

Following thermocycling, there was a noticeable reduction in SBS irrespective of the surface pre-treatment methods.<sup>2,14,19,20</sup> Biodegradation of the treated Y-TZP surface, bonded brackets, and adhesives may have contributed to this evidence. Hence, the assessment of the bond strength in a simulated clinical environment (i.e., *in-vivo* experiment) is necessary. Thermocycling is an artificial aging procedure to test the long-term effect of bond strength. According to a study, 10,000 cycles of thermocycling are equivalent to one year of usage in the oral cavity.<sup>33</sup> Application of MDP and MDP containing silane primers resulted in durable and optimal SBS on both forms of sandblasted Y-TZP, even after 10,000 cycles of thermocycling.<sup>2,20</sup> Conversely, in the case of universal adhesives, the SBS was stable up to 2,000 cycles, but degraded significantly after 10,000 cycles.<sup>2,20,27</sup> Among lasers, the effect of thermocycling on the Er:YAG and Nd:YAG laser irradiated surfaces were tested. The SBS on Er:YAG laser-treated surface was found to be just clinically acceptable within the range of 500-2,000 cycles.<sup>12,25</sup> In the case of Nd:YAG laser, the SBS was below an acceptable level after thermocycling.<sup>12</sup> Surprisingly, the effect of thermocycling on the femtosecond laser irradiation could not be found.

The validation risk of the bias tool utilized in this study could not be confirmed. This fact should be regarded as an important limitation of the study, but the contents of this quality assessment tool seemed to be more justifiable and relevant to the methodology of the selected studies. The absence of meta-analysis is another limitation reflecting the heterogeneity of the studies.

## CONCLUSION

As this review is solely based on the qualitative analysis of the laboratory-based *in-vitro* findings, the results should be interpreted with caution. To answer the research question of this review more precisely, quantitative analysis is deemed necessary. Therefore, standardization of the study protocol is necessary. However, certain points may be advised, in light of this comprehensive review:

- a) Hydrofluoric acid etching can be avoided to treat the Y-TZP surface, as it did not remarkably improve the SBS, considering the damage to the ceramic surface.

- b) Mechanical pretreatments like sandblasting and lasers are useful, as they both improved the SBS of orthodontic brackets.
- c) Tribochemical silica-coated sandblasting with the advantage of chemical adhesion resulted in greater SBS than conventional sandblasting.
- d) Among lasers, the femtosecond laser can be suggested as the first choice; although the effect of thermocycling on this laser irradiated zirconia surface is unknown.
- e) Use of primers, particularly the MDP and the MDP containing silane primers as an adjunct to the mechanical pretreatments may be justified. There is a concern over the longevity of the universal adhesive.

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### *Conception or design of the study:*

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TA, NF, MKA.

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# Orthodontic retreatment: positive effects on the patient's self-esteem and quality of life

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## ABSTRACT

**Introduction:** An increasing percentage of the world's population has had access to orthodontic treatment within the last few decades. Consequently, a larger number of patients seeking for correction of their malocclusions, nowadays, present with a history of previous orthodontic therapy. Orthodontists performing retreatments in their practice may have to face additional difficulties, and one of them is treating individuals that may be even more demanding for excellent results and efficient treatments.

**Objectives:** This manuscript discusses the challenges faced when performing orthodontic retreatments. It illustrates a two-phase retreatment of a pre-adolescent and the ortho-surgical retreatment of a young adult with high demands for fast and exceptional results. Finally, this paper elaborates on the positive impacts that these retreatments had on the patients' self-esteem and quality of life.

**Keywords:** Quality of life. Oral health. Orthodontic retreatment.

## RESUMO

**Introdução:** Um percentual crescente da população mundial vem tendo acesso ao tratamento ortodôntico ao longo das últimas décadas. Consequentemente, hoje em dia, um maior número de pacientes em busca da correção de suas más oclusões apresenta um histórico de tratamento ortodôntico prévio. Ortodontistas que realizam retratamentos ortodônticos podem enfrentar dificuldades adicionais, e uma delas é ter que lidar com indivíduos que apresentam demandas e expectativas ainda maiores em relação à obtenção de resultados excelentes e de forma bastante eficiente.

**Objetivos:** O presente artigo discute os desafios e os impactos positivos do retratamento ortodôntico causados na autoestima e na qualidade de vida dos pacientes, e ilustra o retratamento em duas fases de uma pré-adolescente, e o retratamento ortodôntico-cirúrgico de uma paciente adulta jovem que tinha demandas muito elevadas para a obtenção de resultados rápidos e excelentes.

**Palavras-chave:** Qualidade de vida. Saúde bucal. Ortodontia. Retratamento.

## INTRODUCTION

Orthodontic treatment has increasingly become available to a larger percentage of the population within the last decades.<sup>1,2</sup> This is due to increased access to oral health care based on the preventive philosophies of contemporary Dentistry, greater longevity of the population, better access to information, higher aesthetic demands of modern society, technological advances in Orthodontics,<sup>3-6</sup> and lower treatment costs in some countries.

The positive effects of orthodontic treatment on patient's quality of life have been clearly demonstrated.<sup>7,8</sup> Children, adolescents and adults present a better body image and self-confidence related to their appearance after the completion of their orthodontic therapy, thus presenting lower levels of anxiety in social relationships and positive impacts on their self-esteem.<sup>9,10</sup>

An increasing proportion of the individuals pursuing orthodontic treatment nowadays present with a history of previous orthodontic therapy.<sup>11</sup> The reasons why patients seek orthodontic retreatment are multifactorial, and may include: desire to further improve esthetics and oral function, inadequate retention phase, maturational changes, unfavorable skeletal growth, failure in diagnosis and treatment planning or poor treatment.<sup>12,13</sup>

Orthodontists performing retreatments in their daily practice might have to manage patients presenting higher demands

in relation to treatment quality and duration. Therefore, for an orthodontist to retreat successfully, a strong understanding of the difficulties that could lead to failure is necessary. Furthermore, an objective system to guide the excellence in finishing retreatments could facilitate the clinical management of these cases and increase the chances of success.<sup>4,14</sup>

The purpose of this manuscript is to illustrate how the application of the objective criteria of the Brazilian Board of Orthodontics (BBO) assisted in achieving excellent finishing in two orthodontic retreatment patients.

## **CASE 1**

### **DIAGNOSIS**

The parents of a 9.8-year-old female patient sought for a second opinion about the results of an interceptive orthodontic treatment performed in their daughter. According to the parents, the patient had been wearing a removable palatal crib to try to eliminate a thumb-sucking and tongue thrust habits, and to correct an open-bite without success. The patient mentioned that she had been bullied at school due to her unpleasant smile, and her parents reinforced how her self-esteem was low because she did not show her teeth upon smiling. Both her medical and dental history were within normal limits.

Extraoral evaluation revealed a symmetric face, absence of passive lip sealing, moderately hyperdivergent growth pattern with an increased lower facial height and a slightly convex facial profile. Furthermore, the patient presented a significantly compromised smile esthetics without any maxillary incisors display upon smiling (Fig 1).

Intraoral analysis showed an Angle Class I malocclusion combined with a severe anterior open bite. Although no posterior crossbite was observed, there was a transverse maxillary deficiency, a tapered maxillary arch form and an increased palate depth. Mandibular posterior teeth presented increased lingual inclination as a compensation for the decreased maxillary transverse dimension. Mild crowding on both dental arches was also registered. Periodontally, there was a significant gingival recession on both mandibular central incisors, presence of calculus on the lingual surface of the lower incisors, and a low insertion of the upper lip frenum (Fig 1).

Panoramic radiograph confirmed the presence of all permanent teeth and a reduced eruption of all maxillary and mandibular incisors (Fig 2). Cephalometric evaluation revealed a Class II skeletal malocclusion ( $ANB = 7^\circ$ ;  $Witts = +6$  mm), with a properly positioned maxilla ( $SNA = 82^\circ$ ), a retruded mandible ( $SNB = 75^\circ$ ) and a convex profile (Angle of convexity =  $13^\circ$ ).

There was an increased vertical dimension of the face ( $FMA = 30^\circ$   $SN.GoGn = 39^\circ$ ). Both maxillary and mandibular incisors presented normal bodily position ( $1-NA = 5\text{ mm}$ ;  $1-NB = 6\text{ mm}$ , respectively), but were significantly proclined ( $1.NA = 32^\circ$  and  $IMPA = 97^\circ$ , respectively) (Fig 3 and Table 1).

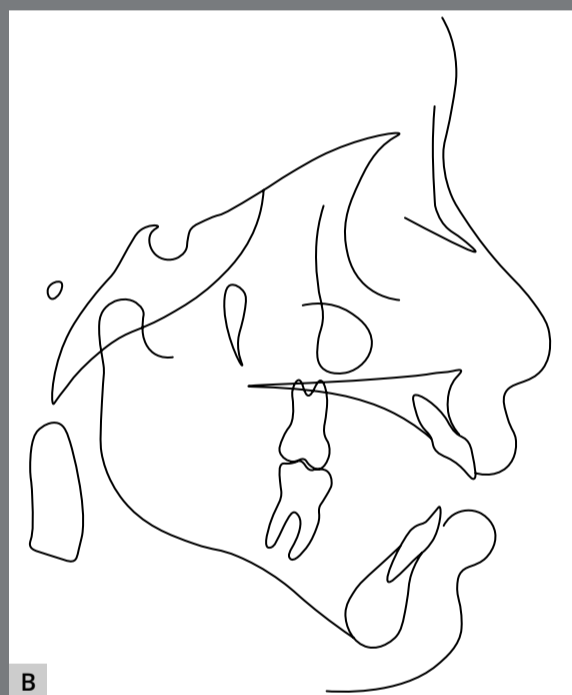


**Figure 1:** Initial facial and intraoral photographs.





**Figure 2:** Initial panoramic radiograph.



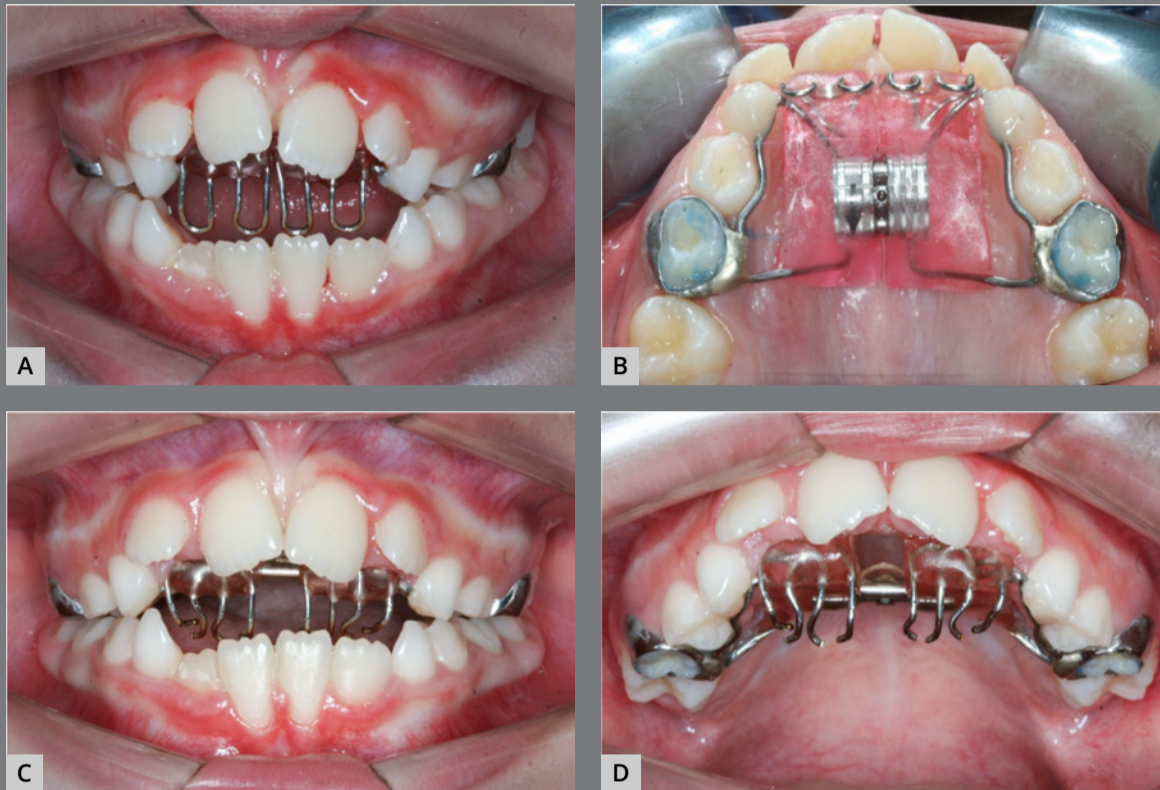
**Figure 3:** Initial cephalometric profile radiograph (A) and cephalometric tracing (B).

### TREATMENT PLANNING AND ORTHODONTIC MECHANICS USED

The previous interceptive orthodontic treatment achieved minor or no results with the use of a removable crib to interrupt the patient's thumb sucking habit, due to the lack of cooperation reported by both parents and the patient herself. Additionally, the removable plate did not address the maxillary transverse deficiency that resulted from the unbalanced muscular pressures observed in patients presenting these types of deleterious oral habits.

The objectives of the first phase of this orthodontic treatment were: to correct the transverse maxillary arch discrepancy, to eliminate the thumb-sucking habit, to control the vertical growth tendency, and to close the anterior open bite, minimizing the complexity of the second phase of treatment, when fixed orthodontic appliances would be placed to achieve ideal esthetics and proper function. Treatment started with a modified Haas rapid palatal expander (RPE), that presented bands on the deciduous maxillary second molars and a crib inserted to the anterior portion of the acrylic pads (Figs 4A and 4B).

Activation protocol was  $\frac{1}{4}$  of a turn per day during three weeks, when the lingual cusps of the maxillary molars were touching the buccal cusps of the mandibular molars, thus the parents were oriented to stop activation. No device, brass wire or ligature, neither acrylic or composite resins were placed to lock the RPE screw. Two months later, the anterior open bite had decreased and the vertical loops of the crib were cut with a #1557 carbide bur, and it was transformed into a spur to further stimulate the elimination of the thumb and tongue thrusting habit (Figs 4C and 4D).

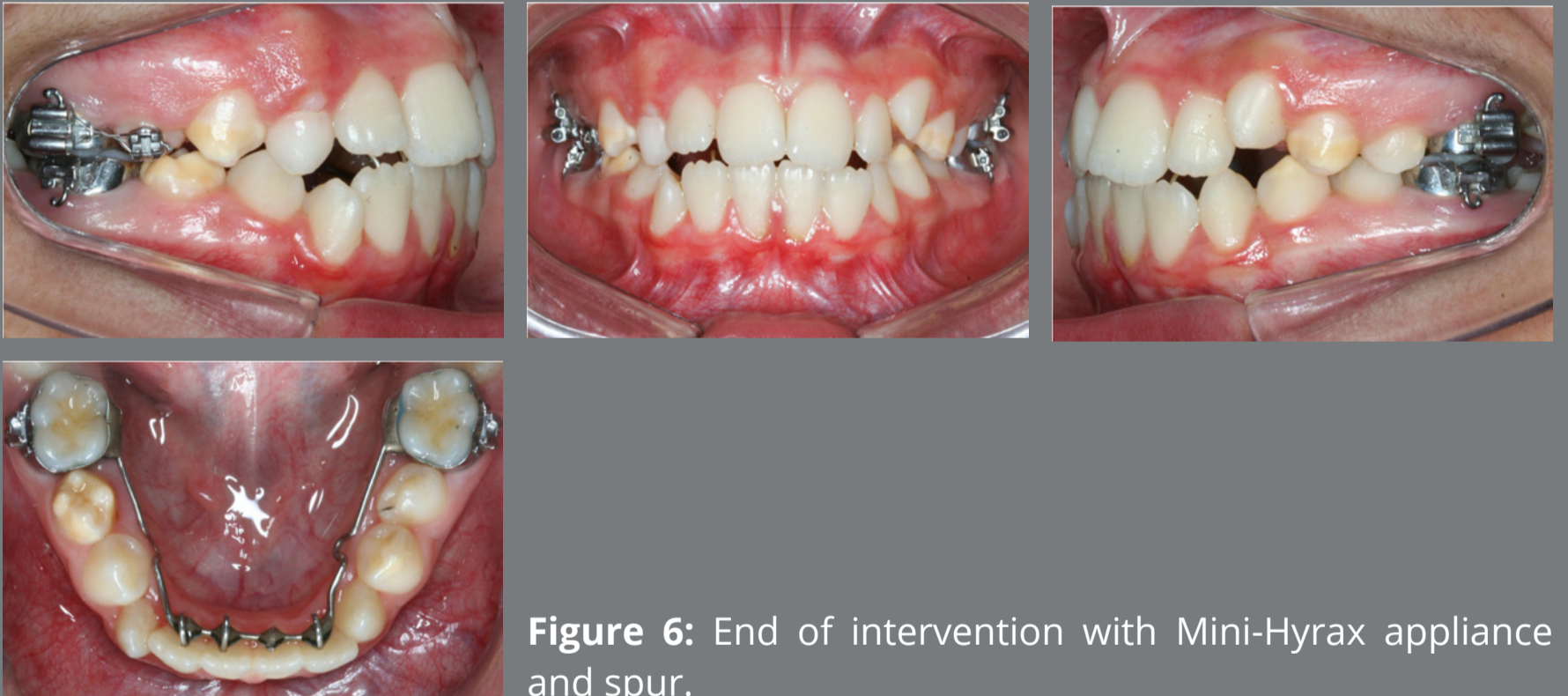


**Figure 4:** Haas appliance with grid installed, without activation.

After a 6-month RPE retention with the modified Haas appliance, there was a significant spontaneous decompensation of the mandibular molars' lingual inclination. Therefore, a second maxillary expansion was performed with a Mini-Hyrax expander (1/4 turn/day for two weeks). The anterior open bite had been reduced in half, and a mandibular tongue spur was inserted to further assist in the open bite correction (Fig 5). After the 6-month second RPE retention, the Mini-Hyrax was removed, a fixed transpalatal arch was inserted to the maxillary permanent first molars, and a high-pull headgear was used at night for vertical growth control. At the end of the first phase, the transverse dimension deficiency and the anterior open bite had been corrected (Fig 6). The mandibular tongue spur was removed when all mandibular premolar had been fully erupted.



**Figure 5:** Anterior open bite six months after treatment onset (A). Mini-Hyrax used for second RME (B). Lingual arch with spurs (C).



**Figure 6:** End of intervention with Mini-Hyrax appliance and spur.

The second phase of treatment started when all permanent second molars were fully erupted, and maxillary and mandibular fixed 0.022 x 0.028-in appliances were bonded on all mandibular and maxillary teeth (MBT Radiance brackets and Master Series Standard Edgewise tubes, American Orthodontics, Sheboygan, WI, USA). Leveling and alignment was achieved with 0.014-in NiTi, 0.018-in NiTi, 0.018-in SS wires and mild interproximal enamel reduction. Subsequently, 0.017 x 0.025-in and 0.019 x 0.025-in TMA wires were used to improve torque control. At the beginning of the finishing phase, a panoramic radiograph was obtained to check the necessity to improve root parallelism, and progress photographs (Fig 7) and models were obtained to evaluate the need for any bracket repositioning, as previously reported.<sup>15</sup> The BBO objective evaluating criteria (<https://bbo.org.br>) were used during the final stages of this orthodontic retreatment, to increase finishing efficiency and to optimize the achievement of excellent results. Fixed appliances were removed 15 months after the start of the second phase of treatment. Retention protocol consisted of a 0.036-in SS modified wraparound retainer on the maxillary arch and a 0.035-in Essix retainer on the mandibular arch. Patient was oriented to full-time wear of the retainers during the first six months post-debonding and night-time wear thereafter.



**Figure 7:** Intraoral photographs at alignment and leveling phase of dental arches.

### TREATMENT RESULTS

Treatment goals were achieved after the two phases of intervention. First of all, the thumb-sucking habit was controlled, and the major etiologic factor that caused her malocclusion was eliminated. In the facial aspect, passive lip sealing was obtained and there was a remarkable improvement on her smile esthetics, due to the proper correction of her smile arch and the improved proportions of the buccal corridors. The facial profile also improved and a better and well-defined chin-neck line was noted at the end of treatment (Fig 8). Intraoral post-treatment examination revealed that an ideal occlusion was achieved, with a Class I molar and canine relationship bilaterally, adequate overjet and overbite, coincident midlines and appropriate alignment and leveling of the marginal ridges (Fig 8). Final panoramic radiograph evaluation showed no signs of root resorption, adequate overall alveolar bone levels and appropriate root parallelism (Fig 9).

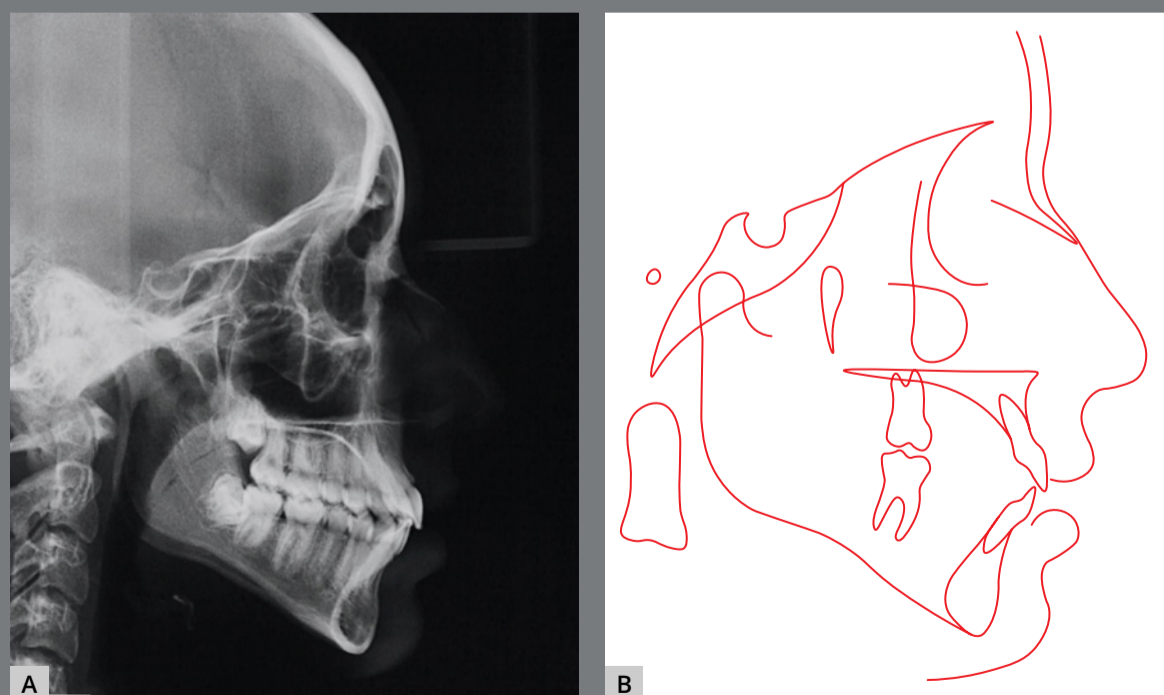


**Figure 8:** Final extraoral and intraoral photographs.



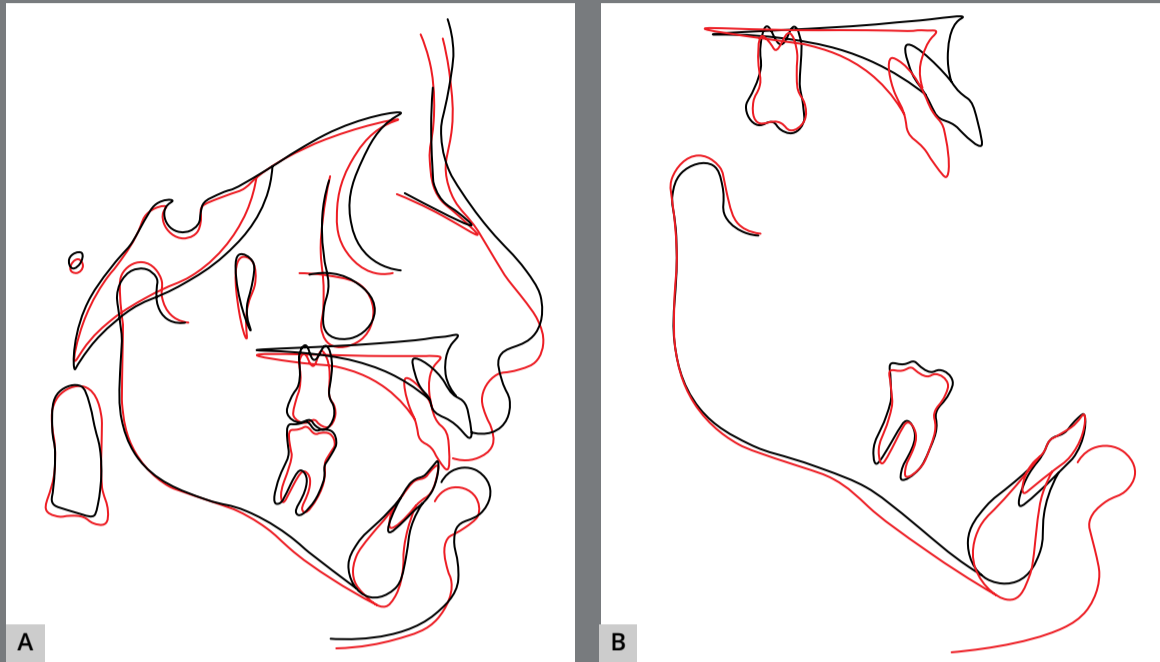
**Figure 9:** Final panoramic radiograph.

Post-treatment cephalometric evaluation (Fig 10) confirmed the improvement of the anteroposterior discrepancy (ANB from  $7^\circ$  to  $4^\circ$ ; Wits from +6 to 0 mm) and a good vertical dimension control, even without premolar extractions (SN.GoGn from  $39^\circ$  to  $40^\circ$  and FMA remained the same). Maxillary incisors presented a significant reduction on their labial inclination (1.NA from  $32^\circ$  to  $27^\circ$ ), while the mandibular incisors were slightly flared (IMPA from  $97^\circ$  to  $98^\circ$ ). Finally, no reduction on airway space was observed. Cephalometric superimpositions also confirmed the good vertical control during orthodontic mechanics, with the overall superimposition showing an improvement on maxillary spatial position, maxillary partial superimpositions confirming a better position of the incisors and the partial mandibular superimposition showing the maintenance of the incisors spatial position (Fig 11). Four years after treatment and two years without wearing any retainers, according to the patient, the results remained stable (Fig 12).



**Figure 10:** Final cephalometric profile radiograph (A) and cephalometric tracing (B).





**Figure 11:** Initial (black) and post-treatment (red) total (A) and partial (B) superimpositions of cephalometric tracings.



**Figure 12:** Four years after debonding, the patient's occlusion remained stable.

**Table 1:** Cephalometric values at start (A) and at the end (B) of treatment.

	MEASURES		Normal	A	B	A/B
Skeletal pattern	SNA	(Steiner)	82°	82°	82°	0
	SNB	(Steiner)	80°	75°	78°	3
	ANB	(Steiner)	2°	7°	4°	3
	Wits	(Jacobson)	♀ 0 ± 2 mm ♂ 1 ± 2 mm	6 mm	0 mm	6
	Angle of convexity	(Downs)	0°	13°	9°	4
	Facial Angle	(Downs)	87°	83°	88°	5
	SN.GoGn	(Steiner)	32°	39°	40°	1
	FMA	(Tweed)	25°	30°	30°	0
Dental pattern	IMPA	(Tweed)	90°	97°	98°	1
	$\perp$ .NA (degrees)	(Steiner)	22°	32°	27°	5
	$\perp$ -NA (mm)	(Steiner)	4 mm	5 mm	4 mm	1
	$\bar{\perp}$ .NB (degrees)	(Steiner)	25°	35°	37°	2
	$\bar{\perp}$ -NB (mm)	(Steiner)	4 mm	6 mm	8 mm	2
	$\frac{1}{1}$ - Interincisal angle	(Downs)	130°	111°	110°	1
Profile	Upper lip — S-line	(Steiner)	0 mm	0 mm	-1.8 mm	1.8
	Lower lip — S-line	(Steiner)	0 mm	0 mm	0 mm	0

## CASE 2

### DIAGNOSIS

A 21-year-old female sought orthodontic retreatment because she was very unhappy with her facial esthetics. She mentioned during her initial consultation how her excessive gummy smile and retrusive chin had been negatively impacting her self-esteem, her social relationships and her quality of life. The patient also stated that she didn't like the esthetics of her nose, and the spaces between her anterior teeth compromised her smile and masticatory function. She explained that her previous orthodontic treatment took place when she was 12 years old and she wore fixed orthodontic appliances for approximately 3 years.

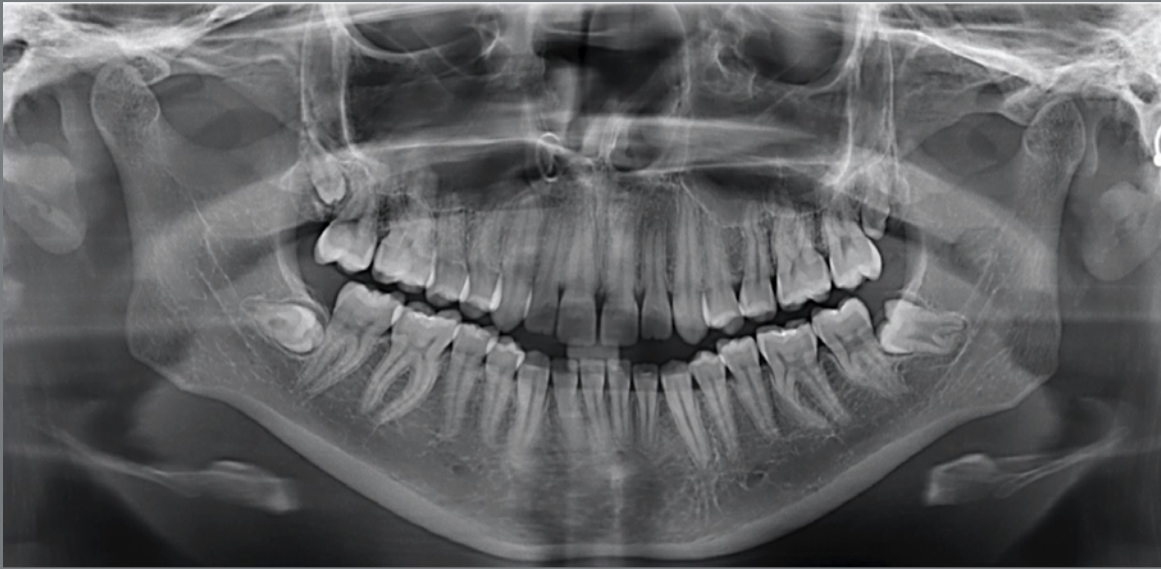
Facial analysis revealed a severely convex profile, an excessive nasolabial angle, incompetent lips, a deep labiomental sulcus and a retruded chin. Frontal evaluation showed a symmetric face, increased facial height, with a long lower facial third and an excessive gingival display at smile (Fig 13).



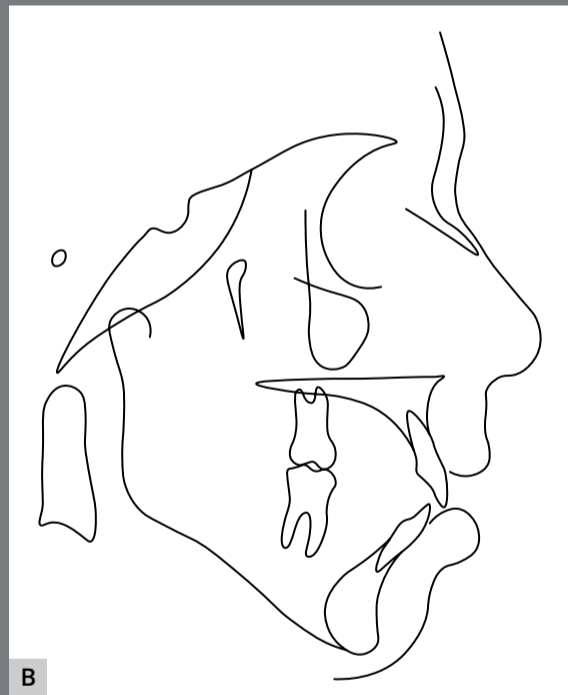
**Figure 13:** Initial extraoral and intraoral photographs.

Intraoral evaluation showed a Class II, division 1 malocclusion, canines also in a Class II relationship, reduced anterior overbite and an increased overjet. The patient presented good oral hygiene, but a thin gingival phenotype in the mandibular incisors' region (Fig 13).

Pre-retreatment panoramic radiograph showed that all permanent teeth were present. However, all third molars were impacted in an unfavorable position and without enough space for their eruption (Fig 14). Cephalometric analysis confirmed the facial diagnosis of a skeletal Class II (ANB = 8°; Wits = +10 mm), with a properly positioned maxilla in the sagittal plane (SNA = 82°) and a retruded mandible (SNB = 74°). The increased vertical dimension of her face was also confirmed (SN.GoGn = 41°, FMA = 32°). Maxillary incisors presented axial inclination within normal limits (1.NA = 22°), but were retroclined (1-NA = 1 mm). Finally, the mandibular incisor were both proclined (IMPA = 101°; 1.NB = 36°) (Fig 15 and Table 2).



**Figure 14:** Initial panoramic radiograph.



**Figure 15:** Initial lateral cephalometric radiograph (A) and cephalometric tracing (B).

**Table 2:** Cephalometric values at start (A) and at the end (B) of treatment.

	MEASURES		Normal	A	B	A/B
Skeletal pattern	SNA	(Steiner)	82°	82°	81°	1
	SNB	(Steiner)	80°	74°	77°	3
	ANB	(Steiner)	2°	8°	4°	4
	Wits	(Jacobson)	♀ 0 ± 2 mm ♂ 1 ± 2 mm	10 mm	1 mm	9
	Angle of convexity	(Downs)	0°	15°	9°	6
	Facial Angle	(Downs)	87°	81°	84°	3
	SN.GoGn	(Steiner)	32°	41°	34°	7
	FMA	(Tweed)	25°	32°	28°	4
Dental pattern	IMPA	(Tweed)	90°	101°	99°	2
	$\perp$ .NA (degrees)	(Steiner)	22°	22°	22°	0
	$\perp$ .NA (mm)	(Steiner)	4 mm	1 mm	4 mm	3
	$\bar{1}$ .NB (degrees)	(Steiner)	25°	36°	30°	6
	$\bar{1}$ .NB (mm)	(Steiner)	4 mm	10 mm	9°	1
	$\frac{1}{1}$ - Interincisal angle	(Downs)	130°	110°	112°	2
Profile	Upper lip — S-line	(Steiner)	0 mm	1 mm	-1 mm	2
	Lower lip — S-line	(Steiner)	0 mm	4 mm	-0.5 mm	4.5

### TREATMENT PLAN AND MECHANICS USED

The patient was very assertive during her initial consultation, and she understood the need and the potential benefits of an orthodontic retreatment. However, she was a little frustrated to face that reality and thus she made it clear that she wanted the shortest treatment possible, with the best possible results. Treatment objectives included: decrease the vertical dimension of her face, reduce her gummy smile, improve her facial profile and lip posture, achieve adequate Class I molar and

canine relationships, and appropriate overjet and overbite. Consequently, her treatment planning included fixed orthodontic appliances, orthognathic surgery for maxillary impaction, mandibular advancement, counterclockwise rotation of the occlusal plane and a genioplasty. Furthermore, the multidisciplinary team involved in her treatment suggested the performance of a rhinoplasty at the same surgical intervention as the orthognathic surgery, what would eliminate the need for a second surgical procedure some months later.

Orthodontic retreatment was initiated with the bonding of 0.022 x 0.028-in brackets in both arches (MBT Radiance brackets and Master Series Standard Edgewise tubes, American Orthodontics, Sheboygan, WI, USA). Leveling and alignment was achieved with 0.018-in NiTi and 0.018-in SS. During the initial stages of the presurgical orthodontic phase, the patient also extracted all impacted third molars. Subsequently, 0.018 x 0.025-in TMA wires were used to improve torque control, and a 0.018 x 0.025-in SS wire was inserted two months prior to the orthognathic surgery. After the multidisciplinary team evaluated the surgical simulation with presurgical study models and were satisfied with the orthodontic preparation, surgical hooks were welded to the 0.018 x 0.025-in SS wire one week before surgery (Fig 16). Presurgical orthodontic retreatment lasted nine months.



**Figure 16:** Presurgical orthodontic retreatment lasted 9 months.

Orthognathic surgery and rhinoplasty took place as planned. The patient was seen by the orthodontist 1-, 2- and 4-weeks post-surgery. During the first two appointments, intermaxillary elastics were kept in the same position as determined by the oralmaxillofacial surgeon. However, one month post-surgery, both surgical wires were removed and 0.018-in SS wires were inserted, and intermaxillary elastics were used as needed to initiate the correction of the residual malocclusion.



Four months after surgery, the finishing stages of the orthodontic retreatment started with the evaluation of a panoramic radiograph and finishing study models.<sup>15</sup> Once again, the BBO objective evaluating (<https://bbo.org.br>) criteria was used to assist in achieving ideal finishing, and bracket repositioning was performed as needed. Post-surgical orthodontics lasted another nine months and the fixed appliances were removed after a total retreatment time of 18 months. Retention protocol consisted of a 0.035-in Essix retainer on the maxillary arch and a 0.018-in SS bonded to all mandibular six anterior teeth. Patient was oriented to full-time wear the Essix retainer during the first six months post-debonding, and night thereafter.

### TREATMENT RESULTS

Treatment goals were achieved. Post-retreatment facial evaluation showed a significant improvement on the overall facial harmony. Vertical discrepancies were corrected, passive lip sealing was present, smile esthetics significantly improved, as seen with the amount of gingival display within normal limits. Profile analysis revealed a remarkable improvement, as seen with the Class I facial profile, better lip posture, equilibrated facial thirds and harmonic nose. Post-debonding intraoral analysis showed Class I molar and canine relationships, well-coordinated dental arches, adequate overbite and overjet (Fig 17).



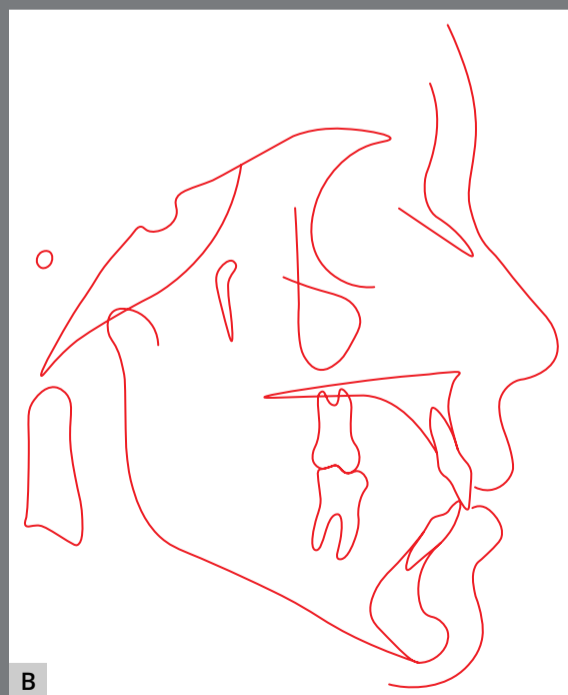
**Figure 17:** Final extraoral and intraoral photographs.

Panoramic radiograph evaluation revealed adequate root parallelism, maintenance of normal alveolar bone levels no signs of root resorption or any sequelae from the surgical procedures (Fig 18). Cephalometric evaluation confirmed the improvement on both sagittal (ANB from  $8^{\circ}$  to  $4^{\circ}$ ; Wits from 10 mm to 1 mm) and vertical planes (SN.GoGn from  $41^{\circ}$  to  $34^{\circ}$ ; FMA from  $32^{\circ}$  to  $28^{\circ}$ ). The spatial position and axial inclination

of the maxillary incisors were maintained, and the labial inclination of the mandibular incisors was reduced (IMPA from  $101^\circ$  to  $99^\circ$ ) (Fig 19, Table 2) The superposition of cephalometric tracings showed the results obtained after orthognathic surgery, with an improvement in the position of the maxilla



**Figure 18:** Final panoramic radiograph after treatment.



**Figure 19:** Final cephalometric profile radiograph (A) and cephalometric tracing (B).