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RESEARCH ARTICLE

Comparative Assessment of The Expansion of The Dentition Using Ligature and Passive Self-Ligating Braces in Combination with Pitts Broad and Early Elastics

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ABSTRACT

Background: The study aimed to analyze the effectiveness of the use of the Pitts Broad and early elastics in the treatment of patients with narrowing and deformation of the dentition.

Materials and methods: A comprehensive examination of 46 patients, aged 18 to 30 years, with narrowing and deformation of the dentition was performed. Patients were separated into two groups, depending on the algorithm of treatment: group 1 – using the brackets of passive self-ligation, the Pitts Broad and early short elastics; group 2 – using ligature brackets and archwires Orthos.

Results: Biometric analysis of the diagnostic models of the 1st group after treatment showed a significant expansion of maxillary arch between the premolars and molars (a distance between premolars: 39,8±0,4mm, between molars: 48,3±0,5mm) and mandibular arch (a distance between premolars: 37,1±0,5mm, between molars: 46,3±0,6mm) compared to the data before treatment. Biometric analysis of the diagnostic models of the 2nd group showed that expansion between the molars was achieved on a much smaller extent on both jaws, compared with the 1st group (maxilla: a distance between premolars – 35,7±0,4mm, between molars – 43,5±0,5mm; mandible: a distance between premolars – 33,2±0,3mm, between molars – 42,3±0,5mm).

Conclusions: As a result of the study, it was found that the passive self-ligation system in combination with a protocol of the Pitts Broad contributes to the expansion of dentition in aesthetically significant areas (distal regions) at the early stages of treatment. The use of early light elastics provides an early control of the premolars torque, and it allows us to achieve a balanced and wide smile at the end of treatment.

KEYWORDS:
orthodontic treatment, narrowing of the dentition, dentoalveolar dilatation, wide archwires.

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INTRODUCTION

The narrowing of the dentition is one of the most common dental anomalies. According to domestic and foreign authors, the incidence of pathology ranges from 30 to 63.2% [4]. From a functional point of view, the narrowing of the dentition leads to anomalies of the teeth position, occlusion anomalies, changes in the temporomandibular joint, periodontium of teeth, discoordination in work of the masticatory, and facial muscles, etc. [1,7].

In addition to functional problems, the narrowing of the dentition is associated with aesthetic disorders that reduce the social adaptation of patients [2,5]. The most frequent complaint of patients is a violation of smile aesthetics. The presence of wide buccal corridors with a maximum smile does not satisfy patients aesthetically [3,6].

The increased patient`s attention to the correction of dentition aesthetic anomalies shows that the issue of using the technique of effective dentition expansion is becoming urgent [8].

The study aimed to analyze the effectiveness of using the Pitts Broad and early elastics in the treatment of patients with narrowing and deformation of the dentition to improve aesthetic results.

MATERIALS AND METHODS

We have examined and treated 46 patients with narrowing and deformation of the dentition of 18 to 30 years. We divided patients into 2 groups of 23 people each, depending on the chosen treatment algorithms. Inclusion criteria: narrowing and deformation of the dentition, treatment without extraction of premolars, normal gingival phenotype. Exclusion criteria: chronic generalized periodontitis in the stage of exacerbation, acute or the stage of exacerbation of chronic infectious diseases.

In the 1st group, we performed orthodontic treatment by using passive self-ligation brackets, slot size 0.022 ": Damon Q, Clear (ORMCO, USA) - 8 people; H4 (Orthoclassic, USA) - 8 people; Carriere SLX 3D (Ortho Organizers, Inc., USA) - 7 people, the Pitts Broad (Orthoclassic, USA) and intermaxillary light short elastics at the early stage of treatment, in group 2 - Orthos ligature brackets, slot size 0.022 "(ORMCO, USA) and Orthos nickel-titanium archwires (ORMCO, USA).

The torque values in Damon Q and H4 brackets on the first and second maxillary premolars - (-11°), on the first mandibular premolars - (-12°), on the second mandibular premolars - (-17°). We used the identical values of the torque with Carriere SLX 3D brackets, except for the 1st and 2nd maxillary premolars - (-7°). We applied the values of the torque on the first and second maxillary premolars - (-6° and -8°), on the first and second mandibular premolars - (-7° and -9°) for Orthos brackets.

During the treatment of patients of the 1st group, the protocol of archwire sequence according to Tom Pitts was used for both jaws: thermal activated nickel-titanium archwire (TA NiTi) 0.014 ", 0.020" TA NiTi, 0.014 "x0.025" TA NiTi, 0.020 "x0.020" TA NiTi (control of incisors anchorage during the expansion), betta-titanium archwire (BT) 0.019 "x0.025".

In the 2nd group, the archwire sequence was for both jaws: 0.014 "NiTi, 0.016" x0.022 "NiTi, 0.017" x0.025 "NiTi, 0.019" x0.025 " BT.

We carried out an anthropometric study of control and diagnostic models of the jaws before and after orthodontic treatment according to the methods of Pone and Snagina to identify morphological changes in the dentition of patients. The following values were measured and compared: the width of maxilla and mandible between the first premolars, first molars, the length and width of the apical bases of the jaws. Statistical processing of the obtained data was carried out using the StatSoft Statistica 10 Enterprise program.

After the end of the active period of orthodontic treatment, we fixed retainers on the anterior group of maxillary and mandibular teeth and prescribed an elastocorrector to stabilize the occlusion and myodynamic balance.

RESULTS AND DISCUSSION

We studied diagnostic models before and after treatment of two groups of patients with a narrowing of the dentition. The analysis of the diagnostic models revealed a narrowing of the maxillary and mandibular arches between the first premolars and molars, a narrowing of the apical bases, a deficiency of the apical bases in length and width, comparing the values before treatment with the average individual norm.

Biometric analysis of diagnostic models of the first group showed a significant increase of maxillary and mandibular arches between the premolars and molars: maxilla – a distance between premolars 39.8 ± 0.4 mm, between molars 48.3 ± 0.5 mm; mandible – a distance between premolars 37.1 ± 0.5 mm, between molars 46.3 ± 0.6 mm, compared to the data before treatment (Table 1). The width of the maxillary apical base, after treatment, (45.4 ± 0.5 mm) is also significantly greater than the value before treatment (42.5 ± 0.3 mm). An anthropometric study of the models of the 1st group revealed that the effect of the Pitts Broad is identical on each of the passive self-ligation systems and does not have a statistically significant difference between them.

Table 1. Dentition and apical base indicators of the 1st group of patients before and after orthodontic treatment

Jaw	Parameters, mm	Values		p
		Before treatment (M±m)mm	After treatment (M±m)mm	
maxilla	between the premolars	32,5±0,3	39,8±0,4	< 0,05
	between the molars	41,5±0,6	48,3±0,5	< 0,05
	the width of the apical base	42,5±0,3	45,4±0,5	< 0,05
	the length of the apical base	33,2±0,5	35,5±0,4	< 0,05
mandible	between the premolars	31,1±0,5	37,1±0,5	< 0,05
	between the molars	40,2±0,3	46,3±0,6	< 0,05
	the width of the apical base	35,1±0,5	36,6±0,5	< 0,05
	the length of the apical base	28,3±0,6	32,4±0,6	< 0,05

Biometric analysis of diagnostic models of patients of the 2nd group showed that we achieved less expansion between the maxillary and mandibular premolars and molars compared with the 1st group (maxilla: a distance between premolars - 35.7 ± 0, 4mm, between molars - 43.5 ± 0.5mm; mandible: a distance between premolars - 33.2 ± 0.3mm, between molars - 42.3 ± 0.5mm), (Table 2).

Table 2. Dentition and apical base indicators of the 2nd group of patients before and after orthodontic treatment

Jaw	Parameters, mm	Values		p
		Before treatment (M±m)mm	After treatment (M±m)mm	
maxilla	between the premolars	32,5±0,3	35,7±0,4	< 0,05
	between the molars	41,4±0,6	43,5±0,5	< 0,05
	the width of the apical base	42,4±0,3	45,1±0,5	< 0,05
	the length of the apical base	33,2±0,5	35,3±0,4	< 0,05
mandible	between the premolars	31,1±0,4	33,2±0,3	< 0,05
	between the molars	40,2±0,3	42,3±0,5	< 0,05
	the width of the apical base	35,1±0,5	36,1±0,5	< 0,05
	the length of the apical base	28,3±0,6	32,5±0,6	< 0,05

We have normalized the form of the arches due to using the Pitts Broad and S-shaped elastics in patients of the 1st group. We revealed the expansion and lengthening of the apical bases. The torque normalization of the maxillary premolars contributed to the additional development of the maxillary arch in the transversal plane.

Using Orthos ligature brackets with a low torque value on the first and second premolars (on maxilla - (- 6 ° and -8 °), on mandible - (- 7 ° and -9 °)) is not enough to compensate for the side effect of S-shaped elastics, prescribed to achieve optimal expansion.

We revealed that the use of passive self-ligation systems, the Pitts Broad, and early light elastics changes the exposure of the maxillary incisors during a smile: a decrease in the area of the buccal corridors, an increase in the area of the dental component of a smile, and the formation of a smile arch.

A CLINICAL CASE

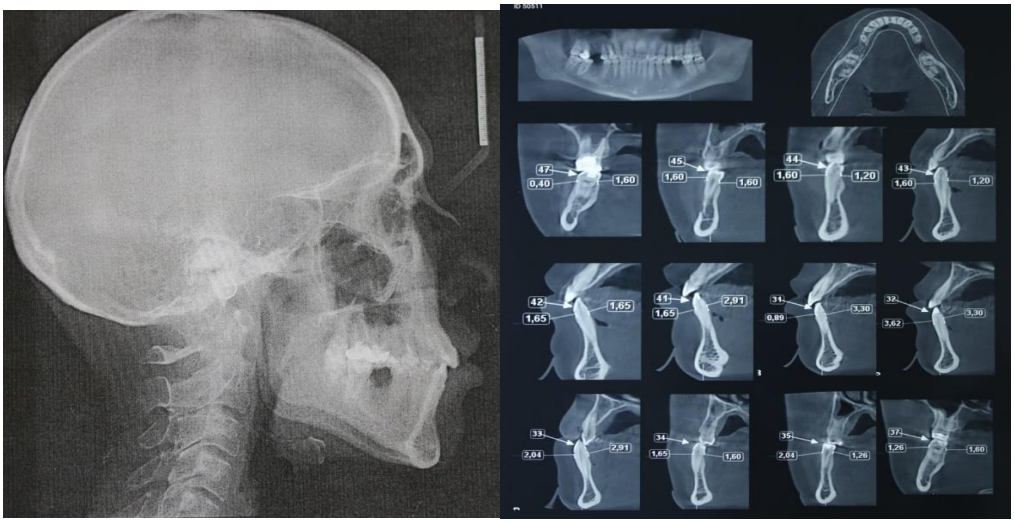
Patient P., 26 years old, complaining of an incorrect bite, the absence of separate teeth, and the inconvenience of chewing.

The clinical examination and analysis of the CBCT examination of the skull indicated a palatoocclusion of the posterior teeth on the left side, asymmetric narrowing, and deformation of the dentition (33.5 mm between the teeth 1.4-2.4, 36 mm between the teeth 1.5-2.5; 32.5 mm between teeth 3.4-4.4, 35 mm between teeth 3.5-4.5, 46 mm between teeth 3.7-4.7), crowding, displacement of inter-incisal lines due to asymmetric pronounced narrowing of the left side of the maxilla, lack of space for the third molars, loss of teeth 3.6, 4.6, right deflexion of the mandible during opening the mouth, TMJ dysfunction (Fig. 1 a-j).

a b c

d e f

g h



i j

Fig. 1: Patient P. before treatment. a - c - patient`s face; d - h - dental occlusion; pretreatment lateral cephalogram (i); pretreatment CBCT of mandible and maxilla (j).

The patient refused combined orthodontic-surgical treatment and a surgically-assisted rapid maxillary expansion, in this way

it was decided to start a compromise orthodontic treatment with a self-ligating bracket system to normalize the form and size of the arches. The treatment plan included the use of the Pitts Broad to expand the arches, early light S-shaped elastics to normalize the torque of the maxillary premolars, bite turbos to normalize the position of the mandible, and disarticulate the dentition.

The Damon Clear brackets were positioned on the group of the anterior teeth of both jaws, Damon Q brackets on the posterior teeth of both jaws. The brackets on the teeth 1.4-1.5, 2.4-2.5, 3.4-3.5, 4.4-4.5 were turned over to obtain a positive torque - (+ 5°). The first thermal activated nickel-titanium archwire 0.014" was placed on both arches. Disarticulation was carried out using active bite turbos, fixed on the palatal surface of teeth 1.4, 1.5 to correct mandible position (Fig. 2 a-e).

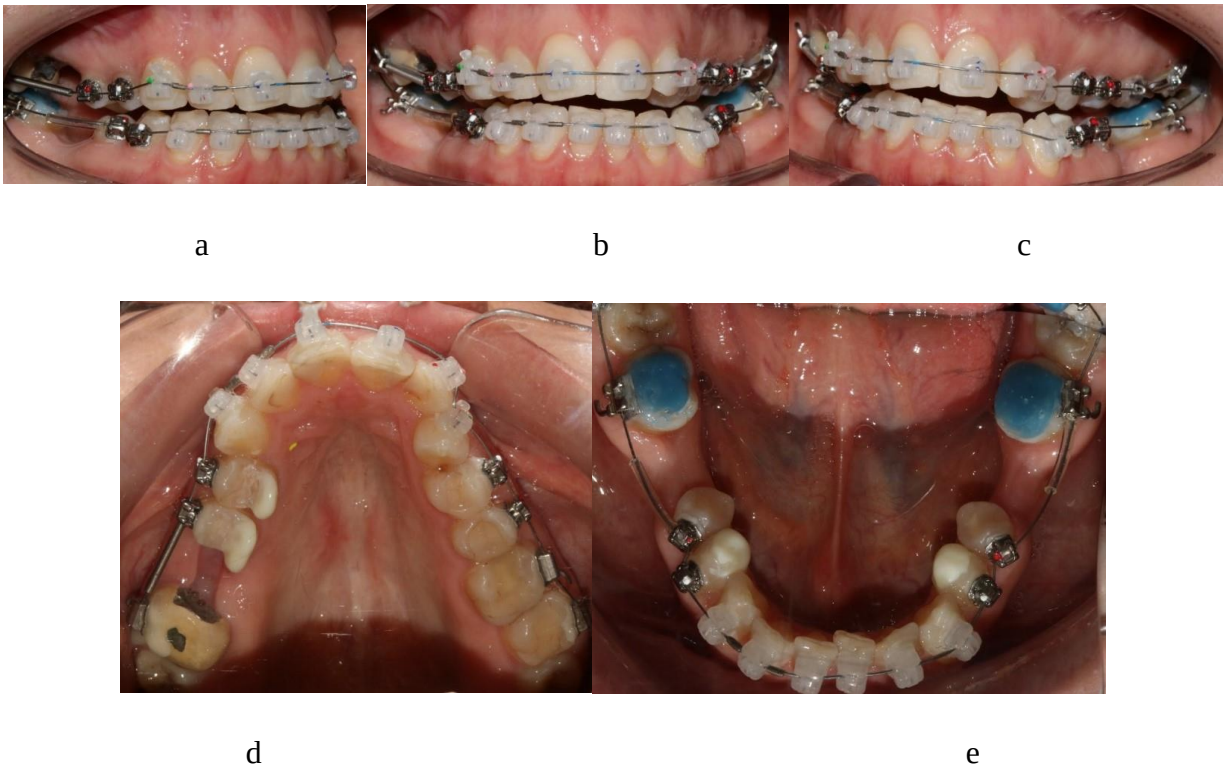


Fig. 2: Beginning of the orthodontic treatment. a – e – Damon Q braces fixation on posterior teeth, Damon Clear braces fixation on anterior teeth of the upper and lower jaws.

After 12 weeks, we replaced the bracket on tooth 2.3 with a positive torque - (+ 11°) to correct the palatal inclination of the tooth and eliminate a crossbite between teeth 2.3-3.3, fixed thermal activated nickel-titanium archwire 0.020" on both jaws. We prescribed early light S-shaped elastics from the buttons of teeth 2.3, 2.4, 2.5 to the hooks on brackets of teeth 3.3, 3.4, 3.5 (3/16˝; 2.5 oz.) We recommended changing the elastics every 12 hours (Fig. 3 a-e).

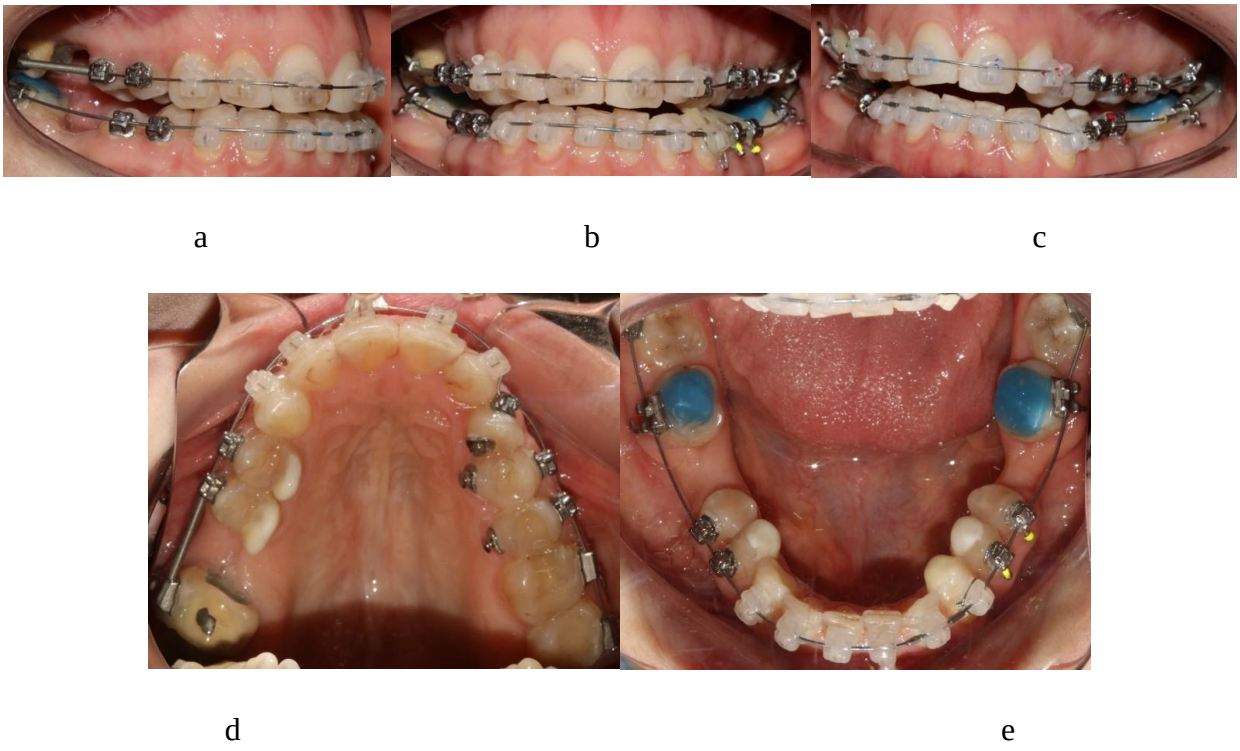


Fig. 3: Next stage of orthodontic treatment. a - e - using of S-shaped elastics.

After 10 weeks since the last visit, the archwires were changed to thermal activated nickel-titanium 0.014″x0.025″. Orthodontic buttons were fixed on the palatal surface of teeth 1.4, 1.5.

Passive opening springs were placed in the area of defects in the dentition. We prescribed S-shaped elastics from palatine buttons of teeth 1.4, 1.5 to teeth 4.4, 4.5 (3 / 16″; 3.5 oz). It was recommended to wear S-shaped elastics on both sides.

After 32 weeks of treatment, thermal activated nickel-titanium archwires 0.020″x0.020 ″ were placed on both jaws.

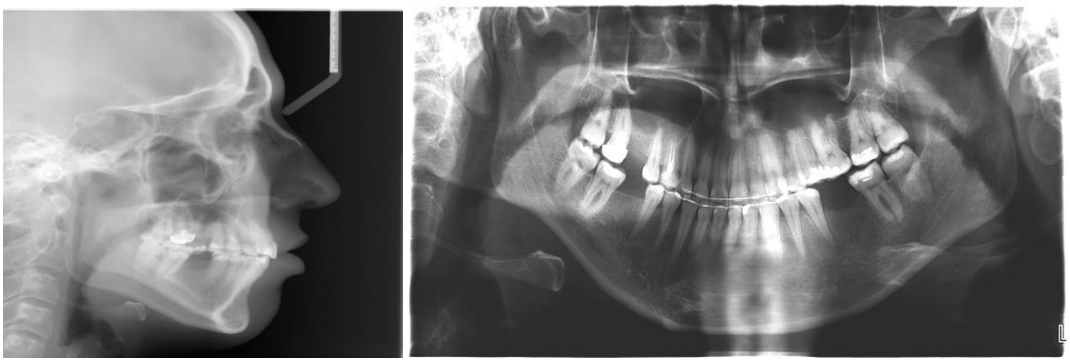
It was recommended to continue wearing elastics according to the pattern. After 8 weeks from the last visit, betta-titanium archwires (BT) 0.019″x0.025″ were fixed on both jaws to make detailing bends for teeth 2.1, 2.2. We assigned

"box" elastics from teeth 1.4-1.3 to teeth 4.5-4.4, "triangular" elastics from teeth 2.3-2.4 to tooth 3.5 (1/4 ″; 3.5 oz). After 12,5 months of treatment, we noted positive dynamics of treatment, removed brackets, positioned the fixed lingual retainer on the teeth 1.3-2.3, 3.5-4.5, and bands on the teeth 1.7, 3.7, 4.7 to keep space for subsequent implantation. The removable retention appliances were made for both jaws (minimum retention period lasts for 4 years) (Fig. 4 a-k).

a b c d

e f g

h i



j k

Fig. 4: Retention period. a - d - face and smile of the patient after treatment; e - i - removal of braces system, fixation of retainers and bands on dental arches; posttreatment lateral cephalogram(j); posttreatment panoramic radiograph (k).

After 12.5 months of orthodontic treatment, we achieved a significant expansion of the dental arches, eliminated the palatoocclusion of the posterior teeth due to the use of the Pitts Broad and S-shaped light elastics at the early stages of treatment. The distance between the teeth 1.4-2.4 was 38 mm (4.5 mm more), 43 mm between the teeth 1.5-2.5 (7 mm more).

CONCLUSIONS

We achieved an optimal expansion of the arches between the premolars and molars using passive self-ligation systems, the

Pitts Broad, and early elastics in patients with narrowing and deformation of the dentition. The inclination of the posterior teeth was improved, and the buccal corridors were eliminated. The use of bite turbos normalized mandible position and occlusal relationships.

The use of Orthos brackets and nickel-titanium archwires is not so effective in creating a wide form of dental arches without using S-shaped elastics at the early stages of treatment of patients with narrowing of the dentition. The process of normalization and control of the torque of premolars and molars becomes more complicated, and it limits the possibilities of expansion in the distal parts of arches.

Thus, the use of the Pitts' protocol of archwire sequence in conjunction with passive self-ligation systems and early elastics allows achieving a stable expansion of the dental arches, as well as creating a balanced smile, which is important and necessary for the successful completion of orthodontic treatment.

ABBREVIATIONS:

TMD: temporomandibular joint dysfunction

CBCT of mandible and maxilla: cone-beam computed tomography of mandible and maxilla

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DISCLOSURE OF INTEREST

The authors declare that they have no competing interests. Ethics approval and consent to participate Approved by the ethics committee of the National Medical Research Center of Dentistry and Maxillofacial Surgery, Moscow, Russia

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

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