

Trainer System Appliances in Early Treatment of Malocclusions

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SUMMARY

Orthodontics is dental specialty focused on preventing and treating morphological and functional irregularities of orofacial system in order to establish adequate function of mastication apparatus, good occlusion and pleasant facial appearance. It has been shown that early treatment of orthodontic anomalies during the period of children's growth is very important. The purpose of early orthodontic treatment is to eliminate or modify deviant skeletal growth and to stimulate adequate dentoalveolar and skeletal development. As known, the treatment of malocclusions should begin in primary or early mixed dentition, since the status of primary dentition has profound effect on the development of permanent dentition. Functional orthodontic appliances are most commonly used in early orthodontic treatment. The aim of this study was to describe a new prefabricated polyurethane myo-functional appliance clinically proved to be very effective.

Keywords: early orthodontic treatment; functional appliances; Trainer system appliances

INTRODUCTION

Great technological development achieved in recent decades has greatly improved the efficiency of fixed orthodontic appliances in the treatment of adolescents, adults and even elderly people mainly due to the development of new materials, fixed orthodontic techniques and multidisciplinary (orthodontic and surgical) approach. However, preventive character of orthodontics focused primarily towards the young population has been shown not utilized enough in the world as well as in our country. From the birth, through primary, mixed and permanent dentition, by observing genetic predisposition, insisting on adequate exercise of the orofacial functions and interceptive correcting of slight morphological and/or developmental irregularities it is possible to guide and modify skeletal orofacial growth. In other words, most of severe skeletal irregularities in sagittal, transversal and vertical direction that require complicated and expensive orthodontic-surgical procedures in adolescence could be prevented in early stage [1].

EARLY ORTHODONTIC TREATMENT

The concept of early treatment of orthodontic anomalies in growing child has been known in practice for years, particularly in the European orthodontic practice. The

purpose of early orthodontic treatment is to eliminate or modify deviant skeletal growth, exclude some bad habits (mouth breathing, tongue thrusting, others) and stimulate adequate dentoalveolar and skeletal development. Prevention of orthodontic anomalies is in compliance with general agreement that it is easier to prevent than treat, i.e. to eliminate the cause instead of the consequence of a disease.

The treatment of some malocclusions should begin in primary or early mixed dentition since the status of primary dentition has a profound effect on the development of permanent dentition [2-8]. Some authors argue that posterior cross bite is one of the most common malocclusions of deciduous dentition in Caucasian children. If left untreated, it can lead to craniofacial asymmetry [4, 6, 9, 10, 11]. If the treatment is applied later there is a risk of temporomandibular joint damage [9, 10, 12]. In the children with chronic oral breathing and non competent lips, distal bite can be detected even in deciduous dentition. If not treated, it will affect mixed and permanent dentition causing narrow maxilla, protrusion and crowding of front upper teeth [13-16]. Early treatment of open bite caused by tongue thrusting or thumb sucking is very important in the prevention of severe malocclusion, unbalanced facial growth, and dominating vertical growth [1].

Functional orthodontic appliances are most commonly used in early orthodontic treatment. They can be simple as vestibular plate, most commonly used activator and its

modifications or complex such as Twin Block and Fränkel appliance. They have been used for over a hundred years to eliminate oral dysfunctions, achieve muscular balance, limit incisor protrusion and create good maxillo-mandibular relation. Skeletal and dentoalveolar effects of the treatment using functional appliances have been evaluated by many authors [17-22]. However, one of major problems of the therapy using functional appliances is low compliance of patients and their parents. Functional appliances are very often uncomfortable and children easily give up of the treatment. On the other hand parents have also been shown not persistent in motivating their children for treatment. As a consequence, irregularities persist leading to inadequate development of orofacial system, sometimes even whole organism.

FUNCTIONAL APPLIANCES TYPE OF TRAINER

Functional orthodontics advocates myo-functional treatment of malocclusions. Stimulation or inhibition of the activity of masticatory and/or facial muscles establishes muscular balance in the craniofacial system, improves the relation between upper and lower jaws and forces teeth to achieve better position and proper articulation [23, 24]. New functional appliances, Trainers, have been developed recently. They have possibility to re-educate masticatory and facial muscles, improve the position of tongue and more actively than any other known functional appliance to improve teeth position [25].

Trainer system appliances are used in accordance with indications and patient's age, including Infant Trainer intended for use in children 2-5 years old, Trainer for children with mixed dentition (T4KTM) (Figure 1), Trainer for adolescents/adults (T4ATM), Trainer the Brackets (T4BTM), Trainer for class II malocclusion (T4CIITM), Trainer for class III malocclusion (i-3), Trainer Lingua and Myobrace. Although indications are different, all Trainer system appliances work in similar way. As suggested by the name, Trainer System appliances train or exercise craniofacial system muscles to physiological load of bones and stimulate growth and development of all craniofacial system structures. Leading the facial and masticatory muscles to work properly, balancing the forces of the tongue and cheeks by proper tongue positioning in function and at rest, Trainer appliances stimulate growth and development of maxilla, mandible and dental arches including correct teeth positioning [25].

For early orthodontic or interceptive treatment aimed to correct functional anomalies of soft tissues, such as lingual malposition, centripetal lips and cheeks thrust, lip incompetence, mouth breathing or bruxism, the myo-functional device the Trainer T4K indicated in children 5 to 10 years old has drawn our attention. The Trainer T4K is a polyurethane prefabricated myo-functional appliance pre-molded into the class I (edge to edge position) composed of various elements designed to stimulate facial, masticatory and tongue muscles and to reposition the mandible [26] (Figure 1). It is recommended for use 1 to 2 hours during the day and 10 to 12 hours at night dur-

ing sleep similar to other Trainer system appliances. Our clinical experience has shown some advantages of this appliance over other functional appliances: no need for impressions especially convenient for non-cooperative children; no need for complicated appliance positioning often difficult to achieve since children at this age do not have patience; flexibility of the material makes this appliance comfortable and safe from breakage which is the greatest disadvantage of other functional appliances. Children preferably accept and use this appliance.

The effects of Trainer system appliances on maxilla and mandible have been demonstrated through scientific studies and clinical cases successfully treated and reported in the current literature [27-30]. This prefabricated functional appliance produces sagittal effect similar to that achieved with other functional appliances (activator, bionator, Twin block, Fränkel regulator or Herbst appliance) designed to stimulate mandibular growth by leading the mandible forward into the edge-to-edge position [20, 21, 22, 27, 31, 32, 33]. Leading the mandible in anterior position, Trainer, similarly to other functional appliances, stretches muscular fibers of mandible protractors (masseter, medial pterigoid and lateral pterigoid muscles). During the period of 10-12 hours of using the Trainer appliance (during sleep) muscles remain stretched; the diameter of blood vessels is reduced hindering sufficient blood flow and decreasing oxygenation and metabolism. These conditions cause muscular fatigue due to the accumulation of lactic acid in muscles. Similar process is achieved in the body at the beginning of exercise when muscles not active for long time become activated. When the appliance is removed, protruding muscles become hyper-contractible moving the mandible forward and backward. This explains why at the beginning of the treatment (about three to four weeks), patients report that in the morning when they remove the Trainer from their mouth, they can neither relax the mandible nor maintain the teeth in maximum intercuspation. Subsequent muscular hyper-contractibility after several hours of stretching muscle fibers leads to increased blood flow and removal of accumulated lactic acid. At the same time, increase in blood flow in muscles brings more undifferentiated cells with the ability to



Figure 1. T4K appliance
Slika 1. Ortodontski aparat T4K

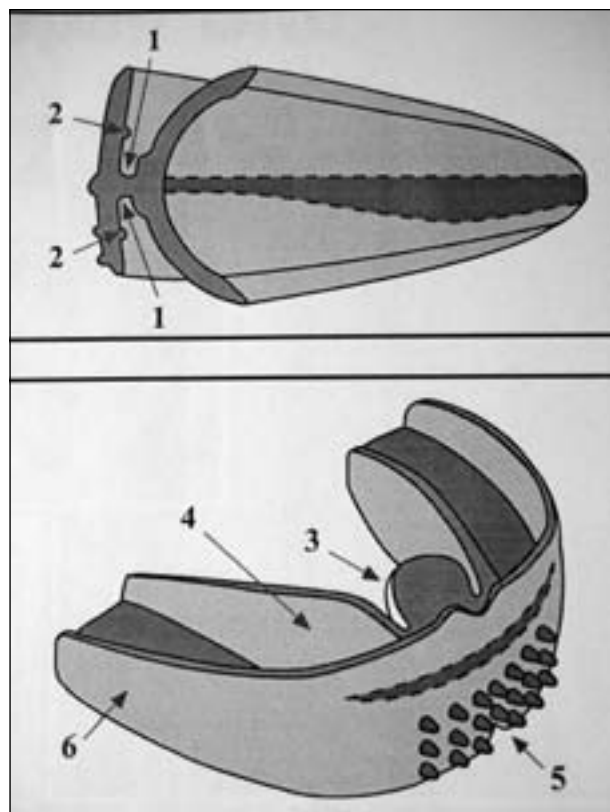


Figure 2. 1 – Tooth channels; 2 – Labial bows impart a light force on misaligned anterior teeth during their development; 3 – Tongue tag actively trains the positioning of the tongue tip as in myofunctional and speech therapies; 4 – Tongue bumper prevents tongue thrusting when in place and force nasal breathing; 5 – Lip bumpers discourage over-active mentalis muscle activity; 6 – Edge to edge class I achieved when appliance is in place.

Slika 2. 1 – Kanali za zube; 2 – Labijalni lukovi vrše blagu silu na nepravilno postavljene prednje zube tokom razvoja; 3 – Lingvalni jezičak aktivno vežba pozicioniranje vrha jezika kao u miofunkcionalnim i govornim vežbama; 4 – Branik za jezik onemogućava tiskanje jezika i podstiče disanje kroz nos; 5 – Branici za usne obeshrabruju preteranu aktivnost mišića mentalisa; 6 – Kada je u ustima, postiže se međuvilični odnos I klase.

differentiate into myoblasts causing production of new muscle fibers in protractors [34]. The increase in muscle fibers and trained muscles in further treatment allow keeping the mandible in anterior position without having muscle fatigue [26, 27, 28].

Another effect of the Trainer T4K reported in the literature is the stimulation of transversal development of dental arches [28]. Authors have reported the increase in the intercanine, interpremolar and intermolar distance of dental arches in patients treated with the Trainer T4K. The mechanism of this effect is similar to the Fränkel function regulator [35]. The presence of buccal shields prevent cheeks to apply the force on the buccal aspects of the upper and lower posterior teeth. This force is about 2.7 g/cm^3 . It can be increased up to 20 g/cm^3 in patients with digital sucking or tongue thrusting habits while it achieves the force of up to 80 g/cm^3 in the area of mouth corners and canines in the same patients [36, 37]. Counterbalance of these forces allows the proper position of the tongue and its action on the lingual side of teeth and stimulation of dentoalveolar unit growth in buccal

direction. The other effect of buccal shields is stretching of buccinator and orbicularis oris muscles, creating the tension zone in the area of muscle insertion. These tension zones stimulate bone apposition in both maxilla and mandible contributing to their transversal development [38].

The Trainer T4K has been clinically proved as very effective in improving vertical relation of the upper and lower teeth (overbite) in patients who have either deep or open bite [27, 28]. It is interesting how the same appliance works differently in patients with deep and open bite. Patients with deep bite have stronger muscles that control mouth closure, resulting in steep occlusal plane (deep Spee curve), where incisors erupt over and molars below the occlusal plane. The presence of Trainer in the mouth prevents posterior teeth intercuspitation due to the silicon surface between the upper and lower component of the appliance (Figure 2). That way, dentoalveolar units can develop in vertical direction. This results in teeth positioning in the flat occlusal plane given by the occlusal surfaces of the appliance. On the other hand, the use of the Trainer T4K in open bite (treatment) effectively cause bite closure with counter-clockwise rotation of mandible [27]. Training and forcing the tongue in physiological position is achieved by lingual tag located in the upper palatal area of all Trainer appliances, as well as the Trainer T4K. Tongue thrusting between the teeth is absolutely prevented, stimulating vertical dentoalveolar unit development and open bite correction.

Mouth breathing and incompetent lips in the period of early mixed dentition are indications for use of Trainer appliances [39, 40, 41]. At early age, the most common cause of chronic oral respiration is nasopharyngeal obstruction with excessively increased adenoid vegetations. While breathing through the mouth, the tongue is positioned low in the mouth with no contact with hard palate. Soft palate is in constant tonic contraction, orbicularis oris tonus becomes weak, upper lip becomes short and lower lip full and positioned behind upper labially inclined incisors. Maxilla remains narrow with crowded frontal teeth, there is crossbite or tendency to crossbite and deviated sagittal and vertical jaw relationship [13-16]. Some percentage of children even after removal of nasopharyngeal obstruction, continue to breathe through the mouth, due to acquired habits. That way, morphological changes of the craniofacial system remain present in the further course of the growth and development [13]. In these patients the Trainer T4K is appliance of choice in mixed dentition [27, 28, 41]. Sometimes nasal respiration can be reestablished and transversal, sagittal and vertical development improved.

As already mentioned, lip incompetence is associated with oral respiration. The cause is low muscle activity of orbicularis oris and increased activity of mentalis and vice versa [39, 40]. Lips competence could be achieved by increasing the activity of mentalis muscles that push up the lower lip to touch the upper lip, which is usually short and reversed. The T4K has some elements in anterior-inferior area of the buccal shield that touch the mucosa of the lower lip when lip is raised by the mentalis mus-

cles (Figure 2) [41]. Stimulation of the lower lip mucosa inhibits the activity of mentalis [42]. Due to previously mentioned antagonism, when mentalis reduces its activity, the activity of orbicularis oris is increased [39]. By this mechanism the Trainer T4K helps improving the function of orbicularis oris and therefore improves the physiological competence of lips.

As the part of preventive measures and/or early orthodontic treatment of malocclusion Trainer system appliances have been used for many years with the aim of correcting early myo-functional habits, stimulation of sagittal and transversal growth and better teeth and jaw positioning. Our clinical experience with the Trainer T4K is very positive. Children readily accept and use it. It encourages breathing through the nose, activity of masticatory and facial muscles and re-education of tongue to capture relaxed position both in function and physiological position. That is very important for the retention and relapse in orthodontics. This appliance also stimulates transversal development of dental arches, improving vertical aspect in patients with deep and open bite, and by maintaining the mandible in anterior position improves the sagittal aspect in children with distocclusion. Teeth get more space and position better in dental arch.

Trainer system appliances proved to be comfortable and economical and should be utilized more in clinical practice and research. Current clinical experience and scientific studies confirmed their effectiveness.

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Aparati sistema „trejner” u ranoj terapiji malokluzija

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KRATAK SADRŽAJ

Ortopedija vilica je specijalistička grana stomatologije koja se bavi prevencijom i lečenjem morfoloških i funkcionalnih nepravilnosti orofacijalnog sistema. Njen cilj je uspostavljanje pravilnih funkcija organa za žvakanje, dobre okluzije i prijatnog izgleda lica pacijenta. Rana terapija ortodontskih problema kod dece tokom rasta je veoma važna. Ciljevi ranog ortodontskog lečenja su eliminacija ili modifikacija devijantnog skeletnog rasta i kontrolisano usmeravanje dentoalveolarnog i skeletnog razvoja. Kao što je poznato, lečenje nekih malokluzija treba započeti u periodu mlečne ili rane mešovite denticije, jer stanje mlečnih zuba u velikoj meri utiče na razvoj stalnih zuba. Naprave koje se koriste za rano ortodontsko lečenje uglavnom pripadaju funkcionalnim ortodontskim aparatima. Cilj ovog rada bio je da se predstavi jedan od novijih funkcionalnih aparata. Ovi aparati nisu izrađeni od akrilata, već predstavljaju poliuretanski prefabrikovane miofunkcionalne aparate koji su se klinički pokazali vrlo efikasnim.

Ključne reči: rano ortodontsko lečenje; funkcionalni aparati; aparati sistema „trejner”

UVOD

Opšti tehnološki razvoj civilizacije poslednjih decenija znatno je povećao efikasnost fiksnih ortodontskih aparata u lečenju adolescenata, odraslih, pa i starih osoba, pre svega zahvaljujući razvoju novih materijala, fiksnih ortodontskih tehnika i multidisciplinarnom pristupu, odnosno kombinovanom ortodontskohirurškom lečenju. Potreba za razvojem struke u ovom pravcu, kako u svetu, tako i kod nas, ukazuje na to da postoje veliki propusti na nivou preventivnog i ranog ortodontskog delovanja, prevashodno na mladu populaciju. Počev od rođenja, kroz mlečnu, mešovitu i stalnu denticiju, sagledavanjem genetskih predispozicija, insistiranjem na pravilnom vršenju orofacijalnih funkcija i interceptivnim korigovanjem početnih razvojnih odstupanja, ortopedija vilica ima mogućnosti da usmerava rast i razvoj kraniofacijalnog kompleksa. To znači da u velikoj meri može da osužeti nastanak teških skeletnih nepravilnosti, sagitalnog, transverznog i vertikalnog pravca, koje se u doba adolescencije moraju lečiti komplikovanim i skupim ortodontskohirurškim zahvatima [1].

RANO ORTODONTSKO LEČENJE

Koncept rane terapije ortodontskih problema kod dece tokom rasta zastupljen je godinama, naročito u evropskoj ortodontskoj praksi. Ciljevi ranog ortodontskog lečenja su eliminacija ili modifikacija devijantnog skeletnog rasta, funkcionalnog matriksa (disanje kroz usta, infantilno gutanje, ostale loše navike) i kontrolisano usmeravanje dentoalveolarnog i skeletnog razvoja. Ovi ciljevi su potpuno saglasni sa savremenim medicinskim težnjama da je bolje sprečiti nego lečiti, odnosno da treba lečiti uzroke, a ne posledice.

Lečenje nekih malokluzija treba započeti u mlečnoj ili ranoj fazi mešovite denticije, jer stanje mlečnih zuba u velikoj meri

utiče na razvoj stalnih zuba [2-8]. Neki autori navode da je posteriorno ukršten zagrižaj jedna od najčešćih malokluzija mlečne denticije kod dece bele rase. Ako se ne leči, može dovesti do kraniofacijalne asimetrije [4, 6, 9, 10, 11]. Kasnije lečenje ukrštenog zagrižaja ima veći rizik od oštećenja temporomandibularnog zgloba [9, 10, 12]. Kod dece koja hronično dišu kroz usta i sa nemogućnošću zatvaranja usta već u mlečnoj denticiji može se dijagnostikovati distalni zagrižaj. Ukoliko se ne leči, prenosi se na mešovitu i stalnu denticiju, zajedno s uskošću gornje vilice, visoko zasvođenim nepcem i protruzijom i teskobnošću gornjih frontalnih zuba [13-16]. Rano lečenje otvorenog zagrižaja koji je uzrokovan infantilnim gutanjem ili sisanjem prsta veoma je važno u prevenciji teške malokluzije i neuravnoteženog rasta lica u celini, sa dominacijom vertikalnog rasta [1].

Naprave koje se koriste u ranom ortodontskom lečenju uglavnom pripadaju funkcionalnim ortodontskim aparatima. Čitava paleta pokretnih aparata, počev od krajnje jednostavnih, kao što je vestibularna ploča, preko najčešće korišćenog aktivatora i njegovih modifikacija, do vrlo komplikovanih *twin block* aparata i Frenklovih regulatora funkcije, koriste se već čitav vek sa ciljem eliminacije oralnih disfunkcija, uspostavljanja mišićne ravnoteže, smanjenja protruzije maksilarnih sekutića i uspostavljanja dobrih međuviličnih odnosa. Skeletnim i dentoalveolarnim efektima lečenja funkcionalnim aparatima bavili su se mnogi autori [17-22]. Međutim, stvarni problemi kliničkih lekara danas tokom lečenja konvencionalnim funkcionalnim napravama su, pre svega, loša saradnja s malim pacijentima i njihovim roditeljima. Nekomfornost i često vrlo komplikovana žičano-akrilatna konstrukcija ne deluje privlačno malim pacijentima, pa oni izbegavaju da je nose. Roditelji su, usled nedostatka vremena i nedovoljno posvećeni potrebama dece, često u nemogućnosti da sagledaju posledice, te i sami, sažaljevajući decu, ne insistiraju na nošenju aparata. Nepravilne funkcije ostaju, a posledice su nepravilan rast i razvoj kraniofacijalnog sistema, koji se može odraziti i na organizam u celini.

FUNKCIONALNI APARATI TIPRA „TREJNER“

Funkcionalna ortopedija vilica zagovara miofunkcionalnu terapiju malokluzija. Stimulisanjem ili suzbijanjem aktivnosti mastikatornih i mišića lica, u kraniofacijalnom sistemu se uspostavlja mišićna ravnoteža koja je praćena poboljšanjem odnosa između gornje i donje vilice i težnjom zuba da se bolje pozicioniraju i pravilno usklade [20, 21]. U skorije vreme razvijeni su novi funkcionalni aparati, tzv. trejneri (engl. *trainer* – trener, vežbač), koji imaju mogućnost da ponovo usklade i mastikatorne i mišićne lica, popravljaju položaj jezika i, više nego bilo koji drugi funkcionalni aparat dosad, popravljaju položaj zuba [25].

Aparati sistema „trejner“ koriste se u skladu s indikacijama i uzrastom pacijenata, a obuhvataju: „infant trejner“, namenjen za decu uzrasta od dve godine do pet godina, trejner za decu s mešovitom dencijom (T4K) (Slika 1), trejner za adolescente (T4A), trejner uz brekete (T4B), trejner za malokluziju II klase (T4CII), trejner za malokluziju III klase (i-3), *Trainer lingua* i *Myobrace*. Mada su indikacije različite, svi aparati ovoga sistema deluju na sličan način: kao što i samo ime kaže, ovi aparati, trenirajući ili vežbajući mišićne kraniofacijalnog sistema do fiziološkog opterećenja kosti, podstiču pravilan rast i razvoj svih struktura kraniofacijalnog sistema. Vodeći facijalne i mastikatorne mišićne da rade ispravno, uspostavljajući ravnotežu sila jezika i obraza pravilnim pozicioniranjem jezika pri mirovanju i pri pokretu, trejner aparati stimulišu pravilan rast i razvoj gornje i donje vilice i zubnih lukova, uključujući i pravilnije pozicioniranje zuba [25].

U službi ranog ortodontskog ili čak preortodontskog lečenja, sa ciljem ranog ispravljanja funkcionalnih problema mekih tkiva, kao što su malpozicije jezika, centripetalno uvlačenje obraza, nemogućnost zatvaranja usta, disanje kroz usta ili bruskizam, našu pažnju je posebno privukao miofunkcionalni aparat „trejner T4K“, koji se primenjuje kod dece uzrasta od pet do deset godina. To je poliuretanski prefabrikovani miofunkcionalni aparat izmodelovan u I klasi (tet-a-tet pozicija), koji se sastoji od različitih elemenata dizajniranih da stimulišu facijalne, mastikatorne i mišićne jezika i repositioniraju mandibulu [26] (Slika 1). Preporučeno je da se nosi, kao i ostali aparati sistema trejner, sat-dva tokom dana i 10-12 sati noću, za vreme spavanja. Naša klinička iskustva s ovim aparatom ukazuju na neke prednosti nad ostalim funkcionalnim aparatima koji se primenjuju u ranom uzrastu: izbegavanje uzimanja otisaka, što kod dece koja nisu spremna na ovu vrstu saradnje može biti vrlo neprijatno, pa čak i opasno, izbegavanje komplikovanog upasivanja aparata, za šta deca u ovom uzrastu često nemaju strpljenja, fleksibilnost materijala od koga je aparat napravljen čini ga komfornim i bezbednim od lomljenja, što je najveći nedostatak drugih funkcionalnih aparata. Takođe, deca ga radije prihvataju i nose.

Efekti proizvedeni trejner aparatima na maksili i mandibuli opisani su kroz naučne studije i kliničke slučajeve tretirane ovim aparatima i objavljeni u aktuelnoj literaturi [27-30]. Ističe se da ovaj prefabrikovani funkcionalni aparat proizvodi sagitalni efekat sličan onim funkcionalnim aparatima koji su dizajnirani da stimulišu rast i razvoj donje vilice, dovodeći je napred u položaj tet-a-tet, kao što su aktivator, bionator, *twin block*, Frenklov regulator funkcije ili Herbstov aparat [20, 21, 22, 27, 31, 32, 33]. Dovodeći mandibulu u anteriornu poziciju, trejner, kao i ostali funkcionalni aparati, izaziva istežanje vlakana miši-

ća protraktora mandibule (maseter, pterigoideus medijalis i lateralis). Tokom 10-12 sati nošenja trejnera noću, mišići ostaju istegnuti, prečnik krvnih sudova je smanjen, što onemogućava dovoljan protok krvi, smanjuje oksigenaciju i razmenu materija. Usled nagomilavanja mlečne kiseline, u istegnutim mišićima javlja se mišićni zamor. Sličan fiziološki proces se dešava u bilo kojem delu tela kada se otpočne treniranje i vežbanje, pa se mišići koji dugo nisu bili korišćeni aktiviraju. Kada se aparat ujutru izvadi iz usta, mišići protraktori upadaju u hiperkontraktilnost koja pomera mandibulu napred i nazad. Ovo je razlog što se pacijenti koji nose trejner prvih nekoliko nedelja žale na bol, a kada ujutru izvade aparat iz usta ne mogu da održe mandibulu u opuštenom položaju ni u maksimalnoj interkuspidaciji. Sledstvena hiperkontraktilnost nakon prethodno nekoliko časova istegnutih mišića dovodi do povećanja protoka krvi i odnošenja nagomilane mlečne kiseline. Istovremeno, povećani protok krvi dovodi do tretiranih mišića više nediferenciranih ćelija sposobnih da se diferenciraju u mioblaste, što vodi stvaranju novih mišićnih vlakana u mišićima protraktori mandibule [34]. Porast količine mišićnih vlakana i njihova utreniranost omogućavaju mandibuli da se tokom nastavka lečenja održava u anteriornom položaju mišićima protraktori ma bez zamora [26, 27, 28].

Drugi značajan efekat trejnera T4K koji se navodi u literaturi jeste stimulacija transversalnog razvoja zubnih lukova [28]. Autori su uočili da kod pacijenata koji su koristili trejner T4K postoji značajan porast u rastojanju između očajaka, prednjog i zadnjog širini zubnih nizova. Mehanizam nastanka ovog efekta je sličan kao kod Frenklovih regulatora funkcije [35]. Bukalni štitovi udaljuju obraze od bukalnih predela gornjih i donjih bočnih zuba, čime se neutrališe sila od 2,7 g/cm³, kojom bukcinator normalno deluje na bočne zube. Ova sila može biti povećana do 20 g/cm³ kod pacijenata s navikom sisanja prsta ili tiskanja jezika, a kod istih pacijenata u predelu uglova usana, odnosno očajaka, i do 80 g/cm³ [36, 37]. Neutralisanje ovih sila dozvoljava da sila proizvedena aktivnošću pravilno pozicioniranog jezika u ovom aparatu deluje na lingvalna područja bočnih zuba, stimulišući razvoj dentoalveolarnih jedinica tih zuba prema bukalno. Druga funkcija bukalnih štitova je istežanje bukcinatora i orbikularis orisa, čime se stvara zona tenzije na području pripoja ovih mišića. U zoni tenzije stimulirana je apozicija kosti, kako u maksili, tako i u mandibuli, što doprinosi njihovom transversalnom razvoju [38].

Trejner T4K pokazao se klinički vrlo efikasnim u poboljšanje vertikalnih odnosa gornjih i donjih zuba (vertikalni preklap) kod pacijenata koji imaju dubok ili otvoren zagrižaj [27, 28]. Zanimljivo je to kako isti aparat deluje na drugačiji način kod dubokog, odnosno otvorenog zagrižaja. Pacijenti sa dubokim zagrižajem imaju jače mišićne zatvarače, što dovodi do naglašene krive okluzalne ravni (naglašena Špeova kriva), pri čemu su sekutići preterano, a bočni zubi nedovoljno iznikli. Postojanje trejnera u ustima, zbog silikonske površine između gornje i donje komponente aparata, ne dozvoljava maksimalnu interkuspidaciju (Slika 2), što smanjuje opterećenje na bočnim zubima i omogućava njihovim dentoalveolarnim jedinicama da se razvijaju u vertikalni. Ovo rezultira postavljanjem zuba u ravnu okluzalnu ravan koja je zadata okluzalnim površinama aparata. S druge strane, upotrebom trejnera T4K otvoreni zagrižaj, čiji je najčešći uzrok interponiranje jezika pri infantilnom gutanju, uspešno se zatvara rotacijom mandibule suprotno smeru

kazaljki na satu [27]. Obuka i stimulacija jezika da se pozicionira u fiziološki položaj postiže se jezičkom na unutrašnjoj strani, lociranim u gornjoj palatinalnoj oblasti svih trener aparata, kao i T4K. Interponiranje jezika između zuba je apsolutno onemogućeno, što zajedno stimuliše vertikalni razvoj njihovih dentoalveolarnih jedinica i korekciju otvorenog zagrižaja.

Disanje kroz usta (oralna respiracija) i nemogućnost zatvaranja usta tokom perioda rane mešovite denticije jesu prava indikacija za primenu trener aparata [39, 40, 41]. U ranom dečjem dobu najčešći uzrok hronične oralne respiracije je opstrukcija nazofaringealnog vazdušnog puta preterano uvećanim adenoidnim vegetacijama. Pri disanju kroz usta jezik je u niskom položaju, nema kontakt s palatumom, meko nepce je u stalnoj toničnoj kontrakciji, tonus orbikularis orisa slabi, pa gornja usna postaje kratka i posuvraćena, a donja punija i podvlači se iza često protrudiranih gornjih sekutića, na koje ne deluje. Gornja vilica ostaje uska u odnosu na donju, postoji nepravilan položaj ili teskobnost gornjih frontalnih zuba, ukršten zagrižaj ili sklonost ka njemu i poremećen sagitalni i vertikalni odnos vilica [13-16]. Neka deca i nakon uklanjanja nazofaringealne opstrukcije nastavljaju i dalje da dišu kroz usta zbog stečene navike. Već nastale morfološke promene na kraniofacijalnom sistemu se na ovaj način održavaju i tokom daljeg rasta i razvoja [13]. Autori ističu da je kod ovih pacijenata T4K aparat izbora u mešovitoj denticiji [27, 28, 41]. Njime se uspostavlja nazalna respiracija, razvoj gornjeg zubnog luka u transverzali i poboljšanje sagitalnog i vertikalnog odnosa vilica.

Kao što je pomenuto, nemogućnost zatvaranja usta je udružena sa disanjem kroz usta. Uzrok je mala aktivnost mišića orbikularis oris, što povećava aktivnost mentalisa, i obratno [39, 40]. Kod ovih pacijenata kompetentnost usana postiže se povećanom aktivnošću mentalisa, koji gura donju usnu nagore, da dodirne gornju, za koju je već rečeno da je uglavnom kratka i posuvraćena. T4K ima neke elemente na svojoj prednje donjoj

površini bukalnog štita koji dodiruju mukožu donje usne kada je usna podignuta mentalisom (Slika 2) [41]. Stimulacija mukože donje usne inhibira aktivnost mentalisa [42]. Zbog prethodno pomenutog antagonizma, smanjenje aktivnosti mentalisa povećava aktivnost orbikularis orisa [39]. Ovim mehanizmom trener T4K podstiče razvoj i jačanje orbikularis orisa, čime poboljšava fiziološku kompetentnost usana.

U sklopu preventivnog i ranog ortodontskog lečenja malokluzija miofunkcionalni aparati tipa „trejner” koriste se u svetu dugi niz godina, radi rane korekcije miofunkcionalnih navika, podsticanja transverznog i sagitalnog razvoja i međusobnog pozicioniranja vilica, kao i boljeg pozicioniranja zuba, o čemu svedoče brojna naučna i klinička istraživanja. Naša klinička iskustva s trenerom T4K su veoma pozitivna, a deca ga rado prihvataju i nose. Njegova primena podstiče disanje kroz nos, aktivnost mastikatornih i mimičnih mišića i reedukaciju jezika da zauzme fiziološki položaj, kako pri mirovanju, tako i prvi vršenju svoje funkcije, što sa stanovišta retencije i recidiva u ortodontici ima poseban značaj. Forsira transverzalni razvoj zubnih lukova, poboljšava vertikalne odnose kod pacijenata se dubokim i otvorenim zagrižajem, dovodeći mandibulu u anteriornu poziciju poboljšava sagitalni aspekt kod dece sa distokluzijom. Zubi dobijaju više prostora i bolje se pozicioniraju u zubnim lukovima.

Aparati sistema trener zaslužuju da masovnije uđu u našu kliničku i istraživačku praksu, jer su komforni i ekonomični, a dosadašnja klinička iskustva i naučne studije ističu njihovu efikasnost.

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