biological sciences in clinical orthodontics AJO 2009; 135:222-31. https://doi.org/10.1016/j.ajodo.2007.03.028

2. Tanne K, Matsubara S, Hotei Y, Sakuda M, Yoshida M. Frictional forces and surface tophography of a new ceramic bracket. Am J Orthod Dentofacial Orthop 1994;106(3):273-278. https://doi.org/10.1016/s0889-5406(94)70047-8

3. Proffit WR, Fields HW, Sarver DM. Contemporary Orthodontics. Fourth Edition, Missouri, Elsevier Health Sciences. 2007; 359-394. ISBN: 9780323093002.

Biography

Ozkan Buyuk graduated from Faculty of Dentistry, Gazi University in 2006. In his undergraduate education, he also studied at Cardiff

University within Erasmus Student Exchange Program. After graduation, he started his postgraduate education at Gazi University, Institute of Health Sciences, Oral Pathology Program. In 2013, he did internship and studies on molecular biology at the Department of Pathology, Faculty of Medicine, Cologne University. Between 2014-2019, he worked as a lecturer at Nisantasi University Dental Prosthesis Technology Program. He also got enrolled in undergraduate education in Anadolu University Open Education, Healthcare Management Program in 2017. In 2019, he started his doctorate education at Izmir Katip Celebi University, Institute of Health Sciences, Department of Orthodontics. In 2020, he was appointed to the Oral and Dental Health Program of Izmir Katip Celebi University Vocational School of Health Services. He continues his clinical and academic studies in orthodontics and lectures at associate degree level.

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Facial Biometrics : Important guides in diagnosis and planning in upper anterior Dental Oral Rehabilitation

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Background/ Objectives and Goals: The goal of present study is to determine the individual shape and dimensions for the permanent upper central incisors, for the oral rehabilitation patients, based on the facial and biometrics measurements.

Methods: A group of 20 young dentate volunteers were photographed and captured their faces and their permanent upper central incisors. Using virtual measurements, the following dimensions were determinate for each participant: the inter-pupillar distance (IPd), inter-zigomatic distance (IZd), the horizontal dimension of the facial contour on the occlusion plane (Hd), the vertical dimension of the facial contour on the medial-sagital plane (Vd) and the fascial contour and the central permanent upper incisor contour. Based on the measurements and face contour, the overlap of photographs was made using digital Software.

Expected Results/ Conclusion/ Contribution: The average measurements obtained are:(Ipd= 62 mm) for the inter-pupillar distance, (Izd=135 mm) for the inter-zigomatic distance, (Hd=114 mm) for the horizontal dimension and (Vd=110 mm) for the vertical dimension. On the other hand, by virtual overlap of the two contours (the facial contour and the permanent upper central incisor's contour) and their afferent surfaces, a similarity between the face shape and the shape of the permanent upper central incisor was highlighted with up to 90% mach. The oral rehabilitation treatment can be done individually and integrated for each patient, in harmony with facial biometrics.

Keywords: oral rehabilitation, facial biometrics, permanent upper central incisor, face shape

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Raman spectroscopy, *In vivo* application for bone evaluation on dental surgery and periodontology. Possible alternative to histology

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Our days, there is a large number of surgical techniques involving the implantation of various types of bone graft and /or bone substitutes in order to achieve periodontal regeneration. Despite positive observations in animal models and successful outcomes reported for many of the available regenerative techniques and materials in patients, including histologic evidence, robust information on the degree to which reported clinical improvements reflect true periodontal regeneration remains just limited. It is requested a method adapted for a quik evaluation of the bone and precise in the mean time.

For the bone tissue, at micro level octacalcium phosphate (OCP, Ca8 (HPO4)2(PO4)4·5H2O,) is considered very important because it is regarded as an *in vivo* precursor of HA. Trying to find traces for phase transition of OCP to HA, the presence of HA nano rods and plate-like HA particles can be utilized as signs of bone good quality evidenced by SEM investigation (Fig. 1 b). The normalized peak intensity values, are related to each compounds concentration.

A group of ten patients was involved to our study. Investigation was performed by RAMAN technique, first *in vivo* and then *in vitro* for the harvested bone samples.

There were evaluated / compared the following peaks, for *in vivo* and then *in vitro* for the harvested bone samples (Fig 1 a):

- 430 – 450 cm-1 (v2, PO43-);
- 955 – 960 cm-1 (HPO4 2-, immature bone);
- 960 – 965 cm-1 (mineral bone, mature bone);
- 1023 cm-1 (P2 O7 4- ; PPi, inorganic pyrophosphate)

Raman method adapted for"*in vivo*" bone quality evaluation, is much less invasive then the well-known CT (computer tomography) or CBCT (con beam computer tomography) already used and more accurate. For this purpose, the Raman probe was modified with a "special cap" in order to assure regular sterilization for *in vivo* use.

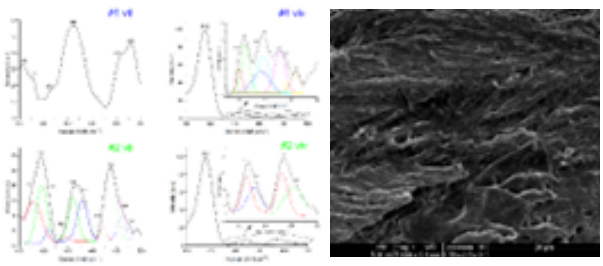

Figure.1. (a) Raman spectra for patients (#1, #2) *in vitro* and *in vivo*; (b) SEM micrograph patient #1.

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Evaluation of the effects of human dental pulp stem cells on the biological phenotype of hypertrophic keloid fibroblasts

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Objective: Despite numerous existing treatments for keloids, the responses in the clinic have been disappointing, due to either low efficacy or side effects. Numerous studies dealing with preclinical and clinical trials have been published about effective therapies for fibrotic diseases using mesenchymal stem cells; however, no research has yet been reported to scientifically investigate the effect of human dental pulp stem cells (HDPSCs) on the treatment of keloids. The objective is to provide an experimental basis for the application of stem cells in the treatment of keloids. Methods: Human normal fibroblasts (HNFs) and human keloid fibroblasts (HKFs) were cultured alone and in combination with HDPSCs using a transwell cell-contact-independent cell culture system. The effects of HDPSCs on HKFs were tested using a CCK-8 assay, live/dead staining assay, quantitative polymerase chain reaction, Western blot and immunofluorescence microscopy. Results: HDPSCs did not inhibit the proliferation nor the apoptosis of HKFs and HNFs. HDPSCs did, however, inhibit their migration. Furthermore, HDPSCs significantly decreased the expression of profibrotic genes (CTGF, TGF-β1 and TGF- β2) in HKFs and KNFs ($p < 0.05$), except for CTGF in HNFs. Moreover, HDPSCs suppressed the extracellular matrix (ECM) synthesis in HKFs, as indicated by the decreased expression of collagen I as well as the low levels of hydroxyproline in the cell culture supernatant ($p < 0.05$). Conclusions: The co-culture of HDPSCs inhibits the migration of HKFs and the expression of pro-fibrotic genes, while promoting the expression of anti-fibrotic genes. HDPSCs' co-culture also inhibits the synthesis of the extracellular matrix by HKFs, whereas it does not affect the proliferation and apoptosis of HKFs. Therefore, it can be concluded that HDPSCs can themselves be used as a tool for restraining/hindering the initiation or progression of fibrotic tissue.

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Advanced ceramics in Implant Dentistry: InPerio® Implant System

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The interest in ceramic implants has been renewed as an important and wide research goal. Nowadays, certain advanced ceramic materials make it possible to combine the versatility of titanium-based implantology and the biological benefits of traditional ceramic-based implants. These disruptive materials expand the boundaries of conventional ceramics in terms of mechanical properties, material engineering, surface topography, biological integration, aesthetics, microbial adhesion and long-term success of dental implants. The goal of this lecture is to provide an overview of the technical progressions in advanced ceramics for dental implantology and the preclinical and clinical evaluation of new ceramic dental implants designed to provide modern implantology. Specifically, new ceria-stabilised zirconia and alumina (Ce-TZP/Al) shows superior fracture toughness than other ceramic materials and exhibits semi-plastic deformation (ceramic ductility), a key factor in modern implant design. Based on the features of this new advanced ceramic, the InPerio® Implant System overcomes the gap between the versatility of cutting-edge titanium implants and the biological advantages of ceramics. Clinically speaking, InPerio® is suitable for immediate loading protocols and direct screwing to the implant with primary stability, even in extremely compromised cases. Prosthetically, InPerio® has a multiunit connection that allows the use of straight or dynamic screws and rotatory or anti-rotational systems for multiple and single restorations (respectively) and allows for a complete digital work-flow.

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Regulation of orthodontic Tooth movement by stem cells

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During orthodontic tooth movement (OTM), the tooth relocates to a new periodontal position formed by alveolar bone and periodontal ligament remodeling. Instrumental to this process and to the maintenance of homeostasis in periodontal tissues are an unique group of multipotent stem cells residing in the periodontal ligament, called periodontal ligament stem cells (PDLSCs). PDLSCs can respond to mechanical (orthodontic force), environmental (hypoxia) and biological (paracrine signals) stimuli present during OTM and orchestrate it both directly (osteogenic differentiation and osteogenesis, collagen regeneration in the extracellular matrix of the periodontal ligament) and indirectly (paracrine signaling with other cell types to promote angiogenesis, osteoclastogenesis or recruiting of circulating cells to the periodontal ligament). The understanding of the mechanisms through which PDLSCs govern OTM, as well as the stimuli which cause this response and the different signals and messengers involved could give rise to development of future therapies leveraging modulation of endogenous PDLSCs activity to control OTM, adding Orthodontics to the growing number of disciplines which benefit from the application of stem cell therapies, for many the next revolution in Medicine.

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Development and initial validation of the Oral health activities questionnaire

Slavica Kozina
Split University School of Medicine, Croatia

Statement of the problem: The purpose of this study was to introduce a new Oral Health Activities Questionnaire (OHAQ, hereinafter) that examines different activities and behaviours related to the oral hygiene regimen of each analysed subject.

Methodology & Theoretical Orientation: A sample of 658 students was analysed to determine the OHAQ scale's basic metric characteristics. To determine the construct validity of the OHAQ, descriptive statistics and correlation analysis, as well as differences testing, were applied to groups of subjects on the basis of self-reported oral status measures.

Findings: The dimensions of oral health activities were determined and the scales for their measurement were constructed. Females and males differed in the OHAQ questionnaire measures. Significant but low inter-correlations were found among the measures. In the female and male subsample, four different oral health (OH, hereinafter) types of subjects were identified, exhibiting different characteristic behaviours regarding oral health. OHAQ scales showed good discriminant validity, revealing the differences related to specific self-reported oral status measures (e.g., frequency of toothache and the number of filled teeth).

Conclusion & Significance: The OHAQ represents a satisfactory measurement instrument for determining the level of OH activities and for doing quick and reliable classifications of the participating subjects according to their OH activities and behaviours. The process of further validation and advancements of the OHAQ scales and measures should be continued through a clinical examination of subjects.

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