Journal of the World Federation of Orthodontists 4 (2015) 92–105

Contents lists available at ScienceDirect

Journal of the World Federation of Orthodontists

journal homepage: www.jwfo.org

The stability of orthosurgical Class II treatment in growing patients

Luiza Paiva Bittencourt [a], José Nelson Mucha [b], Paulo José Medeiros [c], Giordani Santos Silveira [a,*], Alexandre Trindade Motta [d]

[a] Certificate in Orthodontics, Master's Student, Department of Orthodontics, Universidade Federal Fluminense, Niterói/RJ, Brazil
[b] Professor and Chair, Department of Orthodontics, Universidade Federal Fluminense, Niterói/RJ, Brazil
[c] Professor and Chair of Oral and Maxillofacial Surgery, Universidade do Estado do Rio de Janeiro, RJ, Brazil
[d] Associate Professor, Department of Orthodontics, Universidade Federal Fluminense, Niterói/RJ, Brazil

ARTICLE INFO

Article history:
Received 10 December 2014
Accepted 6 March 2015
Available online 9 May 2015

Keywords:
Orthognatic surgery
Orthodontics
Class II malocclusion
Puberty growth

ABSTRACT

Background: The orthosurgical treatment of a 13-year-old girl who had undergone two previous unsuccessful orthodontic treatments is described and discussed. She presented with a Class II, Division 1 malocclusion with marked discrepancy between maxilla and mandible, pronounced overjet, and convex profile.
Methods: Orthodontic preparation was performed with a full fixed orthodontic appliance (Standard Edgewise, 0.022 × 0.028 in), followed by orthognathic surgery with mandibular advancement and genioplasty at age 14, when she was at the end of growth.
Results: At the end of treatment, the patient exhibited a good facial appearance, a pleasant smile with coincident midlines, adequate gingival display, and correct dental relationships that remained stable after a 2-year follow-up.
Conclusions: In cases of patients with mandibular deficiency and marked discrepancy between the maxilla and mandible, orthosurgical treatment can be performed by sagittal split osteotomy and genioplasty with predictable and stable results in female patients who are in the final stage of craniofacial growth and exhibit harmonious growth.

1. Introduction

About 70% of Class II malocclusion cases show skeletal discrepancy between the maxilla and mandible. Mandibular retrognathia is the most common problem [1]. Consequently, in many patients, performing only orthodontic treatment is not sufficient to properly rehabilitate facial aesthetics, function, and occlusion. Thus, surgical procedures play a significant role in the correction of Class II [2]. The most common surgery is mandibular advancement, and when orthodontic planning does not include orthodontic decompensation of the lower incisors, mandibular advancement may be insufficient to attain a harmonious facial profile. Therefore, genioplasty is indicated as an auxiliary resource [3].

This approach is viable in patients with established bone maturity, but its implementation in patients with active craniofacial growth remains controversial. Thus, the surgical option should be based on individual malocclusion characteristics and the degree of aesthetic dissatisfaction of the patient [4–6]. The key rationale for carrying out orthognathic surgery before the end of growth is when there is a maxillomandibular discrepancy sufficiently harmful so as to interfere with function, aesthetics, and psychosocial well-being.

When surgical intervention during adolescence becomes a necessity, three factors should be considered: (1) Mandibular advancement should not exceed 10 mm at the risk of post-treatment instability [7,8], (2) facial growth should be normal (i.e., the existing maxillofacial discrepancy should remain stable throughout the growth period), and (3) the temporomandibular joints (TMJs) should be healthy [5]. Thus, stability can be observed after the successful execution of the techniques of osteotomy of the mandibular ramus, along with a proportional maxillomandibular growth [5,7].

Reported here is a clinical case and its preparation and completion of orthodontic treatment. Also described are the surgical procedures involving mandibular advancement and genioplasty in a female patient who presented for treatment at age 13 years 1 month with mandibular retrusion. In addition, she reported that two previous orthodontic treatments had failed. After a 2-year follow-up since the treatment was completed, the case remains stable and the patient reports great emotional satisfaction.

* Corresponding author: Giordani Santos Silveira, Av. Antônio Abrahão Caran, 820 sala 708 São José, Belo Horizonte/MG, Brazil 31275-000.
E-mail address: giordanisilveira@hotmail.com (G.S. Silveira).

2212-4438/$ – see front matter © 2015 World Federation of Orthodontists.
http://dx.doi.org/10.1016/j.ejwf.2015.03.003

2. Diagnosis and cause

A white female patient aged 13 years 1 month sought a new orthodontic treatment given that she was unhappy with the two previously completed orthodontic treatments. Her chief complaint was mandibular retrusion and the unpleasant facial appearance resulting from this disharmony.

Examination of the patient's face revealed a convex profile with mandibular retrusion and well-positioned maxilla. The lower lip was everted and protruding relative to the chin. Front view examination disclosed that the patient had a very mild facial asymmetry with a normal smile line and adequate exposure of teeth at rest (Fig. 1).

Intraoral clinical examination revealed satisfactory oral hygiene. The second molars were not fully erupted, whereas the first molars and canines were in angle Class II, Division 1 relationship. The upper anterior teeth had brackets bonded to them but without orthodontic arch wire, and there was a fixed lingual retainer placed on the lower anterior teeth. The maxillary arch had a −2-mm space deficiency and the lower dental arch was normal, with 1 mm curve of Spee. There was an 8-mm overjet and 2-mm over bite, with the upper and lower midlines coinciding with each other and with the face (Figs. 1 and 2), as well as a deviation in the pattern of mandibular closure with occlusal interferences that caused the mandible to slide with no signs and symptoms in the TMJs. Breathing was predominantly nasal without oral habits, and medical history did not indicate systemic changes.

The panoramic and periapical radiographs showed the presence of right maxillary third molar formation, second molars with apexes still under formation, and the absence of periodontal or periapical changes that might affect the orthodontic treatment (Figs. 3 and 4).

In the measurements performed on the lateral cephalometric radiograph (Fig. 5 and Table 1), there was a retrusion of the maxilla and mandible relative to the cranial base with marked maxillofacial mandibular discrepancy (sella nasion point A = 79°; sella nasion point B = 71°; A point, nasion, B point = 8° and distance between AO point and BO point on occlusal plane [Wits] = 6.5 mm) and a good vertical relationship (sella nasion gonial gnathion intersection, 35°; Frankfurt mandibular plane angle, 24°), and angle of convexity of 9°, appropriate upper lip relationship and a slight retrusion, but with eversion of the lower lip (upper lip to Steiner

Fig. 1. Pretreatment facial and intraoral photographs.

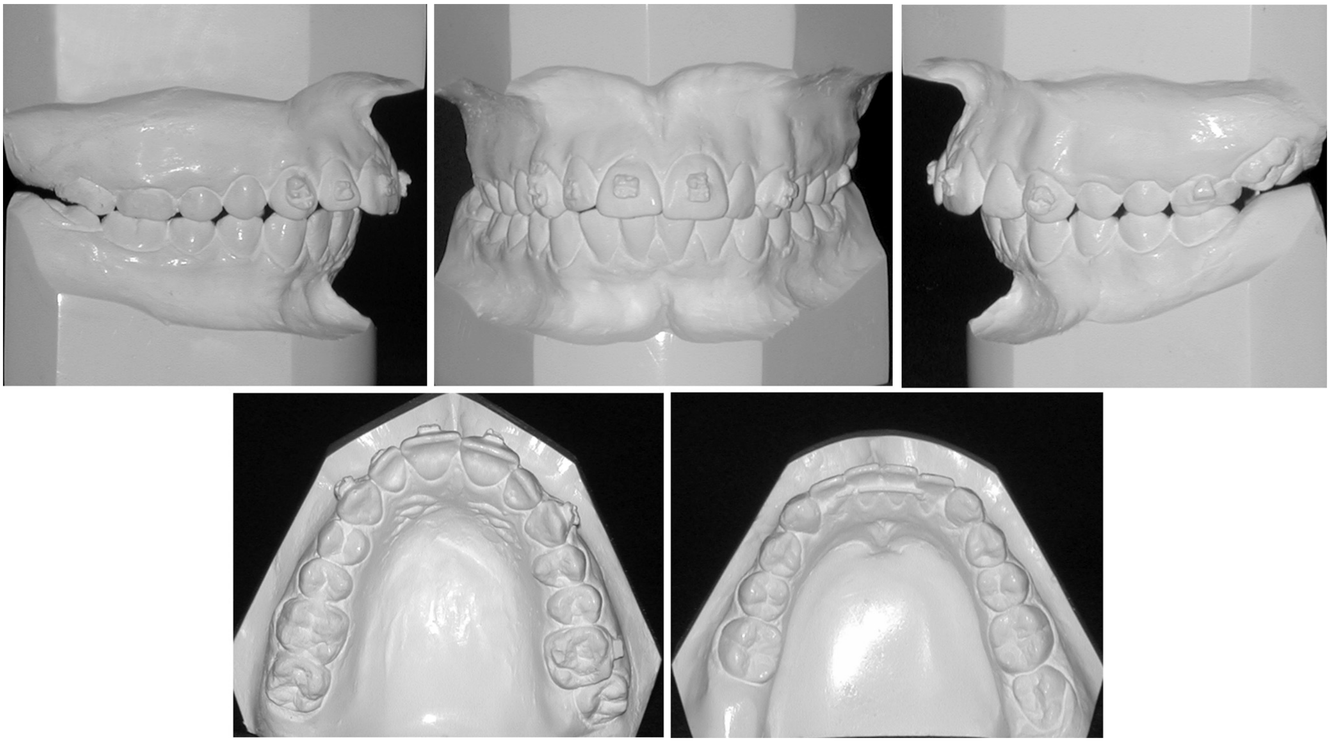

Fig. 2. Pretreatment dental casts.

line, 0 mm; lower lip to Steiner line, −0.5 mm). The upper incisors were well positioned (1-nasion point A = 6 mm and 1.nasion point A = 24°) and the lower incisors inclined labially (1-nasion point B = 8.5 mm; 1.nasion point B = 33° and incisal mandibular plane angle = 116°).

3. Treatment Objectives

(1) align and level the teeth in their bony bases; (2) correct the Class II, Division 1; (3) obtain a harmonious facial profile with adequate maxillomandibular relationships; (4) decrease the marked overjet and eversion of the lower lip; (5) improve the relationship between lower lip and chin; (6) obtain a mutually protected occlusion with stable and simultaneous occlusal contacts for all teeth; and (7) stabilize the treatment after the craniofacial growth ends.

4. Treatment alternatives

Factors such as (1) two previous orthodontic treatments with unsatisfactory results (due to an uncooperative patient in the use of growth control appliances), (2) the patient's age, and (3) the large mandibular retrusion, with marked discrepancy between the maxilla and mandible, were seen as hurdles to a new treatment

Fig. 3. Pretreatment panoramic radiograph.

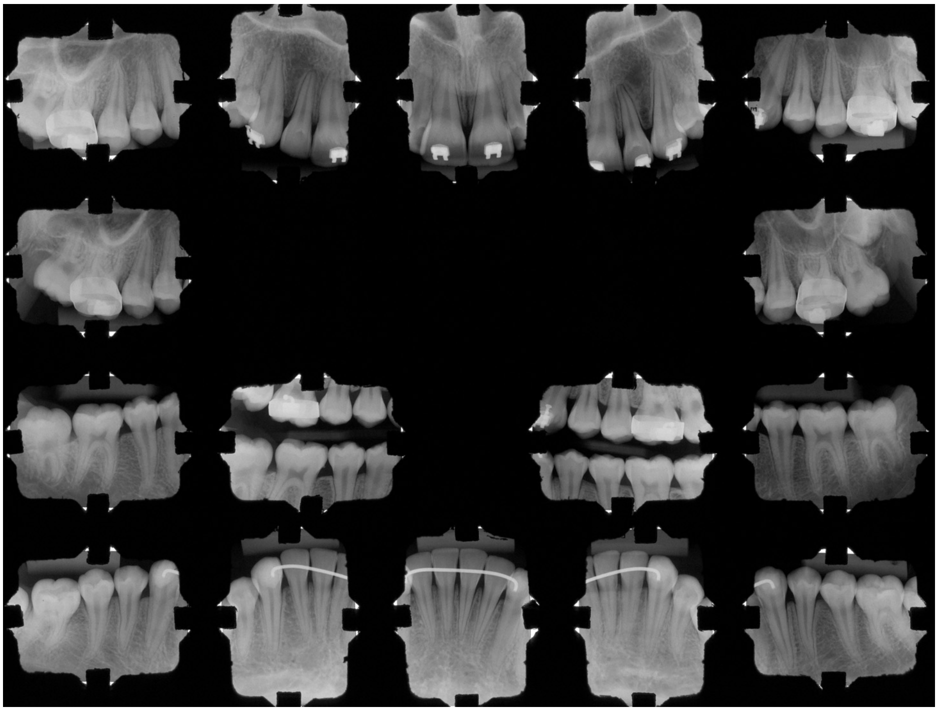

Fig. 4. Pretreatment periapical radiographs.

with excellent results, without compromise and with high predictability. As a first option, orthosurgical treatment with mandibular and chin advancement was proposed.

An alternative plan involved extracting the first two premolars for orthodontic camouflage, keeping the Class II molar relationship, and reducing the sharp overjet by achieving good anterior occlusal relationships. Facial aesthetics would still be compromised because the mandibular deficiency would not be resolved.

Another alternative treatment would involve the use of an extraoral appliance, but it was ruled out because it had already been used in previous treatments without patient compliance.

A third alternative would be to use miniplates for anchorage. There would still be the need for extractions, possibly the upper left third molar or first premolar. With this alternative, overjet would be significantly reduced, and a Class I molar relationship could even be obtained, but it still would not resolve the mandibular deficiency.

5. Treatment progress

Treatment consisted of three steps: (1) presurgery orthodontic preparation by aligning and leveling the teeth in their bony bases, a sequence of impression taking and modeling, and manipulation of the casts to assess the occlusion; (2) orthognathic surgery proper, whereby a sagittal split osteotomy and genioplasty were performed to advance the mandible 6 mm and the chin 8 mm; (3) orthodontic

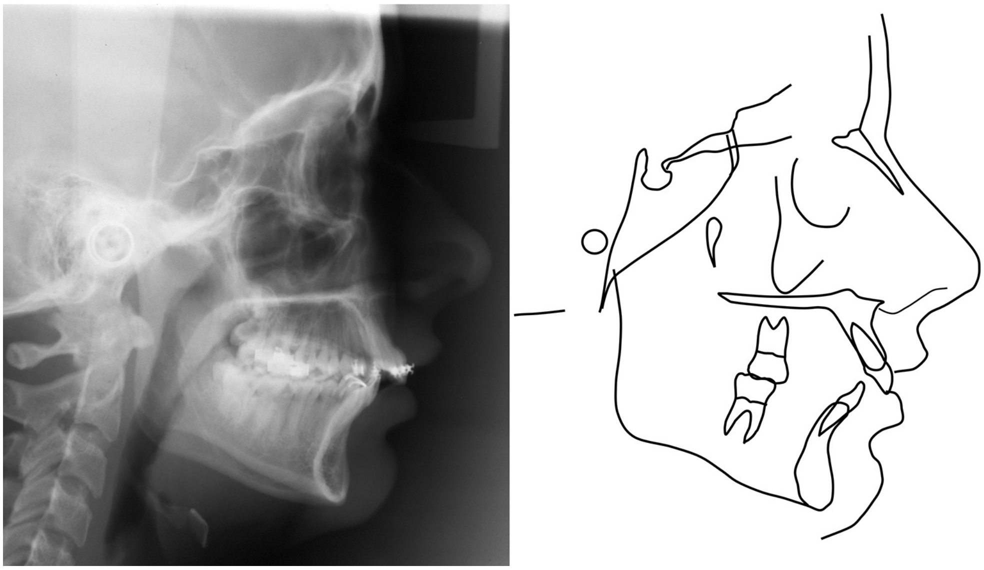

Fig. 5. Pretreatment lateral cephalometric radiograph and tracing (T1).

Table 1
Cephalometric measurements: Normal; Pretreatment; Pre-surgery; Post-surgery; Post-treatment and at 2 years follow-up after the end of treatment

Measure	Normal	Pretreatment (T1)	Presurgery (T2)	Postsurgery (T3)	Post-treatment (T4)	Follow-up (T5)
Age		13 y 1 mo	13 y 11 mo	14 y 0 mo	15 y 7 mo	17 y 7 mo
Skeletal pattern						
SNA (°)	82	79	80	80	79	79
SNB (°)	80	71	72	76	75	75
ANB (°)	2	8	8	4	4	4
Facial Convexity (°)	0	9	14	3	4	6
y-axis (°)	59	66	64	65	62	62
Facial angle (°)	87	84	87	87	88	88
SN.GoGn (°)	32	35	34	35	36	36
AO-BO (mm)	−1	6.5	10	−0.5	3.5	3
Pog-NB (mm)		2	2.5	5	3.5	4
FMA (°)	25	24	20	24	24	24
Dental pattern						
IMPA (°)	87	116	116	110	109	106
1.NA (°)	22	24	28	29	28	22
1-NA (mm)	4	6	6	6.5	6	4
1.NB (°)	25	33	40	40	39	35
1-NB (mm)	4	8.5	9	9.5	8.5	9
1.1 (°)	131	117	103	106	108	105
Profile						
Upper lip to S line(mm)	0	0	0.5	−3	−2	−2
Lower lip to S line(mm)	0	−0.5	4	−2	0	−1

SNA, sella-nasion-A point angle; SNB, sella-nasion-B point angle; ANB, A point-nasion-B point angle; SN.GoGn, SN line-GoGn line angle; AO-BO, distance between AO point and BO point on occlusal plane; Pog-NB, distance from Pog point to NB line; FMA, Frankfort-mandibular plane angle; IMPA, incisal mandibular plane angle; 1.NA, long axis upper incisor-NA line angle; 1-NA, distance from most mesial point on the crown of upper incisor to NA line; 1.NB, long axis upper incisor-NB line angle; 1-NB, distance from most mesial point on the crown of upper incisor to NB line; 1.1, interincisal angle; S, Steiner.

finishing by reassembling some accessories, placing bends and adjustments in the arch wires, and using intermaxillary elastics.

Initially, the brackets bonded to the upper teeth and the lower lingual retainer bonded to the canines, which the patient still had from the previous treatment, were removed.

A Standard Edgewise 0.022 × 0.028-in fixed orthodontic appliance was bonded to all teeth. Second molar tubes were bonded as soon as possible after eruption. Alignment and leveling were achieved with Thermoset 0.014-in and 0.019 × 0.025-in nickel-titanium wires. After 10 months of treatment, an impression was taken to confirm the quality of intercuspation under manipulation, and new radiographic records were requested (Figs. 6–8). Then, 0.019 × 0.026-in stainless steel wires were prepared and adapted with vertical hooks soldered to the

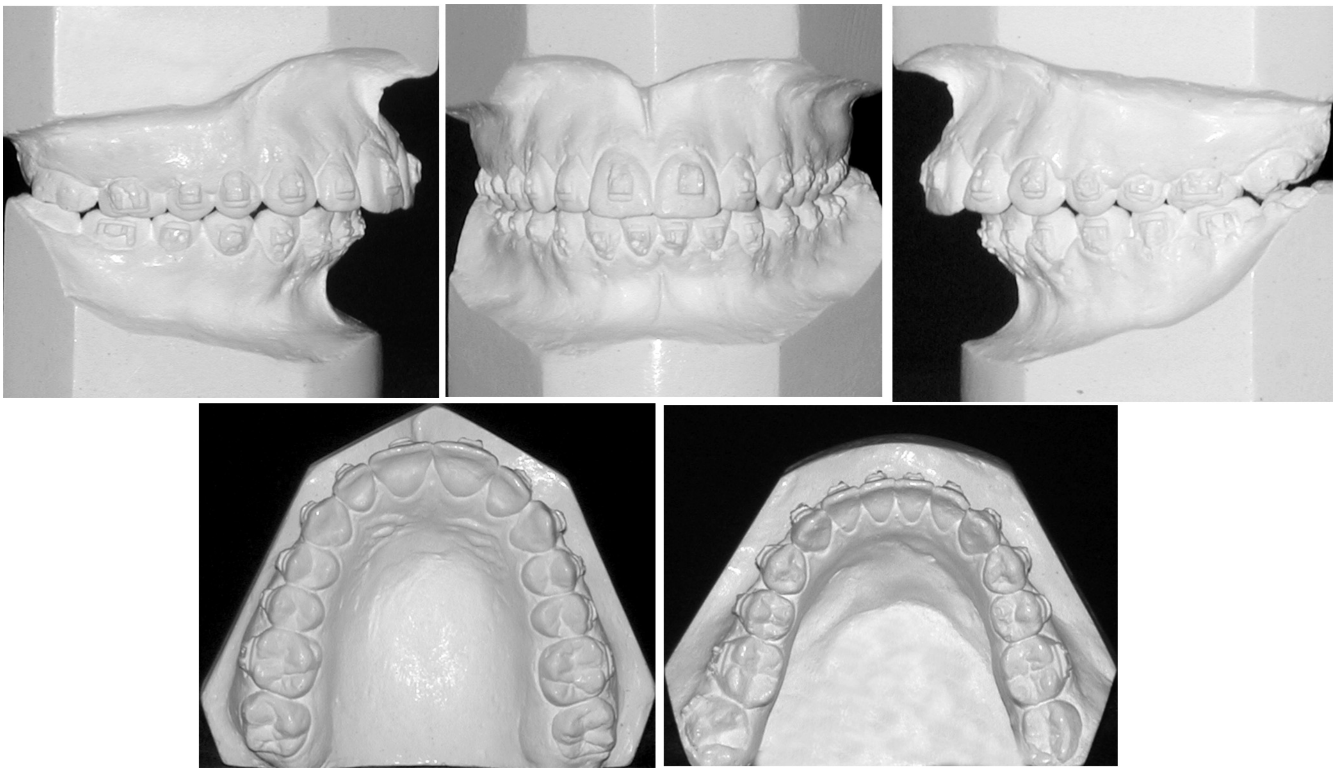

Fig. 6. Presurgery dental casts.

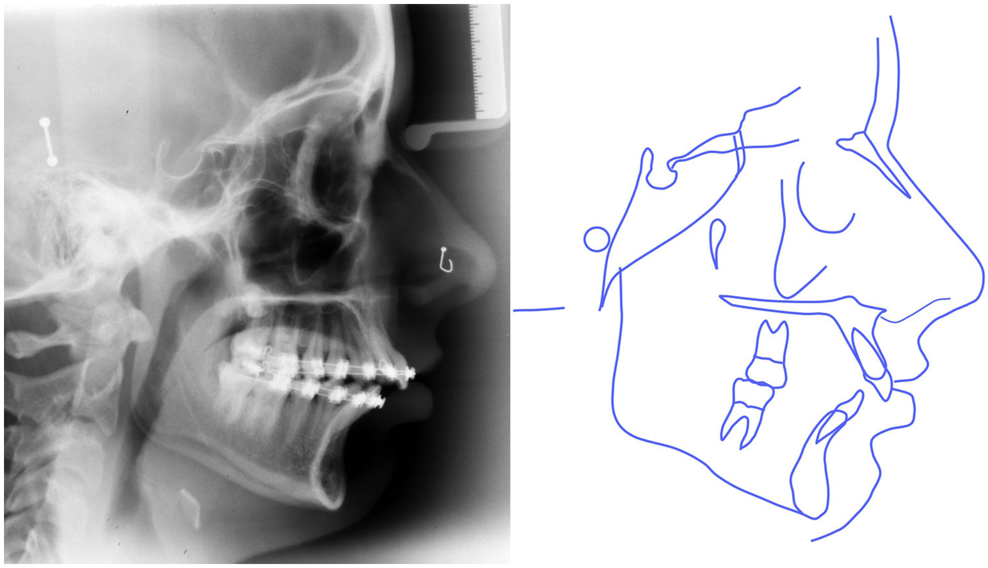

Fig. 7. Profile cephalometric radiographs and tracing before orthognathic surgery. Orthodontic preparation progress (T2).

interproximal spaces in both arches to ensure stability during orthognathic surgery procedures.

The radiographs and cephalometric tracings were superimposed immediately after surgery (Figs. 9–11), and illustrate the correction of the Class II skeletal discrepancy and severe overjet. The genioplasty achieved lip competence and improvement in the relationship between the chin and the lower lip.

After surgery, the arch wires with hooks were replaced with 0.019 × 0.026-in stainless steel arch wires fabricated with delta loops located between the lateral incisors and upper and lower canines for the use of intermaxillary elastics. Anterior vertical elastics were attached to the delta loops to improve intercuspation, as well as Class III elastics on the left side, and Class II elastics on the right side to improve the sagittal correction and consequently the midline correction.

Twenty-five months into treatment, the fixed appliance was removed and a lower lingual retainer made from 0.028-in steel wire was bonded to the canines. Additionally, a 0.036-in steel wire wraparound-type retention plate was placed in the maxillary arch.

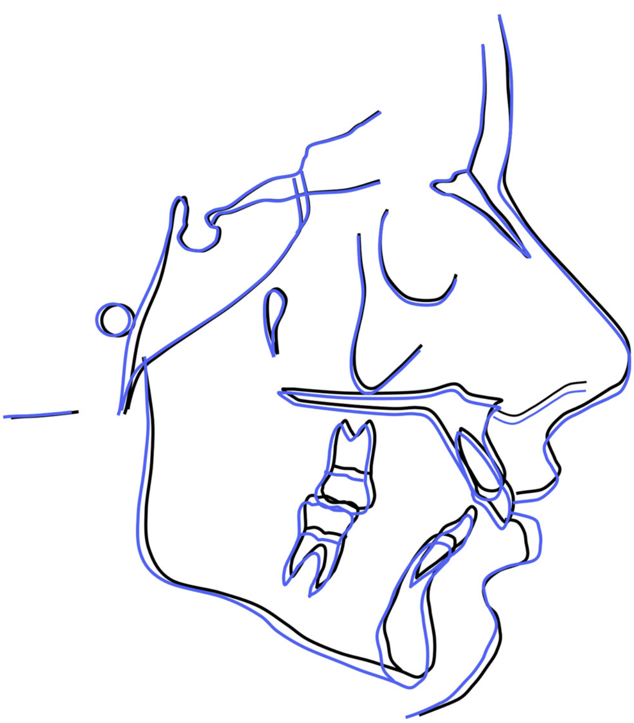

Fig. 8. Cephalometric superimpositions: pretreatment and presurgery (T1-T2).

6. Results

There was a significant improvement in facial aesthetics with a balanced profile, proper alignment, leveling, and intercuspation. Class I relationship between canines and molars was achieved, with proper overbite and overjet (Figs. 12–16). The total treatment time was 25 months. Functionally, the patient developed lip competence. Moreover, the eccentric mandibular movements exhibited anterior guidance, with efficient canine movements. From a psychosocial standpoint, the patient developed more cheerful and sociable behavior and an outgoing attitude.

At the time of the orthognathic surgery, the patient was 14 years 2 months old. After appliance removal, facial aesthetics remained harmonious and dental occlusion, over bite, and overjet stabilized. The cephalometric measurements obtained at this stage confirm a highly favorable outcome (Table 1).

The facial, intraoral (Fig. 17), dental cast photographs (Fig. 18), and panoramic and periapical radiographs (Fig. 19) taken over a 2-year follow-up period also exhibit excellent aesthetic and functional stability of the results. There is reason to believe that the results will stabilize because at this stage, the patient is 17 years 7 months old and therefore beyond the growth period.

The cephalometric measurements (Table 1) obtained during the 2-year follow-up period show that the skeletal discrepancy between the maxilla and the mandible remained stable. This was also evident in the measurements of the tracing of superimposition of post-treatment and 2-year follow-up results (Figs. 20,21).

7. Discussion

Retreatment of orthodontic cases is a challenge for any professional as it is often no longer possible to rely on growth given the patient's age. Furthermore, there is potential risk of root resorption

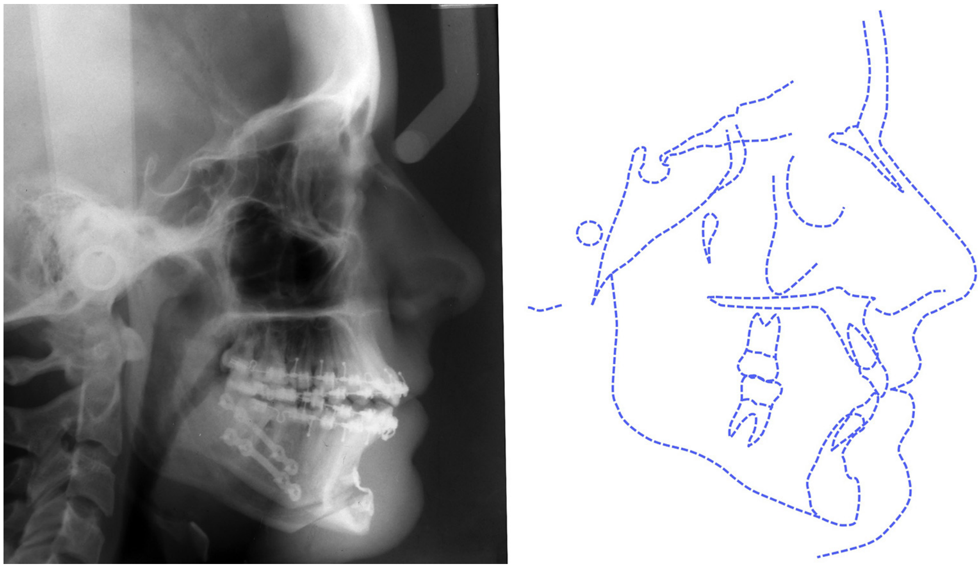

Fig. 9. Profile cephalometric radiographs and tracing immediately after surgery (T3)

occurring, or increasing, if already present. In this case, orthognathic surgery was the best option because it reduced the need for compliance in the use of auxiliary devices, streamlined the mechanics, and decreased treatment time.

Among the main indications for orthognathic surgery in patients with active facial growth is the psychosocial factor. Facial attractiveness influences the way mothers interact with their children, the number of friends, and professional relationships, both in landing a job and in garnering recognition at work [4,5]. Despite the lack of a facial deformity, as in syndromic patients, the patient in this case expressed dissatisfaction with her facial appearance. In fact, this was the chief complaint. This fact was taken into account because the patient was in her teens and improving self-esteem would be a major treatment benefit [9–11].

On average, growth spurt peaks in girls at age 12 years and in boys at age 14 years [12]. As of approximately 15 years of age, girls reach 98% of their full adult facial growth, and their facial shape subsequently undergoes few additional changes [13,14].

Studies suggest that in girls who present with Class II, Division 1, the correctness and stability of the Class I molar relationship can be achieved more easily, between the ages of 10 and 14. This is unlike in boys, whose mandibles are expected to exhibit a greater vertical growth component [15]. Between the ages of 12 and 15, the anterior facial height increases, on average, 1.7 mm in girls. These changes occur early in puberty and in the late teens, when the amount of growth is considerably lower [16].

Although significant facial and mandibular growth still occurs in girls in their late teens, these growth increments are smaller than those found in boys [17].

The mandibular growth pattern will determine the final amount of maxillomandibular discrepancy [18,19] and the feasibility of surgery being performed in the growth phase. When development is disharmonious, with a poor mandibular growth rate, the malocclusion and deformity will likely worsen with growth. Moreover, if early surgical correction is performed, recurrence may take place, because the maxilla will continue its normal development while the mandible will remain in retrusion.

When development is harmonious, the preexisting deformity and malocclusion will stop developing by the end of growth, thereby yielding a predictable and stable outcome. In these

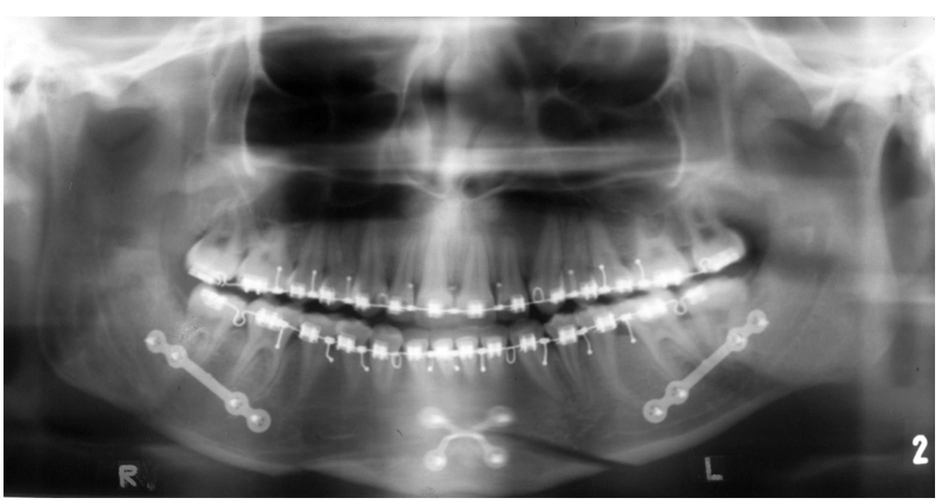

Fig. 10. Panoramic radiograph immediately after surgery.

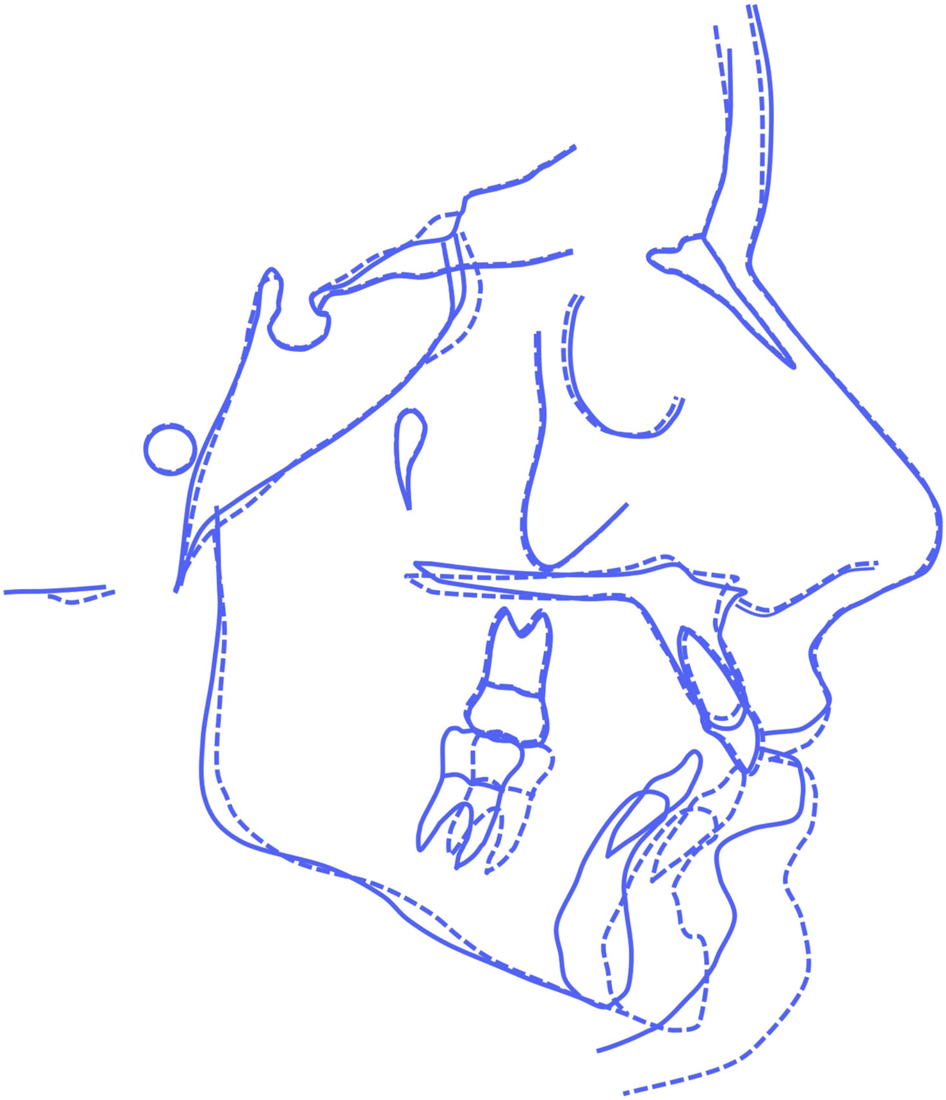

Fig. 11. Cephalometric superimpositions: presurgery and postsurgery (T2-T3).

patients, dental and skeletal patterns are established around 8 years of age, and mandibular advancement can be performed from age 12, shortly after the eruption of the second molars, by using the sagittal split osteotomy of the mandibular ramus [3,20,21].

The results of mandibular advancement surgery in the growing child will vary depending on the amount of advancement achieved, so the smaller the advancement, the more stable is the outcome. Further, this does not appear to vary with age (above age 11), sex, mandibular discrepancy cause, mandibular plane angle, dental overlap, or concurrent surgical procedures [8].

The absence of TMJ signs and symptoms is a factor that favors an indication for surgery and contributes to the stability and predictability of the outcome. Individuals with preexisting TMJ dysfunction undergoing orthognathic surgery, particularly mandibular advancement, are likely to experience significant worsening of the dysfunction after surgery. Therefore, the preoperative evaluation of the TMJs is critical to the success of orthognathic surgery because pathologies that remain undiagnosed or untreated are a major factor leading to postoperative complications, which result in poor and unpredictable results [21,22].

Genioplasty is often necessary. It involves sliding basilar osteotomy combined with sagittal split osteotomy of the mandibular ramus to improve facial aesthetics where no extractions were performed. This procedure improved the position of the lower lip and lip competence while also improving aesthetic results.

8. Conclusions

In cases of patients with mandibular deficiency and marked discrepancy between the maxilla and mandible, orthosurgical treatment can be performed by sagittal split osteotomy and genioplasty with predictable and stable results in female patients who are in the final stage of craniofacial growth and exhibit harmonious growth.

References

[1] Mitchell L. An introduction to orthodontics. 2nd ed. Oxford: Oxford University Press; 2001.

[2] Burden D, Johnston C, Kennedy D, Harradine N, Stevensond M. A cephalometric study of Class II malocclusions treated with mandibular surgery. Am J Orthod Dentofacial Orthop 2007;131:7.e1–8.

[3] Medeiros PJ, Medeiros PP. Cirurgia ortognática para o ortodontista. 2nd ed. 2004. São Paulo: Ed. Santos.

[4] Keim GR. Making a case for early orthognathic surgery. J Clin Orthod 2010;44:641–2.

Fig. 12. Post-treatment facial and intraoral photographs.

[5] Wolford LM, Karras SC, Mehra P. Considerations for orthognathic surgery during growth, Part 1: mandibular deformities. Am J Orthod Dentofacial Orthop 2001;119:95–101.
[6] Shell TL, Woods MG. Perception of facial esthetics: a comparison of imilar Class II cases treated with attempted growth modification or later orthognathic surgery. Angle Orthod 2003;73:365–73.
[7] Snow MD, Turvey TA, Walker D, Proffit WR. Surgical mandibular advancement in adolescents: postsurgical growth related to stability. Int J Adult Orthodon Orthognath Surg 1991;6:143–51.
[8] Huang CS, Ross RB. Surgical advancement of the retrognathic mandible in growing children. Am J Orthod 1982;82:89–103.
[9] Flanary CM, Batnwell GM, Alexander JM. Patient perceptions of orthognathic surgery. Am J Orthod 1985;88:137–45.
[10] Proffit WR, Phillips C, Dann C. Who seeks surgical-orthodontic treatment. Int J Adult Orthodon Orthognath Surg 1990;5:153–60.
[11] Orlagh HT, Chris JD, Peter HG, Donald BJ. The psychosocial impact of orthognathic surgery: a systematic review. Am J Orthod Dentofacial Orthop 2001;120:490–7.
[12] Lewis AB, Roche AF, Wagner B. Growth of the mandible during pubescence. Angle Orthod 1982;52:325–42.
[13] Broadbent Sr BH, Broadbent Jr BH, Golden WH. Bolton standards of dentofacial developmental growth. St Louis: CV Mosby; 1975.
[14] Van der Linden F. Facial growth and facial orthopedics. Surrey, UK: Quintessence; 1986.
[15] Rothstein T, Phan XL. Dental and facial skeletal characteristics and growth of females and males with Class II Division 1 malocclusion between the ages of 10 and 14 (revisited). Part II. Anteroposterior and vertical circumpubertal growth. Am J Orthod 2001;120:542–55.
[16] Fudalej P, Kokich VG, Leroux B. Determining the cessation of vertical growth of the craniofacial structures to facilitate placement of single-tooth implants. Am J Orthod Dentofacial Orthop 2007;131:s59–67.
[17] Foley TF, Mamandras AH. Facial growth in females 14 to 20 years of age. Am J Orthod Dentofacial Orthop 1992;101:248–54.
[18] Broadbent BH. The face of the normal child. Angle Orthod 1937;4:183–209.
[19] Bjork A, Skieller V. Facial development and tooth eruption; an implant study at the age of puberty. Am J Orthod 1972;62:339–83.
[20] Proffit WR, Phillips C, Turvey TA. Long-term stability of adolescent versus adult surgery for treatment of mandibular deficiency. Int J Oral Maxillofac Surg 2010;39:327–32.
[21] Wolford LM, Rodrigues DB, Limoeiro E. Orthognathic and TMJ surgery: postsurgical patient management. J Oral Maxillofac Surg 2011;69:2893–903.
[22] Wolford LM, Reiche-Fischel O, Mehra P. Changes in temporomandibular joint dysfunction after orthognathic surgery. J Oral Maxillofac Surg 1996;54:84.

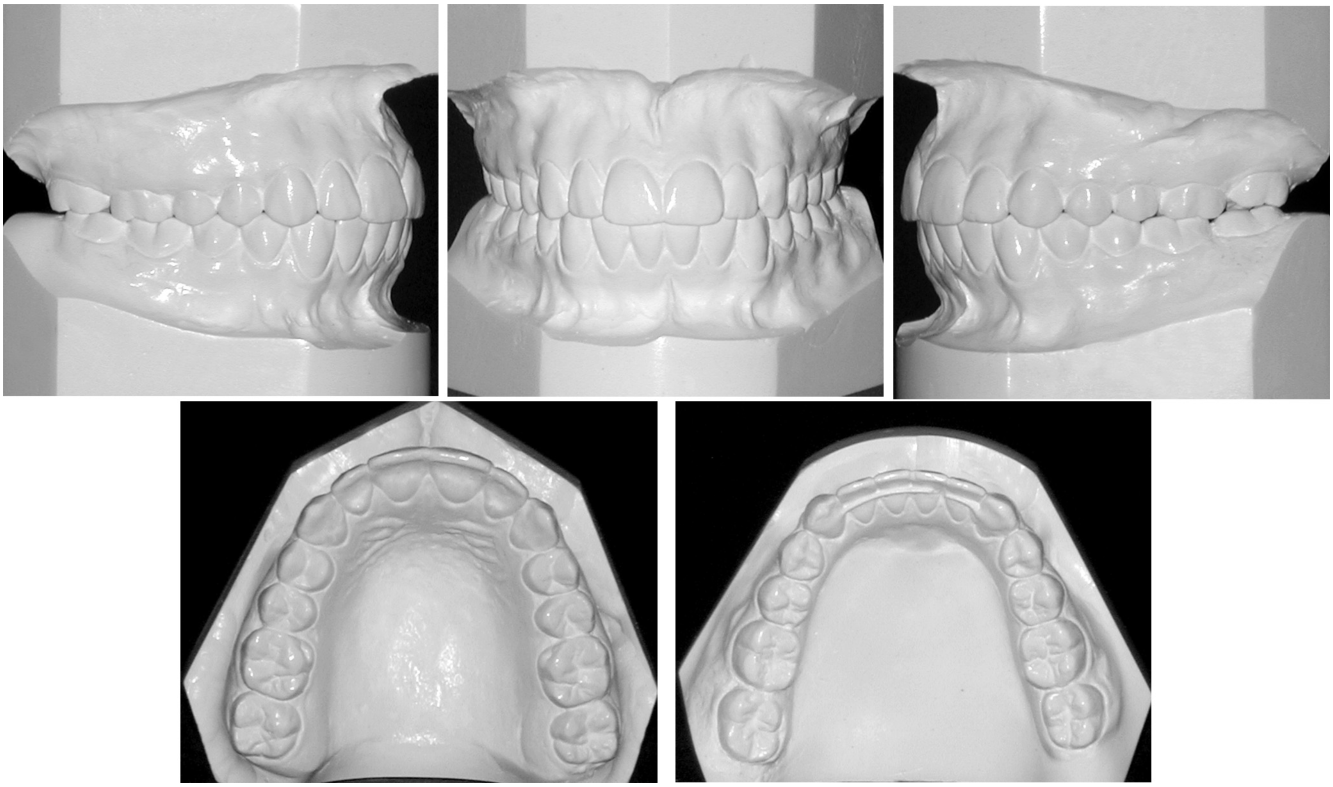

Fig. 13. Post-treatment dental casts.

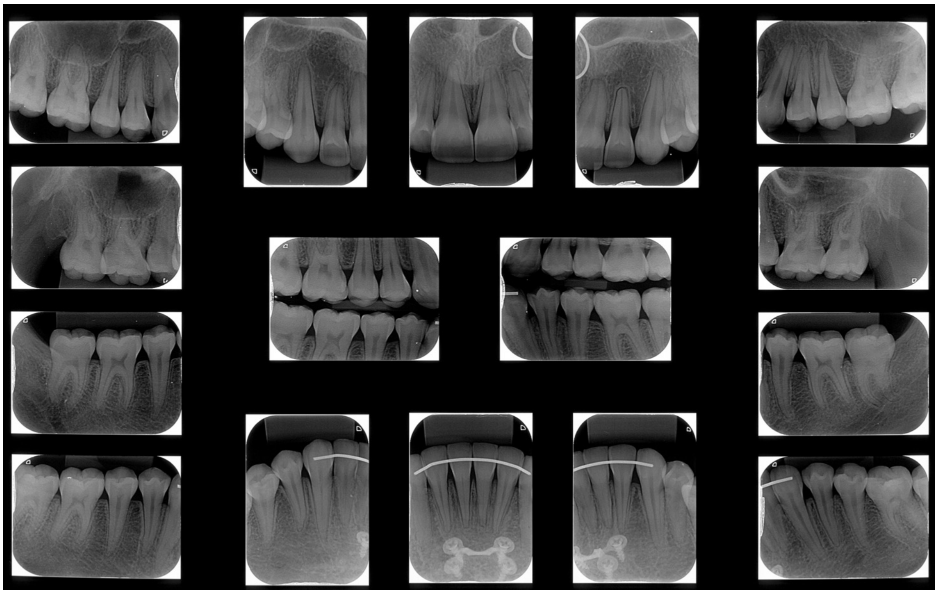

Fig. 14. Post-treatment periapical radiographs.

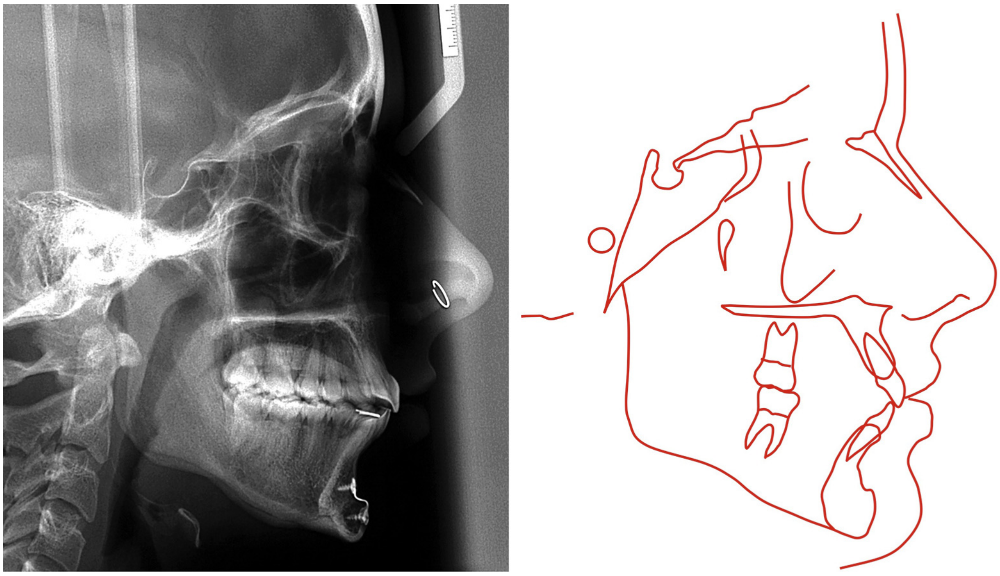

Fig. 15. Posttreatment lateral cephalometric radiograph and tracing (T4).

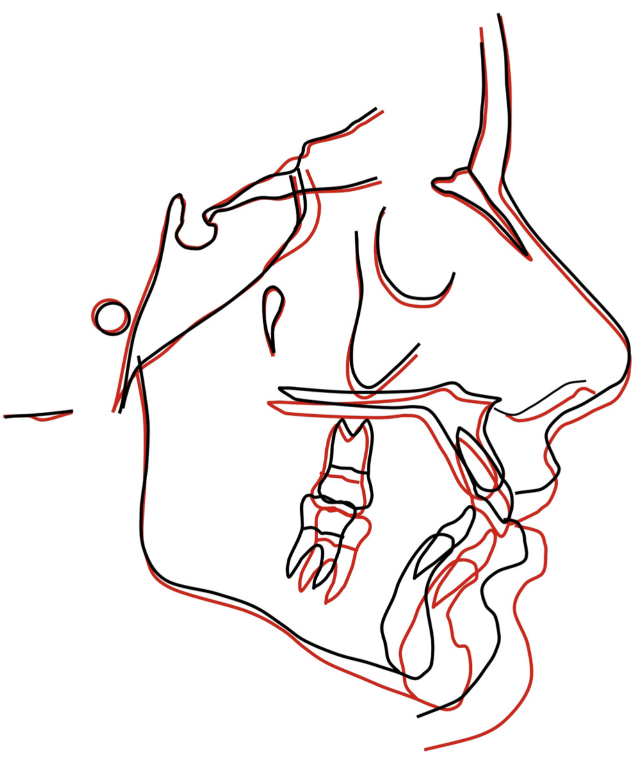

Fig. 16. Cepha lometric superimpositions: pretreatment and post-treatment (T1-T4).

Fig. 17. Facial and intraoral photographs at 2-year follow-up.

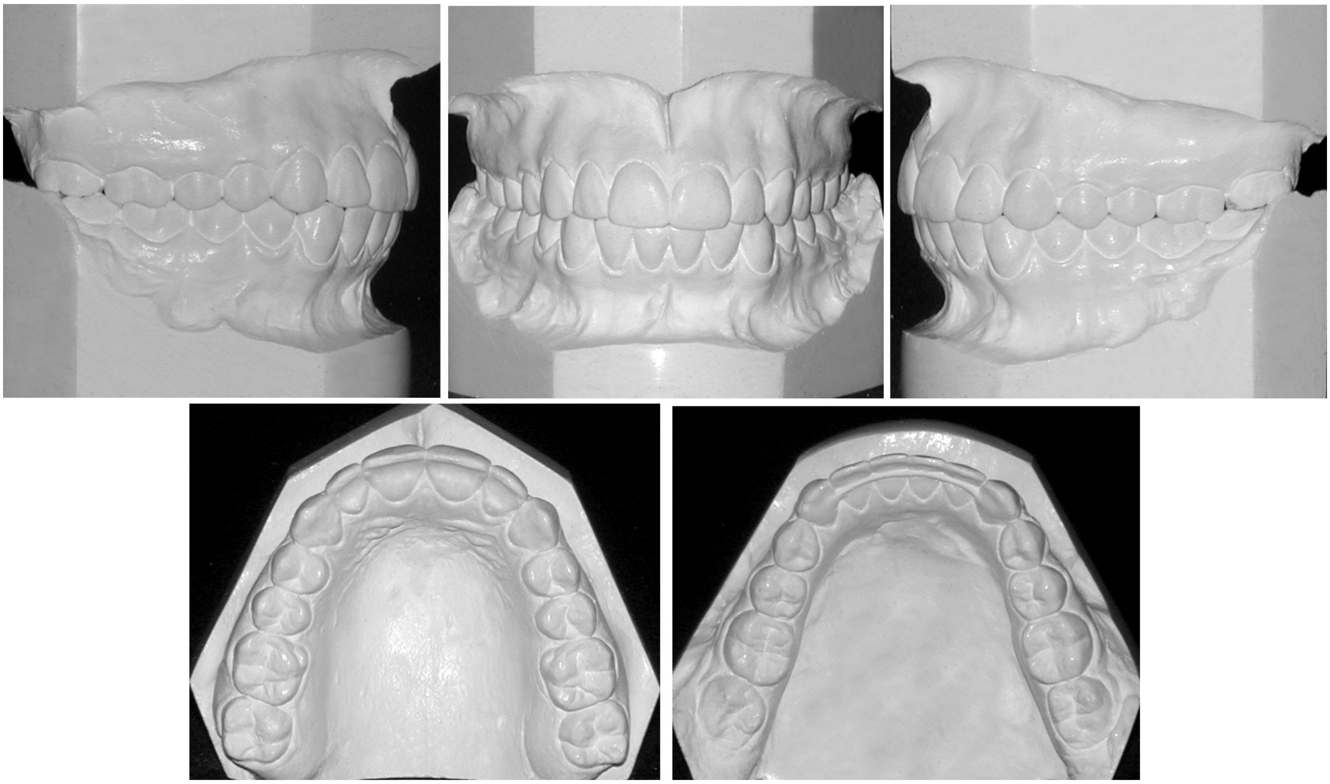

Fig. 18. Dental casts at 2-year follow-up.

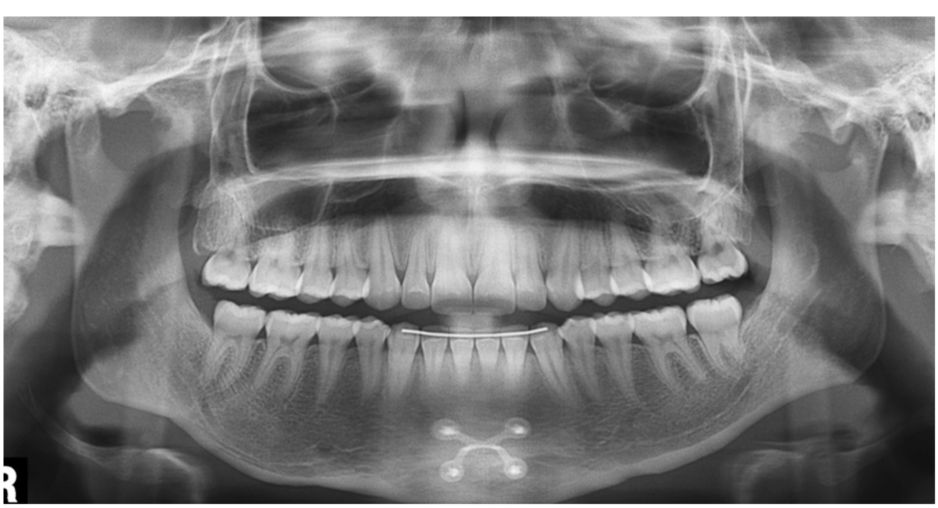

Fig. 19. Panoramic radiograph at 2-year follow-up.

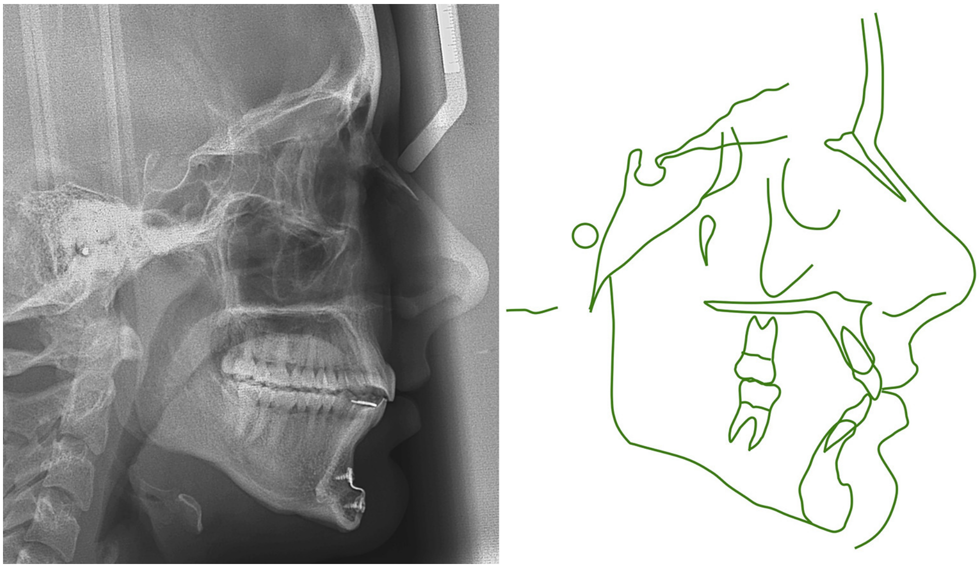

Fig. 20. Lateral cephalometric radiograph and tracing 2-year follow-up (T5).

Fig. 21. Facial and intraoral photographs at 2-year follow-up (T4-T5).