

## ***Arch development using clear aligners, a case report.***

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### **ORIGINAL ARTICLE**

#### **ABSTRACT**

##### **Objective:**

This paper aims to present the case of a young boy in late mixed dentition without space for aligning all permanent teeth. He was treated using clear aligners that stimulated facial growth and developed the dental arches gaining space to align his teeth.

##### **Background:**

The most frequent malocclusions, that come to the dental office, are Angle class I or norm occlusion malocclusions, with crowding.

Treatment objectives depend on the facial type, the cephalometric discrepancy, the patient's age, arch dimensions, and professional ability.

Early treatment can reduce the requirements for premolar extractions to respect arch dimensions and cephalometric measurements, gaining space to align teeth.

It is possible to stimulate bone growth during the growth period if space is necessary for dental alignment.

This stimulus can be done by dental orthopedic devices. We treated this case using clear aligners.

##### **Method:**

The patient was scanned using ITERO™. He used 75 INVISALIGN™ clear aligners, divided into four virtual treatment plans (clinchecks™).

##### **Results:**

Clear aligners increased intermolar and inter-premolar dimensions and gained space to align all teeth. CBTC after treatment proved that despite the huge buccal expansion of the dental arches, there is a 0.33mm to 2.53mm buccal cortical plate.



**Conclusion:**

Clear aligners can develop orthodontic and orthopedic movements during growth spread, increasing bone and arch dimensions. Moreover, patient compliance reduced as treatment time advanced.

**Keywords:** Clear aligner, Orthodontic treatment, mixed dentition, dental expansion.

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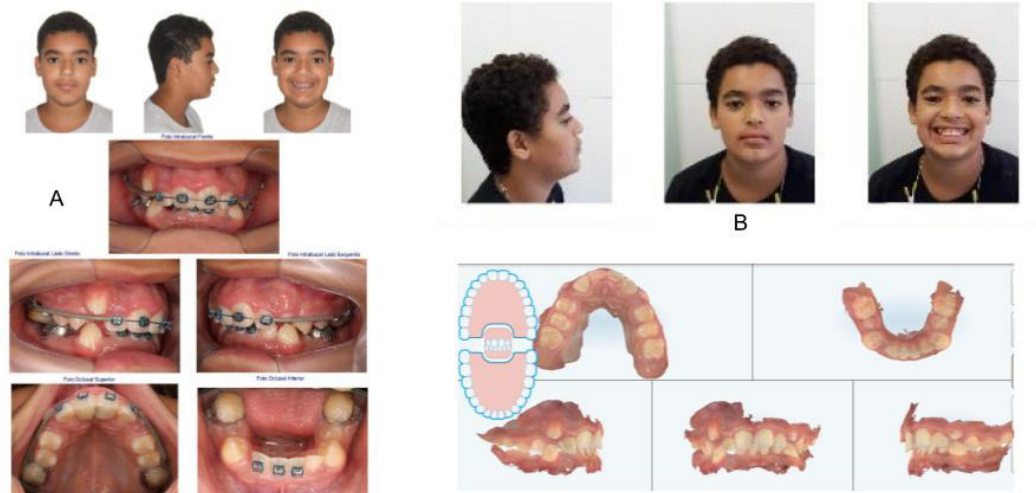


Figure 1 - Images before treatment, A - before fixed orthodontic device removal, B - After fixed orthodontic device removal, 03-2019.

The patient had his buildups, made of dental composite, removed by Professor Camperlingo J. C. according to the following protocol:

The gross amounts of dental composite from the first upper and lower molars, and the lingual surface of upper incisors, were removed using a dental handpiece under refrigeration, and diamond dental burs, series F, KG Sorensen, São Paulo, Brazil, numbers 3118f, 3168f, 3195f. For the final removal of dental composite, preserving dental enamel was used finishing carbide burs, Microdont, São Paulo, Brazil, numbers 7406, 7414, 7903, 284. The final polishing was achieved using Enhance, Dentisply, São Paulo Brazil, at low-speed handpiece, and propylene glycol. (Figure 1B)

Cephalometric analysis revealed a child before his growth spread, confirmed evaluating the fourth cervical vertebrae (C4), which still presented a square form.<sup>7</sup> (Figure 2A)

Ricketts cephalogram revealed a balanced profile (Figure 2B) of a brachyfacial patient (Vert = 0.55), convexity normal for this age (1,38), upper and lower incisors lingually inclined, and lower incisors lingually positioned to A-Po (Figure 2C).

## **INTRODUCTION**

The most frequent malocclusions, 62.9% of Latino Americans that come to the dental office, are Angle class I or norm occlusion malocclusions, with crowding.<sup>1</sup>

Treatment objectives depend on the facial type, the cephalometric discrepancy, the patient's age, arch dimensions, and professional ability.<sup>2</sup>

Sometimes premolar extractions can be necessary to respect arch dimensions and cephalometric requirements,<sup>3</sup> early treatment reduces this need, as bone can be stimulated to grow in specific directions, gaining space to align teeth<sup>4</sup>.

During the growth period, if space is necessary for dental alignment, as muscles and bones are growing, and the whole face is being remodeled, it is essential to stimulate bone growth<sup>4</sup>.

This stimulus can be done by dental orthopedic devices like quad-helix, bi-helix, Haas, hyrax<sup>5</sup>, ie., or functional orthopedic devices<sup>6</sup> like Planas (RNO), SNs, Frankel, Bionator, Bimler.

## **OBJECTIVE**

This paper presents the case of a young boy in late mixed dentition without space for aligning all the permanent teeth. Clear aligners stimulated facial growth and developed the dental arches gaining space to align his teeth.

## **CASE REPORT**

RDC, 11 years old, caucasian male, was brought by his parents to the Dental Clinic of Nove de Julho University, using braces on all erupted permanent teeth, and buildups over the occlusal surface of the lower first permanent molars, their chief complaint was the lack of space for the unerupted permanent teeth.

The professional prescribed the first premolar extraction to continue treatment, manage space to align permanent teeth, and properly achieve final occlusion. The parents brought the patient searching for a second opinion.

This case was submitted to the Ethics Committee of Universidade Nove de Julho and received a protocol number: 1.358.738. Clinical examination revealed a late mixed dentition, molars in a false Class III, overjet 6mm, overbite 4.3mm, lack of space for teeth 4.5, 4.3, 3.3, 3.5, and a continuous archwire attached to the braces, deep bite, a severe curve of Spee, lower incisors extruded and retruded, and a severe overjet with lower lip trusting. (Figure 1A)

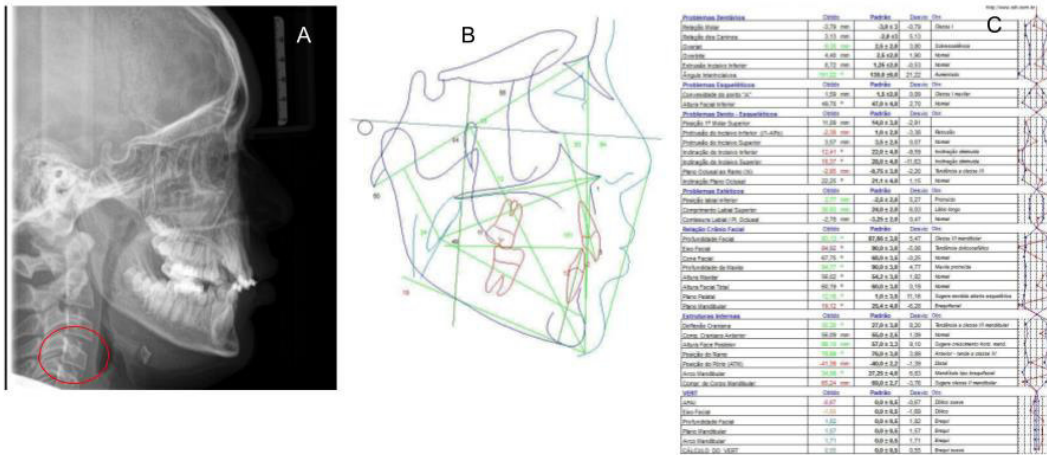


Figure 2 A - Lateral X-ray, 2B - Ricketts cephalogram, 2C - Ricketts 32 factors analysis before treatment, 03-2019.

The X-ray analysis showed a patient in the late mixed dentition, with second molars, premolars, and canines in the eruption process but without enough space for proper alignment. First molars and incisors had their roots completely formed (Figure 3).



Figure 6 B - Occlusal view before and after treatment simulation, intermolar width 46,4mm to 48.6mm, interpremolar width 34.3mm to 37mm, m 12-2019.



Figure 3 - Panoramic X-ray before treatment, 03-2019.

### First Clincheck™

The patient was scanned using an intra-oral 3D scanner ITR0™ to prepare a first treatment plan using the software Clincheck™, with 30 clear aligners changed weekly, to expand the dental arches and gain space for the unerupted teeth. (Figure 4A,4B)

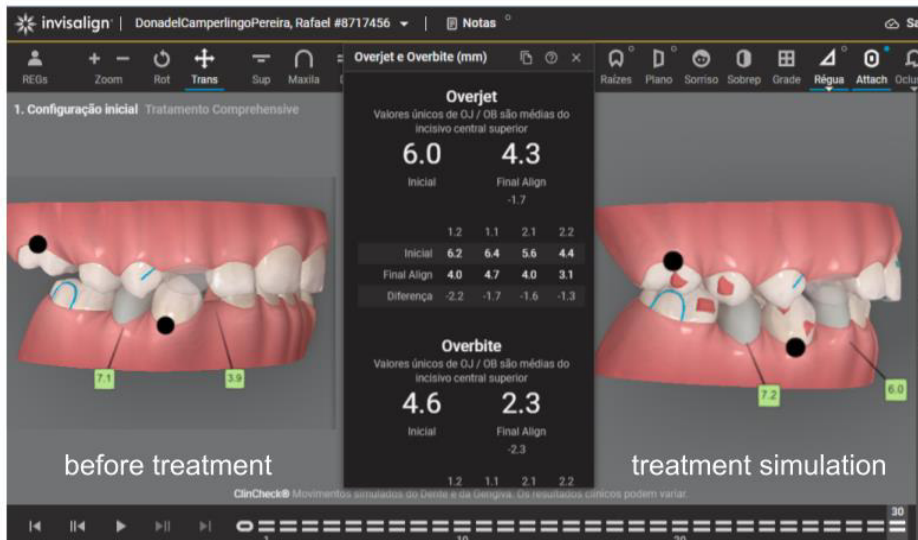


Figure 4A - Lateral view before and after treatment simulation, overjet 6mm to 4.3mm and overbite 4.6mm to 2.3mm, 03-2019.

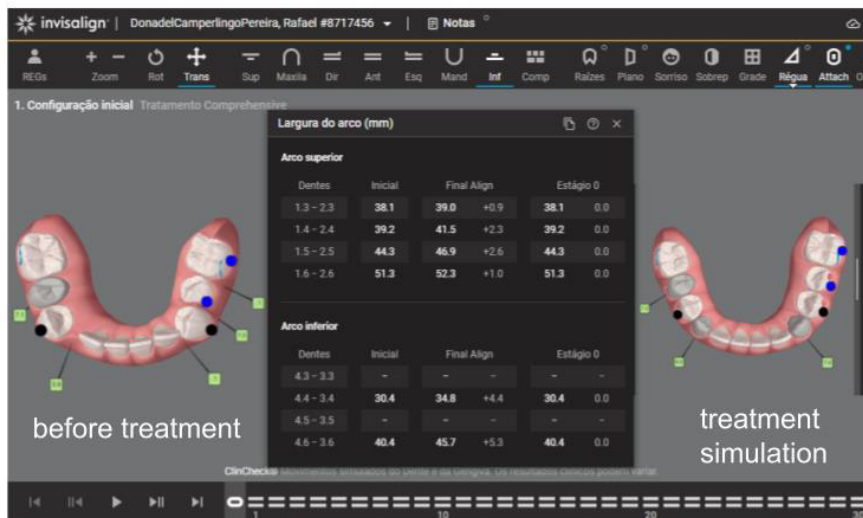


Figure 4 B - Occlusal view before and after treatment simulation, intermolar width 40,4mm to 45.7mm, interpremolar width 30,4mm to 34.8mm, 03-2019.

Although the patient was very collaborative, after 24 weeks (six months) aligners were not well adapted, achieving a partial result. In the lower arch, overjet was expected to reduce by 1.7mm (Figure 4A) and decreased by 2.4mm (Figure 6A), overbite was expected to reduce by 2.3mm (Figure 4A) but decreased by 1.9mm (Figure 6A), intermolar width was expected to increase by 5.3mm (Figure 4B) and expanded by 6.0mm (Figure 6B) and inter premolar width was expected to increase by 4.4mm (Figure 4B) and increased by 3.9mm (Figure 6B) (Table 1). The first molars were in class I, lower incisors were aligned, the first premolars erupted, and the second premolars were partially erupted. After this first set of aligners, there was insufficient space to align the permanent canines, so we had to rescan the patient for a second Clincheck™ and additional aligners. (Figure 5)

Table 1 - Dental arch measures(mm) before and after treatment simulation (Clincheck™)



clincheck	overject		overbite		6-6		4-4	
	before	simulation	before	simulation	before	simulation	before	simulation
first	6.0	4.3	4.6	2.3	40.4	45.7	30.4	34.8
second	3.6	2.4	3.7	1.8	46.4	48.6	34.3	37.0
third	2.7	2.0	3.4	1.6	48.5	50.2	37.5	38.9
fourth	2.5	3.2	2.3	1.8	49.2	49.2	36.8	37.4
dif.1-4	3.5	reduction	2.3	reduction	8.8	expansion	6.4	expansion



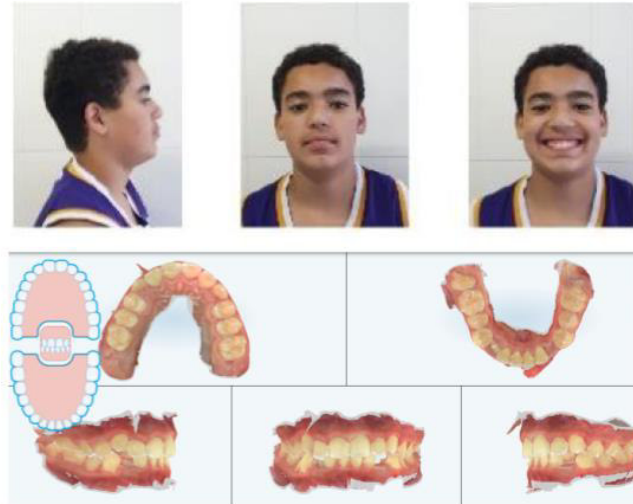


Figure 5 - Images before the 2<sup>nd</sup> clinic check, 12-2019.

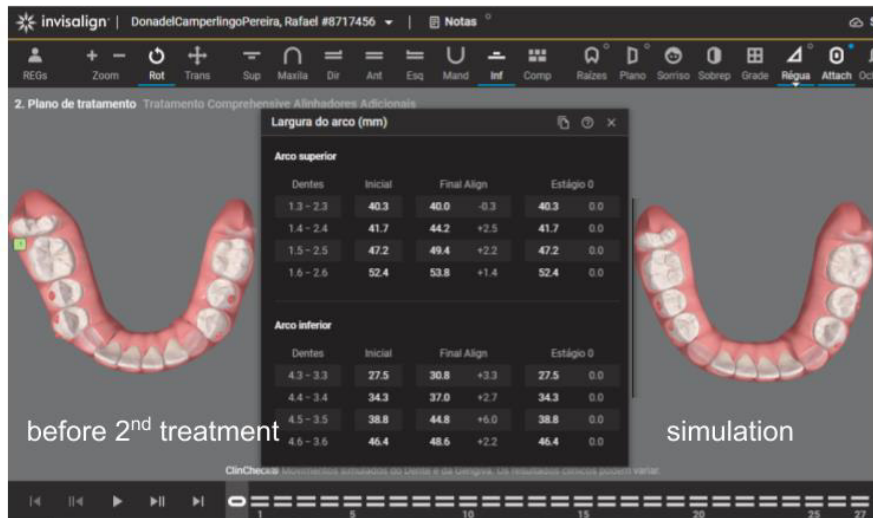


Figure 6 B - Occlusal view before and after treatment simulation, intermolar width 46,4mm to 48,6mm, interpremolar width 34,3mm to 37mm, 12-2019.

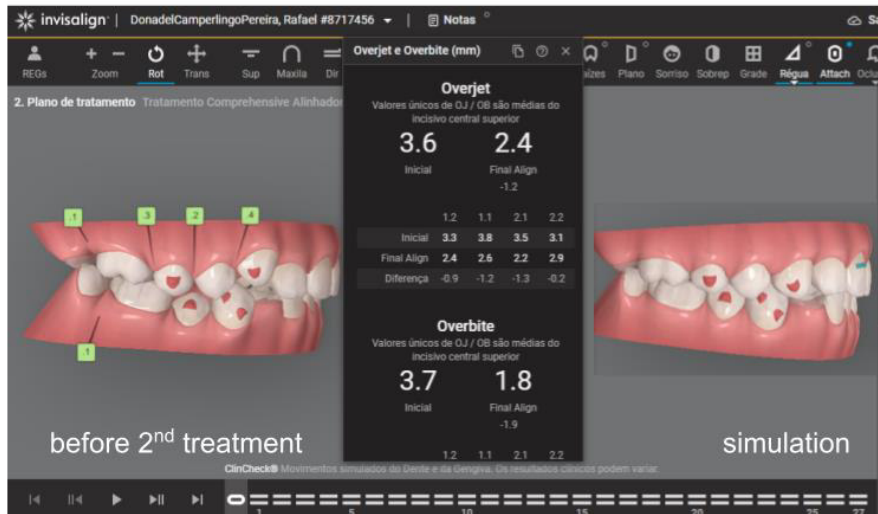


Figure 6A - Lateral view before and after treatment simulation, overject 3.6mm to 2.4mm and overbite 3.7mm to 1.8mm, 12-2019.

### Second Clincheck™

The patient used the second set of 27 aligners. After 7 months of treatment, the overjet was expected to reduce by 1.2mm (Figure 6A) but decreased by 0.9mm (Figure 8A), overbite was expected to reduce by 1.9mm (Figure 6A) but decreased by 0.3mm (Figure 8A), intermolar width was expected to increase by 2.2mm (Figure 6B) but expanded by 2.1mm (Figure 8B), inter premolar width was expected to increase by 2.7mm (Figure 6B) but expanded by 3.2mm (Figure 8B) (Table 1). At the end of this second set of aligners, teeth were aligned, and both arches were symmetrical and coordinated, but still, there was not enough space for the permanent canines (Figure 7).

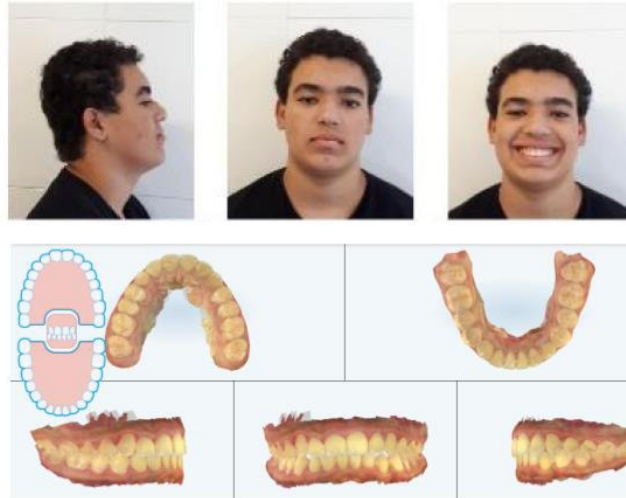


Figure 9 - Images before the 4<sup>th</sup> clinic check, 03-2021.

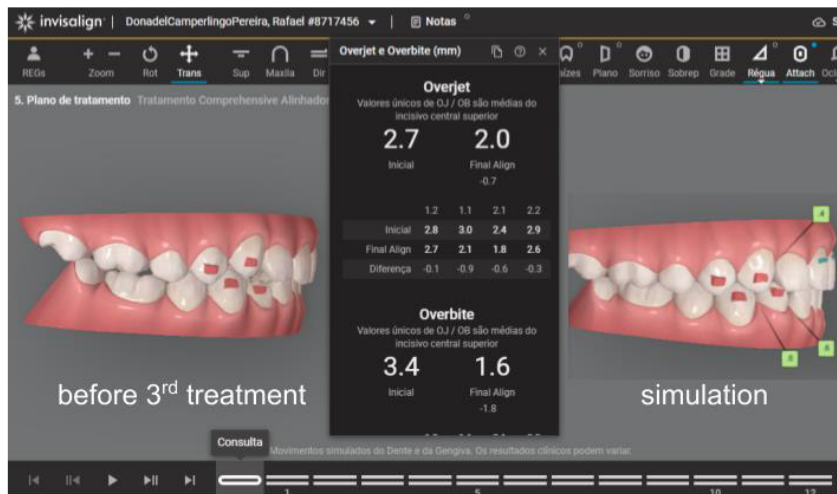


Figure 8A - Lateral view before and after treatment simulation, overjet 2.7mm to 2.0mm and overbite 3.4mm to 1.6mm, 08-2020.

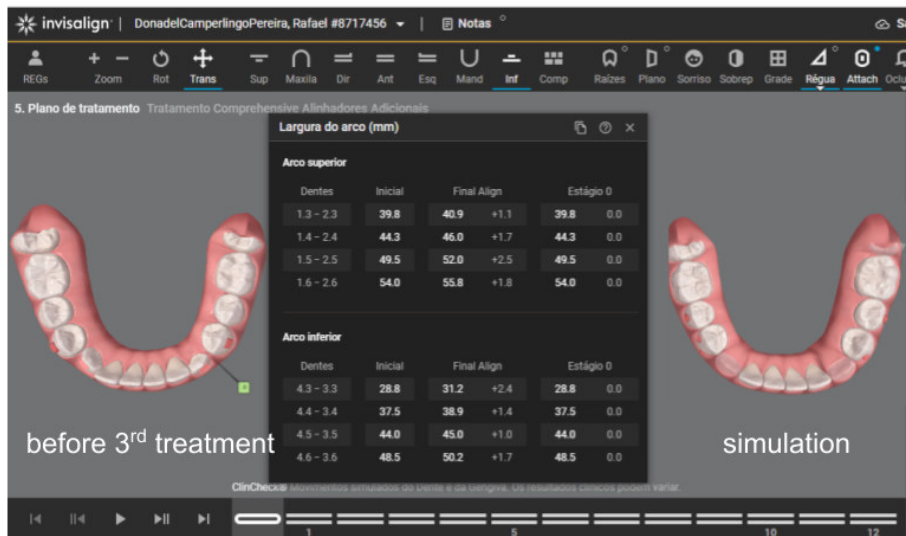


Figure 8B - Occlusal view before and after treatment simulation, intermolar width 48.5mm to 50.2mm, interpremolar width 37.5mm to 38.9mm, 08-2020.

### Third Clincheck™

A third treatment plan was made with 12 aligners. This time it was possible to identify that the patient was less collaborative than he was at the beginning of the treatment. That became clear when comparing his treatment goals and the results. He used these 12 aligners for six months. In the end, overjet was expected to reduce by 0.7mm (Figure 8A) but decreased by 0.2mm (Figure 10A), overbite was expected to reduce by 1.8mm (Figure 8A) but decreased by 1.1mm (Figure 10A), intermolar width was expected to increase by 1.7mm (Figure 6B) but expanded by 0.7mm (Figure 8B) and inter premolar width was expected to increase by 1.4mm (Figure 6B) but contracted by 0.7mm (Figure 8B) (Table 1). At the last appointment, it was possible to identify that little dental movements still need to be done and that there was not enough space for the lower canines to be properly aligned (Figure 11).

### Fourth Clincheck™

Although the patient and his family were already satisfied with the results, a fourth Clincheck™ was made and the patient used (again without much compliance) 12 aligners. Overjet was expected to increase by 0.7mm (Figure 10A), overbite was expected to reduce by 0.5mm (Figure 10A), intermolar width was expected to maintain the same (Figure 10B) and inter-premolar width was expected to increase by 0.6mm (Figure 10B) (Table 1).

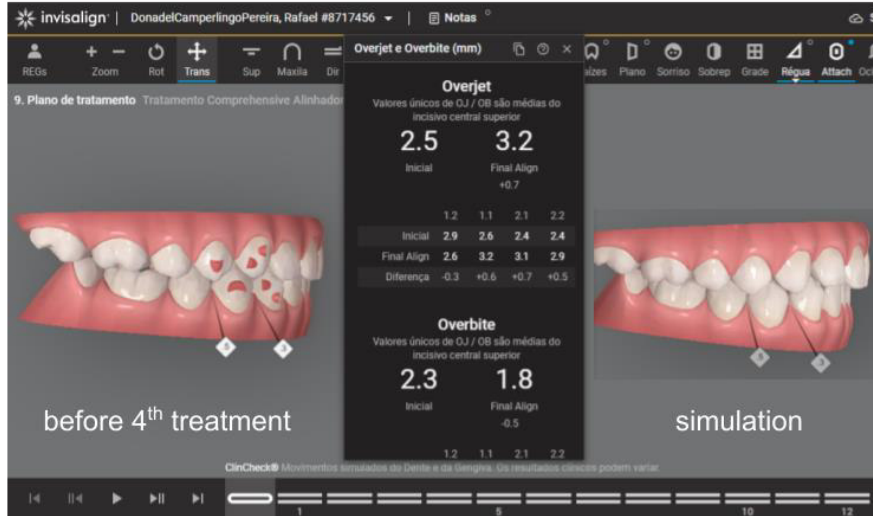


Figure 10A - Lateral view before and after treatment simulation, overjet 2.5mm to 3.2mm and overbite 2.3mm to 1.8mm, 03-2021.



Figure 10B - Occlusal view before and after treatment simulation, intermolar width maintained 49.2mm, interpremolar width increased 36.8mm to 37.4mm, 03-2021.

The patient returned after 13 months and the results were still partially, but at this time the family quit treatment without retention (Figure 11).

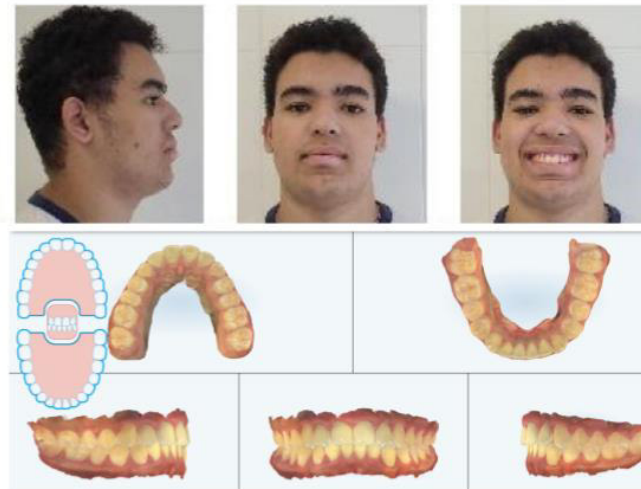


Figure 11 - Images after the 4<sup>th</sup> clinic check, 04-2022.

In late October 2024, he returned to another consultation, a panoramic X-ray, a CBTC, and final photos. (Figure 12).

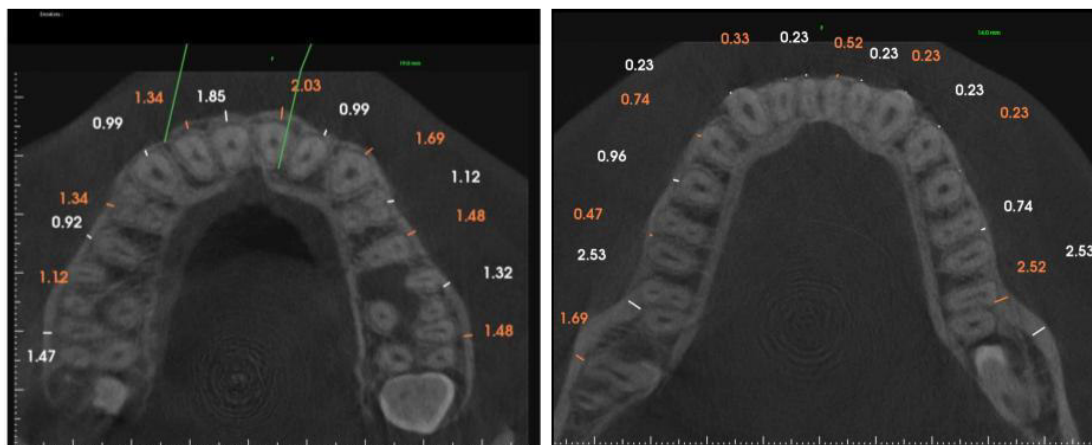


Figure 12 - CBTC after treatment. Images of the maxillary and mandibular alveolar bone demonstrating that despite there was a huge dentoalveolar expansion during treatment, there is still preserved buccal cortical bone in both arches 10-2024.

## **DISCUSSION**

Orthodontic treatment of the growing patient is a defying challenge for the professional.

Timing for orthodontic treatment is still controversial<sup>7</sup>. While some professionals decide to wait until all permanent teeth have erupted<sup>3</sup> others including us defend the early treatment<sup>4,8</sup>.

It was important to start this case before growth spread<sup>9</sup> and use all his growth potential to stimulate transversally maxilla and mandible and gain space for his misaligned teeth<sup>8</sup>.



The orthodontist must attempt to whether growth will help or puzzle the achievement of the treatment goals of young patients and adjust it to the normal individual<sup>8,10,11</sup>.

Growth management can reduce premolar extractions to a level of less than 4% of the cases.<sup>5,11</sup>

When skeletal intervention is required the proper orthodontic or orthopedic device is prescribed.<sup>4,11,12</sup>

We started treating this young boy before his growth spread and comparing the results after using 75 clear aligners, the overjet was reduced by 3.5mm, the overbite was decreased by 2.3mm, the arch dimensions increased (intermolar width increased by 8.8mm and inter-premolar width increased by 6.4mm).

Although there was not enough space in the lower dental arch for the eruption of the canines, our treatment plan, expanding the dental arches instead of extracting teeth, gained space for aligning his teeth without extraction and flaring incisors.

Moreover, CBTC after treatment proved that despite the clear aligners promoting a huge buccal expansion of molars, premolars, and lower incisors, this treatment achieved bone expansion and not just dental movements<sup>13</sup>. CBTC measured from 0.33mm to 2.53mm of buccal cortical plate around these teeth in the maxilla and mandible.

One critical question that comes to the professional is when to start the early treatment. We prescribe that treatment should start as soon as a deviation from normal is detected<sup>14</sup>. For that, the orthodontist must be able to see what is normal in facial growth and balance and what is normal occlusion for each age<sup>10</sup>. Moreover, starting early was important because it became evident that patient compliance decreased as treatment time increased.

Some professionals believe that early treatment should continue until the final occlusion. Our point is that in the growth period when normality for age is achieved, the treatment should pause, the patient should be instructed to use a functional orthopedic appliance as a night retainer<sup>5</sup>, and treatment can be restarted if a new deviation of normality appears<sup>10</sup>.

Growth management can improve facial balance and the quality of orthodontic treatment<sup>4,10</sup> reducing extractions requirements,<sup>4</sup> and clear aligners have been used as an efficient tool in this field.

## **FINAL CONSIDERATIONS**

Clear aligners properly planned by the professional and compliantly used by the patient can develop orthodontic and orthopedic movements during growth spread, increasing bone and arch dimensions.

Clear aligners are a powerful tool, but patients and professionals should be aware that depending on the amount of details requested the best results normally will not be achieved with just one set of aligners, and patient compliance can decrease as treatment extends for longer periods.

#### Authors disclosure

All the authors disclose financial interests.

#### Acknowledgments

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#### Work management

Marcos Fernando Xisto Braga Cavalcanti treated the case and wrote the manuscript, José Carlos Camperlingo removed the buildups and attachments, Marcelo Dutra analyzed and organized images and Olga Maria Altavista revised the manuscript.

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