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DIAGNOSIS AND TREATMENT PLAN FOR CLASS II DIVISION 1 MALOCCLUSION

ДИЈАГНОЗА И ПЛАН НА ТРЕТМАН НА МАЛОКЛУЗИЈА II КЛАСА 1 ОДДЕЛЕНИЕ

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Abstract

Growth conditioned by endogenous and exogenous factors may occur irregulary, which shall result in altered morphology in the dentofacial region and the appearance of malocclusions in the sagittal, vertical, and transverse planes. ClassII division 1 malocclusion is a sagittal anomaly with distinct morphological variations that reflect the extraoral appearance of the patient. Class II division 1 malocclusion is an anomaly in antero-posterior direction characterized by a distall placement of the mandible to the maxilla with varying degrees of labial inclination of the maxillary frontal segment. Regarding the vertical discrepancy in class II division 1 malocclusion, large variations are noticed from the appearance of a deep overbite in the hypodivergent type of facial growth to an open bite in the hyperdivergent growth pattern. There are several literature data on class II division 1 malocclusion, the etiological factors influencing the formation of malocclusion, and orthodontic treatment of this malocclusion. Orthodontic diagnosis is gathered through medical and dental history, clinical examination, and records that include gnatometric analysis of studio models, analysis of photographs, and radiographic recordings. **Aim:** The aim of this study is to evaluate the morphological variations of class II division 1 malocclusion, to follow the endogenous and exogenous factors and functional disorders that conditioned its formation, and the appropriate treatment plan that shall be applied to achieve: stable occlusion, proper mastication function, proper functioning of the temporomandibular joint, harmonious facial aesthetics and a beautiful smile on the patient face.
Keywords: Class II division 1 malocclusion, etiological factors for class II division 1 malocclusion, therapy of class II division 1 malocclusion.

Апстракт

Растот условен од ендогените и егзогените фактори може да се одвива со неправилен тек, што ќе резултира со променета морфологија во дентофацијалната регија и појава на малоклузии во сагитална, вертикална и трансверзална рамнина. Класа прво одделение малоклузијата е аномалија во сагитална насока со изразени морфолошки варијации кои даваат одраз на екстраоралниот изглед на пациентот. КласаII 1 одделениемалоклузија е аномалија во антеро-постериорен правец која се карактеризира со дистално поставената мандибула во однос на максилата со различен степен на лабијална накосеност на максиларните фронтални заби. Во однос на вертикалните отстапувања кај малоклузија класа II прво одделение се забележуваат големи варијации, од појава на длабока вертикална инцизална стапалка кај хиподивергентниот тип на раст на лицето до отворен загриз кај хипердивергентниот начин на раст. Постојат повеќе литературни податоци за малоклузија класа II прво одделение, етиолошките фактори кои влијаат на формирањето на малоклузија, и ортодонскиот третман кај оваа малоклузија. Податоците за малоклузијата се собираат преку медицинска и дентална историја, клинички преглед и записи кои вклучуваат гнатометриска анализа на студио модели, анализа на фотографии и радиографски снимања. **Цел:** Цел на оваа студија е да ги процениме морфолошки варијации на малоклузија класа II прво одделение, да ги проследиме ендогените и егзогени фактори и функционални нарушувања кои условиле нејзино формирање, и соодветниот план на терапија кој ќе се примени за да се постигне: стабилна оклузија, правилна функција на мастикација, правилно функционирање на темпоромандибуларниот зглоб, хармонична естетика на лицето и убава насмевка на лицето на пациентот.
Клучни зборови: малоклузија класа II прво одделение, етиолошки фактори за малоклузијата класа II прво одделение, терапија на малоклузија II прво одделение.

Introduction

The morphological characteristics of growth and development in the orofacial complex, the position of the jaws with the cranial base and the development of dentoalveolar structures is an individual and genetically determined process. Growth, conditioned by external and internal factors, can occur with irregularities, resulting in altered morphology in the dentofacial region and malocclusions in sagittal, vertical and transverse planes.

Class II division 1 malocclusion is a sagittal and dental anomaly, characterized by a distal positioning of mandibular dental arch related to maxillary dental arch, and there is protrusion of maxillary frontal teeth, that can be mild, moderate or severe, states Kanurkova[1].

According to Mitchell[2], the labial inclination of maxillary frontal teeth, a hallmark of this malocclusion, increases their vulnerability to trauma. If cases where the horizontal incisal overlap is pronounced the mandibular incisors may fail to contact the maxillary incisors, and instead come into contact with the palatal mucosa, indicating a supraposition.

Regarding vertical deviations in class II division 1 malocclusion, large variations are observed, from the appearance of a deep overbite in the hypodivergent type of facial growth to an open bite in the hyperdivergent type of growth.

Based on the cephalometric analysis in class II division 1 malocclusion, an increased ANB angle is often noted, that in most cases there is a distal position of the mandible, mandible is retropositioned while the maxilla is placed in the normal position. But there are also cases where, in addition to the distal position of the mandible, there is also the prognatics of the maxilla.

A skeletal class II represents anteroposterior discrepancy between the basal parts of the maxilla and the mandible. This can result from a small or distally positioned mandible, a large or anteriorly positioned maxilla or a combination of both factors[4].

During puberty, the growth of the mandible tends toexceed maxillary growth. According to Gill[6], 0 pubertal peak in growth in boys occurs later and lasts longer than girls. This difference in the growth of mandibule and maxilla is a favorable prognosis in the treatment of skeletal malocclusions II class. In patients undergoing a growth spurt and are diagnosed with class II malocclusion, dentoalveolar compensation can often occur, labial tipping of mandibular teeth and palatal inclination of maxillary incisions.

The terminal plane, defined by the distal surfaces of the second deciduous molars plays a crucial role in determining the eruption path of the first permanent molars. In class II division 1 malocclusion, a distal placement of the mandibular second deciduous molar leads to a distal shift in the terminal plane. As Phulari[5] explains, this distal placement results in the first permanent mandibular molar erupting in more distal position, creating a distal interrelation of the buccal segment.

A retrospective study conducted by Pădure et al.[11] analyzes the etiology of class II division 1 malocclusion in patients with a dominant hereditary factor, and those where - the cause of malocclusion is bad habit. The study included patients aged 7 to 23-years of both gender, with dental and skeletal class II division 1 malocclusion. The results revealed that hereditary factor in the etiology of class II division 1 malocclusion is represented in 41%, compared to 13% when the cause of class II division 1 malocclusion is a bad habit - digit sucking. Notably, in the group where bad habits were the primary cause, 66.7% were girls. This higher prevalence among females was attributed to the emotional factor present in girls.

Patients with a history of digit sucking frequently exhibit facial asymmetry directly linked to the unilateral or inconsistent nature of this habit.

This group also demonstrated a 100% occurrence of a convex facial profile, accompanied by a pronounced curve of Spee. The persistent habit inhibits mandibular growth, alters incisor positioning, and results in an increased labial inclination of the maxillary incisors. In this group the overjet exceeds 8 mm, highlighting the severity of the dental displacement.

Patients with this malocclusion often have nasal obstruction and mouth breathing. The upper lip tends to be underdeveloped, and the pressure on the labial surfaces of the maxillary incisors is insufficient. Consequently, the tongue exerts strong anterior forces, contributing to the protrusion of the maxillary incisors

A characteristic feature of this class II division 1 malocclusion, is lip incompetence, caused by the proclination of the maxillary incisors. The lower lip is positioned behind the maxillary incisors, a placement that further enhancesthe retrusion of mandibular incisors and the protusion of maxillary incisors.

During swallowing, the lip musculature become active to establish lip contact. In this process the mandible is placed in an anterior position. The tongue moves anteriorly to touch the lower lip, further intensifying the protrusion of maxillary incisors. In class II division 1 malocclusion, a partial performance of lip function, leading to a disruption in the equilibrium of orofacial muscular forces.

In addition to the disordered breathing function, bad oral habits such as digit sucking or pacifier use, and tongue pressure between teeth can all affect occlusal development. Insufficient transversal development of the maxillary dental arch-caused by reduced intra-oral air pressure and increased activity of the buccal musculature leads to constriction of the buccal segments of the maxillary dental arch. As a result the maxillary dental arch becomes elongated and compressed, often taking the shape of the Latin letter “U” or “V”. According to Zuzhelova[8] this compression of the maxillary arch, may lead to unilaterally or bilaterally cross-bite.

Proffit[9] emphasizes that the bad habit of digit sucking can result in an open bite and interfere with the eruption while promoting excessive eruption of the posterior teeth. Placing a finger between the anterior teeth positions the mandible downward and hinders the eruption of the front teeth. The lack of interocclusal contact affects jaw development, alters the vertical equilibrium of the posterior teeth and contributes to their prolonged eruption. Due to the morphological characteristics of the jaws, a 1 mm elongation of the posterior segment, may result in a 2 mm anteri-

or open bite, thus contributing to the development of an anterior open bite. Open bite is observed in approximately 50% of the three-year-old patients, but in a significant number of cases, it self-corrects, if the bad habit is eliminated.

The facial profile is convex, and the degree of convexity depends on the distal positioning of the lower jaw, the anterior position of the upper jaw, the protrusion of maxillary incisors and the retrusion of mandibular incisors.

The prevalence of class II division 1 malocclusion in the Western European population ranges from 25–33%. Research has shown that the SNA and SNB angles which determine maxillary prognatism and mandibular position are inherited. In this type of malocclusion, the mandibula is retruded (Gill)[6].

The class 2 division 1 malocclusion occurs in deciduous dentition and often persists into the mixed and permanent dentition. In the deciduous dentition it is presented up to 40% of cases, while in the permanent dentition its prevalence varies from 14.7-24.6% depending on the population studied (Kanurkova[1]).

Material and methods

In order to achieve the objectives of this study, we were using data obtained from a comprehensive review literature available in data bases such as PubMed, Google Scholar and Elsevier. The research articles we analyzed focus specifically to class 2 division 1 malocclusion. We systemized the data related to this type of malocclusion included the variations, endogenous and exogenous factors contributing of affected patients and outlined corresponding treatment plans.

The study sample consisted of patients aged 3 to 18 years, both genders equally represented.

The literature reviewed included authoritative textbooks, published by Elsevier, Wiley-Blackwell, as well as review articles, prospective, retrospective, longitudinal studies and case reports.

All data were organized and analyzed in accordance to the predetermined goals.

Discussion

Functional disorders of the craniofacial complex causes irregular development of the occlusion during the period when proper tongue posture, swallowing and chewing habits should be established. A thorough understanding of the dental occlusion development is essential for recognizing irregular development and begin the treatment of malocclusion.

According to Nanda[3] the influence of soft facial structures affects the appearance of class II division 1 malocclusion that we have identified and traced in our literature review. The development of the orofacial region is affected by the muscular activity of the tongue, lips and cheeks. Within this dynamic and complex environment, the position of the teeth and the shape of the dental arches are defined by the balance of muscular activity of the cheeks, lips and tongue, which is why there is a large variability in the form of dental arches.

The tongue, in particular, has a formative role in occlusal development. Its placement at the bottom of the oral cavity, whereby the pressure from the oral side of the dental arches is less intense, results in reduced transverse growth of the maxilla and diminished sagittal growth of the mandible. As a consequence a cross bite may develop in the buccal segment, and in the incisal segment, it leads to formation of an open bite.

Literature data further reveal that oral breathing is frequently associated with anatomic obstruction such as septum deviation and chronic nasal congestion. The activity of the muscles of the cheeks that interrupt the transversal development of the alveolar processes dominates, while the hypotonia of the orbicularis oris results to the appearance of incompetent lips.

Thilander[10] emphasizes the critical role of medical history (anamnesis) as the first step in orthodontic treatment that seeks to diagnose clinical changes of malocclusion and identify the causes of its occurrence. In this context, particular attention is paid to the patient's general health , with an emphasis on whether drugs are used that are important for the formation of malocclusion, especially in patients with metabolic diseases that certainly affect the growth and reaction of tissues, it is also reported whether anti-inflammatory drugs are being taken that affect bone development. It is recorded whether the patient has a tendency to respiratory allergies that affect breathing and respiratory capacity. From the anamnestic data, attention is paid to the hereditary factor, the existence of bad habits, diet, diseases in early childhood, because these are factors that influence the development of bone and soft tissues in the orofacial region.

From our literature it has been established that patients with class II division 1 malocclusion, often exhibit alterations in facial symmetry, facial profile, lip positioning and temporomandibular joint function-findings particularly emphasized in studies of Graber[7].

In our assessment we followed functional tests to evaluate TMJ mobility, the mandibular position at rest, and its path during maximum mouth opening and closing. We observed parameters related to the data on swallowing, the position of the tongue and lips, the type of chewing, the way of respiration, the presence of phonetic disorders.

According to the a comprehensive diagnosis involves gnatometrics analysis on study models which is conducted in three planes transverse, sagittal and vertical.

Since orthodontic patients are often children during the period of rapid growth and development, when skeletal and dentoalveolar structures have not yet reached their full maturity, the application of X-ray imaging is an essential tool for accurate diagnosis and growth predictions and treatment planning.

It is recommended that the initial X-ray be taken during a period of mixed detention, around the age of seven.

Class II division 1 malocclusion is described as a dental and skeletal anomaly in which soft tissue structures camouflage the underlying bone and dentoalveolar configurations. Therefore it is necessary to apply cephalometric analyzes to accurately determine at which level of the orofacial region a deviation from normal growth and development has occurred resulting in sagittal irregularity. Lateral cephalometric radiographs are used to assess the relationships of viscerocranium to the cranial base.

According to Mitchell[2] and Cobourne[12] the results achieved with orthodontic appliances and the extent of facial harmony depend on the patient's age, the duration of the orthodontic treatment, and the degree of overjet correction.

Zorko[15] emphasizes that the dental arches are under constant pressure from surrounding structures. These include forces generated by mastication, tongue and lip pressure both at rest and during speech and swallowing-as well as forces from tooth eruption. The purpose of orthodontic appliances is to modify the natural system of pressure on dental arches[3].

Nanda[3] highlights that the goal of treatment is the correction of skeletal, dental and soft tissue irregularities, as well as maintaining the stability of results, after the appliance is removed. Since therapeutic approaches affect craniofacial structures differently, appliances selection should correspond to the underlying etiology of malocclusion. Due to the wide range of clinical manifestations of class II division 1 malocclusion, treatment must be individualized.

Mitchell[2] and Graber[7] note that mandibular growth is most pronounced during puberty and early adolescence, which is advantageous for correction class II division 1 malocclusion. Children with increased vertical skeletal proportions and a posteriorly roteted mandible have a poorer prognosis regarding incisal stability. This is due to the worsening anteroposterior discrepancy during growth, an increase in the height of the lower facial third and difficulty in achieving lip competence. In patients whose growth is complete and who present skeletal class II malocclusion, successful treatment with orthodontic appliance alone is challenging as noted by Mitchell[2].

Interceptive therapy is a phase of orthodontic treatment aimed at identifying and eliminating potential irregularities early. Although effective, it may not always produce high-quality final results, as also stated by Špalj[22]. However its benefits include reducing irregularities, eliminating harmful habits, enabling proper tooth eruption, guiding jaw and facial growth, and enhancing the patient's self-confidence.

Interceptive therapy begins during the deciduous or early mixed dentition stage, with the goal of enabling normal growth and development of the dentofacial complex when possible, achieving complete correction of the malocclusion. According to Špalj.[22] 50% of children benefit from interceptive therapy.

Noar[14] notes that the severity of malocclusion depends on the duration and intensity of the harmful habit. Persistent habits-such as digit sucking can lead to open bite, proclination of upper anterior teeth and lateral cross-bite, due to negative pressure by the habit. In children under the age of 6 treatment focuses on eliminating such habits, including digit sucking, tongue thrusting, and mouth breathing.

The Vestibular Plate and myofunctional exercises are considered part of the interceptive therapy in the correction of class II division1 correction. Proponents of early treatment follow the principle of promoting favorable developmental changes while suppressing unfavorable ones[15].

Zorko[16] emphasizes the use of the vestibular plate as an appliance for treating class II division 1 malocclusion in the deciduous and early mixed dentition stages (3-9 years), for correcting the parafunctions. This is used alongside myotherapy which targets the tonus of m. orbicularis oris[16].

Proffit[9] states that treatment of maxillary protrusion in early mixed dentition is indicated only when maxillary incisors erupt with diastemas, cause aesthetic concerns or are at risk of trauma. He further explains that maxillary protrusion in children without skeletal discrepancy is often the result of parafunction habits, which must be eliminated before orthodontic treatment begins.

Phulari[5] and Couburne[12] recommend early treatment of Class II division 1 malocclusion-typically between the ages of 8 and 10-due to the availability to maximize growth potential, reduce the risk of dental trauma, and simplify the overall treatment. However, potential drawbacks include prolonged treatment duration, the need for retention during the transition from mixed to permanent dentition, and economic considerations.

Correcting class II division 1 malocclusion using mobile appliances and teeth tipping is only feasible when the severity of the class II malocclusion expression is mild, highlights Couburne[1].

Mitchell[2] identifies three primary approaches to addressing class II skeletal discrepancy: growth modification, orthodontic camouflage, and surgical correction.

The findings of the Mitchell[2] align with the conclusions of Phulari[5] who explains that growth modification aims to restrict maxillary growth and stimulate mandible development. Headgear appliances are used to influence maxilliary growth both horizontally and vertically depending on the direction of the applied force.

Functional therapy has proven effective in reducing overjet in growing patients with more pronounced degree of skeletal class II. When crowding is present, correction in the anteroposterior plane can be achieved using functional appliances, followed by extractions and fixed appliances to achieve final dental alignment[2].

According to Nanda[3] Functional appliances utilize muscle forces to counteract unfavorable orofacial muscle activity. These devices enable modification of orofacial growth by directing the mandible mesially, based on the construction bite. The construction bite uses the stretching forces of the muscles, which are transmitted through the appliance to the teeth and jaws. This mechanism inhibits vertical maxillary growth and tooth eruption minimizing downward mandibular rotation[3].

Coubourn[12], highlights that the optimal time forusing functional appliances, is during adolescent peak of growth. In girls this typically begins around age 10 with the at approximately 11.5 years. In boys, growth starts between 11 and 12 years, peaking 14 and 15 years. Treatment is less effective if initiated during late mixed or early permanent dentition[12].

Literature findings suggest that patients with posterior rotation respond less favorable than those anterior mandibular rotation. The latter group typically presents with increased overbite a reduced lower facial third and a decreased angle between the Frankfurt and mandibular plane. While the ability to predict orofacial growth patternsand treatment response to functional devices remains limited, the use of Cone Beam Computed Tomography (CBCT) and three-dimensional imaging has enhanced clinicians' ability to assess and forecast treatment more accurately.

Fleming and Lee[24] report that, during treatment with functional appliances, the height of the lower third of the face increases due to a combination of natural growth and the anterior inclination of the occlusal plane. This vertical dimension increase is one reason why functional therapy is often avoided in patients with an increased gonial angle[24].

According to the literature functional appliances promote forward growth of the retruded and underdeveloped mandible. These appliances position the mandible in a more protrusive state initiating adaptive changes in the teeth, jaws and TMJ, ultimately resulting in the correction of malocclusion. The therapeutic effect of functional appliances include skeletal, dentoalveolar, and soft tissue modifications that can be estimated with cephalometric analysis.

Correction of the mandible in anteroposterior direction is proportionally dependent on the degree of the initial intermaxillary discrepancy. This is evidenced in cephalometric recordings by the forward movement of the Pogonion forward by 1-3mm, and correction of the ANB value, as noted by Fleming and Lee[24].

Functional appliances achieve overjet reduction through various mechanisms, including retroclination of maxillary incisors, proclined mandibular incisors, distal tipping of maxillary teeth, mesial eruption of mandibular teeth, restriction of maxillary growth, and anterior repositioning of the mandible via remodeling of the glenoid fossa, as described by Cobourne[12] andKoli[18].

Recent molecular level research has shed light on the process of enhanced cellular growth and genetic activity in the condyle cartilage cells. Stimulated cartilage cells signal the differentiation of mesenchymal stromal cells into chondrocytes in the articular layer, leading to cell division and remodeling the condyle.

Lee[24] further notes that the effects of functional appliance are more dental than skeletal occurring in ratio 2:1.

An improvement in the Class II relationship was observed following functional treatment, primarily due to dentoalveolar changes: the correction of the upper incisor position and proclination of the lower anterior teeth. Skeletal changes were also noticed: there was a constriction of the maxillary growth combined with a more protruded position of the mandible says Zelderloo et all.[25].

Given that the functional appliance increases the vertical dimension of the face through molar extrusion, Fleming and Lee[24] recommend the use of extraoral traction with an increased gonial angle when correcting Class II division 1 malocclusion. Extraoral traction helps to control vertical dimension while emphasizing sagittal correction In patients with a reduced lower facial third and increased overbite, eruption of the buccal segment contributes positively to malocclusion correction. The presence of a pronounced curve of Spee is reduced by a posterior disocclusion that favors extrusion in the buccal segment and reducing overbite[24].

The stability of the reduced overjet directly depends on the balance of soft tissues which is one of the determining factors. By the end of the treatment, lip competence should be achieved, with the lower lip covering the incisal third of the upper incisors.

Mitchell's[2] analysis alligns with the findings of Phulari[5] emphasizing that the decision to resolve crowding through tooth extraction significantly affects the facial profile. In patients with an increased nasolabial angle, a prominent nose and a retrognated mandible, extracting teeth and retroclination of the maxillary frontal segment, does not lead to an improvement in facial aesthetics.

Overjet can be corrected either by the distalization of maxillary molars or through extraction. The severity of protrusion of the maxillary anterior segment, as along with the degree of arch crowding, are key factors that determine the need for extraction. Most often, the first maxillary premolar is extracted, as noted by Nanda[3].

The Andresen activator has been successful in correction sagittal and vertical irregularities, with the greatest

effect observed during the late mixed dentition phase from 10 to 12. The success is attributed to the repositioning of jaw growth due to the skeletal pubertal peak in growth.

Combining of an activator with a headgear results in a retrusion of the upper incisors, distalization of maxillary molars, and mesial movement of mandibular molars.

Cephalometric analysis following bionator therapy demonstrated an increase in the height of the face dimensions, both anterior and posterior, a forward movement of point B on the mandible and an increase in the SNB angle The most favorable results are observed when the appliances if used during the pubertal peak, resulting in mandibular elongation, an increased gonial angle, posterior rotation of the condyle, and reverse shift of the caput mandibule, states Oshagh[26].

A study by Almeida-Pedrin and Osor[19] compared the effect of the bionator and headgear with anterior plate bite. The finding showed that the headgear restricts forward growth, while the bionator promotes mandibular protusion, indicating a significant favorable impact on both appliances of the antero-posterior relation of the maxilla and the mandible.

The mandible appear more pronounced by an average of 2mm-in the group treated with a headgear. Disarticulation the occlusion to minimize adaptive changes in the dentoalveolar complex is consider to significantly facilitate the treatment of II/1 malocclusion.

Twin-Block devices are most effective during the peak growth of late mixed and early permanent dentation. According to Koli[18] the class correction is achieved through a combination of skeletal (40%) and dental (60%) changes.

Mudgil[21] notes that twin-block therapy results in mandibular elongation and an increases in the SNB angle. The rapid reduction in overjet is due to the dentoalveolar changes. The appliance also effect the inclination of mandibular incisors, retroclination of maxillary incisors, eruption of lower molars and their mesialisation, as well as the distalization of maxillary molars. One common side effect, tipping of the mandibular incisors, is mitigated by placing acryling materials on the incisal edges Post- treatment changes in soft tissues include facial convexity, an increase in the mentolabial angle, and the lower lip and the soft Pogonion are moved in anterior direction, concludes Mudgil[21].

Greber[7] points the role of Frankel regulator, in eliminating functional irregularities of the tongue and lips. The resulting changes in soft tissues lead to gradual skeletal and dentoalveolar adaptation. The best results are achieved in early mixed dentition, when intensive growth of the alveolar bone is used and initial removal of functional irregularities before their complete manifestation[7].

The Frankel appliance is designed to alter the biomechanical conditions of the periodontal functional matrix of the maxilla and mandible. Grabel[7] attributes mandibular underdevelopment to an imbalance between retractor and protractor muscles. By positioning the mandible, such that the periodontal tissue of the mandibular condyle are exposed to biomechanical stimulus, growth is stimulated promoting forward relocation of the mandible in anterior direction.

Functional appliances can be combined with headgear, to restrict maxillary growth. The direction of the mandible growth toward the front and down is mainly due to the eruption of the molars.

Growth modification in skeletal class II malocclusion is achieved using headgear orthopedic appliances that apply intra-oral action and extraoral anchorage. The intermaxillary force transmitted through the labial arc on the maxillary dental arc creates orthopedic pressure that inhibits the both vertical and horizontal growth of the maxilla, thereby contributing to the correction of the skeletal II class, Nanda[3].

Extraoral traction reduces the forward growth of the maxillary dentition to establish proper occlusion. Nanda[3] emphasizes the headgear therapy restricts anterior and downward maxillary growth while allowing the the mandible to grow forward, thereby correcting the second class.

The extrusive component of the cervical headgear is particularly effective in reducing overbite in patients with a deep bite. For hyperdivergent patients, a high-pull headgear configuration is used to control vertical extrusive forces[3].

In addition to the skeletal effect, the appliance also induces significant dental changes, as noted by Staley[13]. The direction of force depends on the type of extraoral anchorage used. Cervical anchorage produces a horizontal component - distalization and extrusion of the upper molars, while parietal anchorage exerts force- distalization and the intrusion of maxillary molars.

In patients with an open bite extrusion of molars, must be avoided. Conversely, in patients with a low mandibular plane angle molar extrusion is a desired effect. The application of force in these patients is above the resistance center, producing extrusion and distal movement points out Staley[13].

Headgear can be used independently or in combination with fixed or removable appliances. The treatment outcome depends on the intensity of the force that can cause orthodontic (distalization, intrusion, extrusion) and orthopedic changes (inhibition of maxillary growth). According to Nanda[3] the optimal force for orthodontic tooth displacement is 1.5 N (150 gr) per side. If the second molars have erupted the applied force should be increased.

Greber[7] and Proffit[9] both emphasize that inhibition of maxillary growth is achieved by applying force that com-

press the sutures between maxilla and zygomatic bones, pterygoid and frontal bones. It is indicated the application of a minimum force of 2.5N (250 gr) on each side to inhibit maxillary growth. The skeletal effect of headgear therapy is achieved only if therapy is started during the pubertal growth peak, and improve the benefit by wearing the appliance at night when the secretion of growth hormone is greatest.

Expansion of the dental arches and correction of crowding are importan components of class II malocclusion. In Class II division 1 malocclusion, correction is often achieved through distalization of the molars, to create a space within the dental arch. Several appliances can achieve thus without the need for tooth extractions, including headgear, the pendulum appliance, the herbst appliance, and the Jasper Jumper.

The Hilgers Pendulum is an orthodontic device designed for distalization of maxillary first permanent molars, correction of dental II class and the derotation of molars, Nanda[3].

Almuzian et al.[27] applied moderate and continuous forces using such appliances, achieving molar distalization 4 to 5 mm for 3-4 months thus correcting the crowding and the second class.

The optimal timing for maxillary first distalization is prior to the eruption of the maxillary second molar indicates the authors[27]. Intraoral molar distalization leads to anchorage loss in the incisor or premolar region (or both) in various amounts depending on choice of distalization unit[28].

Lip bumper as an intramaxillary appliance for distalization, according to Almuzian[27] is a passive, fixed functional orthodontic appliance that operates through a labial arch technique, which affects the balance between cheeks, lips and tongue, activates the m. orbicularis oris and transfers forces from the perioral muscles to the molars.

The force that creates the tongue muscles from the lingual side pushes the teeth labial and thus corrects their position to increase the perimeter of the mandibular dental arch with passive lateral and anterior expansion and the distalization of molars, states Almuzian et al.[27]. In class II/1 malocclusion lip bumper is placed in the middle third of the incisors for labial inclination of the mandibular front. The reciprocal force exerted by the lips is transmitted through the arch to the molars and results in their distalization and extrusion. Graber[7] notes that changes in the balance of soft tissue cause proclination of lower incisions, an increase in inter-canine width, and a buccal inclination of molars.

Patients with a lip bumper should be monitored to prevent impaction of second molars during their eruption.

Researchers have concluded, that the spontaneous dental compensation in the mandibular dental arch generated by maxillary enlargement does not affect the basal structures of the mandible. Lip bumper therapy has been shown significantly increase the mandibular transverse basal dimension. Starting from the fact that transversal growth ends first, the condition for the amplification of therapy with lip-bumper is the early beginning of treatment, Vanasrdall[29].

The Herbst fixed functional orthopedic appliance developed according to Kingsley's "bite jumping" principles applies force to the molars pushing the jaws of each other. The force vector moves the mandible forward, and the maxilla backward is the conclusion of the Almusian etal[27]. The continuous 24-hour activity makes the Herbst appliance potentially the most efficient functional fixed appliance in the modification of the mandible growth, notes Proffit[9].

For the optimal effective treatment, Fleming and Lee[24] recommend construction the appliance based on an edge-to-edge construction bite[24].

Quad helix is a flexible modification of the transverse arch, whose application in late mixed and early permanent dentition makes it suitable for expanding the maxillary dental arch by slowly opening the palatal suture and derotation of the molars.

The effects observed by Phulari[5] are primarily dentoalveolar than skeletal, caused by light forces. The extraoral activation of the arch results in the extension of the maxillary arch from 2 mm to achieving hypercorrection, i.e. the palatal tubers of the upper teeth occlude with buccal tubers of the lower teeth. The combination of lateral cross-bite and bad habit of digit sucking is the best indication for this appliance[5]. The construction of the appliances positions the arch away from the palatal mucosa of the for 1-1.5 mm, thus avoiding the irritation of the palate as a side effect. After removing the appliance, the effectirritation disappears, but it can last up to a year.

The amplification of the treatment Proffit[9] is most effective when the appliance is used before adolescence, when medial palatal sutura is not ossified or there is only a small initial intermediation, so it does not require extensive microfracturation to separate the palatal parts[9].

The four helixes are bent in a plane parallel to the occlusal plane, not parallel to the palate. Upon activation, a horizontal vector force is created when the helixes are activated, with more translation movement of the molars, than only an inclination - Staley[13].

The correction of a skeletal maxillary constriction manifested by a narrow palate is achieved by the forced palatal expansion.

According to Špalj[23], the average upper limit for forced expansion is 16 years, and after that age the skeletal effect of the appliance decreases. For this purpose, hyrax-screw is applied, which is fixed on a metal frame of the maxillary first permanent molars and premolars or the first deciduous molars[23].

Transversal expansion of the palate, as a side effect, extrudes the side teeth and opens the bite, points out Ngan[33]. These side effects are desirable in patients with deep bite but not in patients with vertical growth. Placing acrylic plate on the occlusal surfaces prevents extrusion of the teeth from the buccal segment. The expansion of the maxillary arch does not only correct the skeletal crossbite but also the crowding. Each millimeter of maxillary expansion results in a 0.7 mm increase in the perimeter of the maxillary arch, which can be seen as a protrusion of the front teeth[33].

Orthodontic camouflage is achieved through the used of fixed appliance, translatory retraction of maxillary incisors and the proclination of the mandibular labial segment.

Comprehensive orthodontic treatment is an attempt to establish an ideal occlusion by repositioning all or almost all of the teeth. Therapy with removable appliances is not able to completely position the teeth; it is achieved only with devices that can cause translatory movements.

Elastic bands is used as intermaxillary and intramaxillary. Power chains are intramaxillary chains that connect the same dental arch attachments applying force for distalizing of canines and the retraction of incisors notes Demirovic[31]. Modules, elastic ligatures, and power chain generate force that is not constant it rapidly diminishes as soon as the material absorbs water from the mouth[31].

The elastic force of class II elastics is applied diagonally between the mandibular posterior segment and maxillary front teeth and creates a force that possesses a vertical and horizontal component. When the force does not pass through the center of resistance causes mesiopalatal rotation and expansion, according to Nanda[30].

The vertical component highlights Nanda[30] causes extrusion of maxillary canines and incisors and the mandibular buccal segment. The excessive use of elastic ligatures of large diameter causes the anterior rotation of the occlusal plane, extrusion of the mandibular molars and maxillary incisors resulting in deep bite and anterior rotation of the mandible. The magnitude of the vertical component increases when the mouth opens.

In hyperdivergent patients, excessive use of elastic long-diameter rubber may result in molar extrusion and anterior rotation of the mandible, increased face height. Nanda[30] avoided these undesirable effects on the vertical component by reducing its action or by increasing the action of the horizontal component and placing the ligature diagonally between the mandibular second molar and the maxillary lateral incisor.

The elimination of the protrusion of mandibular incisors and the recession of the labial gingiva Nanda[30] achieves this by reducing the time and magnitude of force[30].

Surgical correction associated with orthodontic therapy is the most appropriate approach in a strongly manifested skeletal class II malocclusion, to achieve aesthetic harmony and stable occlusion, as stated by Mitchell[2].

The study of Oh et al.[32] examines the stability of the results achieved 10 years after the end of orthodontic treatment. The changes observed, in most of the respondents, were not greater than 1mm in the length and width of the dental arches. Oh et al.[32] concluded that the presence of a fixed mandibular retainer affects the stability of the achieved results in the mandibular arch.

As McNamara underlines, the goal of all therapeutic regimens is to correct existing problems in the hard and soft tissues and to attain a normal relationship which remains after all appliances have been removed. Since specific therapeutic techniques affect craniofacial structures in different ways, the variety available should correspondent to the variety of true etiologies[34].

Conclusion

A thorough review of the literature provides comprehensive insight into the etiological factors that accurately guide us to the morphological variations of this malocclusion and the manner of its formation.

The data gathered from the literature review helped us to determine the impact of etiological factors on the clinical manifestations of class II division 1 malocclusion and the changes of the aesthetic of the person.

By searching the literature, we have determined the diagnostic methods: anamnesis, clinical trials, cephalometric analysis, which accurately described class II division 1 malocclusion, determined dental and skeletal changes in the orofacial region and thus helped determine the treatment plan for class II/1 malocclusion.

Through the conducted search of the data obtained from the literature we have indicated the treatment plan appropriate for the patient's age and the degree of expression of class II/1 malocclusion.

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