Original Article

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Cephalometric evaluation of effectiveness Interland headgear on class II, division 1, malocclusion

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Abstract

Aim: The purpose of this study was to determine the effects of early treatment on the maxillary dental arches in children with mixed dentition. **Methods:** It was evaluated 40 lateral cephalograms (20 pre and 20 posttreatment) from girls with mean age of 9.15 years, who had class II, division 1 malocclusion and received occipital headgear treatment with 350 g of force applied bilaterally 14 hours per day, during 22.35 months. The values of: SN.GoGn, FMA, N-ANS, ANS-Me, S-Ptm, Ptm-ANS, SNA, SNB, ANB, Ptm-6, 1.NA, 1.PP were evaluated. The Dahlberg's formula revealed a casual error smaller than 1.5° and 1.0 mm, indicating reliability of the obtained data. **Results:** The data revealed that the growth pattern did not change with the treatment. The ANS-Me decreased. The jaw relationship changed positively, reducing the value of ANB. Anterior maxillary displacement was limited and the anteroposterior dimension increased. The maxillary molars were moved distally and incisors were retracted. **Conclusions:** The early treatment with occipital headgear was effective in moving maxillary teeth distally and retracting incisors, improving the jaw relationship and favoring the second phase of the orthodontic treatment when necessary.

Keywords: extraoral traction appliances, interceptive orthodontics/cephalometry, class II malocclusion

Introduction

Class II, division 1 malocclusion occurs frequently in the Brazilian population. In a previous study, on the prevalence of normal occlusion and malocclusion in the city of Bauru, Brazil, this type of malocclusion was found in 42% of a population of 7-to-11-year-old children[1]. Most patients with moderate or severe Class II dental malocclusion present some skeletal imbalance and the required orthodontic treatment modifies the growth of the jaws[2,3].

Early treatment in the developmental period allows tooth movements and dentoalveolar and skeletal changes to be obtained. The treatment can improve occlusion and facial esthetics, as well as promote the stability of occlusion[2-4]. The treatment is indicated in Class II and III malocclusion with maxillary midface deficiency, anterior and posterior crossbite, midline discrepancies due to early loss of primary teeth with a midline shift, severe anterior open bite, severe deep bite, ectopic maxillary canines, thumb and finger-sucking habits, crowding resulting in ectopic positioning of permanent teeth, crowding resulting in periodontal compromise, congenitally missing teeth, and supernumerary teeth. The early treatment's goal is to reduce the time of the second stage of the orthodontic treatment, when necessary, reduce the need for extractions in permanent dentition, root resorption, periodontal problems, impacted canines and orthognathic surgery[4-10].

The aim of the treatment in the prepubertal growth spurt in Class II, division 1, hyperdivergent facial patterns is to rotate the maxilla in a clockwise direction, allowing

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counterclockwise mandible rotate by inhibition of maxillary posterior dental eruption, guiding the mandibular growth forwards rather than downwards[11]. Several treatments may be instituted for the treatment of Class II, division 1 malocclusion. Application of extraoral force is effective since it promotes arch expansion, superior distal molar moment and consequently premolar and alveolar remodeling[12-14].

The purpose of the present study was to verify the dentomaxillary alterations occurred after occipital headgear treatment in girls, in the mixed dentition stage during the prepubertal growth spurt.

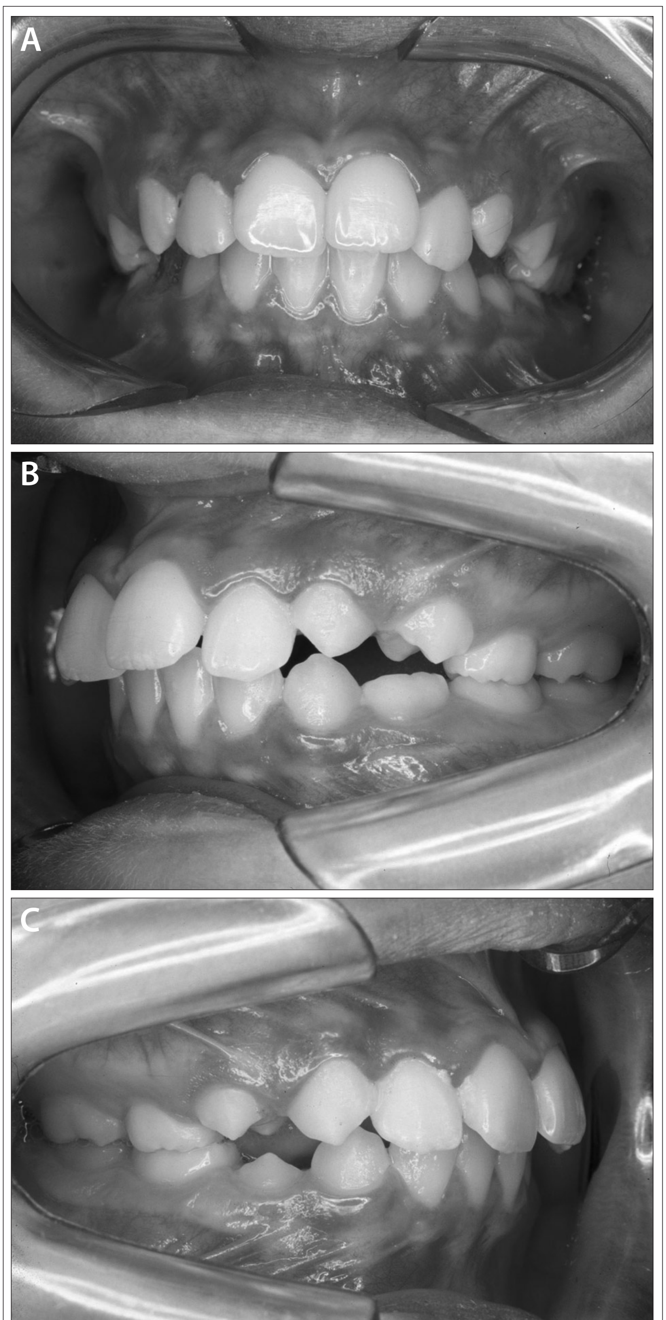

Figure 1. (**A**) Intraoral frontal view before treatment; (**B**) intraoral left side before treatment; (**C**) intraoral right side before treatment.

Material and methods

The research protocol was reviewed and approved by the Research Ethics Committee of Dental School of Piracicaba of Universidade Estadual de Campinas (FOP-Unicamp), process #089/2005

The study sample consisted of 20 girls selected from schoolchildren attending public schools who met strict criteria for enrollment in the study. The initial mean age was 9.15 years old. The following clinical selection criteria were used: bilateral Class II molar relationship, and overbite and overjet greater than 3.0 mm (**Figures 1A**, **1B**, **1C**). The cephalometric selection criteria were ANB range 5º, SNA range 80º, SNB range 75º, SN.GoGn range 35º, Ptm-ANS range 50 mm.

The patients were treated with an Interlandi occipital pull (**Figure 2**), outer bow length was close to the first maxillary molar and 1 cm longer than the inner bow. The inner bow was attached to the tube placed on the first maxillary molar, and further than 4.5 mm from the maxillary incisors, parallel to the occlusal plane. The force was located in the resistance centre. In the first month, 250 g force was used on each side, and thereafter 350 g was used during 14 to 18 hours. After Class I molar relationship was achieved, the force was reduced to 250 g during three months. Then, the appliance was completely removed, and new documentation was requested (**Figures 3A**, **3B**, **3C**).

Patients were asked to change the elastic everyday and there were visits scheduled once a month. The compliance and the dental alterations were assessed. The lateral cephalometric radiographs were obtained in the same position and tracing was done by the

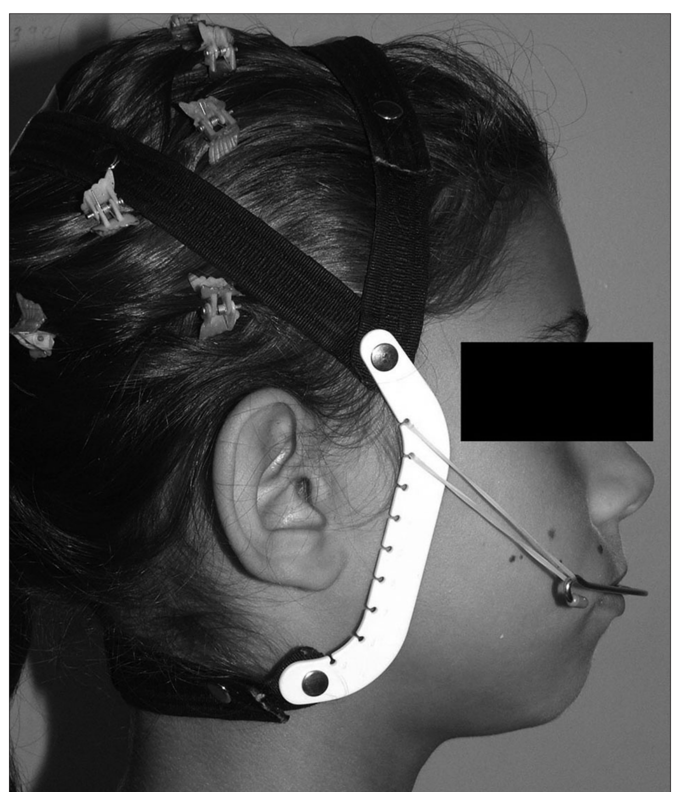

Figure 2. Interlandi occipital pull.

same operator twice at a 30-day interval to obtain the Dahlberg's formula. The linear measurements selected were N-ANS, ANS-Me, S-Ptm, Ptm-ANS, Ptm-6. The angular measurements were SN.GoGn, FMA, SNA, SNB, ANB, 1.NA, 1.PP (**Figures 4A, B, C**).

Statistical analysis

Random error was calculated with Dahlberg's formula. Method errors of the model measurements and cephalometric variables were less than 1.0 mm, for linear measurements, and 1.5° for angular measurements[15,16]. Descriptive statistics was used to calculate the minimum, maximum, range, mean, standard deviation and median. In order to analyze the dentomaxillary alterations promoted by the extraoral force, paired sample t-tests were used to compare the pre- and posttreatment cephalometric values for each patient at 5% significance level.

Results

The Dahlberg's formula indicated the reliability of the initial (T1) and final (T2) data of the cephalograms (**Table 1**). Before the treatment, the skeletal pattern was predominantly dolicofacial, and did not change during the evaluated period (**Tables 3 and 4**).

The maxilla was close to a neutral skeletal position. The values of S-Ptm in T1 were similar to normal average values (**Table 2**). The maxilla was displaced backwards to some extent during the treatment (**Tables 3 and 4**). The extraoral force remodeled the A point vi-

Figure 3. (**A**) Intraoral frontal view after treatment; (**B**) intraoral left side after treatment; (**C**) intraoral right side after treatment.

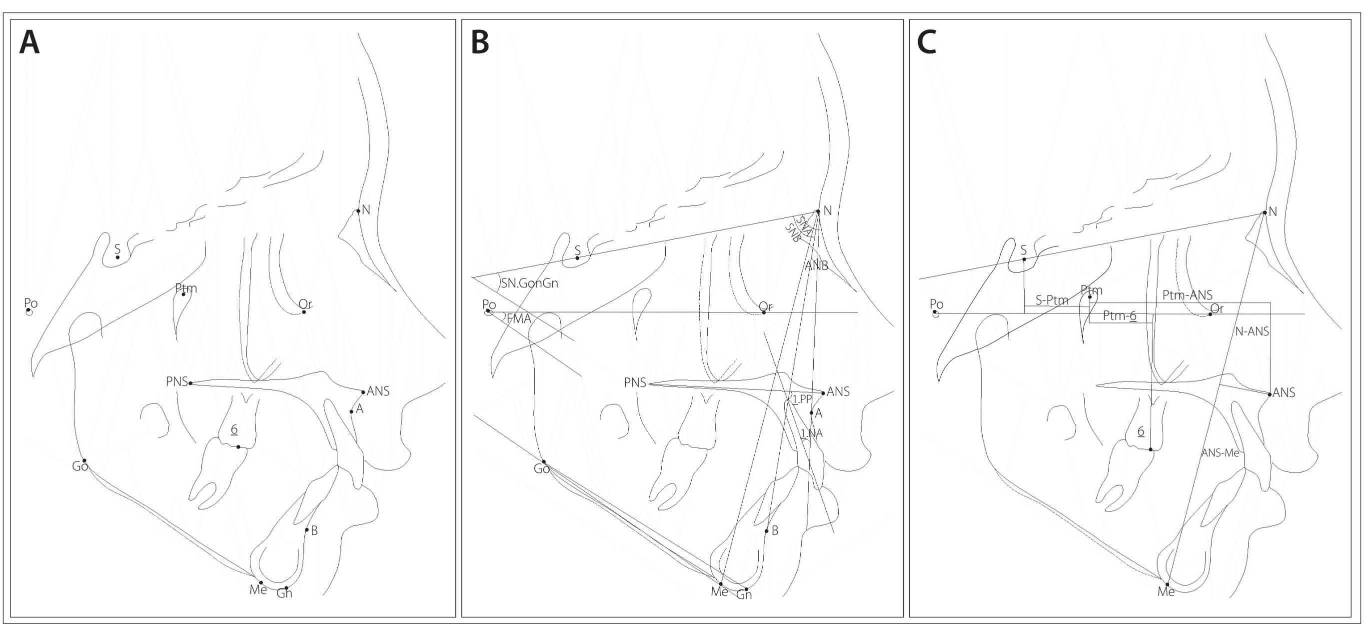

Figure 4. Cephalometric tracing of the initial treatment. (**A**) points utilized – Sella (S) is the center of the pituitary fossa; Nasion (N) is the junction of the frontonasal suture; Orbitale (Or) is the lowest point in the inferior margin of the orbit; Porion (Po) is the most superior point of the external auditory meatus; Pterygomaxillary fissure (Ptm) is the center point of the pterygomaxillary fissure; anterior nasal spine (ANS) is the tip of the bony anterior nasal spine; posterior nasal spine (PNS) is the dorsal limit of the maxilla; A point (A) is the point at the deepest midline concavity on the maxilla; 6 is the middle molar point; B point (B) is the point at the deepest midline concavity on the mandibular symphysis; Gonion (Go) is the point of intersection of the ramus plane and the mandibular plane; Menton (Me); Gnation (Gn) this is the most anteroinferior point on the symphysis of the chin; (**B**) angular measurements – SNA is the position of maxilla to cranial base; SNB is the position of mandible to cranial base; ANB is the skeletal anteroposterior jaw relationship, SN.GoGn is the skeletal pattern; FMA is the skeletal pattern; 1.NA is the axial inclinations of the upper central incisors to NA line; 1.PP is the axial inclinations of the upper central incisors to palatal plane. (**C**) linear measurements – S-Ptm is the anteroposterior position of the maxillary jaw; Ptm-ANS is the maxillary length; N-ANS is the anterosuperior facial height; ANS-Me is the anteroinferior facial height; Ptm-6 is the anteroposterior position of the upper molar.

Table 1. Dahlberg's formula

Cephalometric measurements	Dahlberg's formula	Dahlberg's formula
	T1	T2
SN.GoGn°	0.48	0.48
FMA°	0.63	1.42
S-Ptm mm	0.38	0.37
SNA°	0.31	0.00
Ptm-ANS mm	0.12	0.054
SNB°	0.16	0.32
ANB°	0.48	0.32
N-ANS%	0.30	0.38
ANS-Me%	0.02	0.61
Ptm-6 mm	0.19	0.81
1.NA°	0.05	1.42
1.PP °	0.95	1.22

Dahlberg's formula showed values less than 1.50 and 1.00 mm = no statistically significance error.

Table 2. Comparison of starting forms at T1. Cephalometric measurements

Cephalometric measurements	Mean	SD	Minimum	Maximum	t-test Normal/ T1
	T1	T1	T1	T1	p
S-Ptm mm	17.59	1.40	15.22	21.14	0.074
Ptm-ANS mm	50.91	2.01	45.45	54.63	0.025*
N-ANS%	44.00	2.41	40.62	51.25	0.079
ANS-Me%	56.00	2.35	52.13	64.40	0.079
Ptm-6 mm	16.84	2.01	12.80	20.35	0.077
FMA°	27.10	3.24	22.00	33.00	0.009*
SNA°	79.85	3.68	75.0	89.0	0.017*
SNB°	74.10	2.95	70.0	80.0	0.0001*
ANB°	5.75	1.52	3.0	10.0	0.0001*
SN.GoGn°	35.95	4.94	28.0	44.0	0.002*
1.NA°	22.95	5.57	12.0	34.0	0.455
1.PP°	70.00	6.13	60.0	80.0	1.0

* Statistical significance.
Mean, SD, minimum, maximum and statistical significance for cephalometric values before orthodontic treatment.

Table 3. Comparison of starting forms at T2

Cephalometric measurements	Mean	SD	Minimum	Maximum	t-test Normal /T2
	T2	T2	T2	T2	p
S-Ptm mm	17.36	1.59	14.18	20.71	0.33
Ptm-ANS mm	51.43	2.19	47.83	54.86	0.25
N-ANS%	44.25	1.71	42.0	47.0	0.065
ANS-Me%	55.75	1.71	53.0	58.0	0.065
Ptm-6 mm	15.61	2.71	9.26	20.32	0.53
FMA°	28.40	4.97	21.0	40.0	0.006*
SNA°	79.45	3.58	75.0	89.0	0.005*
SNB°	74.95	3.38	70.0	82.0	0.012*
ANB°	4.50	1.50	2.0	9.0	0.15
SN.GoGn°	35.25	5.24	28.0	45.0	0.012*
1.NA°	21.40	5.66	9.0	32.0	0.641
1.PP°	71.10	5.57	62.0	83.0	0.39

* Statistical significance.
Mean, SD, minimum, maximum and statistical significance for cephalometric values after orthodontic treatment.

Table 4. Comparison of changes during treatment T1 to T2

Cephalometric measurements	MD	SD	T	p
S-Ptm	- 0.24	1.07	- 0.99	0.33
Ptm-ANS	0.52	2.06	1.12	0.28
N-ANS	- 0.25	1.71	- 0.65	0.522
ANS-Me	- 0.25	1.71	- 0.65	0.522
Ptm-6	- 1.23	1.62	- 3.38	0.003*
FMA	1.30	4.41	1.32	0.20
SNA	- 0.40	1.39	- 1.28	0.21
SNB	0.85	1.49	2.54	0.020*
ANB	- 1.25	1.16	- 4.48	0.0001*
SN.GoGn	- 0.70	3.76	- 0.83	0.42
1.NA	- 1.55	4.67	- 1.48	0.154
1.PP	- 0.70	3.76	- 0.83	0.415

MD: mean difference, SD: standard difference, *Statistical significance.

sualized for the SNA values. The maxillary length was shorter than normal average indicated for the Ptm-ANS values, but increased during the treatment period (p = 0.28), as is seen in **Tables 2 and 4**.

The skeletal anteroposterior jaw relationship verified for the ANB values was higher than the normal average ones (p = 0.0001) (**Table 2**), but decreased significantly towards normal values during the treatment period (**Tables 3 and 4**).

In the pretreatment period, the relationship between N-ANS and ANS-Me was balanced (p = 0.079) (**Table 2**). In the course of the treatment period, the relationship remained balanced, but the ANS-Me decreased 0.25%. When T1 and T2 were compared, no statistically significant difference (p = 0.52) was verified (**Table 4**).

The maxillary first molar, indicated for the Ptm-6, was forward positioned (**Table 2**), and during orthodontic treatment using extraoral force, the maxillary first molar was displaced for backwards (**Table 3**) with statistical significance (p = 0.003), as seen in **Table 4**.

The axial inclination of the maxillary incisors, shown for the 1.PP and 1.NA values, decreased without statistical significance (**Tables 2, 3 and 4**).

Discussion

The orthodontic treatment alters the growth, improving the skeletal and dental balance, shortening treatment duration and complexity, and reducing the incidence of root resorption, periodontal problems and premolar extraction[6]. Growth modification is often desirable and is more successful when undertaken during the prepubertal growth spurt[17], at which stage more stable treatment outcomes can be obtained[10].

The effectiveness of early treatment is intimately related to a comprehensive diagnosis, an appropriate treatment plan based on the malocclusion characteristics, and the continuous surveillance until the permanent teeth erupt[10].

The headgear is an appliance that promotes movements in three planes of space. It is effective for treatment of discrepancy in the jaws and teeth, characteristics of Class II malocclusion[18,19].

With the occipital headgear, it is possible to restrain forward maxillary jaw displacement and its clockwise rotation, distal molar movement and limit molar eruption, as well as to allow forward displacement of the mandibular jaw, and its counterclockwise rotation[11,20,21].

In the present study, the facial growth was not altered during therapy and no statistical significance was observed (p = 0.42) (**Table 4**). Only a minor reduction of the SN.GoGn (**Tables 2 and 3**) suggested the effectiveness of vertical control, which is consistent with the findings of other authors[7,12], those which also observed an increase in SN.GoGn.

No significant changes were observed in the maxilla during the orthodontic treatment. A small restriction of forward displacement occurred, as demonstrated by the S-Ptm values (**Tables 2 and 3**). Several authors[2,3,7] verified modifications in the maxillary position with statistical significance and Baumrind et al.[22] reported a substantial retraction. The A point moved backwards visualize for the SNA values (**Tables 2 and 3**), in the same way as reported by O'Reilly et al.[23]. The headgear redirected anteroposterior growth of the maxilla.

Ptm-ANS increased, even though without statistical significance (p = 0.28). This result is in agreement with those of different authors[8,14,19,24], who reported that, during the developmental period, the maxilla was displaced backwards and forwards, and the anteroposterior dimension increased. In the present study, the treatment promoted posterior displacement, and the anteroposterior dimension increased only 0.52 mm, demonstrating the effectiveness of the appliance.

The jaw relationship improved, decreasing significantly (p = 0.0001), as seen in **Table 4**. The appliance reduced the severity of skeletal discrepancy, which is likely to have an important impact on the improvement of malocclusion. Several authors[2,3,7,8] have verified an improvement in the ANB and reported that the correction obtained in the growth period was stable in the post-contention period.

The treatment did not have a significant effect on the facial height, but the ANS-Me decreased (**Table 2 and 3**), though without statistical significance (p = 0.522) (**Table 4**). This result suggests that the maxillary molar moved distally but was not extruded. Similar results were observed in the study by Baumrind et al.[22].

The maxillary first molar distal movement shown for the Ptm-6 values was significant (p = 0.003) (**Table 4**). The occipital headgear moved distally, but controlled the extrusion, which was verified by the vertical control visualized for SN.GoGn and ANS-Me values (**Table 2 and 3**). Keeling et al.[8], Fioruz et al.[20] and Billet et al.[25] found similar results.

After the treatment, the axial inclination of the anterior teeth, shown for the 1.NA and 1.PP angles, decreased without statistical significance (**Table 4**). Ghafari et al.[7] and Keeling et al.[8], on the other hand, found an increase in the axial inclination of the anterior teeth.

Freman et al.[11] reported that the success of early treatment in the prepubertal growth spurt of hyperdivergent facial patterns depended on three points: clockwise rotation of the maxilla, inhibition of posterior maxillary tooth eruption (allowing mandibular counterclockwise rotation), and its growth in a forward direction. According to the obtained results (**Tables 2, 3 and 4; Figure 5**), the present study showed that the treatment with occipital headgear reached these goals, which suggests its effectiveness.

In conclusion, the facial growth was not altered during therapy. Vertical control was obtained. The jaw relationship improved, decreasing significantly. The maxillary first molar moved distally to a significant extent, and the Class II molar relation was corrected. After the treatment, the axial inclination of the anterior teeth decreased.

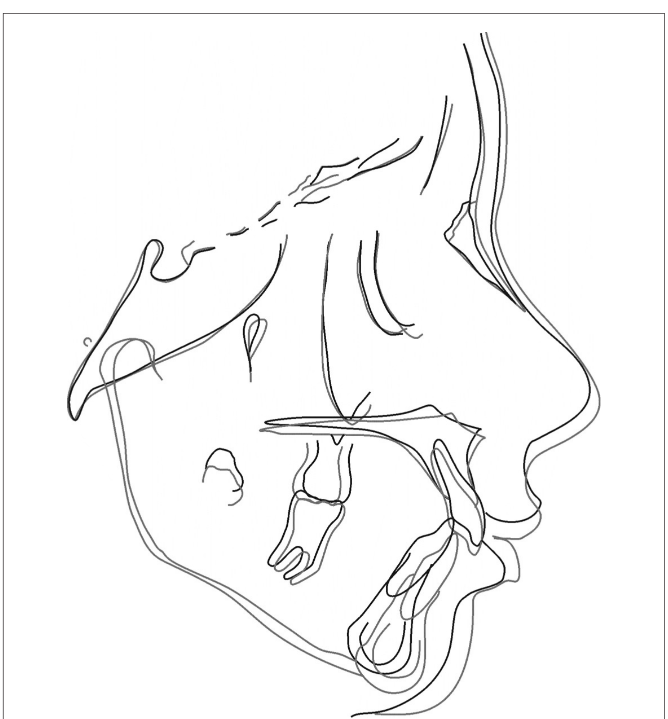

Figure 5. Composite tracings of treated T1 and T2.

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