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Management of Deep Bite in Adults–A Combination of Myofunctional Appliances and Fixed Technique

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Abstract: ***Deep bite is one of the most common malocclusions. Traditional techniques correcting overbite features in all malocclusions have been known to be quite complicated, and challenging to orthodontists. The aim of current study was to present a combined approach for management of deep bite adult patients including fixed appliances and myofunctional Trainer for Braces appliance. Materials and methods: The current study included 28 patients (18- 52 y.). Full orthodontic analyses, including diagnostic radiology, photo documentation and impressions of every patient were before and after the treatment. Inclusion criteria for the study were: Class I and Class II malocclusions (dental and/or skeletal), deep overbite with overlap in incisors> 30%, completed skeletal growth (>18years), malocclusion requiring fixed techniques, oral muscles' hyperactivity. Patients were grouped – Group 1- patients treated only with fixed mechanics and Group 2 - patients treated with fixed mechanics and Trainer for Braces. Results showed no significant skeletal changes. The achieved overbite correction was due to dentoalveolar changes (incisor inclination, upper to lower incisor relationship, Curve of Spee). The treatment time was reduced due to the combined approach of fixed and myofunctional appliances for treatment of deep bite in adults.***

Keywords: Deep bite, Trainer^{TM}, Myofunction, Fixed technique, Treatment

1. Introduction

Deep bite is one of the most common malocclusions after crowding. [1] It can be observed as an isolated problem or in a combination with other malocclusions (TMJ). [2] Deep overbite is a complex orthodontic problem which can affect a single tooth, the entire dentition, alveolar bones, maxillary and mandibular basal bones and soft facial tissues. The management of this problem depends on the diagnostic analysis, treatment plan and the choice of treatment appliances. The norm is considered as 2-3mm overbite or 30% (1/3) of the height of the clinical crown of the mandibular incisors (Fig. 1).[2]

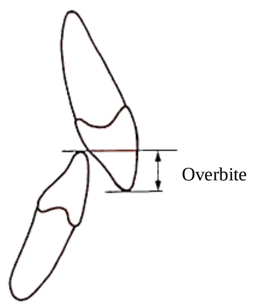

Figure 1: Overbite

Some authors reported undesirable consequences of deep occlusion when it remains untreated, such as increasing crowding of the lower front teeth, flaring of upper front teeth, associated periodontal and temporo-mandibular joint problems [3,4]

Orthodontic literature has described various approaches for overbite correction. Some approaches used bite plates, fixed techniques with Utility arch, V- bends, fabricated loops, helices and springs made of stainless steel wires to create the bite-opening force system [5-10]. Other ones used functional appliances (Bionator [11,12], Twinblock [13], Fränkel [14,15], Harvold's activator [14], Herbst [15,16], with and without headgears [13,14], mini implants and other, while severe skeletal cases were managed with surgical approaches. [3, 17-20] All of these methods result in bite lifting, but it is disputable which of these are more effective and long-term stable.

For treatment of deep occlusion a lot of functional devices have been developed, causing skeletal and dento-alveolar changes. [11-16] The skeletal effects of these appliances are expressed in remodeling and relocation of the glenoid fossa [15,21], accelerated and amplified condylar growth [22,23] and neuromuscular adaptation. [24-26]

In 1989 Myofunctional Research Co, Australia developed a new concept of functional appliances called Trainer system (Myobrace®). The system consists of polyurethane manufactured appliances for correction of various malocclusions at an early age by acting on the muscular dysfunction and repositioning the mandible. [27]

The main advantage of these myofunctional appliances to fixed technique is their orthopedic effect, enabling early correction of the dentoalveolar and skeletal malocclusions. [12]

Clinical experience shows frequent need for treatment with fixed appliances as well as with functional appliances. If used them both successively, the period of active orthodontic treatment would be prolonged. As a result, patients become impatient and non-cooperative.

The above mentioned gives us a reason to offer a more complex treatment plan including treatment not only of the visible malocclusions but also the causes for them, reduced treatment period, combination of different appliances for more stable and long-term results. It is necessary to pay attention to the muscles, position of the tongue, breathing problems, TMJ problems because they are regarded as main

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factors for relapse.

The need for combining fixed appliances with myofunctional ones for treatment of complex cases with deep bite leads to creating a new concept in the treatment of deep occlusion.

Trainer for Braces (T4B) of Myofunctional Research Co, Australia, is an appliance designed to help the treatment of soft tissues, incorrect positioning of the tongue and potential problems in the TMJ (Fig. 2). The appliance is designed for combined use with fixed appliances. T4B has special channels for the brackets and buccal cannulas of the bands. It is a further advantage by which the soft tissues are protected from an injury. It`s myofunctional nature supports the correction of dental Class II while lifting the occlusion. T4B™ is also used for treatment of patients with accompanying soft tissue dysfunction [27-29].

Figure 2: T4B™ appliance

Functional appliances are a choice of treatment in patients with skeletal deficit, insufficient mandibular growth or transversal development [22]. However, the effectiveness of these devices is still a controversial issue. One of the criticisms in the investigation of these devices is to what extent the achieved treatment results are directly influenced by the functional appliance and to what by the natural development.

2. Aim

To present a combined approach for management of deep bite in adult patients including fixed appliances and myofunctional Trainer for Braces appliance.

3. Materials and Methods

The current study included 28 patients from 18 to 52 years of age. Full orthodontic analyses, including diagnostic radiology (panoramic radiography, profile cephalometric radiography), photo documentation (intra- and extra-oral) and both jaws impression of every patient were made before the treatment. Inclusion criteria for the study were: Class I and Class II malocclusions (dental and/or skeletal), deep overbite with overlap in incisors> 30%, completed skeletal growth (>18years), malocclusion which requires treatment with fixed appliances, established hyperactivity of masticatory musculature. For results comparison, patients were grouped into 2 groups depending on the used treatment protocol. Group 1 - patients treated only with fixed mechanics; Group 2 - patients treated with fixed mechanics and Trainer for Braces (T4B™ group). Treatments were carried out by a specialist orthodontist in the period between 1999 and 2015. After the treatments a comparative orthodontic analyses for changes establishment were made. All the patients were called one year after the treatment to establish the presence / absence of relapse.

Statistical methods

Data were entered and processed with statistical package IBM SPSS Statistics 23.0. For level of significance, rejecting the null hypothesis, was accepted p <0.05.
The following methods were applied:

1. **Descriptive analysis** –the frequency distribution of the studied parameters, divided into groups and presented in tables.
2. **Variation analysis** - evaluation of the characteristics of central tendency and statistical dispersion.
3. **Graphic analysis** – visualization of the results obtained.
4. **Alternative analysis** - a comparison of the relative proportions.
5. **Fisher's exact test and test $\chi 2$** - to verify the hypothesis of a correlation between categorical variables.
6. **Nonparametric test of Shapiro-Wilk** - to check the distribution of normality.
7. **Student T-test** – to verify the hypothesis of difference between two independent samples.
8. **Nonparametric test of Mann-Whitney** - to verify the hypothesis of difference between two independent samples.
9. **Student T-test** – to verify the hypothesis of difference between two dependent samples.
10. **Nonparametric test of Wilcoxon** - testing of hypotheses for difference between two dependent samples.
11. **Nonparametric test homogeneity border** (marginal homogeneity) - to check the hypotheses of difference between two dependent samples.

4. Results

The current study included 28 patients aged from 18 to 52 years (mean age 27, 21±8, 39). Of these, 14 (50%) were men and 14 (50%) were women. The age group with the highest number (7) in men was 20-29 years, followed by 10-19 with 4, while the smallest one (3) was 30-39 years age group. There were no men in the groups of 40-49 and 50-59 years. Among women with the highest number (9) was the 20-29 years age group, followed by 30-39 with 2, and the other age groups had only 1 woman in each – 10-19, 40-49 and 50-59 years (Fig. 3).

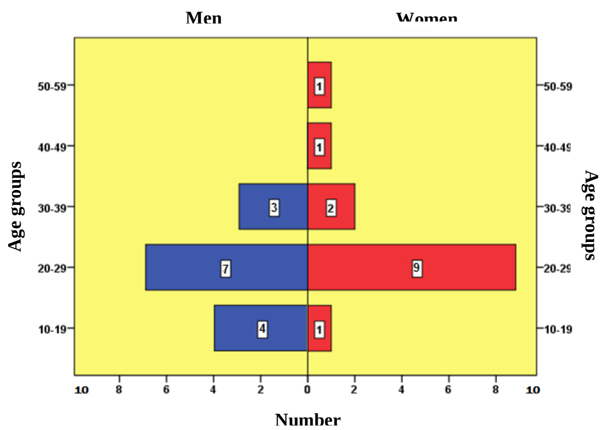

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Figure 3: Distribution of patients by gender and age.

Distribution by gender, age, treatment duration

Table 1 shows that the two studied samples were statistically uniform by gender and age.

Most of the patients (46.4%) were treated with braces in both jaws, combined with Trainer for Braces^{TM} (T4B^{TM}), followed by a group treated with braces only (control group) -32.1%, and the smallest group of patients (21.4%) was treated with braces in the upper jaw and T4B^{TM} (Fig. 4).

Table 1: Comparative analysis of the two studied groups by gender and age

Indicator	Control group (n=9)		T4B^{TM} (n=19)	
	$\overline{X}$	SD	$\overline{X}$	SD
Age (years)	27,33	8,96	27,16	8,37
Gender	n	%	n	%
Men	4	44,4	10	52,6
Women	5	55,6	9	47,4

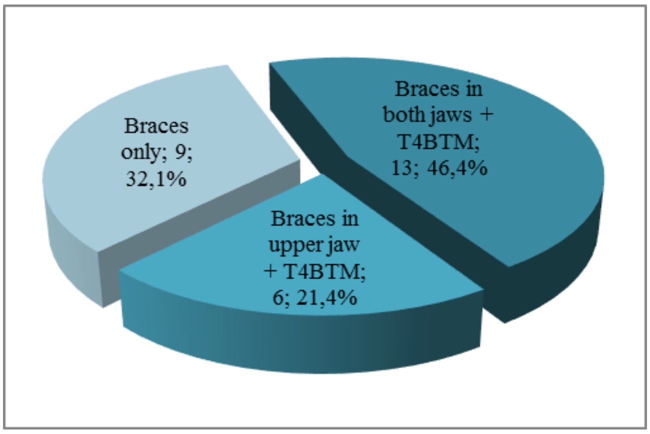

Figure 4: Frequency distribution of studied patients on the treatment methods.

Changes in SNA, SNB, ANB, I/ANS-PNS, I/F, I/SN, I/i, i/M, M/SN, M/F, M/ANS-PNS, M/Occ angles - treated versus control group

Table 2 shows that:

• In **SNA** ($81 \pm 3^{\circ}$) no significant dynamics in both study groups was observed, but in T4B^{TM} group the number of patients with normal angle value has increased by 4, while in the control group there was no change. There was a statistically significant difference only at the beginning, as T4B^{TM} patients had significantly more cases with abnormal values of this angle. After treatment, their number decreased by 60% and the difference became insignificant.

• In **SNB** ($78 \pm 3^{\circ}$) no significant dynamics in both study groups was observed, but in the T4B^{TM} group the number of patients with normal angle value has increased by 1, while no change was observed in the control group. There was a statistically significant difference between the groups at the beginning and at the end of treatment, as patients treated with T4B^{TM} had significantly more cases with abnormal values of this angle. After the treatment, their number has decreased by 1, but the difference remained significant;

• In **ANB** (0-4) no significant dynamics in both groups was established, but in the T4B^{TM} group, the number of patients has decreased by 2, while in the control group - by 3. There was no statistically significant difference between the studied groups either at the beginning or at the end of treatment, in respect of both
categories;

• In **I/ANS-PNS** ($112 \pm 3^{\circ}$) a significant dynamics was found only in the T4B^{TM} group. The patients with angels below the normal values were reduced by 8, in 2 other normal values were achieved, and in 6 values above the norm were observed. There was no statistically significant difference between the groups either at the beginning or at the end of the treatment, in none of the categories of interest;

• In **I/F** ($107 \pm 2^{\circ}$) a significant dynamics was observed only in the T4B^{TM} group. The patients with values below the norm were reduced by 7, and those with values above the norm has increased by 8, one of which had normal value of the angle before the treatment. There was no statistically significant difference between the both groups either at the beginning or at the end of treatment, in none of the categories of interest;

• In **I/SN** ($102 \pm 2^{\circ}$) a significant dynamics was found in the T4B^{TM} group. The patients with values below the norm were reduced by 5 people, and those having values above the norm has increased by 6, one of which was initially with normal value of this angle. There was a reduction of patients with normal values of the angle in both groups, bigger in the T4B^{TM} group. Both study groups had a statistically significant difference only at the beginning, as patients with T4B^{TM} were having more cases with values of the angle below the norm. After the treatment their number was reduced by 30% and the difference became insignificant;

• In **I/i** ($129 \pm 2^{\circ}$) a significant dynamics was observed only in the T4B^{TM} group. Patients with values below the norm increased by 8 people, those with normal values were reduced from 2 to 0, and those with excessive values were reduced by 6. Both study groups had a statistically significant difference only at the beginning, as patients treated with T4B^{TM} had significantly more cases with values below and above the norm. After the treatment the difference in both categories became insignificant;

Table 2: Comparative analysis of the angles' dynamics by time and study groups

Angle	Beginning						End						P
	↓		Norm		↑		↓		Norm		↑		
	N	%	n	%	n	%	n	%	n	%	n	%	
SNA	3	33,3	6	66,7	0	0	3	33,3	6	66,7	0	0,0	1,000
	6	31,6	8	42,1	5	26,3	5	26,3	12	63,2	2	10,5	0,317
SNB	3	33,3	6	66,7	0	0	3	33,3	6	66,7	0	0,0	1,000

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	7	36,8	6	31,6	6	31,6	7	36,8	7	36,8	5	26,3	0,655
ANB (0-4)	3	33,3	5	55,6	1	11,1	4	44,4	2	22,2	3	33,3	0,564
	6	31,6	5	26,3	8	42,1	8	42,1	3	15,8	8	42,1	0,480
I/ANS-PNS	5	55,6	1	11,1	3	33,3	5	55,6	2	22,2	2	22,2	0,783
	14	73,7	4	21,1	1	5,3	6	31,6	6	31,6	7	36,8	0,006
I/F	2	22,2	2	22,2	5	55,6	2	22,2	3	33,3	4	44,4	0,782
	11	57,9	4	21,1	4	21,1	4	21,1	3	15,8	12	63,2	0,004
I/SN	3	33,3	2	22,2	4	44,4	6	66,7	1	11,1	2	22,2	0,197
	14	73,7	3	15,8	2	10,5	9	47,4	2	10,5	8	42,1	0,028
I/i	6	66,7	1	11,1	2	22,2	5	55,6	0	0	4	44,4	0,405
	5	26,3	2	10,5	12	63,2	13	68,4	0	0	6	31,6	0,016
i/M	0	0,0	2	22,2	7	77,8	1	11,1	3	33,3	5	55,6	0,180
	4	21,1	7	36,8	8	42,1	1	5,3	5	26,3	13	68,4	0,011
M/SN	5	55,6	1	11,1	3	33,3	4	44,4	2	22,2	3	33,3	0,317
	13	68,4	0	0	6	31,6	12	63,2	1	5,3	6	31,6	0,655
M/F	5	55,6	4	44,4	0	0	4	44,4	5	55,6	0	0	0,317
	14	73,7	5	26,3	0	0	13	68,4	6	31,6	0	0	0,317
M/ANS-	5	55,6	1	11,1	3	33,3	5	55,6	1	11,1	3	33,3	1,000
	14	73,7	2	10,5	3	15,8	13	68,4	2	10,5	4	21,1	0,157
M/Occ	5	55,6	2	22,2	2	22,2	5	55,6	2	22,2	2	22,2	1,000
	16	84,2	3	15,8	0	0	16	84,2	1	5,3	2	10,5	0,414
***Legend:**	Control Group		T4B™ group		Statistically significant result								

• In **i/M** (93 ± 3°) a significant dynamics in the T4B™ group was established. Patients with values below the norm were reduced by 3, and those with values above the norm were increased by 5, as two of them were initially with normal value of the angle. In the control group there was an increase in the patients with normal value (by 1), while in the group treated with T4B™ – a decrease by 2. There was a statistically significant difference only at the beginning, as patients treated with T4B™ had more cases with values of the angle below the norm. After the treatment the difference became insignificant;

• In **M/SN** (32 ± 2°) and **M/F** (31 ± 8°) there was no significant dynamics in both study groups, although in both groups the number of patients with normal values was increased by 1 and those with values below the norm were also reduced by 1. The both study groups did not differ significantly either at the beginning or at the end of the treatment, in none of the categories of interest;

• In **M/ANS-PNS** (25 ± 3°) and **M/Occ** (18 ± 2°) there was no significant dynamics in both study groups, although in M/Occ the number of patients with normal values in the group treated with T4B™ was reduced from 3 to 1, while in the control group in both angles there was no change. The both study groups did not differ significantly either at the beginning or at the end of the treatment, in none of the categories of interest.

Skeletal Class changes (according to ANB and Witt)

The results shown on Table 3 indicate that:

• According to ANB angle there was no significant dynamics in both study groups, but in the T4B™ group the number of patients Skeletal Class I increased by 2, while in the control group decreased by 2. Both study groups differed significantly only at the beginning, as patients with T4B™ had more cases with Skeletal Class II relationship. After treatment their number decreased with 1/3 and the difference became insignificant;

Table 3: Comparative analysis of angles' dynamics by time and study groups

Angle	Beginning						End						P
	Class I		Class II		Class III		Class I		Class II		Class III		
	n	%	n	%	n	%	n	%	n	%	n	%	
ANB	7	77,8	1	11,1	1	11,1	5	55,6	3	33,3	1	11,1	0,157
	9	47,4	9	47,4	1	5,3	11	57,9	6	31,6	2	10,5	0,739
Witt	1	11,1	8	88,9	0	0	0	0	8	88,9	1	11,1	0,317
	2	10,5	14	73,7	3	15,8	4	21,1	13	68,4	2	10,5	0,257
***Legend:**	Control Group		T4B™ group		Statistically significant result								

• There was no significant dynamics in Witt value in both study groups, although in the T4B™ group the number of patients with Skeletal Class I increased by 2, while in the control group decreased by 1. Both study groups differed significantly at the end of the treatment, as patients with T4B™ had significantly more cases with Skeletal Class I.

Average treatment time

Table 4 shows that average time for treatment of the Control group was about 9 months longer than that the T4B™ group.

Average time of wearing T4B™ appliances was 18,68±7,86

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months in the range of 4 to 27 months.

Table 4: Comparative analysis of treatment time in both study groups

Indicator	Control group (n=9)		Group with T4B™ (n=19)		P
	$\bar{X}$	SD	$\bar{X}$	SD	
Treatment time	31,56	9,14	22,29	7,86	0,010

Changes in overjet, curve of Spee, clinical crown height (lower incisors) and overbite (mm and %)

Table 5 shows that:

- The overjet, at the end of the treatment, decreased with a higher absolute value in the control group, but there was no significant difference between both groups;
- There was no statistically significant difference in the curve of Spee between both groups before the treatment. At the end of the treatment there was such a difference and also a statistically significant change in the average values for this indicator. Average value was significantly lower in the T4B™ group, although the absolute value of the change was higher.
- There was a statistically significant difference in Overbite between both groups before the treatment as well as in their average values for change of the indicator, but there was not any at the end of treatment. The average value for Overbite was significantly higher before the beginning of the treatment in the T4B™ group, as well as the absolute average value for the change. There is a statistically significant decrease of Overbite at the end of the treatment in the T4B™ group.
- There was a statistically significant difference in the percentage of overbite between both groups before the treatment, and in the average values for Overbite change, but at the end of the treatment there was not any difference. The average value of Overbite before treatment was significantly higher, as well as the absolute value for Overbite change in the T4B™ group. In this group there was statistically significant decrease in the Overbite.
- The only significant difference in Clinical Crown Height (CCH) was between the average values at the beginning and at the end of treatment in the T4B™ group. At the end of the treatment the average value was significantly higher.

Table 5: Comparative analysis of the Overjet, curve of Spee, Overbite (mm and %) in both study groups

Indicator	n	Beginning $\bar{X}$	Beginning SD	End $\bar{X}$	End SD	P	End/Beginnig $\bar{X}$	End/Beginnig SD
Overjet	9	3,84	1,51	3,22	1,38	0,285	-0,62	1,63
	19	2,89	1,54	2,74	1,50	0,868	-0,15	1,86
Curve of Spee	9	3,03	0,99	3,27	0,80	0,589	0,23	1,24
	19	3,04	1,16	2,26	0,70	0,005	-0,77	1,07
Overbite	9	4,14	1,23	4,38	1,00	0,342	0,23	0,69
	19	6,81	2,70	3,90	0,95	<0,001	-2,91	2,64
CCH	9	8,59	0,80	9,04	0,93	0,145	0,46	0,85
	19	8,15	1,21	8,56	1,32	0,009	0,41	0,60
Overbite (%)	9	47,92	11,95	48,38	9,73	0,817	0,46	5,80
	19	83,65	29,96	45,87	10,09	<0,001	-37,78	30,07
***Legend:**	Control Group		T4B™ group		Statistically significant result			

Table 6 shows that:

- There was no significant difference in Overjet between study groups at any of the examined categories;
- There was a significant difference in curve of Spee in categories "Decrease" and "Increase". The T4B™ group was with significant higher share of "Decrease", and the control group – in category "Increase".

Table 6: Comparative analysis of dynamics of the Overjet and curve of Spee by study groups

Indicator	Overjet						Curve of Spee					
Group	↓		No change		↑		↓		No change		↑	
	n	%	n	%	n	%	n	%	n	%	n	%
Control	6	66,7	0	0	3	33,3	3	33,3	1	11,1	5	55,6
T4B™	10	52,6	2	10,5	7	36,8	15	78,9	1	5,3	3	15,8
***Legend:**	Control Group				T4B™ group		Statistically significant result					

Table 7: Comparative analysis of dynamics of curve of Spee by study groups

Indicator	Beginning						End						P
	↓		Norm		↑		↓		Norm		↑		
	n	%	n	%	n	%	n	%	n	%	n	%	
Curve of Spee	0	0	5	55,6	4	44,4	0	0	5	55,6	4	44,4	1,000
	0	0	12	63,2	7	36,8	0	0	16	84,2	3	15,8	0,046
***Legend:**	Control Group				T4B™ group				Statistically significant result				

Table 7 shows that:

- In curve of Spee was established a significant dynamics only in the T4B™ group. The patients with values above the norm were reduced by 4, as they achieved normal values;
- Both study groups did not differ statistically significant either at the beginning or at the end of treatment, in none of the categories of interest;

Case report

27-year old patient referred to our clinic with main complaint of TMJ problems, bruxing and non-esthetic smile. (Fig.5) An orthodontic analysis was made based on plaster

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models, photos and x-ray diagnostics. The treatment plan included full orthodontic treatment including a fixed appliance in the upper and in the lower arch for levelling and alignment of the teeth (Fig. 6).

Figure 5: S.P., 27y, Photos presenting the beginning of the treatment.

Figure 6: Stage of treatment with fixed appliance

In addition a myofunctional T4B^{TM} appliance was placed 6 month after the beginning of the treatment with the aim of muscle hyperactivity correction, relieving of TMJ symptoms and long-term stability achievement. The T4B^{TM} appliance was placed after achieving the levelling of upper frontal teeth, buccal inclination of upper central incisors and shaping of correct upper dental arch.

The total treatment duration was 23 month. At the end of the treatment the overlap was reduced to 46% or totally jumped by 93,78% (140,45% overbite at the beginning) (Fig.7)

Figure 7: The patients after the removal of fixed appliance. Fixed retainers were used in both jaws for retention.

The patient was satisfied with the combined orthodontic treatment, the facial esthetics was improved and the TMJ problems – resolved. (Fig. 8)

Figure 8: Patient smile before and after the orthodontic treatment.

5. Discussion

Contemporary orthodontics with fixed appliances can align the teeth and can reshape the dental arch within certain limits, but cannot change the functions of tongue, lips and cheeks. The mechanical principles underlying bite opening techniques have been well-established and appreciated in literature [5,30,31].
Dake and Sinclair [9] reported that intrusions and extrusions achieved by both Ricketts and modified Tweed techniques remained stable. Hans et al. [32] compared the efficiency of the headgear and bionator with fixed appliances in bite opening and found that both approaches produced incisor intrusion combined with skeletal mandibular changes that contributed to the correction of deep overbites. Sander et al. [30] described intrusion mechanics completed with NiTi uprighting springs with low load / deflection rates that could intrude incisors a magnitude of 7mm.

Davidovitch and Rebellato [8] described an intrusion archwire that uses only tip back bends close to molars, to achieve bite opening. Nanda has also described appliance systems and biomechanical techniques for incisor intrusion. Melsen et al. [33] compared force systems generated by stainless steel and beta titanium cantilevers with helices and have demonstrated that quality of the wire influences the relative stiffness. They showed how various laboratory wire configurations could deliver predetermined horizontal and vertical forces.

According to H. Brown Otopalik there are a lot of successfully treated patients with deep bite, but all the retention and stability are quite questionable. According to him, the muscle factor, the tongue position, and the function play an important role and can lead to a change or even recovery of the primary malocclusion. This is what determines the necessity for combined treatment including fixed mechanics and myofunctional appliances.

The choice for combined approach for treatment of deep bite we can base on the “Functional matrix theory” by Moss (1960).[34] According to it the change of muscle forces, applied to the dentition, can lead to secondary expansion as craniofacial complex is also changing in a result of changes

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in the functions. This happens despite of genetic factors. In this sense the Functional matrix theory determines the mechanic expansion of the dentition as a non-stable result.

Functional appliances affect the function of orofacial complex for achievement of muscle balance. The main disadvantage of myofunctional appliances is their limited potential for affecting the malposition of single teeth which requires including a fixed mechanics in the treatment plan, as well as a retention period between the both stages. This way the treatment becomes too long which makes the patients not motivated.

The current study established that a significantly shorter treatment period is needed when a combined approach of fixed and myofunctional appliances is used for treatment of deep bite in adults. Thus the treatment protocol becomes more effective and the chair-time is reduced.

Most of the above mentioned measurements have been based on growing patients. In those cases the possibilities for orthodontic tooth movement and skeletal changes were greater. That concerned also the stability of the achieved results due to the different intensity of biological processes, cell methabolism and regenerative possibilities in growing and non-growing patients.

In the treatment of deep bite in non-growing patient, can be considered options for camouflage treatment, surgical correction as well as the risks of compromising the results, which should be taken into account. [35]

The results showed there were no vertical skeletal changes in both studied groups, which proves the study authenticity, because it was provided in group of non-growing patients. In both groups the achieved overbite correction was due to changes in the incisor inclination and upper to lower incisor relationship, i.e. dento-alveolar changes.

The study showed there was no sagittal skeletal changes in the lower jaw. In the upper jaw, A. point (SNA angle) was reduced in the group where the T4B™ was used. This was observed in 100% in Class II/1 malocclusion patients and in 50% in Class II/2 malocclusion patients and can be related to the buccal inclination of upper front teeth.

In the group treated with T4B™ the studied values became closer to the norm. The dentoalveolar correction of deep bite was achieved by the change of different parameters as torque, Curve of Spee, tip of the teeth.
In the T4B™ construction a buccal inclination of lower front teeth and even hypercorrection is set, which can be observed in the achieved results.

In 83,3% of Class II/2 patients and in 66,7% of Class II/1 patients there was a buccal inclination and even hypercorrection of upper front teeth. Thus the combined approach using fixed appliance and T4B™ is more appropriate in patients with Deckbis (Class II/2) malocclusion where a buccal inclination of upper front teeth is needed.

T4B™ levels the Curve of Spee and create more favorable function, multipoint contact and properly distributed functional forces.

6. Conclusion

Traditional techniques correcting overbite features in all malocclusions have been known to be quite complicated, and challenging to orthodontists. Strong mechanical background, sophisticated appliance designs, diligent patient’s cooperation and multiple adjustment visits over a long treatment time are crucial elements for successful treatment prognosis of this dentoalveolar deformity.

This article describes a simple, effective and clinically applicable alternative bite opening method using combination of myofunctional appliances and fixed technique.

This approach can be performed during the regular orthodontic adjustment visits, without the need for costly and time-consuming prefabricated appliances or laboratory works. Future research is needed to quantify the amount of dental and skeletal changes elicited by this technique and compare its efficiency with other conventional bite opening modalities.

References

[1] Daokar S, Agrawal G, Deep Bite Its Etiology, Diagnosis and Management: A Review. J Orthod Endod. 2016, 2:4.
[2] Sreedhar C, Baratam S, Deep overbite – a review. Annals and essences of Dentistry 2009; 1 (1):8:25.
[3] Huang G., S. Bates, A. Ehlert, D. Whiting, S.S-H. Chen, A-M. Bollen, Stability of deep bite correction: A systemic review. J World Fed Orthod. 2012;1(3):89-86.
[4] Bergersen E. A longitudinal study of anterior vertical overbite from eight to twenty years of age. Angle Orthod 1988;58:237-56.
[5] Burstone, C.R., Deep overbite correction by intrusion. Am J. Orthodon Dentofacial Orthop, 1977;72(1):1-22.
[6] Cooke, M.S., Wreakes, G., Upper torque/intrusion mechanics in deep bite cases using the upper utility wire and directional headgear. Br. J. Orthod., 1979;6(3):157-161.
[7] Shroff, B., Lindauer, S.J., Burstone, C.J., Leiss, J.B., Segmented approach to simultaneous intrusion and space closure: biomechanics of the three-piece base arch appliance. Am J. Orthodon Dentofacial Orthop, 1995;107(2):136-143.
[8] Davidovitch, M., Rebellato, J., Two-couple orthodontic appliance systems utility arches: a two-couple intrusion arch. Semin Orthod, 1995;1(1):25-30.
[9] Dake, M.L., A comparison of Ricketts and Tweed-type arch leveling techniques. Am J. Orthodon Dentofacial Orthop, 1989;95(1):72-78.
[10] Nanda, R., Correction of deep bite in adults. Dent Clin North Am, 1997;41(1):67-87.
[11] Tulloch JF, Phillips C, Koch G, Proffit WR. The effect of early intervention on skeletal pattern in Class II malocclusion: aran-domized clinical trial. Am J Orthod Dentofacial Orthop1997;111:391-400.
[12] Tulloch JF, Proffit WR, Phillips C. Influences on the outcome of early treatment for Class II malocclusion.

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Am J Orthod Dentofacial Orthop1997; 111:533-542.
[13] Toth LR, McNamara JA. Treatment effects produced by the twin-block appliance and the FR-2 appliance of Frankel compared with and untreated Class II sample. Am J Orthod Dentofacial Orthop1999; 116:597-609.
[14] Nelson C, Harkness M, Herbison P. Mandibular changes during functional appliance treatment. Am J Orthod Dentofacial Orthop1993; 104:153-161.
[15] McNamara JA, Howe RP, Dischinger TG. A comparison of the Herbst and Frankel appliances in the treatment of Class II malocclusion. Am J Orthod Dentofacial Orthop1990; 98:134-44.
[16] Woodside DG, Metaxas A, Altuna G. The influence of functional appliance therapy on glenoid fossa remodeling. Am J Orthod Dentofacial Orthop1987; 92:181-98.
[17] Delair, J., Sagittal splitting of the body of the mandible (Mehmet's technique) for correction of open bite and deep over bite. J. Maxillofac Surg 1977;5(2):142-145.
[18] Hinkle, F.G., Surgical treatment of adult Class II division 2 malocclusion. Am J. Orthodon Dentofacial Orthop, 1989;95(3):185-191.
[19] Piecuch, J.F., Tideman, Hl, Correction of deep bite by total mandibular osteotomy; report of a case. J Oral Surg., 1981;39(8):601-606.
[20] Bell, W.H., Jacobs, J.D., Legan, H.L., Am J. Orthodon Dentofacial Orthop, 1984;85(1):1-20.
[21] Defabianis P. TMJ internal derangement treatment in the growing patient: effect of functional appliance therapy on condyle and fossa relocation. J Clin Pediatr Dent 2004; 29:11-18.
[22] Rabie ABM, Ha U. Functional appliance therapy accelerates and enhances condylar growth. Am J Orthod Dentofacial Orthop 2003; 123:40-48.
[23] Rabie AB, She TT, Harley VR. Forward mandibular positioning up-regulates SOX9 and type II collagen expression in the glenoid fossa. J Dent Res 2003; 82:725-30.
[24] Carels C, van Steenberghe D. Changes in neuromuscular reflexes in the masseter muscles during functional jaw orthopedic treatment in children. Am J Orthod Dento-facial Orthop1986; 90:410-19.
[25] Oudet C, Petrovic A, Garcia P. An experimental orthopedic treatment of the rat mandible using a functional appliance alters the fibre and myosin types in masticatory muscles. Reprod Nutr Dev 1988; 28:795-803.
[26] Singh GD, Clark WJ. Localization of mandibular changes in patients with Class II Division 1 malocclusions treated with Twinblock appliances: finite element scaling analysis. Am J Orthod Dentofacial Orthop 2001;119:419-25.
[27] Quadrelli C, Gheorgiu M, Marcheti C, Ghiglione V. Early myofunctional approach to skeletal Class II. Mondo Orthod 2002; 2:109- 22.
[28] Jonsson T, Arnlaugsson S, Karlsson KO, Ragnarsson B, Arnarson EO, Magnusson TE. Orthodontic treatment experience and prevalence of malocclusion traits in an Icelandic adult population. Am J Orthod Dentofacial Orthop. 2007; 131:8
[29] Borzabadi-Farahani A, Eslamipour F. Malocclusion and occlusal traits in an urban Iranian population. An epidemiological study of 11- to 14-year-old children. Eur J Orthod. 2009;31:477–84.
[30] Sander, F.G., Wichelhaus, A. Scheimann, C., Intrusion mechanics according to Burstone with the NiTi-SE-steel uprighting spring. J Orofac Orthop 1996.;57(4):210-223.
[31] Parker, C.D., Nanda, R.S., Currier, C.F., Skeletal and dental changes associated with the treatment of deep bite malocclusion. Am J. Orthodon Dentofacial Orthop, 1995. 107(4):382-393.
[32] Hans, G.M., Kishiyama, C., Parker, S.H., Wolf, G.R., Noachtar, R., Cephalometric evaluation of two treatment strategies for deep bite correction. Angle Orthod, 1994. 64(4):265-276.
[33] Melsen, B., Konstantellos, V., Lagoudakis, M., Planet, J., Combined intrusion and retraction generated by cantilevers and helical coil. J Orofac Orthop., 1997. 58(4): 232-241.
[34] Moss, M. L. The functional matrix hypothesis revisited. The role of mechanotransduction. Am J Orthod Dentofacial Orthop. 1997; 112 (1): 8-11.
[35] Joseph G., A. Macari, R. Haddad, Deep bite: Treatment options and challenges. Seminars in Orthodontics 2013;19(4):253–266.

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