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CONTENTS

EDITORIAL

sciendo

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The connection between oral pathology and systemic diseases.

Laura Ștef

Lucian Blaga University of Sibiu, Romania.

If the eyes are the "mirror of the soul", then oral cavity often reflects the state of health of the whole body. Oral pathology is the specialization at the border of dentistry and different medical specialties, which analyze diseases that occur at the level of the oral cavity without a dental or surgical cause. This connection is demonstrated by a two-way mechanism: (A) any change in the homesostasis of the tissues in the oral cavity may induce changes in the rest of the body, and (B) any systemic disease may influence the development and reactivity of the tissues in the oral cavity.

(A) Change in the homeostasis of the tissues in the oral cavity may induce changes in the rest of the human body

Studies show that there is an ecosystem of different microbial species that maintain oral health as long as it is in balance. Joshua Lederberg, used the term "microorganisms" to describe an ecological system of commensal, symbiotic, and perhaps pathogenic microorganisms that reside in the human body [1].

The oral microbiome has a special role in metabolic, immunological and endocrine homeostasis. The balance of the different bacterial species ensures health status. The basic pathogens co-exist with many cultivable germs, their interactions determine dysbiosis [1,2].

While immune evasion is one of the major ways that leads to dysbiosis, new processes and new virulence factors of bacteria have been shown to be involved in this important process that determines a disease or health state [2]. The transformation of these comensal species into an opportunistic flora, capable of producing the parodontal disease, is more of a host organism than of the bacterial species. Key pathogens interact with other bacteria and their interactions cause dysbiosis [3].

Periodontal degradation creates a suitable medium for the multiplication of specific microbes. Deep periodontal pockets provide an oxygen-free environment that creates an environment favorable to anaerobic bacteria. This theory concentrates on such dysbiotic congregations, their reciprocations and their virulence coefficients that predispose hosts to others systemic involvements [2,4]. Periodontal diseases, influenced by age, gender, smoking, oral hygiene, patient genomics, daily stress, are related to bacteremia and endotoxemia, arteriosclerosis, myocardial infarction, pregnancy complications, insulin resistance, obesity, type 2 diabetes, oral cancer, pancreatic cancer, liver disease, respiratory infections, rheumatoid arthritis, osteoporosis [5-7].

A1. The link between chronic periodontitis (CP) and cardiovascular diseases (CD)

In the larger context and given the evident high prevalence of chronic oral infections, early associations were sought between the presence of oral infections and cardiovascular events. Existence of systemic predisposition to periodontitis and relationship between local periodontal disease and systemic inflammatory and immune changes was observed. In principle two types of mechanisms are involved: bacteria from the periodontal disease may enter circulation and directly contribute to the development of atheroma plates (or thrombosis) and/or systemic inflammation, resulting from periodontitis, may contribute to

atherosclerotic cardiovascular disease. A biological mechanism suggest that bacteria or their toxic products can easily gain access to the circulatory system. Bacterial episodes were detected after normal activity, such as chewing or brushing of teeth. Similar to bacterial release, excessive local production of pro-inflammatory cytokines can gain access to blood and trigger an acute systemic response. So, patients with periodontal damage have higher levels of CRP and interleukin 6, compared to a healthy control group. For example, Prevortella gingivalis, aterogenic bacteria, uses the Trojan horse method. The bacteria flow freely through the blood and induces HDL oxidation, damaging the atheroprotective function of HDL [8]. Chronic inflammatory processes that may amplify vascular inflammation in atherosclerosis [9].

A2. The correlation between periodontal disease and pregnancy problems

Several studies have assumed that periodonal diseases can trigger premature birth, and are the cause of reduced fetal weight at birth, so, consideration was given to the possible hematogenic invasion of the hourly pathogens and their metabolites, the circulation of inflammatory products through blood flow, as well as immune responses of the mother/fetus from pathogens [10,11].

A3. The correlation between periodontal diseases and cancer

Clinical studies have observed higher risks of oral, gastro-intestinal, lung and pancreatic cancer in subjects with periodontal disease [12,13]. WHO recognizes that there is an obvious relationship between the oral microbiome and carcinogenicity through the existence of Human Papilloma Virus (which cause oral cancer) and Ebstein Barr Virus (who is involved in nazo-pharingeal cancer) [14,15].

A4. Correlation between oral microbiota and rheumatoid polyarthritis

The presence of chronic inflammation in rheumatoid arthritis alters the symbiosis in the oral cavity leading to a decrease in 'good' bacteria and an increase in the number of pathogenic bacteria (Prevotella spp., Selenomonas spp.) [16]. In rheumatoid arthritis, the history of infections and oral microbes play an important role in the pathogenicity of this disease, along with genetic predisposition, gender, immunological context [17]. The presence of inflammation of the host increase the pathogenicity of microbes in the oral cavity. The success of treatment with anti-inflammatory medication also partially solves oral dysbiosis [18].

(B) Systemic disease may influence the dislotion and reactivity of the tissues of the dental system

The oral cavity is considered the "indicator barometer"/"primary alarm signal"/"primary diagnostic key" of multiple general conditions [19]. Mostly, the oral mucosa can be the place of self-manifestations, easy to diagnose, determined by local factors. Systemic factors may also be involved in the appearance of these lesions, so that the effects of lesions appearance may be the first signs of systemic diseases, or manifestation of diseases, or side effect of drug administraton.

Oral cavity is frequently involved in systemic disorders (haematological, rheumatismic, digestive, endocrine diseases). Sometimes it is the dentist who provides an early diagnosis and management, which can often reduce the morbidity associated with systemic disease, improve the quality of life and reduce the costs of treatment [20].

B1. Oral manifestations in haematological diseases

Among the many conditions which may be encountered in the oral cavity, those in the sphere of haematological disorders should be an area of extreme responsibility for the dentist in the way any treatment is dealt with.

Most of the times, a patient with diagnosed leukemia goes to his dentist for the treatment of oral lesions, without suspecting that their

nature is more than local. Leukemia is a disease characterized by progressive overproduction of white corpuscles usually occurring in circulatory blood. This proliferation of white corpuscles or their precursors occurs in such an unorderly and independent manner that leukemia is generally considered a true malignant tumor, especially as the disease is so often fatal. Typical oral manifestations of acute leukemia include gingival swelling, spontaneous gingival bleeding oral ulceration, petechiae, mucosal pallor, oral candidosis and herpetic infections. Other symptoms include fever, fatigue, pallor, mucosal bleeding, petechiae and local infections leukemic gingival enlargement [21]. Anemia and thrombocytopenia are characteristic of acute leukemia. Gingival hyperplasia, which is one of the most constant characteristics of the disease is usually generalized and varies in severity. The gingiva is edematous and of a bright red, and bleed slightly. Gingival edema is due to leukemia infiltration in areas with chronic mild irritation. Purple lesions of the buccal mucosa similar to skin ecchymosis may also be observed [22,23]. Spontaneous gingival hemorrhage is due to ulceration of the sulcular epithelium and the necrosis of the underlying tissue, and serious ulceration of the nomadic oral mucosa may occur. Thrombosis of gingival vessels seems to contribute to this phenomenon. The mobility of teeth has been observed due to the impairment of the periodontal ligament, and in some cases bone resorbtions also occurs. In early diagnosis and treatment of leukemia it is important to improve the opportunity to resubmit patients' condition. The dentist can play an important role in identifying oral events in this disease and ordering appropriate haematological tests to confirm the diagnosis of leukemia [22,24]. Other hematologic conditions eg. anemia can enclose mucosal pallor, atrophic glossitis, and candidosis. In thrombocytopenia, severe periodontal inflammation or bleeding or ecchymosis can be the first signs [25]. Cyclic neutropenia is a rare acquired disease caused by gene mutation for neutrophil elastase. Patients usually have a fluctuating number of neutrophils and severe neutropenia that occurs every 3 weeks and lasts 3-5 days. During these periods, patients may report recurrent fever, lymphatic nodules, foot-and-mouth ulcers, malaise and pharyngitis. Other oral manifestations may include gingivitis, and gingival ulceration [26,27].

B2. Oral manifestations as first signs in the dermatological diseases

In lupus erythematosus, the reported incidence of oral lesions is between 8-45% in the patients with systemic lupus erythematosus, and 4-25% in the patients with discoid lupus erythematosus [28,29]. The oral lesions vary very much, from the classic presentation of an oral discoid lesion with a very well delimited area of erythema, and atrophy, to ulceration enclosed by white, and radiating striae. All these lesions arise to be like those which exist in the patients suffering by erosive lichen planus [30,31]. In pemphigus vulgaris, the oral lesions appears as an initial manifestation in 50-80% of the patients affected by pemphigus vulgaris, and the disease can be preceded by skin lesions one or more years prior. The patients typically endure painful, diffuse oral ulceration [32-33].

B3. Oral manifestations in inflammatory bowel diseases and autoimmunne diseases

Inflammatory bowel diseases such as Crohn's disease and ulcerative colitis often lead to oral ulcers. Patients experience abdominal pain, diarrhea, fever, fatigue, weight loss, anemia, and all can be detected by a careful history, although oral signs may precede general symptoms. Crohn's disease is a granulomatous inflammatory condition of unknown etiology, although genetic, immunological, environmental, microbial, dietary, and vascular factors have been implicated. It alters the ileum and the large intestine in more than 90% of the patients [34]. It is frequently associated with foot-and-mouth disease. The patients with Crohn disease can present diffuse swelling and oedema of the oral

mucosa, with cracks heaving "cobblestone mucosa" aspect, respectively localised mucogingivitis/cheilitis. In addition, patients may also have pustular and ulcerative lesions in the oral cavity (pyostomatitis vegetans). The pustules usually fuse and then break, leaving superficial erosions [35].

Gluten enteropathy (celiac disease, an autoimmune disease), is caused by a reaction to gliadin. Foot-and-mouth ulcerations are found in 3% to 61% of patients with defects of the enamel. If there is suspicion of this disease, haematological tests for anti-gliadin, anti-endomysial and tissue anti-transglutaminase antibodies should be carried out. Signs and symptoms can be removed by a gluten-free diet, and vitamin B12 [36,37].

B4. Oral manifestation in Covid 19

SARS-CoV-2 infection is the direct cause or is predisposing factor in oral lesions. The new coronavirus possibly has the capability to modify the equilibrium of the oral microbiota, which added to a low responding immune system permits the colonization of the opportunistic microorganisms. SARS-CoV-2 may induce an immune response similar to that observed in other viral disorders in the oral cavity [38]. The oral cavity is an ideal habitat for SARS-CoV-2, due to their particular affinity for the cells with receptors for the converted angiotensin enzyme (ACE2), existent in the respiratory tract, in the mucosa of the oral cavity, and in salivary glands [39]. It is capable to alter the integrity and functionality of the oral mucosa and of the salivary glands, including dysfunctionalities in the sensations of taste and smell [40]. Salivary glands may be the target of SARS-CoV-2 because AEC2 receptors are present in the glandular channel epithelium. This explains why SARS-CoV2 could be detected in human patient saliva [41]. Oral manifestations associated with Covid 19 are agusia, oral ulcerations, occurring in patients who have not had in the past episodes of recurrent ulcerations, saburral tongue, dry mouth, candidosis.

For intubated patients, poor hygiene, disturbances of the balance of the oral microbiocenosis are the result of systemic therapies, and changes in the intra-oral environment may lead to additional respiratory problems [42].

In conclusion, knowledge and connections in the patient's medical history, respectively early highlighting of the oral mucosa lesions are extremely important in establishing the correct diagnosis and prognosis of affections.

Conflict of interest: None to declare.

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ORIGINAL RESEARCH

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Changes in head posture after rapid palatal expansion in mouth-breathing children.

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Abstract

Introduction. It is well known that previously has been demonstrated a correlation between respiratory function and the harmonious craniofacial development and head posture respectively.

Aim of the study. The purpose of this study was to investigate the correlation between rapid maxillary expansion (RME) and the change in natural head position (NHP) resulting from the consequent change in airway resistance and to elucidate how RME influences NHP in terms of cephalometric angles in children with nasal obstruction.

Material and methods. The study included 12 girls and 8 boys who had a history of mouth breathing, as confirmed by the parents and ORL specialist and due to this fact, they underwent RME as part of orthodontic treatment. Dental casts, clinical photographs and lateral skull radiographs exposed in natural head position were obtained at the first visit (T1) and 8-10 months (T2) later for all subjects. In order to evaluate the patient's lateral skull radiographs, I used AudaxCeph software, within which I created a new type of analysis. Student T test and Pearson correlation test were used to statistically analyze the results.

Results. Our findings demonstrate that no significant changes in any of the variables are observed in patients treated with rapid maxillary expansion, however a positive correlation was observed in the variables measured before and after the treatment, respectively between the anomaly and the measured values. Positivity can also be detected when examining the correlation between the patient's gender and the measured values.

Conclusions. Based on the obtained results, we cannot state that there is a correlation between rapid maxillary expansion and cervical posture.

Keywords: head posture, children, nasal obstruction, rapid maxillary expansion, rapid palatal expansion.

Introduction

In the last few decades, the relationship between airway and the head posture was intensively examined by numerous researchers [1-3]. Clinicians are in complete agreement about the fact that, an important etiologic factor of the growth of the craniofacial structure is the respiratory function. In the orthodontic literature, Melvin Moss introduced, for the first time, the "functional matrix". He claimed that the facial development and growth of the individual is correlated to the functional activity of various structures of the head and neck, then it can be stated that oral respiration results in physiological changes of the facial skeleton and in addition in malocclusions [4-6].

In 1968 Ricketts has elucidated a connection between head posture and respiratory functional needs, demonstrating that head extension is a defensive compensatory functional mechanism that helps to keep the ability of the nasopharyngeal airways. Nasal obstruction is compensated by an altered position of tongue and soft palate which facilitates oral respiration [7].

Longitudinal studies, for example Linder-Aronson and co-workers have shown that patients with enlarged adenoids, tonsils, or other forms of airway obstruction have different craniofacial growth than patients who do not present airway obstruction in their history. Two months after adenoidectomy, Solow and Greve, as well as Woodside and Linder-Aronson, found a 2-degree decrease in craniocervical angle and the postural discrepancies between the control group and the children with various respiratory diseases were eliminated [8-11].The typical extraoral appearance of children with respiratory impairment caused by chronic nasopharyngeal obstruction is called "adenoid facies", which includes open mouth posture, hypotonic lips, compression of the upper arch,

decreased transverse dimension of the maxilla, high palate vault, lateral occlusal bite and increased lower facial height [5]. Given that the typical malocclusion associated with respiratory obstruction is characterized by a transverse decrease in the palatal dimension, the primary method used to treat the insufficient transverse dimension of the maxillary base is rapid maxillary expansion (RME), which was introduced by Angell in the 1860s to treat maxillary compression [12-14]. RME is an effective procedure for correcting transverse discrepancies of the maxilla, exerting its enlargement effect on the jawbone through the "rupture/opening" of the medial palatine suture, resulting in the separation of the two maxilla halves to achieve true orthopedic expansion [15-17].

The use of RME was used by Derichsweiler and Korkhaus to increase airway patency. Gerlach advised that although RME is useful in nasal stenosis, not all mouth breathers can be treated this way [1, 18]. Linder-Aronson and Aschan, Hershey et al., Loreille and Béry showed evidence of an improvement in nasal respiration in patients treated with RME, revealing an average 13.6 percent increase in nasal permeability [19, 4]. In a study of 26 patients, Timms observed a 36.2 percent decrease in airway resistance after RME [20, 21].

The aim of the study was to evaluate the cephalometric points, planes and angles determining the head posture on the lateral radiographs of the selected patients with upper jaw compression, and to evaluate and compare the measured results of the initial state and the changes in the angular values after RPE.

Materials and methods

The sample

The observational, retrospective study included lateral skull radiographs of 20 patients with ages between 8-13 and a gender distribution of 60% female and 40% male. The radiographs of the patients were selected taking into consideration that the patients had no previous orthodontic treatment and the diagnostic included maxillary compression. The orthodontic treatment included rapid maxillary expansion, and a history of oral respiration was confirmed, in all of the cases. All of the patients parents signed an informed consent

The device was a Hyrax or a Haas type expander, activated 2 times a day by adjusting 1/4 turn on the screw in the middle of the device with the special activation key in the direction of the arrow on the screw until the desired maxilla expansion was achieved. Activation of the device took an average of 10–14 days, after which the screw was blocked, and the device was left in place for 3 months to achieve the callus mineralization in the area of the median palatine suture.

Clinical recordings

The lateral head skull radiographs of all the 20 patients, were achieved at the first visit (T1) and the second record 8-10 months later. The heads of the patients were fixed in a cephalostat when the radiographs were taken. The mentioned digital X-rays were taken with a Pax Flex 3D +, Vatech X-ray machine with an exposure time of 12.9 seconds, 80 kVp and 9.0 mA. The dental imaging software used was EasyDent at DR X-RAY in Târgu Mureș. The orthodontic cephalometric program used in the study was AudaxCeph software.

A dossier was prepared for every patient and includes the personal data and the x-rays taken before and after the treatment was finalized. Since not all analysis types included in the software analysis type list contain all the elements needed to evaluate head posture, a new type of analysis was created for the study within the AudaxCeph software. The analysis included the angular and linear measurements suggested by Tecco et al.[4]. The X-ray images were calibrated using the cephalostat that appears on them. For the analysis of the head posture, the necessary cephalometric points based on the corresponding anatomical structure were first traced. As a second step, the planes and lines necessary for the analysis from the various combinations of the

cephalometric points listed above were created and diverse variables resulting from the union of the cephalometric lines were measured (Figure 1).

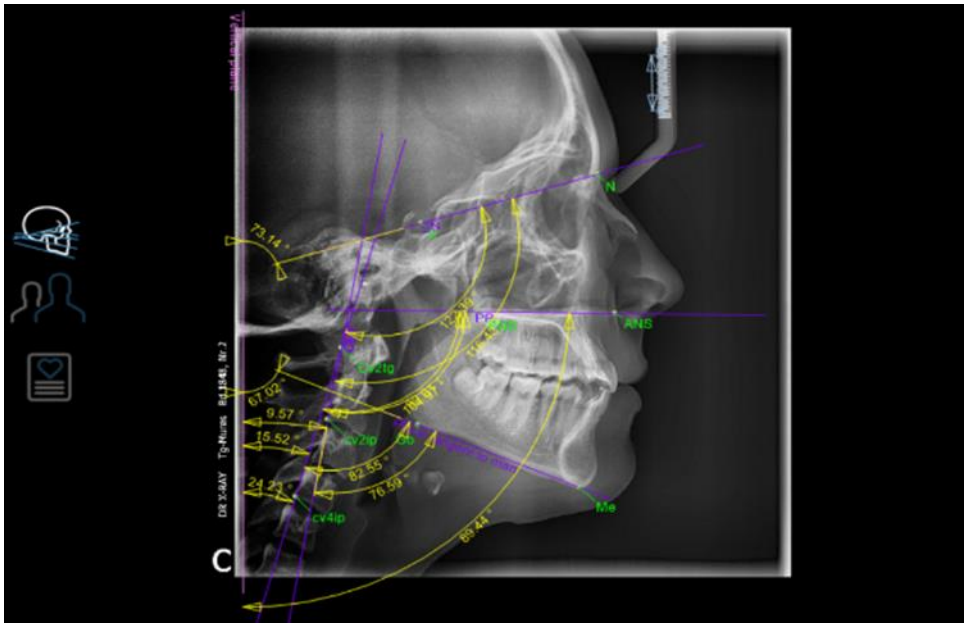

Figure 1. The cephalometric points traced on the lateral skull radiographs.

The points mentioned above: S (Sella Turcica), N (Nasion), PNS (Posterior Nasal Spine), ANS (Anterior nasal spine), Go (Gonion), Me (Menton), Cv2tg: the tangent point of the superior, posterior extremity of the odontoid process of the second cervical vertebra. Cv2ip: the most inferior and posterior point on the corpus of the second cervical vertebra. Cv4ip: the most infero-posterior point on the body of the fourth vertebra.

The cephalometric lines traced on the lateral skull radiographs were those defined and cited by Tecco et al."CVT: the upper part of the cervical spine. A line through cv2tg and cv4ip. OPT: odontoid line. A line through cv2tg and cv2ip. SN: anterior cranial base. A line through point S and point N. PP: palatal plane. A line through posterior nasal spine (PNS) and anterior nasal spine (ANS). MP: mandibular plane. A tangent line to the inferior border of the mandible. VER: true vertical plane.

OPT/VER: odontoid angle. The downward opening angle between the OPT and true vertical lines. EVT/VER: lower cervical column angle. The downward opening angle between the lower part of the cervical spine and true vertical lines. CVT/VER: upper cervical column angle. The downward opening angle between the CVT and true vertical lines. SN/VER: the downward opening angle between the SN and true vertical lines. PP/VER: the downward opening angle between the palatal lines and true vertical lines. MP/VER: the downward opening angle between the mandibular lines and true vertical lines. SN/OPT: the downward opening angle between OPT and SN lines. SN/CVT: the downward opening angle between CVT and SN lines. PP/OPT: the downward opening angle between OPT and palatal lines. PP/CVT: the downward opening angle between CVT and palatal lines. MP/OPT: the downward opening angle between OPT and mandibular lines. MP/CVT: the downward opening angle between CVT and mandibular lines" [4].

Completing these, the different variables were grouped, the first group being the cervical inclination, including OPT / VER and CVT / VER variables, while the second group contained the craniofacial inclination angles, these are SN / VER, PP / VER, and MP / VER. The craniocervical angles represent the

third group constituted by the angles SN / OPT, SN / CVT, PP / OPT, PP / CVT, MP / OPT, and MP / CVT. Once the setup and analysis were performed, the software provided the results (the values obtained from that patients). All the cephalometric analysis were made by an experienced and trained orthodontist.

Using the saved measurements, the pre- and post-treatment angle values were analyzed for the patients both individually and collectively. Statistical analysis was performed using the Student T test and Pearson correlation test, at a level of significance $p \leq 0.05$. Descriptive statistics was also performed using GraphPad Prism 5.0 for Windows.

Results

The 20 patients (12 females, 8 males) who enrolled in the study had a cephalometric radiograph taken before and after the treatment (8-10 months later). The measurements obtained in cephalometric analyses are presented in Tables 1-4.

Tabele 1. Changes with Treatment.

	Pretreatment		Posttreatment		Change with Treatment				
	Mean	SD	Mean	SD	Mean	SD	Minimum	Maximum	Significance
Cervical inclination									
OPT/Ver (°)	7.24	5.07	7.46	5.89	-0.22	5.71	-4.3	3.86	0.91
CVT/Ver (°)	7.73	5.37	9.57	6.06	-1.83	5.47	-6.04	2.37	0.34
Craniofacial inclination									
SN/Ver (°)	97.64	8.63	96.64	9.16	1	5.17	-2.7	4.7	0.56
PP/Ver (°)	93.29	5.77	92.13	2.87	1.16	5.3	-2.63	4.95	0.51
MP/Ver (°)	72.11	17.85	66.33	4.7	5.78	17.76	-6.92	18.48	0.33
Craniocervical inclination									
SN/OPT (°)	100.83	11.69	101.67	12.37	-0.84	6.37	-5.4	3.72	0.69
SN/CVT (°)	104.64	11.13	106.53	12.86	-1.89	5.67	-6.24	2.47	0.35
PP/OPT (°)	93.08	10.52	93.78	9.68	-0.7	6.26	-5.18	3.78	0.73
PP/CVT (°)	96.84	9.88	98.36	9.72	-1.51	5.39	-5.66	2.63	0.42
MP/OPT (°)	67.11	9.34	67.99	9.01	-0.88	7.47	-6.22	4.46	0.72
MP/CVT (°)	70.33	9.17	71.97	8.74	-1.63	6.46	-6.6	3.33	0.47

Table 1 shows the mean and standard deviation of each variable measured at the beginning (Pretreatment) and end of treatment (Posttreatment). It also describes the changes which occurred with the treatment.

The cervical inclination angles, OPT/Ver and CVT/ Ver, both increased mildly when measured at the end of the treatment, but this change was not statistically significant. Craniofacial inclination angles, represented by SN/Ver, PP/Ver, MP/Ver, showed a slightly decreasing between pre- and posttreatment, but neither of the changes were found to be statistically relevant. A slight increase can also be observed in the angles of craniocervical inclination (SN/OPT, SN/CVT, PP/OPT, PP/CVT, MP/OPT, MP/CVT), however these angulations were not found to be significant statistically. The results of our study shows that for the patients treated with RME there is no significant change in any of the variables, however in the study of the long-term effects of RPE on nasopharyngeal airway size, head posture, and cervical curvature angle of Tecco et al from pre- to posttreatment, the study group had a significant ($p < .001$) 3.67° backward inclination of the upper cervical column (OPT/ Ver angle). Twenty-three female patients were included in the study group. For the girls with nasal obstruction under active treatment there was a statistically significant flexion of the head, this is evidenced by the decreased craniofacial inclination angles (5.25°, $P < .0001$ for SN/Ver angel; 5.04°,

P<.0001 for PP/Ver angle; 4.40°, P<.0001 for MP/Ver). A significant decreased of 5.1°, 4.36°, and 5.12° in the mean craniocervical angles (SN/OPT, PP/OPT, and MP/OPT) was also observed. Our research has succeeded to shown that a positive correlation exists in the variables measured before and after the treatment (Table 2).

Table 2. Correlations between the variables measured before and after the treatment.

	Correlation	Significance
Cervical inclination		
OPT/Ver (°)	0.466	0.174
CVT/Ver (°)	0.547	0.127
Craniofacial inclination		
SN/Ver (°)	0.833	0.003
PP/Ver (°)	0.407	0.244
MP/Ver (°)	0.15	0.679
Craniocervical inclination		
SN/OPT (°)	0.861	0.001
SN/CVT (°)	0.898	0.001
PP/OPT (°)	0.811	0.004
PP/CVT (°)	0.849	0.004
MP/OPT (°)	0.669	0.034
MP/CVT (°)	0.741	0.022

Of the craniofacial inclination angles, the SN/Ver (r=0.833, at P<0.003) angle is the one at which the positive correlation can be detected, while all the craniocervical inclinations angles show a significant correlation, SN/OPT (r=0.861, P<0.001), SN/CVT (r=0.898, P<0.001), PP/OPT (r=0.811, P<0.004), PP/CVT (r=0.849, P=0.004), MP/OPT (r=0.669, P<0.034), and MP/CVT (r=0.741, P<0.022). Positivity can also be detected when examining the correlation between the anomaly and the measured values (Table 3).

Table 3. Correlations between the anomaly and the measured values.

	Correlation	Significance
Cervical inclination		
OPT/Ver (°)	0.439	0.277
CVT/Ver (°)	0.56	0.149
Craniofacial inclination		
SN/Ver (°)	0.723	0.043
PP/Ver (°)	0.396	0.331
MP/Ver (°)	0.099	0.815
Craniocervical inclination		
SN/OPT (°)	0.896	0.003
SN/CVT (°)	0.914	0.914
PP/OPT (°)	0.873	0.005
PP/CVT (°)	0.867	0.005
MP/OPT (°)	0.824	0.012
MP/CVT (°)	0.83	0.011

The downward opening angle between the SN and true vertical lines is correlated with nasal obstruction (r=0.723, p<0.043). Among the angles of craniocervical inclination that show a positive correlation with the anomaly, we can mention the SN/OPT (r=0.896, P<0.003), PP/OPT (r=0.873, P<0.005), PP/CVT (r=0.867, P<0.005), MP/OPT (r=0.824, P<0.012), MP/CVT (r=0.83, P<0.011).

There is a positive correlation between the patient's gender and the measured values (Table 4), which is evidenced by the SN/ Ver (r=0.853, P<0.007) from the craniofacial inclination angles shown in Table 4, respectively SN/OPT (r=0.878, P<0.004), SN/CVT (r=0.905, P<0.002), PP/OPT (r=0.852, P<0.007), PP/CVT (r=0.858, P<0.006), MP/OPT (r=0.726, P<0.041), and MP/CVT (r=0.751, P<0.032) angles, which represent the group of craniocervical inclination.

Discussion

One of the most researched topics of the current orthodontic literature is the treatment results of the rapid maxillary expansion on the dentofacial morphology. The increase in palatal width may result in enlargement of the pharyngeal airway space, improved respiratory function, and changes of the head posture on the cervical column, with an increase in the cervical curvature angle and a decrease in craniocervical angulation, according to a potential hypothesis for the role of RME in postural alterations [1, 22, 23].

Following different forms of treatments that enhance nasal respiratory function, several researchers have documented substantial improvements in head position and craniocervical angulation. In a recent case report the authors theorized that the changes in palatal width acquired with RME appliances might influence additional bone structures such as the tongue's muscles and the suboccipital muscles [24, 25].

The objective of this study was to evaluate the effects of rapid maxillary expansion on head posture. Changes in pretreatment and posttreatment were measured using lateral cephalometric radiographs. Both pre- and posttreatment radiographs were taken in natural head position, with the appliance removed.

The result of our study shows no significant changes after the RME in angles which are used to determine head posture. Our findings are not in accordance with those of Tecco et al, who studied the changes of cervical posture following palatal expansion in 45 mouth breathing girls. In Tecco study patients from 8 to 15 years of age were included: 23 subjects in the study group and 22 children in the control group. Lateral cephalograms were obtained at the first visit, respectively 6 and 12 months later for all subjects. 6 months after expansion of the palate, there was a significant backward inclination of the cervical column in the study group (mean increase of 3.67°; P<0.05). The changes observed in flexion of the head after one year in the test group were also significant (5.25° for SN/Ver angle, 5.04° for PP/Ver angle, 4.40° for MP/Ver; all P<0.05). Craniocervical angles, measured by SN/OPT, PP/OPT, and MP/OPT, decreased by 5.1, 4.36 and 5.12 degrees in the study group after 6 months (P<0.05) [4].

Kjurchieva-Chuchkova et al. observed a statistically significant change in the head posture and decrease in craniocervical angulation, especially at the downward opening angle between OPT and palatal lines (4.07, for PP-OPT angle) and angle interaction between the upper part of the cervical spine and palatal plane (4.95 degrees for PP/CVT angle). The findings of this study are not in accordance with our investigation [5].

Our results are corresponding with those of longitudinal studies of Yagci et al, who have investigated the effects of rapid palatal expansion on natural head position in 38 subjects. The treatment group comprised 23 patients and the control group 15 patients. The

NHP data was collected using an inclinometer and a portable data logger. Both the study and control group had NHP recordings taken at the beginning of appliance placement and at the completion of RME therapy. Similar to our results, was no statistically significant difference between initial and final NHP, the mean difference pre-and posttreatment for NHP was 0.31° [26].

The findings of our study confirmed a positive correlation between the measured variables and the gender of the patient, evidenced by the angles SN/Ver, SN/OPT, SN/CVT, PP/OPT, PP/CVT, MP/OPT, MP/CVT, respectively between the anomaly and the measurements, proved by the SN/Ver, SN/OPT, PP/OPT, PP/CVT, MP/OPT, and MP/CVT variables.

Although there is a modification in head position after RME, it cannot be assessed objectively since the few studies that have been published do not adopt the same evaluation approach. One of the shortcomings of our study is the reduced number of patients. To provide a more accurate result, more well-controlled long-term clinical trials utilizing the most accurate methods to determine craniocervical morphology and function, as well as a longer observation time, are needed.

Conclusion

Based on the obtained results, we cannot state that there is a correlation between rapid maxillary expansion and cervical posture.

Conflict of interest: None to declare.

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Prevalence of nonsyndromic hypodontia in a south-east Transylvanian region.

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Abstract

Introduction. Clinicians claim that the prevalence of hypodontia has skyrocketed in recent years. However, there is no clear evidence whether it is really a change in dentition in Homo Sapiens or a purely hypothetical observation, due to the advanced modern technology used in the diagnosis of dento-maxillary anomalies.

The aim of this study was to establish the prevalence and distribution of nonsyndromic hypodontia in young patients from the South-East Transylvanian region of Romania.

Material and methods. A number of 325 dental charts were selected. The patients who needed orthodontic treatment were treated in the Pedodontics Department and Orthodontic Department of UMFST "George Emil Palade" Targu Mures and two private dental offices during 2017-2019. The age of the patients was between 12 and 25 at the moment when the clinical and paraclinical examination were performed.

Results. From a total number of 275 cases investigated, 78 patients were diagnosed with hypodontia in permanent dentition, not taking into consideration the third molars. Hypodontia's prevalence is 6.47% for patients which seek orthodontic treatment, without taking into consideration the third molars. This value is found in the range of 2.8%-11.3% reported in studies in the literature. The present study showed that hypodontia affects a greater proportion of females (6.83%) than males (5.74%), without statistically significant differences.

Conclusions. The prevalence of non-syndromic hypodontia in permanent dentition, compared to the total number of patients who requested orthodontic treatment, is 6.47%, being higher than the data reported in the literature of our country, but falls within the range reported in the international literature in general.

Keywords: hypodontia, non syndromic hypodontia, orthodontic treatment.

Introduction

Over time, numerous studies on the prevalence of hypodontia have been published in the national and international literature, as it is considered to be one of the most common oral conditions and one of the most intriguing dental phenomena, associated with a number of other skeletal dento-maxillary abnormalities, structural variations, congenital malformations and dental position abnormalities [1].

Clinicians claim that the prevalence of hypodontia has skyrocketed in recent years. However, there is no clear evidence whether it is really a real change in dentition in Homo Sapiens or a purely hypothetical observation, due to the advanced modern technology used in the diagnosis of dento-maxillary anomalies.

Early reports of hypodontia prevalence provide much lower absolute frequencies, ranging from 2.8% in the United States [2] to 3.4% in Switzerland [3] and 3.31% in Spain, [4]. The frequency of hypodontia was lower in the population of North America, with values in the range of 3.5% - 3.7% compared to European countries, where the reported values were much higher, in the range of 6-8%. More recent data on the absolute frequency of hypodontia, excluding wisdom teeth, range from 2.8% for the Malaysian population to 11.3% for Irish people to a maximum reported of 14.69% for the Hungarian population [3,5,6].

Hypodontia is a dental anomaly with a decreased prevalence among population (2-7%) but with a large variation of clinical aspects which first of all affects the physiognomy but also the other functions of the dento-maxillary apparatus [7].

In 2004, Polder et al. [8] performed a complex meta-analysis, based on numerous studies on the prevalence of hypodontia in the Caucasian population in Europe, North America and Australia, which reported different values by continent and sex. With the exception of the wisdom molars, the highest incidence of hypodontia, 6.3% with 7.6% for

females and 5.5% for males, was reported in Australia, followed by Europe with 5, 5% with 6.3% for females and 4.6% for males, and North America with the lowest value, respectively 3.9% with 4.6% for females and 3.2% for males. The variation of the obtained results is due to the different research conditions within the examined lots, regarding the age limit, ethnicity and the type of radiographs used.

Referring only to the canine, Sivarajan in 2021 found a general prevalence of canine agenesis of 0.30%, higher in Asia, followed by Africa, Europe and South America, this being more common in the jaw than the mandible, more common in females in comparison with males, except Asia and Africa. The unilateral agenesis being more common in Asia and the bilateral form showing a greater prevalence in Europe [9].

Aim of the study

The aim of this study was to establish the prevalence and distribution of nonsyndromic hypodontia in patients who were treated in the Orthodontics Department of the UMFST of Târgu Mureș and two private dental offices. Following the statistical processing of the recorded data, we compared the results obtained with the specific results reported in previous studies in the literature in the country and abroad. The statistical study was performed in the following directions:

- prevalence of hypodontia in relation to the total number of patients,
- prevalence of hypodontia according to sex,
- prevalence of hypodontia in relation to the number of missing teeth,
- prevalence of hypodontia depending on the type of tooth most frequently affected,
- the prevalence of hypodontia depending on the location and distribution model at the level of the dental arches.

Material and methods

A number of 325 dental charts were selected. The patients that needed orthodontic treatment were treated in the Pedodontics Department and Orthodontic Department of UMFST "George Emil Palade" Targu Mures and two private dental offices during 2017-2019. The age of the patients was between 12 and 25 at the moment when the clinical and paraclinical examination were done.

The study material was focused of the dental charts of the patient which include: personal data, family history, personal history, extra oral examination, intraoral examination, radiographic examination and study models.

The diagnostic of hypodontia was made on the radiographic examination together with the study model and the chart.

The inclusion criteria were the following:

- The patient did not follow an orthodontic treatment,
- Patients aged 25 or younger,
- Quality radiographic documents,
- The type of the missing teeth could be confirmed.

The exclusion criteria were:

- Lack of complete documentation,
- The absence of some teeth which suffered a trauma in the past,
- Younger than 12 years old.

From the total number of charts we selected only 275 with complete documentation. We analysed all the x-rays on a light box, and we considered as a congenital missing of a tooth , the situation in which it did not erupt in the oral cavity and it could not be identified or spotted on the radiograph based on its calcification , and there is no proof of its extraction. To avoid getting a false-positive result and also because the premolars present a high variability in starting the calcification, we took into consideration the hypodontia of second premolars only after the age of 7, and hypodontia of the wisdom teeth was not included in this investigation.

The statistical processing of data consisted of operation, centralization, ordering, grouping and representation of the data in the form of series, tables and graphs. The centralization of the data represented the totalization of the individual values on the entire studied sample. All the datas were statistically analysed using SPSS software (Statistical Package for Social Sciences, Windows Vista, version 19.0, SPSS Inc.).

Results

From the total number of 275 cases investigated, 78 patients were diagnosed with hypodontia in permanent dentition, not taking into consideration the third molars.

Biomechanical constitutional field

Appreciating the biochemical constitutional field of the patient according to the Firu classification, we found that the majority of patients in the group with hypodontia (63.89%) belong to the phosphocalcic type, followed by the fluorocalcic type (19.44%), respectively, carbocalcic (16.67%) (Figure 1).

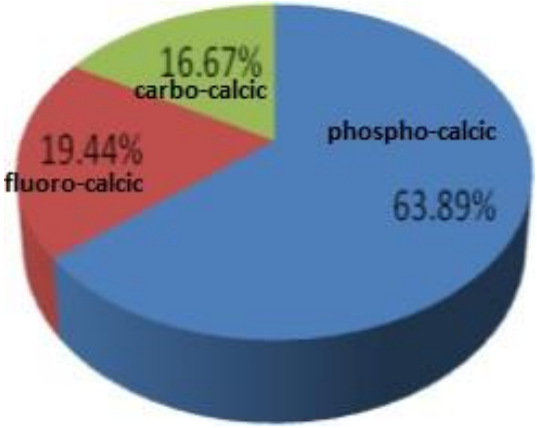

Figure 1. Biochemical constitutional field of patients with hypoplasia

From the point of view of *the pattern of development of the cephalic extremity*, the teeth affected by hypoplasia were more common in patients with dolichocephalic type (47.22%), followed by those with mesocephalic developmental pattern (36.11%), and by those with brachycephalic pattern (16.67%) (Figure 2).

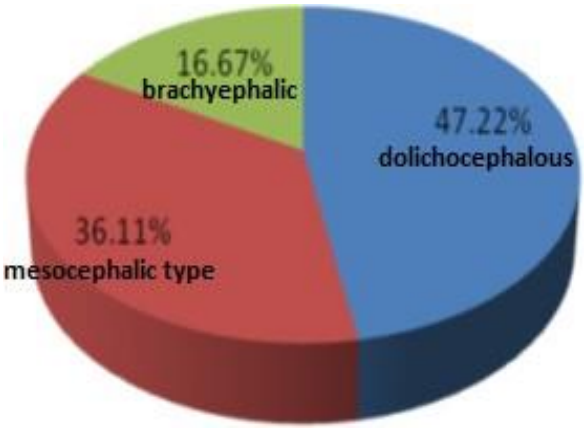

Figure 2. Pattern of development of the cephalic extremity in patients with hypoplasia

Regarding *the divergence of the mandibular basal branch*, we noticed that half of the patients with hypoplasia were hypodivergent, followed by those with a pattern normodivergent (38.89%), and hyperdivergent (11.11% of cases) (Figure 3).

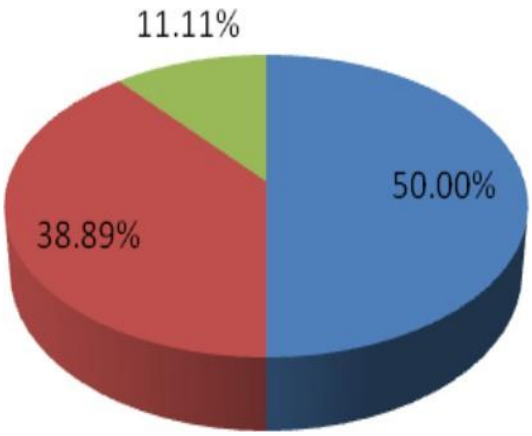

Figure 3. Facial pattern of patients with hypoplasia, related to the divergency of the mandibular basal branch

Related to the entire sample, the prevalence of hypodontia is 6.47% of patients who needed orthodontic treatment in the Orthodontic Department in Targu Mures (Figure 4).

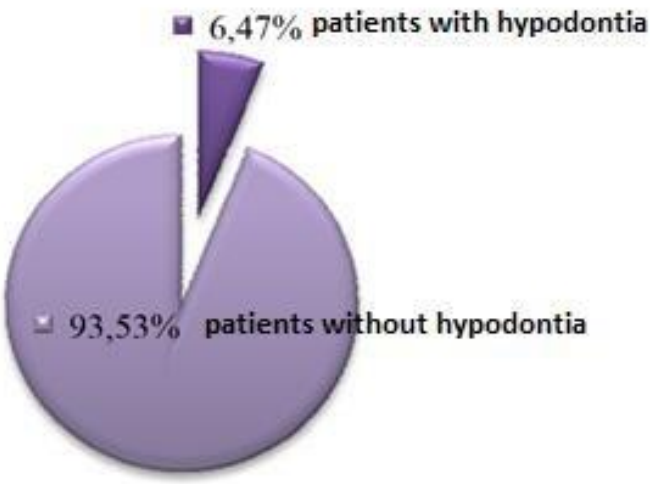

Figure 4. Prevalence of hypodontia of the study sample

Female patients, 55 in the investigated sample, with a prevalence of 6.83%, and male patients 23, the prevalence of hypodontia in this case is 5.74% (Figure5).

The Chi-square test ($\chi 2$) applied shows that although the proportion of female patients with hypodontia is higher than that of males, the differences are not statistically significant between both sexes because p calculated> 0.05. (Table 1)

Table 1. Prevalence of hypodontia of the studied sample based on gender (n=78)

GENDER	NUMBER OF PATIENTS		PREVALENCE (%)
	Affected	Examinated	
FEMALE	55	805	6,83
MALE	23	401	5,74
TOTAL	78	1206	6,47

Figure 5 graphically represents the total composition of the sample, with the mention of the fact that hypodontia within female subjects is higher than of the male subjects, maybe because of esthetic considerations also.

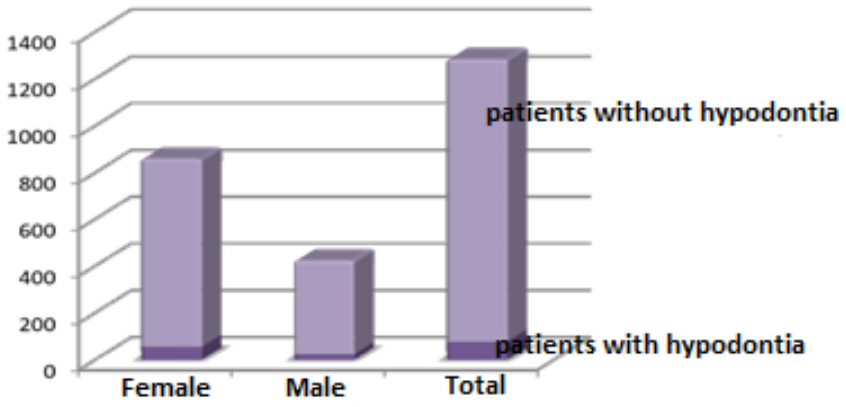

Figure 5. Repartition of the patients of the entire sample based on gender

The total number of missing teeth (without taking into consideration the third molar) is 172, from which 115 for males and 57 for females, with an average of 2,2 per patient. Out of a total of 78 patients diagnosed with hypodontia, 76.92% have one or two missing teeth, 19.23% have three to five missing teeth and 3.85% have severe hypodontia, respectively missing six or more teeth. (Table 2)

Table 2. Distribution of missing teeth number in patients with hypodontia (p=0.01)

NUMBER OF MISSING TEETH	FEMALE	%	MALE	%	TOTAL	%	P	SIG
1	18	23,08	7	8,97	25	32,05	0.01	S
2	26	33,33	9	11,54	35	44,87	0.001	S
3	4	5,13	1	1,28	5	6,41	0.36	NS
4	4	5,13	3	3,85	7	8,97	1.00	NS
5	1	1,28	2	2,56	3	3,85	1.00	NS
6≥	2	2,56	1	1,28	3	3,85	1.00	NS
TOTAL	55	70,51	23	29,49	78	100		

The applied Chi – square test ($\chi 2$) reveals statistically significant differences in the case of patients with reduced hypodontia (1-2 missing teeth).

A percentage of 32.05% of the total number of patients has unidentified hypodontia, with a prevalence of 8.97% in males and 23.08% in females (Figure 6).

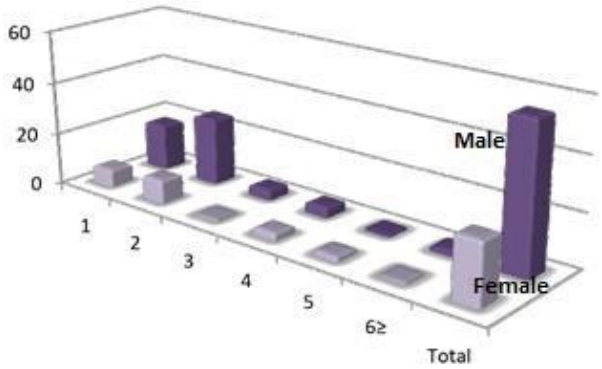

Figure 6. Allocation of unidental hypodontia based on genders

The distribution of hypodontia and statistical comparisons according to the typeof tooth absent in the upper and lower arch, both females and males are presented in Table 3.

Tracking the distribution of the number of missing teeth in relation to the jaws and the arch area concerned, allows the observation of the prevalence of higher hypodontia in the upper jaw with a value of 53.48% compared to 46.52% in the mandible.

Regarding the prevalence of hypodontia compared to the affected arch area, we can see a preponderance in the incisor region (46.99%), with a clear advantage in favorof the upper arch (30.81%), followed by the premolar region (44.72) %), with a higher value at the level of the lower arch (26.14%).

Table 3. Distribution and statistical comparison of missing teeth according to location at the level of dental arches (n = 172)

Tooth	Maxillar		Tooth	Mandible	
	Number	%		Number	%
1.1	0	0	4.1	17	9.8
1.2	23	13.37	4.2	3	1.74
1.3	0	0	4.3	1	0.58
1.4	5	2.9	4.4	3	1.74
1.5	11	6.39	4.5	21	12.2
1.6	2	1.16	4.6	2	1.16
1.7	0	0	4.7	2	1.16
2.1	1	0.58	3.1	6	3.48
2.2	29	16.86	3.2	2	1.16
2.3	1	0.58	3.3	1	0.58
2.4	5	2.9	3.4	5	2.9
2.5	11	6.39	3.5	16	9.3
2.6	2	1.16	3.6	1	0.58
2.7	2	1.16	3.7	0	0
Total	**92**	**53.48**		**80**	**46.52**

Regarding the most frequently affected tooth reported, the data of this study place *the upper lateral incisor* on the *first place* with an incidence of 30.23%, followed by the second lower premolar (21.5%), the lower central incisor (13.28%), upper second premolar (12.78%), upper first premolar (5.8%), lower first premolar (4.64%), lower lateral incisor (2.9%), upper first molar (2.32%).

Teeth considered stable have a much lower frequency: lower first molar (1.74%), lower canine, upper and lower second molar (1.16%), upper canine and upper central incisor (0.58%).

Statistical comparisons and the distribution of missing teeth according to the location at the level of the upper arch, depending on the sex of the patient are shown in Figure 7.

Similarly, the distribution of missing teeth according to the location at the lower arch is shown in Figure 8.

Statistically significant differences were found for five of the 14 teeth investigated, namely the upper lateral incisor, upper second premolar, lower first premolar, lower central incisor and upper first premolar. The prevalence of hypodontia in females was higher than in males in almost all types of affected teeth, both in the upper and lower arch.

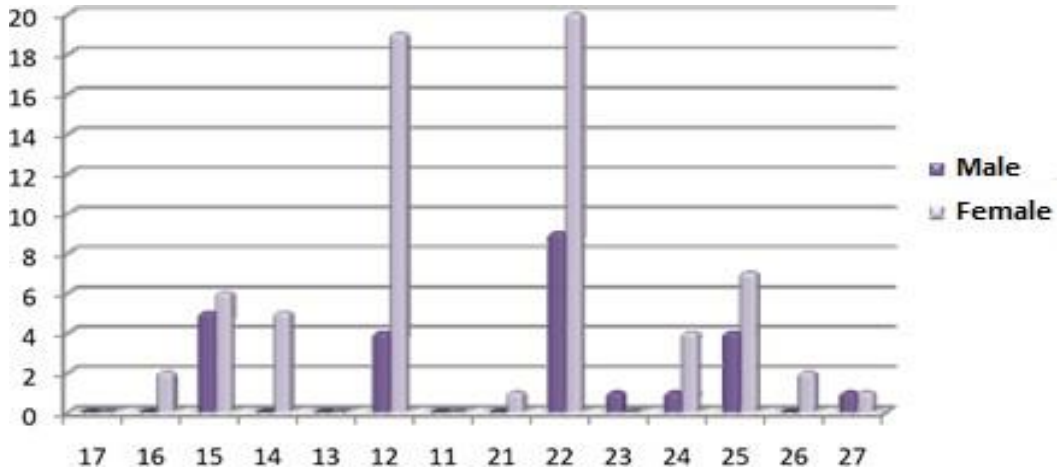

Figure 7. Distribution of hypodontia based on the type of the tooth and gender

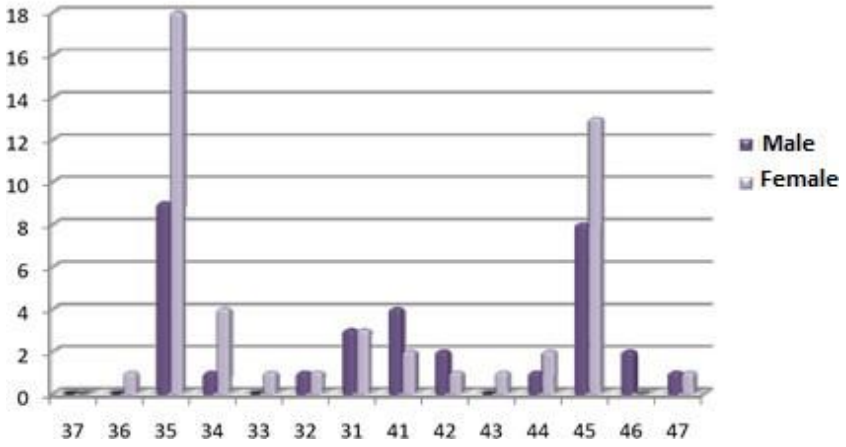

Figure 8. Distribution of hypodontia in lower arch

As we can see on the chart the most affected tooth is the left lateral incisor, 2.2 followed by the right lateral incisor, 1.2.

For the mandible the most frequent absent tooth is the second premolar on theright part, 3.5, followed by the second premolar from the

left side, 4.5.

Discussions

Hypodontia's prevalence is 6.47% for patients which seek orthodontic treatment, without taking into consideration the third molars. This value is found in the range of 2.8%-11.3% reported in studies in the literature. A study about the prevalence of hypodontia in orthodontically treated patients in Brazil, conducted by Gomes et al. [10] between 1998-2000 reported a relative frequency of hypodontia of 6.3% in patients who requested orthodontic treatment, with no statistically significant differences between females and males.

Similar to this study, in Slovenia, Fekonja [2] reported 11.3% in a group of 212 patients, and in Hungary, Gábris et al. [11] reported a much higher frequency with a net higher value of 14.69%, also without statistically significant differences between females and males. The result of this statistical study is much lower than the value of 8.5% reported by Endo et al. [12] in Japan in 2006, than 11.3% reported in 2005 by Fekonja [2] in Slovenia and much lower than the 14.69% value obtained by Gábris et al. [11] in Hungary in 2006.

Compared to similar studies conducted in Romania, the value obtained is higher than the value of 3.53%, reported by other studies done over the years and and is between the values detected by Tarmure et al. [13]. The variation of the results obtained could be attributed to the different methods used by each of the authors mentioned.

The present study showed that hypodontia affects a greater proportion of females (6.83%) than males (5.74%), without statistically significant differences. This result is in agreement with the results obtained by the following authors, Fekonja [2], Endo et al. [12], while other studies who found significant differences between females and males [13].

Regarding the number of missing teeth, in descending percentage order, out of the total number of patients affected by the numerical reduction, two teeth were missing in 44.85% of patients, one tooth in 32.05%, four teeth in 8.97%, three teeth at 6.41%, five teeth and 6 or more teeth at 3.85% of the total number of patients. The result of this study indicates that 76.92% of all patients with hypodontia have one or two missing teeth. Studies on this issue by other authors, such as Fekonja [2], Gomes [10] and Endo et al [12], have reported a much higher frequency for reduced hypodontia.

Regarding the distribution of hypodontia according to the type of tooth affected, except for the three molars, the upper lateral incisor is the most frequently affected tooth in a proportion of 30.23% of cases, followed by the second lower premolar (21.5%) the lower central incisor (13.28%) and the upper second premolar (12.78%). Hypodontia of the lower and upper canines, of the upper and second upper and lower molars, has a very low percentage.

These results are in agreement with most previous studies [13-17] and in contradiction with other authors like Endo et al. [12], which places the lower second premolar first.

Meta-analysis performed by Polder et al. [8], in 2004, based on the analysis of several studies on the incidence of hypodontia, has shown that the upper lateral incisor is most frequently affected in the Caucasian population, a fact confirmed by the results obtained in the present study. In addition, differences between groups of patients seeking orthodontic treatment may reflect various psychosocial issues between regions. Probably, in countries where the aesthetics of the smile is well appreciated, the hypodontia of the lateral incisor motivates patients and their parents to request orthodontic treatment in specialized clinics.

The study revealed that the prevalence of hypodontia occurs in both jaws, but is more common in the upper jaw with a value of 53.48%, compared to 46.52% in the mandible. This result is consistent with the results obtained by Fekonja [2] and in contradiction with the values reported by Endo et al. [12] and Gábris [11].

Regarding the prevalence of hypodontia compared to the affected arch sector, we observed a preponderance in the upper incisor region, with a proportion of 30.81%, followed by the lower premolar region with a proportion of 26.14%, which confirms the results obtained by Fekonja [2] and Endo et al. [12] who

obtained as the area most frequently affected by hypodontia, the upper incisor region.

We observed an almost remarkable similarity in the distribution of missing teeth between the left and right sides of the dental arches in the patients investigated in this study. These results are in agreement with the results obtained by previous studies conducted by Endo et al. [12].

Conclusions

1. The prevalence of non-syndromic hypodontia in permanent dentition, compared to the total number of patients who requested orthodontic treatment, is 6.47%, being higher than the data reported in the literature of our country, but falls within the range reported in the international literature in general.
2. In relation to the number of teeth involved, we obtained an increased result with an average value of 2.2 teeth per patient, which confirms that hypodontia is common in patients who have been referred for orthodontic treatment, requiring a diagnosis and prompt therapeutic resolution to prevent associated aesthetic and functional problems.
3. The results of the present study showed that in the case of the studied group there were no statistically significant differences in the prevalence of hypodontia by sex.
4. The present study shows that the highest degree of damage is encountered at the upper lateral incisor, followed by the lower second premolar, supporting the theory of increased lability of teeth located distally in each dental group.
5. Most patients had reduced hypodontia, severe forms being infrequent, which is a favorable aspect in the therapeutic conduct of this dental abnormality.
6. Hypodontia occurs in both jaws, but mainly in the upper jaw.
7. The increasing trend of the prevalence of this dental anomaly justifies the special clinical interest and the implementation of preventive strategies with the main purpose of the efficiency of interceptive, educational and curative management.

Conflict of interest: None to declare.

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Dento-facial aesthetics in the eyes of adolescent patients during the Covid-19 pandemic.

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Abstract

Introduction: Dental malocclusions are considered a major issue in adolescence, and are often the main reason for which patients go to the dentist. Adolescents´ option to start an orthodontic treatment is questioned in the light of the restrictions imposed in the context of the Covid-19 pandemic.

Aim of the study: The aim of this study was to assess adolescents' perceptions of facial aesthetics and the impact of the Covid-19 pandemic on the decision to start an orthodontic treatment during this time, when a number of restrictions, such as face mask wearing, were imposed.

Material and methods: A 15 items questionnaire was applied in the city of Oradea, Romania and distributed to orthodontic adolescent patients, with a previously diagnosed malocclusion, with ages between 12 and 17.9 years. The questionnaires were correctly filled in by 76 participants.

Results: Patients tend to be affected by the aspect of their teeth (50%), and most patients considered that the aspect of their teeth forces them to socialize less (44.8%), and to avoid smiling (44.8%). 39.4% of the respondents considered that wearing a face mask is useful because it covers all dental malocclusions, and 31.6% of the respondents were not bothered that they had to wear a face mask.

Conclusions: Patients declared that they were affected by the aspect of their teeth, and have a generally positive attitude regarding face masks.

Keywords: malocclusions, face masks, Covid-19, adolescents.

Introduction

Dental anomalies occur as a result of the complex interaction of some genetic and environmental factors [1] that intervene and cause disturbances in the processes of morpho-differentiation or histo-differentiation of dental units [2]. Occlusal features, type and frequency of dental anomalies influence the sagittal ratio between dental arches [3]. These congenital defects manifest in various clinical forms [4], with different degrees of severity [5]. From a functional point of view, dental anomalies due to the malocclusion they cause, favor disorders of mastication, swallowing, phonation, and to a significant extent, change the patient's physiognomy [5].

At a young age, social discrimination due to the disharmonious facial appearance, including oral aesthetics, has negative effects on the quality of life of the individual, and causes physical, psychological and social disturbances [6], the adolescent perceiving this as a stigma [7,8].

Dental malocclusions are considered a major issue in adolescence, dental anomalies that negatively influence facial aesthetics often being the main reason for which patients go to the dentist [9]. The treatment of malocclusions is performed with the help of orthodontic appliances. This method of treatment is increasingly accepted, and it is considered as a solution to the problems of facial aesthetics and social reintegration [10].

The Covid-19 pandemic manifested by a severe acute respiratory syndrome, and caused by the new coronavirus (SARS-CoV-2), has been described by the World Health Organization as a new form of viral pneumonia [11].

Adolescents´ option to start an orthodontic treatment, justified by the need to correct any diagnosed malocclusion and the desire to increase self-confidence [12] is questioned in the light of the restrictions imposed in the context of the Covid-19 pandemic. There was, also, a period in which dental offices´ activity was interrupted, which could have had a

negative influence on the evolution of the orthodontic treatment [13].

Aim of the study

The aim of this study was to assess adolescents' perceptions of facial aesthetics and the impact of the Covid-19 pandemic on the decision to start an orthodontic treatment during this time, when a number of restrictions were imposed. The attitude of the patients regarding the compulsoriness of protective face mask wearing was investigated as well.

Material and methods

Participants and Data Collection

The study was carried out over a period of two months, between February 2021 and March 2021. During this period, restrictive measures regarding the mandatory wearing of face masks and social distancing were active.

The authors conceived a questionnaire consisting of 15 items. The questionnaires were printed on paper and applied in two private orthodontic practices from Oradea, Romania. They were distributed to adolescent patients, aged between 12 and 17.9 years, both girls and boys, from urban and rural areas. The respondents were adolescent patients with previously diagnosed dento-maxillary anomalies who had received the indication for orthodontic treatment. Before filling in the questionnaires, all patients were informed that they were applied for research purposes, and that by filling in the questionnaires, they confirmed their willingness to participate anonymously in this study. Patients had the possibility to withdraw from the research with no consequences. No financial benefits were promised to the respondents. No time limit was imposed. The language used for the questionnaires was Romanian.

A Likert-type scale was used for all items. Participants had to choose a number from 0 to 5 (0 being the lowest possible score and meaning a complete negation, and 5 being the highest possible score and meaning a complete affirmation) in order to assess their attitude regarding the question. Items are translated in Table 1.

Table 1. Items used in the questionnaires

Item	Question
Item 1	„Are you bothered by the aspect of your face?"
Item 2	„Are you bothered by the aspect of your teeth?"
Item 3	„Do you believe that the aspect of your teeth influences the aspect of your face?"
Item 4	„Do you believe that the aspect of your teeth negatively affects the relationship with other people?"
Item 5	„Does the aspect of your teeth makes you socialize less?"
Item 6	„Does the aspect of your teeth cause stress?"
Item 7	„Are you trying to hide your teeth when you speak, smile or laugh?"
Item 8	„Do you want to have the aspect of your teeth improved?"
Item 9	„Do you still want to have the aspect of your teeth corrected in the context of the Covid-19 pandemic when face mask wearing is mandatory?"
Item 10	„Does face mask help in hiding your teeth?"
Item 11	„Are you concerned about face mask wearing?"
Item 12	„Are you sad because you have to wear a face mask?"
Item 13	„Are you happy because you have to wear a face mask?"
Item 14	„Do you believe that wearing a fixed orthodontic appliance will make you look bad?"
Item 15	„Do you believe that now, when face mask wearing is mandatory, is a good time to start the orthodontic treatment?"

The following inclusion criteria were applied: adolescent patients with dento-maxillary anomalies and the indication of a fixed orthodontic appliance bonded on the labial surfaces of the teeth, with ages between 12 and 17.9 years, living in Romania. The questionnaires belonging to patients who answered incompletely or incorrectly were excluded from the study. Incomplete answered questionnaires were survey forms where only a

part of the questions received an answer, while incorrectly answered questionnaires were survey forms where more than one answer was provided for one or more questions.

The questionnaires were handed out to a number of 98 adolescent patients with dento-maxillary anomalies, but only 85 agreed to take part in this research and filled in the survey forms. After applying the exclusion criteria, a number of 76 participants remained in the study.

Statistical Analysis

The statistical analysis was performed by using IBM SPSS software, version 25 (IBM, Chicago, IL, USA). Quantitative variables were tested for distribution using the Shapiro-Wilk test and were expressed as mean values with standard deviations or medians with interpercentile intervals. The independent quantitative variables with a non-parametric distribution were tested with the Mann-Whitney U test, and all correlations between them were verified with the Spearman´s rho correlation coefficient. Qualitative variables were expressed as absolute numbers or percentages.

Ethical Considerations

The study was conducted in accordance with the 1964 Declaration of Helsinki and its later amendments and was approved by the Research Ethics Committee of the University of Oradea.

Results

Socio-Demographic Data

The mean age of the participants was 15.03 ± 1.65 years with a median of 15 years, and a range between 12 and 17.9 years. Of all the respondents, 50 were girls (65.8%) and 26 were boys (34.25). Regarding the living environment of the participants, 26 patients were from a rural environment (34.25) and 50 were from an urban environment (65.8%).

Answers

The responses given for all the items are summarized in Table 2. The answers provided for item 2 showed that patients tend to be affected by the aspect of their teeth, scores of 4 and 5 representing half of the total answers given. Most of the patients considered that the aspect of their teeth forces them to socialize less (Item 5), and to avoid smiling (Item 7). In regards to their desire to correct the position of their teeth, the majority of the respondents wanted to correct the position of their teeth (Item 8), and this desire was not affected by the Covid-19 pandemic. 39.4% of the respondents considered that wearing a face mask is useful because it covers all dental malocclusions, and 31.6% of the respondents were not bothered that they had to wear a face mask.

Table 2. Answers provided by the participants

Answer (No., %)	0	1	2	3	4	5
Item 1	21.1%	26.3%	28.9%	7.9%	15.8%	0%
Item 2	2.6%	13.2%	28.9%	5.3%	34.2%	15.8%
Item 3	10.5%	21.1%	21.1%	7.9%	31.6%	7.9%
Item 4	0%	5.3%	42.1%	34.2%	13.2%	5.3%
Item 5	0%	13.2%	42.1%	15.8%	21.1%	7.9%
Item 6	21.1%	13.2%	36.8%	5.3%	21.1%	2.6%
Item 7	0%	10.5%	39.5%	5.3%	39.5%	5.3%
Item 8	0%	5.3%	7.9%	0%	39.5%	47.4%
Item 9	0%	0%	5.3%	7.9%	23.7%	63.2%
Item 10	0%	18.4%	28.9%	13.2%	36.8%	2.6%
Item 11	28.9%	15.8%	23.7%	13.2%	13.2%	5.3%
Item 12	0%	15.8%	31.6%	23.7%	23.7%	5.3%
Item 13	0%	7.9%	13.2%	23.7%	39.5%	15.8%
Item 14	60.5%	10.5%	23.7%	5.3%	0%	0%
Item 15	0%	5.3%	26.3%	5.3%	50%	13.2%

No.: Number; %: percentage

Correlative and comparative results

Statistically significant correlations were found between the age of the respondents and answers given for Items 2, 6, 11 and 12. These are detailed in Table 3. As such, older patients were more confident with the aspect of their teeth (Item 2) and were less stressed by the aspect of their teeth (Item 6). However, when it comes to wearing the protective face masks, older patients were more concerned about the fact that they had to wear a face mask (Item 11), and were less happy about face mask wearing (Item 12).

Table 3. Correlation between age and Items 2, 6, 11, 12

Correlation	p*
Age (p<0.001**) x Item 2 (p<0.001**)	0.003, R=0.341
Age (p<0.001**) x Item 6 (p<0.001**)	0.046, R= -0.230
Age (p<0.001**) x Item 11 (p<0.001**)	0.035, R=0.242
Age (p<0.001**) x Item 12 (p<0.001**)	0.037, R= -0.240

*: Spearman's rho Correlation Coefficient; **: Shapiro-Wilk Test

Table 4 shows the statistically significant comparisons identified in the studied sample, in relation to respondents´ gender. In the studied sample, boys are more affected by the aspect of their teeth than girls (Item 2), and are more stressed by this matter (Item 6). Boys, more than girls, considered that face mask is useful in covering dental malocclusions (Item 10).

Table 4. Comparisons between answers provided for Items 2, 6, 10 in relation to patients´ gender

Gender	Mean value ± SD	Median (IQR)	Medium Rank	p*
		Item 2		
Girls (p<0.001**)	2.88 ± 1.189	3 (2-4)	42.06	0.041
Boys (p<0.001**)	2.31 ± 1.087	2 (1.75-3.25)	31.65	
		Item 6		
Girls (p<0.001**)	1.72 ± 1.578	2 (0-3)	34.06	0.012
Boys (p<0.001**)	2.54 ± 1.029	2 (2-4)	47.04	
		Item 10		
Girls (p<0.001**)	2.56 ± 1.181	2 (2-4)	34.86	0.037
Boys (p<0.001**)	3.15 ± 1.19	4 (2-4)	45.50	

SD: Standard Deviation; IQR: Interquartile Range; *: Mann-Whitney U Test; **: Shapiro-Wilk Test

Table 5 shows the statistically significant comparisons identified in the studied sample, in relation to patients´ living environment. Patients from the rural environment are more affected by the aspect of their teeth (Item 2) in comparison with patients from an urban environment. Patients living in an urban environment considered the orthodontic treatment less necessary (Item 8) than patients living in a rural environment. Face mask wearing was considered more useful for covering dental malocclusions by patients living in an urban environment (Item 10), caused less concern for these category of patients (Item 11), and more happiness for patients living in an urban environment in comparison with patients living in a rural environment (Item 12).

Table 5. Comparisons between answers provided for Items 2, 8, 10, 11, 12 in relation to patients´ living environment

Living environment	Mean value ± SD	Median (IQR)	Medium Rank	p*
		Item 2		
Rural (p=0.025**)	3.08 ± 1.23	3 (2-4)	45.50	0.037
Urban (p<0.001**)	2.48 ± 1.11	2 (2-3.25)	34.86	
		Item 8		
Rural (p<0.001**)	4.54 ± 0.859	5 (4-5)	46.96	0.008
Urban (p<0.001**)	3.96 ± 1.195	4 (4-5)	34.10	
		Item 10		

Rural (p<0.001**)	2.38 ± 1.299	2 (1-4)	31.81	0.047
Urban (p<0.001**)	2.96 ± 1.124	3 (2-4)	41.98	
		Item 11		
Rural (p<0.001**)	1.38 ± 1.675	1 (0-2.25)	31.73	0.049
Urban (p=0.002**)	2.04 ± 1.47	2 (1-3)	42.02	
		Item 12		
Rural (p=0.015**)	2.77 ± 1.07	3 (2-3.25)	25.58	<0.001
Urban (p<0.001**)	3.76 ± 1.04	4 (3-4)	45.22	

SD: Standard Deviation; IQR: Interquartile Range; *: Mann-Whitney U Test; **: Shapiro-Wilk Test

Statistically significant correlations were identified between different items. As such, patients that were more affected by the aspect of their face were happier to wear a face mask (Item 1 and Item 13), as were patients that were more affected by the aspect of their teeth (Item 2 and Item 13). Patients who considered that the aspect of the teeth influences the aspect of the face considered the Covid-19 pandemic to be an untimely moment to start an orthodontic treatment because face mask would cover the orthodontic appliance (Item 3 and Item 15). Patients who considered that the aspect of their teeth negatively impacts their social life were happier to wear a face mask (Item 4 and Item 13). Participants who said that they want to have their teeth´ position corrected as fast as possible were less worried that they had to wear a face mask (Item 8 and Item 11). The identified statistically significant correlations are presented in Table 6.

Table 6. Correlations between items

Correlations	p*
Item 1 (p<0.001**) x Item 13 (p<0.001**)	0.005, R=0.319
Item 2 (p<0.001**) x Item 13 (p<0.001**)	0.004, R=0.330
Item 3 (p<0.001**) x Item 12 (p<0.001**)	<0.001, R= -0.391
Item 3 (p<0.001**) x Item 13 (p<0.001**)	0.002, R=0.354
Item 3 (p<0.001**) x Item 15 (p<0.001**)	0.007, R= -0.306
Item 4 (p<0.001**) x Item 13 (p<0.001**)	0.013, R=0.284
Item 4 (p<0.001**) x Item 15 (p<0.001**)	0.025, R= -0.257
Item 5 (p<0.001**) x Item 13 (p<0.001**)	<0.001, R= -0.398
Item 6 (p<0.001**) x Item 9 (p<0.001**)	0.040, R= -0.236
Item 6 (p<0.001**) x Item 12 (p<0.001**)	0.050, R= -0.226
Item 6 (p<0.001**) x Item 13 (p<0.001**)	0.030, R=0.249
Item 7 (p<0.001**) x Item 13 (p<0.001**)	<0.001, R=0.504
Item 8 (p<0.001**) x Item 11 (p<0.001**)	0.034, R= -0.243
Item 8 (p<0.001**) x Item 12 (p<0.001**)	0.010, R= -0.294
Item 8 (p<0.001**) x Item 15 (p<0.001**)	0.008, R= -0.303
Item 9 (p<0.001**) x Item 13 (p<0.001**)	<0.001, R= -0.395
Item 9 (p<0.001**) x Item 14 (p<0.001**)	<0.001, R= -0.412
Item 10 (p<0.001**) x Item 13 (p<0.001**)	<0.001, R= 0.417
Item 12 (p<0.001**) x Item 14 (p<0.001**)	0.040, R=0.236

*: Spearman's rho Correlation Coefficient; **: Shapiro-Wilk Test

Discussions

The Covid-19 pandemic represents a recent crisis with serious worldwide effects, which imposed the need for a lockdown, in an attempt to limit the spread of the disease [14]. During the lockdown period, dental offices had their activity suspended [15], which caused stress and anxiety for orthodontic patients [14]. Patients that were previously diagnosed with a dental malocclusion were targeted in this survey. The aim was to find out what was their opinion about the existing malocclusion and how beneficial did they find face mask wearing to be, given their malocclusion.

In order to be able to objectively assess the concerns and attitudes regarding face mask wearing, as a mandatory measure, we chose to apply questionnaires to adolescent patients

with dento-maxillary anomalies. The necessity for an orthodontic treatment was established prior to the onset of the Covid-19 pandemic for all these patients. Questionnaires are considered a valid method that can be used in order to analyze patients' opinions regarding a specific topic [16].

In the vast majority of studies conducted during the Covid-19 pandemic, and especially during lockdown, the questionnaires were applied online, through platforms [17,18], websites [19,20] or e-mail addresses [21], but also in a combined version of both online and on paper [22]. However, in this study, the questionnaires were applied in the orthodontic office after resuming dental offices´ activity, in order to evaluate the perception of adolescent patients on the lockdown period and to understand exactly what they wanted, as well as which were their dissatisfactions in the current context. In addition, any ambiguities in the formulation of the questions could be easily clarified, but without influencing their answers and without promising them certain rewards.

As expected, the results obtained showed that patients who were more disturbed by the aspect of their teeth or face were more happy to wear a protective face mask. The reason for that could be that face mask covers the lower part of the face, and, therefore, covers any visible malocclusion. Face mask wearing was perceived as an aid in developing better social contacts by patients who considered that the aspect of their teeth negatively impacts their social life.

Age had an important influence on the answers provided for some items. Older patients were more confident with the aspect of their teeth, but when it comes to wearing the protective face masks, older patients were more concerned about the fact that they had to wear a face mask, and were less happy about face mask wearing. This could be due to adolescents tendency to disobey any rules imposed by adults, and due to commodity.

The living environment of the patients impacted the way they answered. Patients living in an urban environment considered face mask wearing for covering malocclusions to be more useful, and it caused less concern for them. Interestingly enough, gender influenced answers in an unexpected manner. Boys, more than girls, were more negatively affected and were more stressed by the aspect of their teeth.

Comparing the results obtained in this research with other studies is not possible because there has been no identified survey that was applied on adolescent orthodontic patients, and that investigated the attitude towards face mask wearing. This is the novelty of this study. It focuses on a specific group of patients, adolescent orthodontic patients with a diagnosed dental malocclusion, and investigates their opinion on dento-facial aesthetics and face mask wearing in the Covid-19 pandemic.

The study has its limitations. The size of the sample could be larger for more conclusive results, and the online application of the questionnaires would permit a national approach of this topic. However, we consider it to be a solid starting point for future research.

Conclusions

In general, patients declared that they were affected by the aspect of their teeth, and boys, more than girls, were affected by this matter. In the studied sample, patients have a generally positive attitude regarding face masks and consider face mask wearing as an aid for covering dental malocclusions.

Conflict of interest: None to declare.

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ORIGINAL RESEARCH

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Endodontic anatomy of lower premolars in a subpopulation from the Mureș county.

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Abstract

Background/Aim: Thorough knowledge of the endodontic anatomy and comprehensive understanding of root canal morphological variations are mandatory to ensure the successful outcome of the endodontic treatment. The purpose of this study was to compare the number of root canals of first and second lower premolars in a selected population to the root canal pattern reported by endodontic literature and to analyze the gender distribution.

Material and methods: A total of 376 preoperative periapical radiographs were obtained from patients living in the Mureș County of Romania. The X-rays were analyzed by 3 endodontists into determining whether the mandibular premolars had one, two or three root canals. The difference between male and female gender distribution was also examined. Endodontic treatment was then performed using the operating microscope to confirm the root canal configuration of the radiographic analysis. The results were compared to common knowledge of the endodontic literature.

Results: In this study, by using the radiographic method combined with direct observation aided by the operating microscope, 31.3% of first premolars and 14.6% of second premolars were found to have two root canals. A higher percentage of two root canals were found in females for both first (60.97%) and second premolars (76.9%).

Conclusion: In the Mureș County region, mandibular premolars with two root canals have a significantly higher rate than the literature reports. Female patients have a higher prevalence than male patients. This should concern clinicians from this area to be aware of these facts as it can unquestionably influence the tooth's long-term prognosis.

Keywords: lower premolar; anatomy; radiograph; root canal.

Introduction

The most common cause of root canal therapy failure in lower premolar teeth is the erroneous consideration that they have one single root canal. As the successful approach of the nonsurgical endodontic treatment is closely related to a comprehensive knowledge of the root canal system anatomy, clinicians must be familiar with these various configurations. Distribution of the number of roots and root canals varies widely in the literature [1]. Root canal configuration for the first and second lower premolars is complex and variable, making root canal therapy quite challenging [2,3].

The morphology of the root canal system is strongly related to ethnicity. Thus, important anatomical variations at different population groups, even from neighboring regions of the same country, are highly likely [4]. Numerous studies have shown that certain regions of several countries have an unexpectedly high prevalence of two root canal configured lower premolars, especially first premolars [5]. This fact must draw the attention of clinicians practicing in these geographical areas, into fulfilling the conditions of a correct endodontic treatment by locating all root canals, properly cleaning and shaping, and filling the endodontic system in a three-dimensional way [6,7].

Data regarding the complexity of endodontic anatomy has its origins in the 19th century. Relevant evidence on this subject could be obtained until recently only with in vitro studies [8]. Nowadays, with the aid of the operating microscope, digital radiographs and micro CTs, detection of the second root canal in lower premolars has increased considerably. As most one-rooted teeth including lower premolars, appear to have one single root canal on periapical X-rays, mesial or distal shift radiographs can determine the type of canal system present. These can provide a clearer image of the tooth, necessary to locate all existing root canals [9,10].

Slowey's study has shown that amongst the permanent dentition, mandibular premolars are the most difficult teeth to manage endodontically and have the highest failure rate when it comes to root canal therapy [11]. Lower premolars usually have a single root canal which appears to be oval shaped on a transversal section, the buccolingual dimension being wider than the mesiodistal one [12]. In situations when there are two root canals present, these usually have a round shape on a cross section. The bifurcation can take place at various levels of the root, generating complex shaping and cleaning issues. Numerous studies regarding the endodontic anatomy of lower premolars were published over the years. Some of these are presented in Table 1 [14,15].

Table 1 – Studies on endodontic anatomy of lower premolars

Year	Researcher	First lower premolars with two root canals	Second lower premolars with two root canals
1978	Vertucci	25%	12%
1988	Messing	27%	N/A
1992	Beters	25,5%	2,5%
2002	Rhodes	33%	11%
2006	Lu	46%	N/A
2007	Cleghorn	N/A	9%
2008	Ingle	32,8%	7,8%
2011	Kuttler	25.8%	1,2%
2014	Iliescu	N/A	10%
2014	Singh	22%	N/A
2021	Martius	23,6%	5,3%

N/A – not applicable

Knowledge of endodontic anatomy is the premise for a correct approach to root canal therapy. The awareness of possible internal root morphology variations of lower premolars in a certain population guides the clinician towards the correct radiological and clinical interpretation followed by the successful outcome of the endodontic treatment [16].

Materials and methods

A comprehensive radiographic analysis of first and second lower premolars' endodontic morphology was undertaken. The purpose of this study was to demonstrate a higher percent of two root canaled lower premolars in patients from the Mureş County and to raise awareness of this critical fact among clinicians.

Demographic data regarding gender was collected from the patients. A total of 376 periapical X-rays belonging to patients from a private practice were included in this research.

The private practice of CMI Dr. Lazăr Luminiţa gave permission to use the database of the patients for the purpose of this research on 6th of January 2020. Written and verbal consent from each patient was obtained along. Personal data was processed in accordance with the data protection rules.

Inclusion criteria:

- Lower premolars without previous endodontic treatment
- Unmodified endodontic configuration by internal resorption
- Intact, fully developed root
- Exclusion criteria:
- Root fracture
- Root with external resorption

The X-rays were analyzed by 3 endodontists to establish the number of root canals of the lower premolars. This analysis was followed by the endodontic treatment of these teeth using the operating microscope to confirm the number of root canals discovered by the radiographic findings. The data was collected in Microsoft Excel work sheets (Microsoft Corporation, 2018) and subsequently analyzed with GraphPad (GraphPad Prism version 7.00 for Windows, GraphPad Software, La Jolla California USA) using Chi-square test without Yates` correction. The significance level was set at $P<0.05$.

Results

Out of the 262 first premolars included in this study, 82 (31.3%) had two root canals. From the total of 356 second premolars analyzed, 52 had two root canals, which represents a ratio of 14,6% (Table 2, Figure 1).

Table 2 – Number of root canals in the investigated lower premolars

Number of canals	First premolar (n=262)	Second premolar (n=356)
One	68.7%	85.4%
Two	31.3%	14.6%

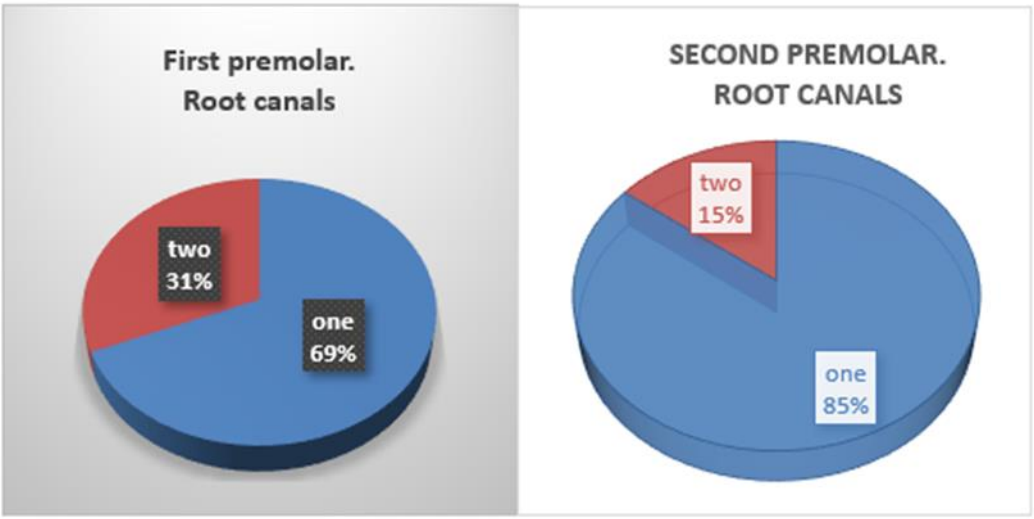

Figure 1. Distribution of one and two root canals in lower premolars

Out of the 82 first premolars with two root canals, 50 (60.97%) were found in female patients and 32 (39.02%) in male patients. Among 52 patients with two root canal configured second premolars, 40 (76.9%) were woman and 12 (23.07%) were men. The prevalence of two root canals was higher for female patients in both first and second premolars but the occurrence of two root canals between genders did not display any significant difference (p=0.055) (Figure 2).

	1st premolar	2nd premolar	Total
Males	32	12	44
	(24%)	(9%)	(33%)
Females	50	40	90
	(37%)	(30%)	(67%)
Total	82	52	134
	(61%)	(39%)	(100%)

p=0.055

Figure 2. Gender distribution for lower premolars with two root canals

Discussion

The misconception that root therapy of lower premolars is straightforward as they only have one root canal should be disbanded.

Clinicians must be aware of anatomical variations of the root canal system of these teeth as it can pay a decisive role in the long-term success of root canal therapy. If the entire root canal system is not located and properly cleaned, a large number of cases could result in failures and flare-ups. Furthermore, careful interpretation of preoperative radiographs and direct observation with the operating microscope is equally important [17,18].

The canal pattern of mandibular premolars may vary from one region to another, and it is closely linked to ethnicity and gender. The results of our research showed that the prevalence of lower premolars with two root canals is higher in patients from the Mureş County compared to regions from other countries. Studies on canal morphology using a variety of techniques were undertaken over time. Lu et al used the cross-sectioning method and found a percentage of 22% of first premolars that had two root canals, while Baisden et al identified similar results (24%) [19].

Decalcification and clearing methods were used by Caiskan et al who found a percentage of 19% of two canals configured first premolars [20]. The 3D reconstruction and computed tomography techniques are also popular within ways that determine root canal patterns. Mikrogeorgis' research reported a 11.59% of first premolars with two root canals while Robinson's study showed a percentage of 14. These studies reported a close link between root canal morphology and male/female gender [21,22]. The results of our study revealed a considerably higher rate of first premolars with two root canals. Results similar to previously mentioned authors were discovered by Willerhausen et al which, similar to our study, using radiological and direct observational means, found a percentage of 24.2% [23].

The findings of a study done by Habib et al on a Syrian population were in agreement with our research, with a 15.3% of second premolars with two root canals. Also, Geiger et al observed a similar percent in a French population (13.4%) [24,25]. Other authors reported significantly lower rates of two canals configured mandibular second premolars: Zaatar et al (4.7%), Yu et al (2.2%), Ok et al (2.5%) [26,27,28].

Within the limitations of our study, the rate of lower premolars with a two root canal configuration, were high in the researched area, but further investigations in other parts of the country are required for comparison.

Conclusion

Variations of the endodontic anatomy of lower premolars in the Mureş area are quite significant. Gender is an important factor that needs to be considered prior to the endodontic treatment of lower premolars. Both first and second premolars should receive more attention of the clinicians treating patients from this region as knowledge of anatomical patterns, radiographic and clinical interpretation could play a critical role in the successful outcome of these challenging situations.

Conflict of interest: None to declare.

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CASE REPORT

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Nanostructured surface dental implants, a modern solution for the treatment of patients with chronic systemic diseases.

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Abstract

Introduction. In modern dentistry the oral rehabilitation of patients with the help of dental implants has a very high success rate. However, the problem is the situation of patients with serious chronic diseases in which the insertion of dental implants is problematic or dental procedures can complicate or aggravate the patients' disease.

Case report. We presented the case of a patient with associated chronic diseases who benefited from the insertion of implants with a nanostructured surface. The nanotube surface of the dental implant has been loaded with anti-inflammatory drugs to promote healing and stimulate the process of osteogenesis.

Conclusions. Within the limitations of this study, we consider the therapy with avant-garde nanostructured dental implants to represent a viable treatment option for patients with a medical history with complicated chronic diseases.

Keywords: oral rehabilitation, dental implants, chronic disease, nanostructured surface, ostegenesis.

Introduction

Oral rehabilitation of patients with dental implants, in the era of modern dentistry, is predictable and with a success rate of over 90% [1]. However, the literature indicates variable percentages of situations of loss of dental implant, among which we mention peri-mucositis, peri-implantitis, loss of osseointegration, poor oral hygiene, etc. [2,3]. In 2015 World Health Organization publishes in its report, the list of the most common diseases of the elderly that can influence the treatment with dental implants, putting in the first place cardiovascular disease (CVD), cancer, respiratory diseases, diabetes mellitus, cirrhosis of the liver, osteoarthritis, etc. [4]. Castellanos-Cosano et. al. (2019) addressed the relationship between dental implant loss and patient systemic disease and observed that there is a statistically significant risk of dental implant loss in patients with diabetes mellitus over 70 years of age and in patients with CVD between 61-70 years ($p < 0.001$) [5]. That is why these chronic systemic diseases and the multiple possibilities of degradation of the biological support or mechanical trauma, which lead to the loss of the dental implant, have always raised problems for specialists in carrying out an individualized treatment, modeled on the specific basic medical conditions [6].

There were over 220 types of dental implants in the early 2000s with an estimated number of over 2000 designs [7]. In order to improve the survival rate of a dental implant, the specialists defined the three important elements that characterize an implant, its geometry, the material and the way of making the surface [8].

If we talk about the geometry of the cylindrical or conical implant, there are studies that consider it a little important, but also vice versa, being considered important. Instead, everyone considers that the most important aspect for obtaining primary stability is the torq [9].

If we approach the material, we can say that pure commercial titanium (Ti 12) showed better cell viability than Ti-6Al-4V alloys (Ti 5, Ti 23), although a significant decrease in cytotoxicity due to TiO2 formation was observed in both types of materials [10]. Some recent studies have questioned the cytotoxicity deficiencies of Ti 5 and Ti 23, which contains vanadium and aluminum, suggesting that in vitro cytotoxicity is different from in vivo, due to different ionic concentrations [11]. Budei et al. (2021) showed that many implant manufacturers prefer Grade 4 pure titanium (Ti

CP4) as their material due to the lack of homogenity in different alloys [12].

If we talk about the surface of the dental implant, a simple search in PubMed (5 years ago, free full text) showed us 1240 articles that debate or propose an efficient surface of the dental implant. If we did the same search for nanotube dental implants we found only 58 results. There have been authors who have used nanotubes to increase the osseointegration of implants with the help of variants of human proteins, collagen or even the in vitro modification of the surface structure [13-15]. Yang et al. (2020) demonstrated through an in vitro study that changing the surface of the dental implant by making nanotubes attenuates the inhibition of osteogenesis induced by diabetes mellitus, this structure giving the dental implant a favorable surface for the diabetic patient [16]. Pathak et al (2019) managed to successfully produce TiO2 nanotubes by combustion synthesis on the surface of the dental implant [17]. The study by Camargo et al. (2021) showed that Ti nanotubes can promote the proliferation of osteoblasts and reduce the adhesion of bacterial biofilm to the surface of the dental implant, which is important to achieve good osseointegration [18].

Case report

We present the case of a 61-year-old male patient, working in a toxic (chemical) environment, who presented to the clinic for a complex oral rehabilitation treatment, with the express request to avoid the application of complete dentures. The general medical history showed the existence of an acute myocardial infarction 13 years ago and a coronary stent applied 1 year ago. The patient does not have high blood pressure and is a non-smoker. The patient's current medication was instituted by the cardiologist and is as follows: Plavocorin 75 mg/day, Nebivolol 5 mg/day and Atorvastatin 10 mg/day.

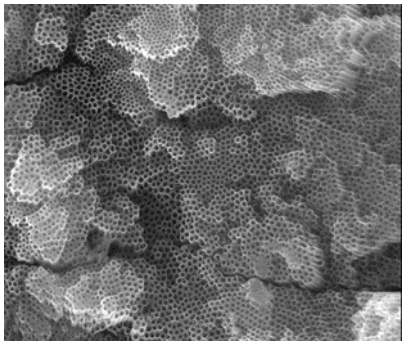
From the point of view of the dental situation, the patient was completely edentulous in the jaw, being the bearer of a complete deficient denture for 6 years. In the lower jaw, the patient had Kennedy class III/2 edentation. The restoration was done with an unsuitable metal-ceramic bridge (figure 1).

Figure 1. Initial status

In order to clarify the diagnoses and to establish a dental treatment plan, the following paraclinical investigations were requested: cardiological consultation with the attending physician, complete blood tests and CBCT investigation. The cardiologist confirmed the general medical diagnoses and maintained the current treatment and made the recommendation that in case of implant insertion the anticoagulant medication be interrupted one day before implantation and resumed after two days. Broad-spectrum antibiotics have also been associated for 7 days. Laboratory analyzes showed normal values for all parameters except: monocytes 0.67 (reference range 0.1-0.6 10^3/µL), basophils 0.14 (reference range 0.01-0.08 10^3/µL), mean erythrocyte volume 100.50 (reference range 78-95 fL), platelet distribution width 22.22 (reference range 10-22 fL), Quik time 14

(reference range 9.8-12.1 seconds), Activated Partial Thromboplastin Time (APTT) 37.30 (reference range 23-31.9 seconds) and APTT Ratio is 1.52 (reference range 0.9-1.1 seconds). The CBCT evaluation confirmed the previously made diagnoses and revealed a D3 bone density in the jaw and mandible, but with a minimum width of the edentulous maxillary ridge between 4.65 and 4.8 mm in quadrant 1 and 5.25-5.6 in quadrant 2. In mandible width the crest was on average 5.52 mm. Under these conditions, the patient was proposed to simulate the implant treatment and then to perform the Dentix Nano® implant treatment, a treatment plan that was accepted. The decision to use this type of nanostructured implant was based on three important arguments: the patient's medical condition, the fact that the implant has a surface with nanotubes and the possibility of loading the nanotubes with antibiotics or anti-inflammatory as needed drugs, delivered in-situ for a long period of time. Implant treatment was performed by inserting five implants in the jaw and six implants in the mandible as seen in figure 2, and the decision to hydrophilize the nanotubes was in favor of dexamethasone (DEX) which reduced local inflammation, pain and postoperative edema. Together with the broad-spectrum antibiotic administered before and after implantation, they favored a better cure later. Hydrophilization of nanotubes on the surface of dental implants was performed in the office by immersing the implant in sterile dexamethasone solution and ultrasonic vibration of the implant (figure 3 A, B).

Figure 2. Maxilar and mandibular implants placement



A

B

Figure 3. A-Nanostructured surface with a layer of Titania nano-tubes on a Dentix Nano dental implant, B-Loading nano-tubes with Dexamethasone

The temporary prostheses for the jaw were made by the foliation of the old complete dentures in the area of dental implants insertion and the application of resilient lining material, and a temporary milled acrylic work was made for the mandible (figure 4).

Figure 4. Temporary prosthesis

Five months after insertion due to the mechanical forces transmitted by the prosthesis on the implant area from position 2.5, it was pushed into the maxillary sinus (figure 5). The patient did not report any allegations about this. The implant was removed from the sinus and another similar implant was applied in position 2.4.

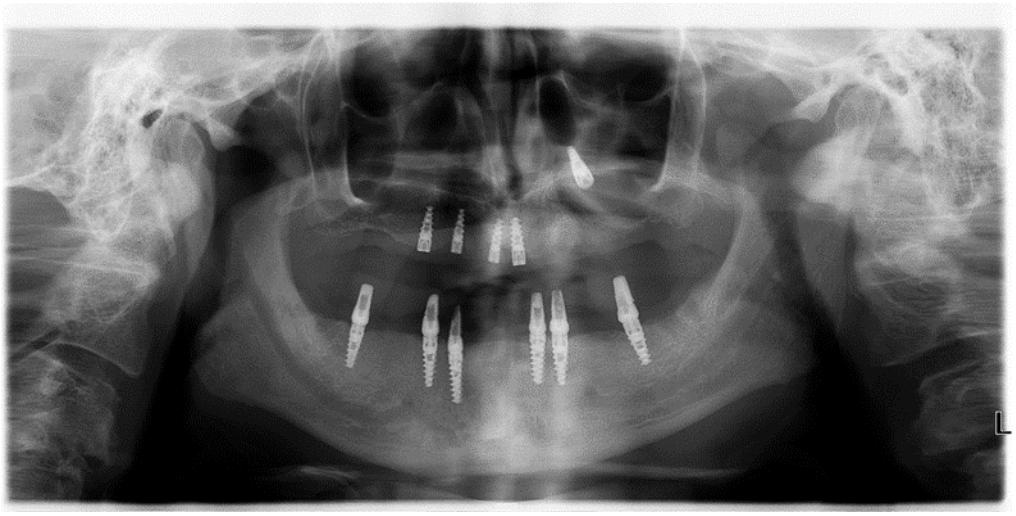


Figure 5. 2.5 Dental implant migrated to maxillary sinus

After the osseointegration period, the final prosthetic treatment was performed. A complete overdenture anchored on implants with a system of connecting bars and palatal vault not covered by the prosthesis was made at the maxilla, and a cemented metal-ceramic bridge with implant support was made at the mandible (figure 6).

Figure 6. Final status

Discussions

All Titanium based dental implants present a Titania (TiO2) nano-layer on the surface due to the specific behaviour of Titanium in contact with Oxygen. In all dental implants with a SLA surface treatment, this nanolayer (few nanometers thick) is amorphous, or non-structured. Live tissue receiving a Titanium based implant, will directly interfere with this Titania nano-layer. The real molecular chemotaxis mechanism subsequent to osseointegration, is trigged by the Titania. One of the reasons behind choosing to structure this nano-layer of Titania into nanotubes arrays, was to empower this chemotaxis mechanism. At the size of 40-60um inner diameter, 60-80um outer diameter and 100-200um in height, the surface of Titania exposed to the live tisuse is more than 6 times higher than on the same size SLA implant[12].

Another reason was that this Titania nanotubes arrays may be used as drug delivery systems (DDS), once they have been loaded with appropriate drugs [19,20]. This opens the perspective to customize the implant treatment to any patient and to make it possible for those with major chronic diseases.

Special production procedures of this arrays, allow to control the diameter (inner and outer) and the height of the nanotubes and hence, to control the drug delivery through the elution mechanism.

The healing process in the oral cavity goes through the same stages every time. One of these stages is the inflammatory reaction produced by cytokines. The role of this stage is to remove tissue debris, necrotic tissue and to some extent microorganisms [21]. It was decided to use DEX to hydrophilize the surface of the dental implant for two reasons. The first was that these implants had to be hydrophilic to ensure osseointegration, and the second was the desire to modulate different phases of the healing process [22]. DEX, a synthetic glucocorticoid, is known and used clinically as an anti-inflammatory drug. Previous studies have reported that DEX can induce osteoporosis or even pathological fractures [23], while DEX in vitro promotes osteoblast differentiation and bone mineralization [24-26]. In fact, DEX has been commonly used to induce mesenchymal stem cell differentiation and is a key component in osteogenic differentiation. However, different effects of DEX on stem cells and undifferentiated osteoblasts have been reported [27]. Specifically, a low concentration of DEX increases the activity of stem cells and promotes differentiation in the healing process, and high concentrations and long-term treatments negatively influence this process [28].

Yang (2021) in a retrospective study mentioned the possible causes of dental implant failure shortly after insertion, incriminating the lack of osseointegration due to dehiscence and wound infection, osteonecrosis due to improper torque, bone perforations during insertion, loading premature implantation or application of excessive force, or periodontitis of adjacent teeth [29].

Do (2020) showed in a literature review that many factors may be involved that cause late

dental implant failure. Common risk factors related to late dental implant failure could be classified into three groups, patient history (radiotherapy, bruxism, periodontitis, and early implant loss), clinical parameters (grade 4 bone and implant placed in a posterior location), and decisions made by the doctor (low initial stability, more than one implant placed during surgery or using a sustained implant overdenture with cone connection) [30]. Taking into account the presented studies, we considered that the early loss of the implant in quadrant 2 was due to the application of inadequate forces, probably transmitted by the imperceptible balance of complete dentures applied to the patient in the temporary prosthesis stage.

After completing these steps, the patient was rehabilitated with the final prosthetic parts according to standard procedures. An overdenture with implant support on the connecting bar was performed on the maxilla. A dental bridge anchored to dental implants was not an option due to the size of the dental implants in the first quadrant of the maxilla. A dental bridge support on six dental implants was applied to the mandible.

Conclusions

Careful study of the patient's medical history and correlation of dental treatment options with the patient's chronic diseases made it possible to take therapeutic measures that favored the healing processes after the insertion of dental implants. A great help was the one offered by the Dentix Nano implants, which allowed the placement of drugs and their gradual release, at the place of the insertion of the dental implants. Within the limitations of this study, subject to the short time of monitoring the case (20 months), we consider the therapy with this type of nanostructured dental implants represent a viable treatment option.

Conflict of interest: Mr. Mircea Suciu and Mr. Florentin Daniel Berneanu report no conflict of interest. Mr. Dragos Budei is a shareholder of Dentix Millennium and the inventor of the nano-structuring method applied on described medical devices.

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

Case reports and case series

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

Original papers

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

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

Brief reports

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

Letter to editor

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

Editorial

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

State-of-the-art papers

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

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

Peer review process

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

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

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

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

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

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

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

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

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

Complaints

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

Acta Stomatologica Marisiensis Journal

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