UNIVERSIDADE DE SÃO PAULO
FACULDADE DE ODONTOLOGIA DE BAURU

Sorileé Carlina Ramón Pujols

Stability of Class II malocclusion treatment with the Distal Jet followed by fixed appliances

Avaliação longitudinal da estabilidade do tratamento da má oclusão de Classe II com o aparelho Distal Jet seguido pelo aparelho ortodôntico fixo

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Orientador: Prof. Dr. José Fernando Castanha Henriques.

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DEDICATÓRIA

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Sempre que cair, levante alguma coisa do chão.

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ABSTRACT

Stability of Class II malocclusion treatment with the Distal Jet followed by fixed appliances

Introduction: This retrospective study aimed to assess the stability of Class II malocclusion treatment with the distal jet, followed by fixed appliances. **Methods:** Seventy-five cephalograms of 30 subjects, were divided into two groups: the treated group consisted of 15 patients who were evaluated at the pretreatment (T1), posttreatment (T2), and long-term posttreatment (T3) stages. The control group, consisted of 15 subjects with normal occlusion, comparable to the experimental group at the long-term posttreatment period. Intergroup comparison of posttreatment changes was evaluated with t tests. **Results:** In the posttreatment period, there was no significant change in the anteroposterior positioning the maxilla and mandible in relation to the cranial base. Lower anterior face height had significantly smaller increase in in the treated than in the control group. The maxillary molars in the treated group had significantly smaller vertical development and the mandibular incisors had significantly greater labial tipping and protrusion than the control group. Treatment produced significant improvement in molar relationship and reduction of overbite and overjet, which remained stable in the posttreatment period. There was greater upper lip protrusion in the experimental than in the control group in the posttreatment period. **Conclusions:** Treatment of Class II malocclusions with the Distal Jet followed by fixed appliances showed long-term stability.

Key Words: Malocclusion, Angle Class II; Molar distalization; Distal Jet appliance; Stability

RESUMO

Avaliação longitudinal da estabilidade do tratamento da má oclusão de Classe II com o aparelho Distal Jet seguido pelo aparelho ortodôntico fixo

Introdução: Este estudo retrospetivo teve como objetivo avaliar a estabilidade do tratamento de má oclusão Classe II com o Distal Jet, seguido do aparelho ortodôntico fixo. **Métodos:** Setenta e cinco cefalogramas de 30 indivíduos foram divididos em dois grupos: o grupo tratado foi constituído por 15 pacientes avaliados nos estágios de pré-tratamento (T1), pós-tratamento (T2) e pós-tratamento em longo prazo (T3). O grupo controle, composto por 15 indivíduos com oclusão normal, comparável ao grupo experimental no período pós-tratamento em longo prazo. A comparação intergrupos das alterações pós-tratamento foi avaliada com os testes t. **Resultados:** No pós-tratamento, não houve alteração significativa no posicionamento ântero-posterior da maxila e da mandíbula em relação à base do crânio. Foi observado um aumento significativamente menor na AFAI no grupo tratado do que no grupo controle. Os molares maxilares no grupo tratado apresentaram desenvolvimento vertical significativamente menor e os incisivos mandibulares apresentaram inclinação vestibular e protrusão significativamente maiores que o grupo controle. O tratamento produziu melhora significativa na relação molar e redução da sobremordida e do overjet, que permaneceram estável no período pós-tratamento. Houve maior protrusão do lábio superior no grupo experimental do que no grupo controle no período pós-tratamento. **Conclusões:** O tratamento das más oclusões de Classe II com o Distal Jet seguido de aparelhos fixos mostrou estabilidade em longo prazo.

Palavras-chaves: Má oclusão de Angle Classe II. Distalização molar. Aparelho Distal jet. Estabilidade.

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1 INTRODUCTION

1 INTRODUCTION

Class II, Division 1 malocclusions represent approximately fifteen to twenty percent in a general population.(GOLDSTEIN; STANTON, 1936) (MASSLER; FRANKEL, 1951; AST; CARLOS; CONS, 1965) Certainly, due to their often obvious skeletal and dental deviations, a greater percentage of those patients seek treatment and it constitutes 12% to 49% of all orthodontic problems.(KIM, 1979) Through the years, many protocols have been developed for Class II malocclusion treatments, including nonextraction protocols with extraoral traction(KLOEHN, 1961; JACOB; BUSCHANG; DOS SANTOS-PINTO, 2013) functional orthopedic appliances,(ALMEIDA et al., 2004; JANSON et al., 2006; ALMEIDA-PEDRIN et al., 2007; CHIQUETO et al., 2013) Class II elastics,(ANDREASEN, 1971) intraoral distalizers(HILGERS, 1992; CARANO; TESTA, 1996) and symmetric or asymmetric extraction protocols.(JANSON et al., 2003) Frequently the most suitable protocol is determined by patient’s age, growth pattern and malocclusion severity.

For patients with maxillary dentoalveolar protrusion or minor skeletal discrepancies, maxillary molar distalization for nonextraction treatment has been used for many years. Conventionally used appliances for molar distalization like extraoral headgear, Cetlin removable plate, and Wilson arches dependent on patient compliance to correct molar relationship. (WILSON, 1978; CETLIN; TEN HOEVE, 1983; NGANTUNG; NANDA; BOWMAN, 2001; PAPADOPOULOS; MAVROPOULOS; KARAMOUZOS, 2004; CHIU; MCNAMARA; FRANCHI, 2005; FONTANA et al., 2015)

Over the years, alternative methods had been proposed to diminish the need for patient cooperation.(BLECHMAN, 1985; GIANELLY et al., 1988; HILGERS, 1992; JONES; WHITE, 1992; LOCATELLI, 1992; CARANO; TESTA, 1996) The intraoral distalizers are appliances with intramaxillary anchorage for distalization, described as an alternative to headgear. The advantages of these appliances are that they act permanently, do not affect facial esthetics and do not depend on patient’s compliance.(KINZINGER et al., 2008) Although these intraoral devices require minimal patient collaboration, they have unfavorable side effects. Many of these appliances by moving posterior teeth distally, produce a certain amount of anterior anchorage loss, such as: —mesial movement of anchoring teeth and proclination of maxillary incisors. In addition, they also tend to produce some distal tipping of the maxillary molars, rather than pure bodily movement.

Various noncompliance appliances for molar distalization have been described in the literature. Developed by Carano and Testa (1996) the distal jet is one of the more frequently used. It is a lingual distalization appliance, consisting of an acrylic Nance button and stainless steel wires. This lingual appliance has three distinct advantages: the maxillary molars are distalized without the lingual movement that occurs with the pendulum, it can be easily converted into a regular Nance holding arch when the distalization is completed and it produces less molar tipping with more bodily movement.(CARANO; TESTA, 1996; CARANO; TESTA; BOWMAN, 2002) Since the introduction of the Distal Jet, many studies(CARANO; TESTA, 1996; BOWMAN, 1998; NGANTUNG; NANDA; BOWMAN, 2001; BOLLA et al., 2002; CHIU; MCNAMARA; FRANCHI, 2005; KINZINGER; EREN; DIEDRICH, 2008) have evaluated the dentoskeletal changes produced by this appliance and its efficiency, but what about the stability?

Besides obtaining good treatment outcomes, maintaining teeth in their corrected positions is challenging and long-term stability is a major goal of orthodontic treatment. However, it is apparent from a number of long-term follow-up studies that changes in dental relationships after completion of the active phase of treatment are to be expected and do not necessarily indicate relapse.(SADOWSKY; SAKOLS, 1982; SADOWSKY et al., 1994)

Posttreatment changes in the dentition may be affected by physiologic dentoalveolar adaptation(BLAKE; BIBBY, 1998) and they are unavoidable. Likewise untreated normal occlusion patients, final tooth positions at maturity appeared to be heavily influenced by the relative amount and direction of anteroposterior and vertical components of facial growth.(SINCLAIR; LITTLE, 1985)

Previously studies have reported data relative to changes that occurred at the end of the distalization phase or at the end of comprehensive fixed appliance therapy with the distal jet appliance. However, in the literature does not exist studies evaluating stability of the changes induced by the distal jet, therefore the aim of this study is to evaluate the long-term stability of Class II treatment with the Distal Jet, followed by fixed appliances.

2 ARTICLE

2 ARTICLE

The article presented in this Dissertation was written according to the *American Journal of Orthodontics and Dentofacial Orthopedics* instructions and guidelines for article submission.

Stability of Class II malocclusion treatment with the Distal Jet followed by fixed appliances

ABSTRACT

Introduction: This retrospective study aimed to assess the stability of Class II malocclusion treatment with the distal jet, followed by fixed appliances. **Methods:** Seventy-five cephalograms of 30 subjects, were divided into two groups: the treated group consisted of 15 patients who were evaluated at the pretreatment (T1), posttreatment (T2), and long-term posttreatment (T3) stages. The control group, consisted of 15 subjects with normal occlusion, comparable to the experimental group at the long-term posttreatment period. Intergroup comparison of posttreatment changes was evaluated with t tests. **Results:** In the posttreatment period, there was no significant change in the anteroposterior positioning the maxilla and mandible in relation to the cranial base. Lower anterior face height had significantly smaller increase in in the treated than in the control group. The maxillary molars in the treated group had significantly smaller vertical development and the mandibular incisors had significantly greater labial tipping and protrusion than the control group. Treatment produced significant improvement in molar relationship and reduction of overbite and overjet, which remained stable in the posttreatment period. There was greater upper lip protrusion in the experimental than in the control group in the posttreatment period. **Conclusions:** Treatment of Class II malocclusions with the Distal Jet followed by fixed appliances showed long-term stability.

Key Words: Malocclusion, Angle Class II; Molar distalization; Distal Jet appliance; Stability

INTRODUCTION

Maxillary molar distalization for nonextraction treatment of patients with Class II malocclusions has been used for many years. Conventionally used appliances for molar distalization like extraoral headgear, Cetlin removable plate, and Wilson arches dependent on patient compliance to correct molar relationship.[1-5]

Patient compliance is the most important key to any treatment success, and plays a major role in achieving the desired results. Nowadays, lack of compliance is a common problem in the orthodontic clinic. Therefore, treatments that require minimal patient compliance may produce better and more predictable results.[1,6,7]

By the end of the 1970s, intraoral distalizers began to be used, which are appliances with intramaxillary anchorage for distalization, described as an alternative to headgear. The advantages of these appliances are that they act permanently, do not affect facial esthetics and are independent of patient compliance.[8]

Developed by Carano and Testa (1996), the distal jet is one of the most frequently used “noncompliance appliances” for molar distalization. It is a lingual distalization appliance, consisting of an acrylic Nance button and stainless steel wires. This lingual appliance has three distinct advantages: the maxillary molars are distalized without the lingual movement that occurs with the pendulum, it can be easily converted into a regular Nance holding arch when the distalization is complete and it produces less molar tipping with more bodily movement.[9,10]

As demonstrated, since the introduction of the Distal Jet, many studies have evaluated the dentoskeletal changes produces by this appliance and its efficiency, but what about the stability? Besides obtaining good treatment outcomes, maintaining teeth in their corrected positions is challenging, and the major objective of orthodontic treatment is to achieve long-term stability of the dental relationships.[1,3,6,8,9,11,12]

In the literature, there is a lack of studies evaluating stability of the changes induced by the Distal Jet. Therefore, the aim of this study is to evaluate the long-term stability of Class II malocclusion treatment with the distal jet, followed by fixed appliances.

Material and Methods

This study was approved by the Ethics Research Committee of Bauru Dental School, University of São Paulo, and all subjects signed informed consent.

The sample size was calculated based on an alpha significance level of 0.05 and a beta of 0.2 to achieve 80% of power to detect a mean difference of 1.5mm with a standard deviation of 1.43 in the changes in molar sagittal position (PTV-6) between the posttreatment and long-term posttreatment stages.[13] The results showed that a minimum of 15 patients were needed for each group.

Therefore, the sample consisted in 45 lateral cephalometric radiographs of 15 patients from the files of the Orthodontic Department at Bauru Dental School, University of São Paulo. The patients were selected according to the following inclusion criteria: a least 5 years after treatment with the Distal Jet followed by fixed appliances. Class II division 1 or 2 malocclusions; permanent dentition including or not fully erupted maxillary second molars; absence of agenesis or loss of permanent teeth; dental archs with slight or moderate crowding; molar distalization achieved only with the distal jet in the first phase of treatment; without history of previous orthodontic treatment; nonextraction treatment. No cephalometric characteristic was considered as inclusion criteria.

The treated group included 15 patients (10 female; 5 male) who were treated with the distal jet followed by fixed appliances, during a mean period of 4.13 (SD 0.99) years. The pretreatment mean age was 12.63 (SD 1.31) years, the posttreatment mean age of 16.76 (SD 1.55) years, and the long-term posttreatment mean age was of 23.32 (SD 1.43). The mean long-term posttreatment period was of 6.55 years (SD 0.57, Table I).

The control group comprised 15 untreated subjects (10 female; 5 male) with normal occlusion and initial mean age of 16.63 years (SD 0.97), and final mean age of 23.57 years (SD 2.06). The long-term posttreatment period of 6.94 years, (SD 1.98) was comparable to the experimental group. This group was selected from the longitudinal growth study sample of the "Iowa Facial Growth Study" (Department of Orthodontics, College of Dentistry, University of Iowa, USA) and "The Oregon Growth Study" (Department of Orthodontics, School of Dentistry, Oregon Health and Science

University, USA) obtained from the online American Association of Orthodontists Foundation (AAOF) Craniofacial Growth Legacy Collection (Table I).

Treatment protocol

The treatment protocol consisted in the use of the Distal Jet appliance, constructed with two bilateral tubes embedded in a modified acrylic Nance palatal button according to the recommendations of Carano and Testa[9]. (Fig. 1). The appliances were used until the maxillary first molars were distalized to a super Class I relationship. Once the first molars had been moved into an overcorrected relationship, the distal jet appliance was converted into a modified Nance holding arch. Subsequently, preadjusted orthodontic fixed appliances were placed to retract the maxillary anterior segment, align the teeth and detail the occlusion. Headgear and intermaxillary Class II elastics were used as active retention. At the end of the orthodontic treatment, all patients were instructed to wear a maxillary Hawley retainer and a fixed canine-to-canine lingual retainer was used for retention in the mandibular arch.

Cephalometric analysis

Lateral cephalometric radiographs were taken of each patient at the pretreatment (T1), posttreatment (T2), and long-term posttreatment stages (T3). They were digitized and had the landmarks identified by a single operator (S.R.P.) in the Dolphin Imaging 11.5 software (Dolphin Imaging and Management Solutions, Chatsworth, California, USA), which also corrects the image magnification factors, because the lateral cephalograms were obtained from different radiographic machines. The cephalometric variables are shown in Table II and figure 2-4. Long-term posttreatment changes were calculated as T3-T2.

Error study

Twenty-two radiographs were randomly selected, retraced, re-digitized and remeasured again by the same examiner (S.C.R.P.), after a month of the first measurements. The random errors were calculated according to Dahlberg's formula ($Se2 = \sum d2/2n$)[14], where Se^2 is the error variance and d is the difference between two determinations of the same variable. The systematic errors were evaluated with paired t-tests, at $P<0.05$.[15]

Statistical analyses

Normal distribution of the variables was evaluated with Kolmogorov-Smirnov tests, which showed that they had normal distribution

Intergroup comparability regarding ages at T2, T3 and at the long-term posttreatment stage was evaluated with t test.

Repeated measures analysis of variance (ANOVA), followed by Tukey tests were used to compare changes in the variables during the treatment period (T2-T1), and the posttreatment period (T3-T2) in the experimental group. T tests were used to compare changes during the long-term posttreatment period (T3-T2) in the experimental group with the changes during a comparable period for the control group.

All statistical tests were performed with Statistica software (Statistica for Windows 10.0; Statsoft, Tulsa, Okla.). Results were considered statistically significant at $P<0.05$.

Results

The range of random errors varied from 0.14 (ANB) to 2.53 (Mx7.SN) and only 2 (Overbite and LL-E) of the 30 evaluated variables showed statistically significant systematic errors (Table III). The groups were comparable for ages at T2, T3 and posttreatment period (Table I).

During treatment, there were no statistically significant changes on the anteroposterior positioning of both maxilla and mandible in relation to the cranial base. There was an increase in lower anterior facial height (LAFH) due to the clockwise mandibular rotation. The maxillary incisors had significantly palatal tipping. Maxillary first premolars, showed significant mesial inclination. Maxillary molars showed statically significant mesial inclination, mesialization and extrusion. The mandibular incisors presented significant labial inclination and protrusion. The treatment produces significant improvement in molar relationship, overbite and overjet, which remained stable at the posttreatment stage. There was upper and lower lips retrusion (Table IV).

In the posttreatment period, the apical bases and their relationship had normal behavior. The lower anterior face height had significantly smaller increase in the treated group than in the control group (Table V). The maxillary molars in the treated group had significantly smaller vertical development that the control group. The mandibular incisors had significantly greater labial tipping and protrusion in the experimental group. There were no significant differences in the nasolabial angle changes and there was greater upper lip protrusion in the experimental than in the control group.

Discussion

The sample size of 15 patients in each group, can be considered a limitation of this study, which resulted by requiring a least 5 years after treatment with the Distal Jet followed by fixed appliances. Nevertheless, the sample size calculation showed that 15 patients were needed, and it is noteworthy that the sample is within the limits recommended by Houston[15] which reports that, for the validity of any longitudinal study, the sample must show at least 15 components. Therefore, the sample used in this study should be considered satisfactory.

The control group was not developed especially for this study, but it was a normal occlusion group, representative of a random population followed over the same period as the treated group. Both groups had the same number of male and female. Therefore, intergroup sex distribution was not statistically evaluated. Intergroup comparability regarding cephalometric characteristics at posttreatment stage was not evaluated. Whereas, the main focus of this study was to assess the changes that occurred between posttreatment and long-tern posttreatment stages (T3-T2) and to compare with a control group. Data relative to treatment that occurred at the end of the distalization phase or at the end of comprehensive fixed appliance therapy have previously been the subject of study.[16,17] Therefore, changes that occurred during treatment, as well as the values of the measures in the three stages of the evaluation were analyzed to assess whether they could explain those that occurred in the long-term post-treatment period.

Skeletal changes

According to previous studies[18] [2,19] intraoral distalization appliances do not interfere with craniofacial growth and development, consequently they yield a predominantly dentoalveolar effect for Class II malocclusion treatment, with no significant changes in the maxillary and mandibular growth. Likewise, in this study this was also demonstrated; the treated group showed that there was no statistically significant difference in the sagittal positioning of the maxilla and mandible before and after treatment with the Distal Jet appliance (Table IV). This has been previously reported.[1,3,6,9,12]

There were no statistically significant changes on the anteroposterior positioning of both maxilla and mandible in relation to the cranial base, at the long-term posttreatment period, similarly there was no difference in the intergroup comparison (Table V). These results are in agreement with a literature review of longitudinal studies of growth, where it was found that differences in craniofacial measures are established early in life, and growth trends of Class II and Class I subjects appeared to be essentially similar thereafter.[20-23] Also there was observed an improvement in maxillomandibular relationship (Table V), however this change was not significant and was smaller in the treated group than in the control group, probably due to normal growth as has been previously described in the literature.[24,25]

Vertical components

There are contrasting findings in the literature concerning the increases in lower anterior facial height after molar distalizing therapy. Some authors [2,6] have reported that did not observe significant changes in LAFH, whereas compared with this, other studies reported that distal molar movement is accompanied by an increase in vertical facial dimension and LAFH.[26,27]

In this study, during treatment there was a significant increase in LAFH (Table IV), which is usually predictable during orthodontic treatment with maxillary molar distalization, and can be explain by extrusion of posterior teeth or the maxillary molars being distalized into the arc of closure.[1,28,29] As a result of extrusion of the maxillary molars, a clockwise rotation of the mandibular plane was observed during treatment.

In the long-term posttreatment period, there was smaller increase in lower anterior face in the treated group than in the control group (Table V). This result could be expected, because the tendency is that variables that demonstrated the greatest influence during treatment will have smaller changes after treatment.[30,31] Additionally, an increase in LAFH due to craniofacial growth and development is a common finding.[32] Nevertheless, the facial pattern and the LAFH has not changed in the post-treatment period. This was also observed by Alessio in 2009.[13] With exception of the LAFH there were no statistically different changes regarding vertical components between the treated and control groups at the long-term posttreatment stage.

Maxillary dentoalveolar component

During treatment, the maxillary incisors had significant extrusion (Table IV), which was probably due to the leveling achieved by the orthodontic fixed appliance[3,33] Maxillary first premolars, showed statically significant mesial inclination and extrusion (Table IV), which is probably because the correction of tooth position. Distal tipping of premolars with the distal jet may be expected due to the geometry of the appliance[3,6] Maxillary molars showed statically significant mesial tipping (Table IV), this effect is likely due to the use of preadjusted orthodontic fixed appliances, which, correct the distal tipping of maxillary first molars that occur during molar distalization with intraoral distalizers.[3,29,34] There were no statistically significant differences between posttreatment and long-term posttreatment stages (Table V). Therefore, the changes produced during treatment remained stable in the long-term posttreatment.

There was significant mesialization of the maxillary first molars at the end of the comprehensive treatment (Table IV), as have been previously reported.[3,29,33] This indicates that the molars were more mesial than when they started treatment. This forward movement can be considered a normal process of dentoalveolar compensation during mandibular growth in order to maintain Class I molar relationship.[35] In the long-term posttreatment the Class I molar relationship was maintained.

Maxillary molars showed statically significant extrusion (Table IV). Similar results have been reported in previous studies for the distal jet appliance and another intraoral distalizers appliances [3,33] This change might be due to the effects of the distal jet,[3,9] the cervical headgear worn at night like active retention,[36-38] or the fixed appliance treatment.[39] Furthermore, studies of late facial growth have shown that continued eruption of the teeth is a normal process.[40-42] Moreover, this statistically significant extrusion is greater in the treated groups with intraoral distalizers than in control groups, as previously reported.[32]

The maxillary molars in the treated group showed significantly smaller vertical development that the control group in posttreatment stage. This is a normal tendency as aforementioned; variables that demonstrated the greatest influence during treatment will have smaller changes after treatment.[30,31]

Mandibular dentoalveolar component

The mandibular incisors presented statically significant labial inclination and protrusion during treatment (Table IV), which remained stable on the posttreatment period. Litowitz[43] stated that, in those mandibular incisors where treatment had resulted in an increase in the axial inclination (greater procumbency) half tended to regain their former inclination and half became more procumbent.

During the posttreatment period, it is generally agreed that teeth that have been moved tend to return to their former positions. [44,45] In contrast, in this study the mandibular incisors showed slight labial inclination and protrusion while the control group showed retrusion of those teeth (Table V). Nevertheless, this labial inclination was small and can be considered clinically irrelevant. Similarly, previous investigations have reported that the inclination of the lower incisor became more labial during the posttreatment period. [43,44,46]

It could be speculated that this difference in the mandibular incisors inclination and protrusion between groups in the posttreatment period, could be due to the fact that the majority of patients in the treated group were still with a fixed canine-to-canine lingual retainer, thus avoiding the frequent tendency to decrease of the mandibular incisors inclination throughout adult life.

Dental Relationship

During treatment, there was a statically significant improvement in the molar relationship and reduction of the overbite and overjet (Table IV). These findings are in agreement with previously published studies.[1,3]

Despite that, occlusal changes can occur during all stages of human development, the present study showed that the molar relationship, overbite, and overjet remained stable in the long-term posttreatment stage and no statically significant changes was fond in the intergroup comparison (Table V).

Soft tissue component

The treated group showed greater upper lip protrusion that the control group in the posttreatment stage (Table V), most likely due to the slight labial inclination and protrusion of the maxillary incisors. As it was not statistically significant, it may be considered clinically irrelevant. As well other studies have shown that the growth trends are essentially similar between Class II division 1 and normal subjects in the various dentofacial parameters compared except for upper lip protrusion.[22]

There were no significant changes in the nasolabial angle during treatment and long-term posttreatment stages (Table IV). This finding demonstrates that the treatment protocol used does not interfere in the tegumental profile, like has been reported in previous studies.[3,6,34]

Conclusion

The improvement of molar relationship, overbite, overjet and dentoalveolar changes obtained with the distal jet followed by fixed appliances, remained stable in the long-term posttreatment stage.

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Figure legends:

Figure 1: Distal Jet appliance.

Figure 2: Angular measurements: A- Mx1.SN; B- Mx4.SN; C- Mx6.SN; D- Mx7.SN

Figure 3: Linear measurements: A- Mx1-PTV; B- Mx4-PTV; C- Mx6-PTV; D- Mx7-PTV; E- Mx1-PP; F- Mx4-PP; G- Mx6-PP; H-Mx7- PP; I- Md6-PgPerp.

Figure 4: Dental Relationship measurements: A- Overjet; B- Overbite; C- Molar relationship

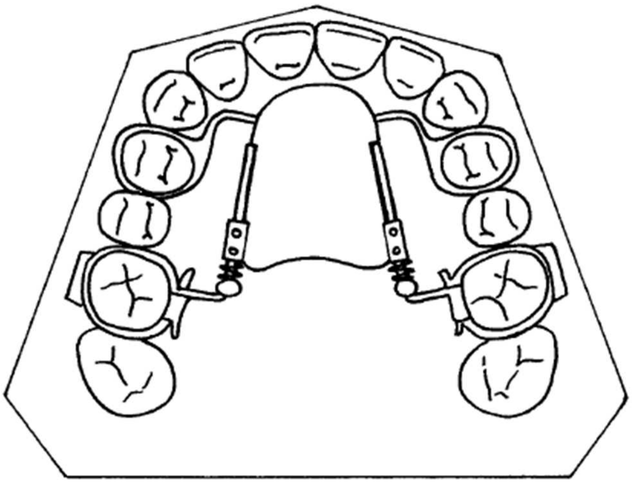
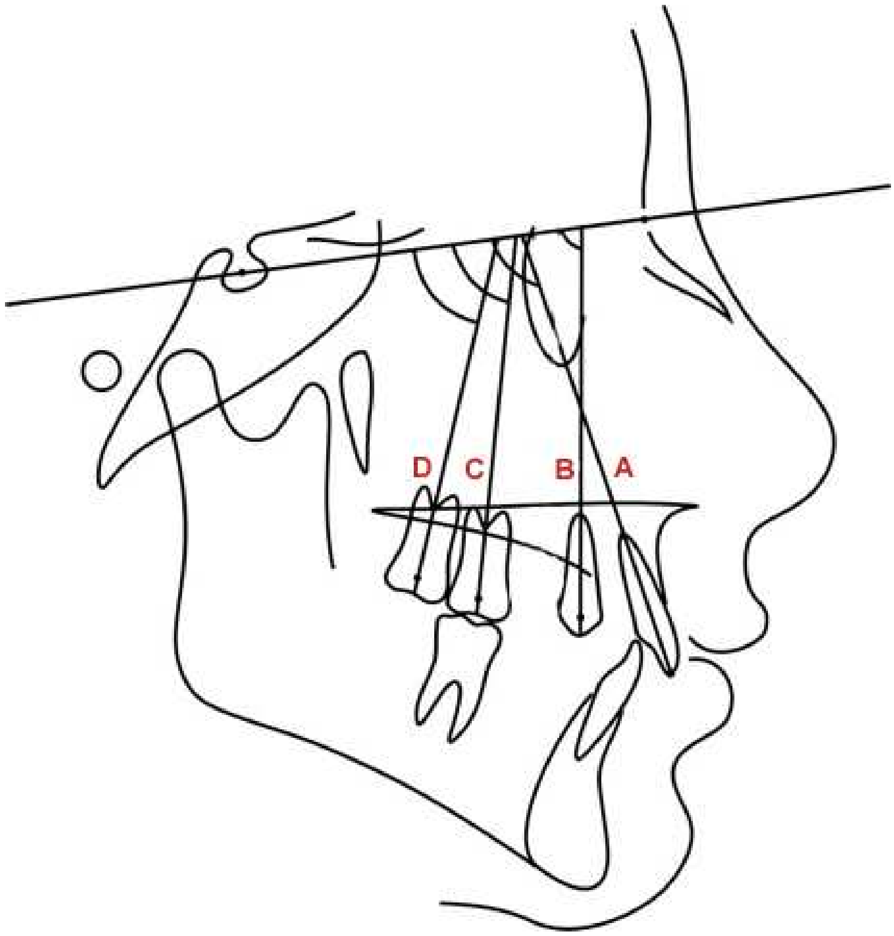


Fig 1.



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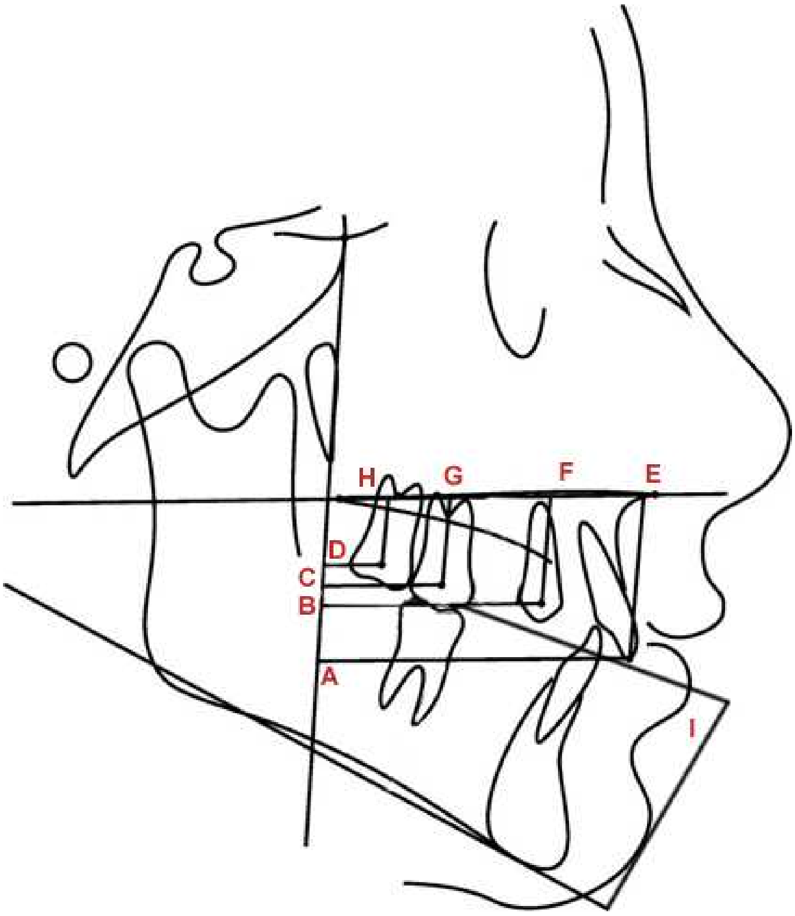

Fig 3.

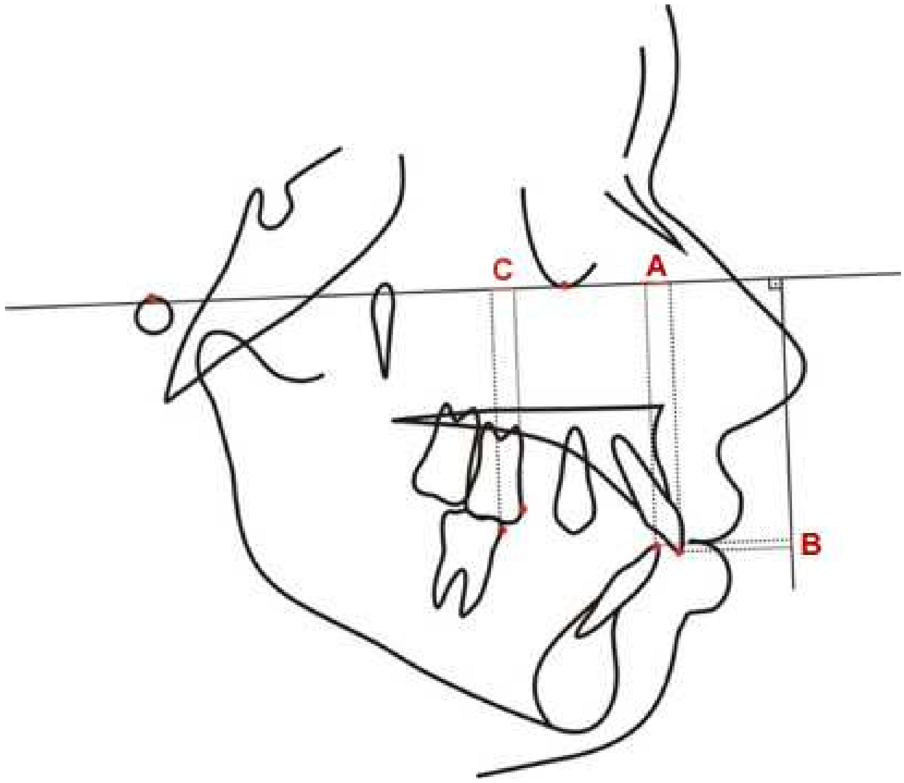

Fig 4.

Table I. Intergroup age comparison at T1, T and T3
(T test)

	Treated Group N= 15		Control Group N= 15		
Stage/Period	Mean	SD	Mean	SD	P
T1 age	12.63	1.31			
T2 age	16.76	1.55	16.40	0.97	0.445
T3 age	23.26	1.33	24.09	2.49	0.263
Treatment period (T2-T1)	4.13	0.99			
Posttreatment period (T3-T2)	6.49	0.59	7.69	2.32	0.062

*Statistically significant at $P < 0.05$

Table II– Definition of skeletal and dental cephalometric variables evaluated

Skeletal cephalometric variables	
SNA (˚)	Angle between SN and A point
SNB (˚)	Angle between SN and B point
ANB (˚)	NA to NB angle
LAFH (mm)	Lower anterior face height - distance between ANS and Me
FMA (˚)	Frankfort mandibular plane angle
SN.GoGn (˚)	Angle between SN line and Mandibular plane
SN.PP (˚)	Angle between SN and Palatal plane
Dental cephalometric variables	
U1.NA (˚)	Angle between the maxillary incisor long axis to NA line
U1-NA (mm)	Distance between the maxillary incisor crown and NA line
Mx1.SN (˚)	Angle between the maxillary incisor long axis to SN line
Mx1-PTV (mm)	Distance between the maxillary incisor long axis to pterigomaxillary vertical (PTV)
Mx1-PP (mm)	Distance between the maxillary incisor crown tip and palatal plane
Mx4.SN (˚)	Angle between the maxillary first premolar long axis to SN line
Mx4-PTV (mm)	Distance between the maxillary first premolar long axis to pterigomaxillary vertical (PTV)
Mx4-PP (mm)	Distance between the maxillary first premolar crown tip and palatal plane
Mx6.SN (˚)	Angle between the maxillary first molar long axis to SN line
Mx6-PTV (mm)	Distance between the maxillary first molar long axis to pterigomaxillary vertical (PTV)
Mx6-PP (mm)	Distance between the maxillary first molar crown tip and palatal
Mx7.SN (˚)	Angle between the maxillary second molar long axis to SN line
Mx7-PTV (mm)	Distance between the maxillary second molar long axis to pterigomaxillary vertical (PTV)
Mx7-PP (mm)	Distance between the maxillary second molar crown tip and palatal plane
L1.NB (˚)	Angle between the mandibular incisor long axis to NB line
L1-NB (mm)	Distance between the mandibular incisor crown and NB line
Md6-PogPerp (mm)	Distance between mandibular first molar occlusal and line perpendicular to mandibular plane, tangent to Pg point
Dental relationship	
Molar relationship (mm)	Distance between mesial points of maxillary and mandibular first molars, parallel to Frankfort plane
Overbite (mm)	Distance between incisal edges of maxillary and mandibular central incisors, perpendicular to Frankfort plane
Overjet (mm)	Distance between incisal edges of maxillary and mandibular central incisors parallel to functional occlusal plane
Soft-tissue component	
NLA (˚)	Nasolabial angle
UL-E (mm)	Distance between the upper lip to the Esthetic plane
LL-E (mm)	Distance between the lower lip to the Esthetic plane

*Statistically significant at $P < 0.05$

Table III. Random and systematic errors between the first and second measurements (Dahlberg´s formula and dependent t tests)

	First measurement		Second measurement		Dahlberg	P
Variable	Mean	SD	Mean	SD	Mean	
Maxillary skeletal component						
SNA (°)	82.17	1.68	82.06	1.68	0.28	0.197
Mandibular skeletal component						
SNB (°)	78.93	2.09	78.86	2.16	0.24	0.331
Maxillomandibular relationship						
ANB (°)	3.23	2.11	3.21	2.16	0.14	0.680
Vertical component						
LAFH (mm)	62.64	8.76	62.89	8.79	0.52	0.106
FMA (°)	24.01	4.84	23.95	4.93	0.65	0.769
SN-GoGn (°)	29.33	5.88	29.25	6.11	0.61	0.665
SN-PP (°)	6.08	3.17	6.12	3.31	0.55	0.813
Maxillary dentoalveolar component						
U1.NA (°)	16.98	6.77	17	6.46	1.05	0.956
U1-NA (mm)	3.41	2.86	3.51	2.89	0.24	0.191
Mx1.SN (°)	99.15	6.53	99.08	6.32	1.05	0.846
Mx1-PTV(mm)	52.59	5.73	52.55	5.71	0.39	0.763
Mx1-PP (mm)	26.82	4.22	26.73	4.21	1.14	0.939
Mx4.SN (°)	77.86	3.92	78.49	3.73	1.72	0.080
Mx4-PTV(mm)	35.28	4.38	35.20	4.34	0.34	0.439
Mx4-PP (mm)	20.25	2.59	20.15	2.60	0.24	0.176
Mx6.SN (°)	76.70	3.27	76.44	3.97	1.23	0.491
Mx6-PTV (mm)	20.53	4.21	20.44	4.18	0.32	0.352
Mx6-PP (mm)	17.41	2.07	17.48	2.05	0.42	0.601
Mx7.SN (°)	62.47	6.87	62.26	7.05	2.53	0.624
Mx7-PTV (mm)	11.46	3.89	11.49	3.90	0.36	0.712
Mx7-PP (mm)	14.19	3.03	14.35	3.12	0.30	0.073
Mandibular dentoalveolar component						
L1.NB (°)	24.99	4.15	25.10	4.44	0.49	0.496
L1-NB (mm)	4.47	1.71	4.46	1.64	0.28	0.959
Md6-PogPerp (mm)	31.98	3.83	32.07	3.70	0.58	0.613
Dentoalveolar relationship						
Molar relationship (mm)	-0.90	0.96	-1.02	0.84	0.35	0.311
Overbite (mm)	2.85	1.56	2.69	1.45	0.23	0.023*
Overjet (mm)	3.34	1.27	3.53	1.13	0,62	0.306
Soft-tissue component						
NLA (°)	102.24	9.26	102.40	10.96	2.10	0.814
UL-E (mm)	-0.39	2.10	-0.40	2.14	0.20	0.719
LL-E (mm)	0.03	2.59	-0.18	2.56	0.29	0.014*

*Statistically significant at $P < 0.05$

Table IV. Comparison of the 3 evaluation stages for the Experimental group (repeated measures ANOVA and Tukey tests).

	Pretreatment (T1)		Posttreatment (T2)		Follow-up (T3)		
Variable	Mean	SD	Mean	SD	Mean	SD	P
Maxillary skeletal component							
SNA (°)	81.45	5.05	81.06	5.38	80.97	5.03	0.586
Mandibular skeletal component							
SNB (°)	77.54	3.44	77.51	4.57	77.58	4.54	0.991
Maxillomandibular relationship							
ANB (°)	3.90	2.11	3.54	2.07	3.40	2.33	0.498
Vertical component							
LAFH (mm)	62.69^{A}	6.86	67.37^{B}	8.82	67.40^{B}	9.47	0.000*
FMA (°)	25.82^{A}	3.85	27.12^{B}	4.42	25.76^{A}	4.18	0.012*
SN-GoGn (°)	31.31	4.89	32.26	5.32	31.97	5.68	0.343
SN-PP (°)	6.04	3.53	6.72	3.38	7.16	3.09	0.151
Maxillary dentoalveolar component							
U1.NA (°)	21.25	6.86	18.83	4.80	19.02	4.41	0.130
U1-NA (mm)	4.45	2.41	4.05	2.85	4.46	2.72	0.710
Mx1.SN (°)	102.72	7.11	99.86	6.69	100.02	6.00	0.072
Mx1-PTV(mm)	79.98	5.13	77.94	6.06	77.33	6.66	0.143
Mx1-PP (mm)	72.76^{A}	3.04	75.87^{B}	5.43	77.08^{B}	5.61	0.005*
Mx4.SN (°)	54.55^{A}	3.62	60.69^{B}	5.94	60.69^{B}	6.98	0.000*
Mx4-PTV(mm)	52.62	4.61	52.99	5.46	53.59	5.63	0.340
Mx4-PP (mm)	34.42^{A}	3.60	35.44^{AB}	3.93	36.45^{B}	4.14	0.003*
Mx6.SN (°)	19.20 ^{A}	3.42	20.30 ^{AB}	3.50	21.20^{B}	3.66	0.002*
Mx6-PTV (mm)	10.50^{A}	3.10	11.00^{AB}	3.72	12.16^{B}	3.42	0.011*
Mx6-PP (mm)	27.14^{A}	3.11	29.19^{B}	4.32	29.42^{B}	4.32	0.000*
Mx7.SN (°)	20.48^{A}	2.29	22.59^{B}	3.21	22.96^{B}	3.52	0.000*
Mx7-PTV (mm)	17.42^{A}	2.26	19.89^{B}	2.78	20.40^{B}	2.86	0.000*
Mx7-PP (mm)	12.31^{A}	3.19	16.82^{B}	2.57	17.62^{B}	2.78	0.000*
Mandibular dentoalveolar component							
L1.NB (°)	24.53^{A}	5.96	28.29^{B}	6.45	29.16^{B}	7.73	0.008*
L1-NB (mm)	4.71^{A}	2.30	6.00^{B}	2.68	6.42^{B}	2.65	0.000*
Md6-PogPerp (mm)	32.50	2.49	33.48	3.51	32.72	3.73	0.073
Dentoalveolar relationship							
Molar relationship (mm)	0.36^{A}	0.71	-1.28^{B}	1.24	-1.27^{B}	0.76	0.000*
Overbite (mm)	2.79^{A}	1.73	1.68^{B}	1.00	1.90^{AB}	1,02	0.016*
Overjet (mm)	4.91^{A}	1.40	2.90^{B}	0.56	2.87^{B}	0.63	0.000*
Soft-tissue component							
NLA (°)	101.54	11.63	105	11.85	105.90	8.93	0.057
UL-E (mm)	1.77^{A}	2.74	-0.51^{B}	2.49	-0.14^{B}	2.34	0.000*
LL-E (mm)	1.78^{A}	2.53	0.96^{AB}	2.88	0.63^{B}	2.84	0.037*

*Statistically significant at $P < 0.05$.

Table V. Intergroup comparison of the long-term posttreatment changes (T3-T2) (t tests).

	Experimental Group		Control Group		
Variable	Mean	SD	Mean	SD	P
Maxillary skeletal component					
SNA (°)	-0.08	1.25	-0.44	1.93	0.550
Mandibular skeletal component					
SNB (°)	0.06	1.61	0.00	1.74	0.922
Maxillomandibular relationship					
ANB (°)	-0.14	0.74	-0.46	1.00	0.340
Vertical component					
LAFH (mm)	0.03	1.82	2.58	2.53	0.003*
FMA (°)	-1.35	1.35	-0.89	2.12	0.485
SN-GoGn (°)	-0.29	2.68	-1.55	2.16	0.168
SN-PP (°)	0.44	2.49	-0.18	1.30	0.400
Maxillary dentoalveolar component					
U1.NA (°)	0.18	3.04	0.46	3.96	0.830
U1-NA (mm)	0.40	1.36	0.00	1.81	0.497
Mx1.SN (°)	0.16	3.42	0.00	3.67	0.482
Mx1-PTV(mm)	0.60	2.06	0.40	1.70	0.774
Mx1-PP (mm)	0.22	1.23	0.68	0.85	0.180
Mx4.SN (°)	0.60	4.97	4.16	7.78	0.104
Mx4-PTV(mm)	1.00	1.90	1.12	1.98	0.876
Mx4-PP (mm)	0.37	0.86	0.77	0.99	0.606
Mx6.SN (°)	1.21	4.24	0.94	3.10	0.253
Mx6-PTV (mm)	0.90	1.74	1.39	2.12	0.478
Mx6-PP (mm)	0,50	0.84	1.87	2.20	0.000*
Mx7.SN (°)	0.00	5.74	4.14	6.27	0.746
Mx7-PTV (mm)	1.16	1.74	1.60	2.04	0.558
Mx7-PP (mm)	0.80	0.92	2.26	2.60	0.000*
Mandibular dentoalveolar component					
L1.NB (°)	0.87	3.69	-1.51	2.14	0.039*
L1-NB (mm)	0.42	0.50	-0.16	0.79	0.024*
Md6-PogPerp (mm)	-0.76	1.07	-0.53	1.28	0.594
Dentoalveolar relationship					
Molar relationship (mm)	0.00	1.06	-0.10	1.10	0.789
Overbite (mm)	0,21	0.62	0.20	0.94	0.982
Overjet (mm)	-0.03	0.63	-0.10	1.04	0.834
Soft-tissue component					
NLA (°)	0.90	7.23	0.63	5.19	0.908
UL-E (mm)	0.36	1.28	-1.35	1.21	0.000*
LL-E (mm)	-0.33	1.74	-0.60	1.32	0.641

*Statistically significant at $P < 0.05$.

3 DISCUSSION

3 DISCUSSION

Analysis of posttreatment changes is essential in evaluating the success of orthodontic treatment. Studies that describe treatment effects are, however, more frequent than reports on posttreatment changes.(FOTIS; MELSEN; WILLIAMS, 1985) Many studies have been done to examine the effects of the intraoral distalizers. (FOTIS; MELSEN; WILLIAMS, 1985; GIANELLY et al., 1988; HILGERS, 1992; JONES; WHITE, 1992; LOCATELLI, 1992; CARANO; TESTA, 1996; BOWMAN, 1998; NGANTUNG; NANDA; BOWMAN, 2001; BOLLA et al., 2002; PAPADOPOULOS; MAVROPOULOS; KARAMOUZOS, 2004; CHIU; MCNAMARA; FRANCHI, 2005; FERGUSON et al., 2005; KINZINGER; EREN; DIEDRICH, 2008; PATEL et al., 2009) Nevertheless, in the literature, only two studies were found that assessed the long-term stability of orthodontic treatment with these appliances and a shortcoming observed was the absence of a control group of untreated subjects for analysis of the results.(JUNIOR; EDUARDO; CAPRIOGLIO et al., 2013)

Any study that involves craniofacial growth and mechanotherapy has the inherent problem of identifying those physiologic changes resulting from treatment and those that merely result from normal growth and development. Based on the principle that occlusal changes can occur during all stages of human development even in patients with normal occlusion, as well as in the absence of active growth.(TIBANA; PALAGI; MIGUEL, 2004)

In the present study, 15 patients with Class II malocclusion treated with the distal jet followed by orthodontic fixed appliances were compared with an untreated Class I group. It can be questionable why we do not used Class II malocclusion patients like control group. In the literature some longitudinal studies of growth, reported that differences in craniofacial measures are established early in life, and growth trends of class II and class I subjects appeared to be essentially similar thereafter.(BUSCHANG et al., 1988; BACCETTI et al., 1997; BISHARA et al., 1997; BISHARA, 1998) In the same way other studies have shown that the growth trends are essentially similar between Class II division 1 and normal subjects in the various dentofacial parameters compared except for upper lip protrusion.(BISHARA et al., 1997)

Because the treated group did not present a severe Class II malocclusion, we considered that a Class I group would be better suited to compare the alterations in the long-term posttreatment period. Since, at the end of treatment an artificial normal occlusion is obtained, it is expected to behave as such.(JANSON et al., 2006)

The groups were comparable for ages at T2, T3 and posttreatment period. Both groups had the same number of of male and female. Therefore, intergroup sex distribution was not statistically evaluated. Intergroup comparability regarding cephalometric characteristics at posttreatment stage was not evaluated. Whereas, the main focus of this study was to assess the changes that occurred between posttreatment and long-tern posttreatment stages (T3-T2) and to compare with a control group. Data relative to treatment that occurred at the end of the distalization phase or at the end of comprehensive fixed appliance therapy have previously been the subject of study.

In the long-term posttreatment period as well as during treatment with the distal jet, most skeletal changes were consequent to normal growth and development. There were no statistically significant changes on the anteroposterior positioning of both maxilla and mandible in relation to the cranial base, similarly there was no difference in the intergroup comparison. The results are in agreement with previously published studies. (BRICKMAN; SINHA; NANDA, 2000; QUICK; HARRIS, 2000; JANSON et al., 2006; ANGELIERI et al., 2008; KINZINGER et al., 2009; FONTANA; COZZANI; CAPRIOGLIO, 2012; PATEL et al., 2013; BOWMAN, 2016)

On the contrary, many changes in the both maxillary and mandibular dentoalveolar components were observed during treatment. These dentoalveolar changes have been found in other studies.(NGANTUNG; NANDA; BOWMAN, 2001; BOLLA et al., 2002; CHIU; MCNAMARA; FRANCHI, 2005) Most of these alterations remained stable in the long-term posttreatment stage and showed a few minor variations, which were not clinically significant, as the extrusion of the maxillary molars, and mandibular incisors labial tipping and protrusion. Similar findings were previously reported.(JUNIOR; EDUARDO; CAPRIOGLIO et al., 2013)

4 CONCLUSIONS

4 CONCLUSIONS

Based on the employed method and the outcomes is accurate to say that:

There were no statistically significant changes on the maxillary and mandibular sagittal skeletal components, during treatment and posttreatment periods.

The treatment produced significant improvement in molar relationship and reduction of overbite and overjet, which remained stable on the long-term posttreatment period.

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APPENDIX

APÊNCIDE A - DECLARAÇÃO DE USO EXCLUSIVO DE ARTIGO EM DISSERTAÇÃO/TESE

DECLARAÇÃO DE USO EXCLUSIVO DE ARTIGO EM DISSERTAÇÃO/TESE

Declaramos estarmos cientes de que o trabalho Stability of Class II malocclusion treatment with the Distal Jet followed by fixed appliancesserá apresentado na Dissertação da aluna Sorileé C. Ramón Pujols, não podendo ser utilizado em outros trabalhos dos Programas de Pós-Graduação da FOB-USP.

Bauru, 02 de dezembro 2016.

Sorileé C. Ramón Pujols
Nome do autor

Sorilee c. Ramón P.
Assinatura

José Fernando Castanha Henriques
Nome do autor

Assinatura

Guilherme Janson
Nome do autor

Assinatura

ANNEX

FACULDADE DE ODONTOLOGIA DE BAURU-USP

Plataforma Brasil

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: "AVALIAÇÃO DA ESTABILIDADE DO TRATAMENTO DA MÁ OCLUSÃO CLASSE II COM O APARELHO DISTAL JET ASSOCIADO AO APARELHO ORTODÔNTICO

Pesquisador: Sorilee Carlina Ramón Pujols

Área Temática:

Versão: 2

CAAE: 54856716.4.0000.5417

Instituição Proponente: Universidade de São Paulo - Faculdade de Odontologia de Bauru

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 1.595.793

Apresentação do Projeto:

Os ortodontistas além de planejarem as melhores intervenções para cada pacientes, precisa ponderar o quanto de colaboração do mesmo obterá. Logo, aparelhos ortodônticos com menos influência da colaboração dos pacientes podem ser uma boa escolha dependendo do caso. Por outro lado, é preciso saber se a estabilidade das alterações realizadas durante o tratamento serão mantidas. Pensando nisso, o presente projeto de pesquisa se propõe avaliar cefalometricamente a estabilidade das alterações decorrestes do tratamento da má oclusão de Classe II, corrigida com o aparelho Distal Jet, seguido de aparelhagem ortodôntica fixa, 5 anos pós-tratamento uma vez que esta intervenção não depende tanto da colaboração dos pacientes.

Objetivo da Pesquisa:

Avaliar cefalometricamente a estabilidade das alterações decorrestes do tratamento da má oclusão de Classe II, corrigida com o aparelho Distal Jet, seguido de aparelhagem ortodôntica fixa, 5 anos póstratamento.

Avaliação dos Riscos e Benefícios:

Riscos:

Não existem riscos, ja que nesta pesquisa amostra será composta de teleradiografias, que se encontram no arquivo do departamento de ortodontia,FOB, USP.

Endereço: DOUTOR OCTAVIO PINHEIRO BRISOLLA 75 QUADRA 9
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Continuação do Parecer: 1.595.793

Benefícios:
Os benefícios esperados é o conhecimento sobre a estabilidade de este tipo de mecânica, permitindo ao ortodontista escolher a melhor opção de tratamento baseado em evidencias cientificas.

Comentários e Considerações sobre a Pesquisa:
O presente projeto de pesquisa, sem custos e sem a necessidade de novas coletas de dados dos pacientes, contribuirá para melhor escolha dos tratamentos ortodônticos de acordo com o perfil do paciente. Uma vez confirmada a estabilidade do tratamento em estudo, este se mostrará de grande importância para os casos de pacientes não colaboradores.

Considerações sobre os Termos de apresentação obrigatória:
Todos os termos estão apresentados corretamente.

Recomendações:
Sem recomendações

Conclusões ou Pendências e Lista de Inadequações:
Sem pendências

Considerações Finais a critério do CEP:
Esse projeto foi considerado APROVADO na reunião ordinária do CEP de 15.06.2016, com base nas normas éticas da Resolução CNS 466/12. Ao término da pesquisa o CEP-FOB/USP exige a apresentação de relatório final. Os relatórios parciais deverão estar de acordo com o cronograma e/ou parecer emitido pelo CEP. Alterações na metodologia, título, inclusão ou exclusão de autores, cronograma e quaisquer outras mudanças que sejam significativas deverão ser previamente comunicadas a este CEP sob risco de não aprovação do relatório final. Quando da apresentação deste, deverão ser incluídos todos os TCLEs e/ou termos de doação assinados e rubricados, se pertinentes.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_662902.pdf	23/05/2016 23:01:55		Aceito
Outros	questionario.pdf	05/04/2016 16:00:32	Sorilee Carlina Ramón Pujols	Aceito
Declaração de Pesquisadores	compromiso.pdf	05/04/2016 15:58:52	Sorilee Carlina Ramón Pujols	Aceito

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FACULDADE DE ODONTOLOGIA DE BAURU-USP

Continuação do Parecer: 1.595.793

Declaração de Instituição e Infraestrutura	NovoDocumento6.pdf	08/03/2016 18:37:56	Sorilee Carlina Ramón Pujols	Aceito
Projeto Detalhado / Brochura Investigador	Projeto.doc	25/02/2016 18:41:43	Sorilee Carlina Ramón Pujols	Aceito
Outros	anexo.pdf	25/02/2016 18:40:11	Sorilee Carlina Ramón Pujols	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	01.pdf	25/02/2016 18:37:08	Sorilee Carlina Ramón Pujols	Aceito
Declaração de Instituição e Infraestrutura	03.pdf	25/02/2016 18:32:40	Sorilee Carlina Ramón Pujols	Aceito
Folha de Rosto	05.pdf	25/02/2016 18:29:29	Sorilee Carlina Ramón Pujols	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

BAURU, 16 de Junho de 2016

Assinado por:
Izabel Regina Fischer Rubira Bullen
(Coordenador)

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