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Methods of Class II Correction in Growing Patients using Clear Aligner Therapy

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OKU Sutro Excellence Day Project Cover Sheet

Project Title

Methods of Class II Correction in Growing Patients using Clear Aligner Therapy

Full name(s) and class year(s) of all project collaborators

Example: Jane Smith, DDS 2022; John Smith, DDS 2022

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Project Category

DDS/IDS/DH - Research Awards

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Objectives: This study aimed to compare 1) treatment time, 2) treatment outcome, and 3) treatment effects in regards to dental and skeletal changes of class II molar correction in growing patients between cases using Invisalign mandibular advancement (MA) and class II elastic simulation jump.

Methods: 44 growing patients with Class II malocclusion were included: 17 patients in the class II elastic group and 27 in the Invisalign MA group. Molar relationships on digital casts at pre-treatment (T1) and end-of-active-treatment (T2) for each treatment group were obtained. 3Shape software was used to measure the amount of Class II correction by comparing molar relationship, overjet (OJ), and overbite (OB) at T1 and T2 respectively. Measurements were taken separately by 2 students, and averaged before data analysis.

Results: The average molar correction was greater for the MA group (-3.48 ± 1.47mm) than the elastics group (-2.88 ± 1.43mm) with negative signs indicating correction to Class I. Treatment time was longer in the MA group, averaging 33.13 ± 12.91 months while the elastics group averaged 26.05 ± 12.93 months. The average overjet correction was greater for the MA group (-3.20 ± 1.83mm) than the elastics group (-2.16 ± 1.79mm). The average overbite correction was slightly greater in the MA group (-2.01 ± 1.21mm) than in the elastics group (-1.49 ± 1.0mm).

Conclusions: Both mandibular advancement and class II elastic jump using clear aligner therapy successfully corrected class II malocclusion. Invisalign MA performed significantly better at correcting molar relationships, but its ability to correct overjet and overbite compared to the elastic jump method is statistically insignificant. While Invisalign MA requires longer treatment time on average, the difference is statistically insignificant.

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Methods of Class II Correction in Growing Patients using Clear Aligner Therapy

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BACKGROUND

- Skeletal class II malocclusions account for over one-third of all malocclusions observed globally.[3]
- The etiology of skeletal class II malocclusion is multifactorial, but most often associated with mandibular deficiency. Therefore, in skeletal class II adolescents growth modification is an effective treatment strategy, which involves suppressing maxillary growth to allow catch up growth of the mandible and/or stimulating mandibular growth, typically with headgear, removable functional appliances, or fixed functional appliances.[3]
- Traditional functional appliances such as the Herbst and twin block systems involve growth modification in addition to dentoalveolar movement. The Herbst appliance is a fixed, rigid functional device that maintains the mandible in an extended forward position to primarily create reciprocal backward force on the maxilla and in theory promote growth of the condyle and mandible. Unlike the Herbst, the twin block involves 2 removable bite blocks that interlock to hold the lower jaw in a forward position. While these treatments are only applicable to patients in the pubertal growth stage, they can be highly effective.[6]
- Class II correction with elastics has been shown to be effective with clear aligner therapy in both growing and nongrowing patients, by applying the biomechanical principles of moving the upper dentition distally, and lower dentition mesially.[1,5] While functional appliances target growth modification specifically with higher force levels, there has been some skeletal effect shown using elastics in growing patients. A systematic review by Janson et al estimated the class II correction with FFA and elastic use to be 18.9% skeletal, a combination of maxillary restraint and mandibular growth, versus 71.1% dentoalveolar when looking at studies that did not compare elastics to other class II correction methods.[2]
- For the growing class II population, clear aligner treatment has an additional option of the mandibular advancement (MA) feature which functions similar to the twin block system by utilizing two trays that interlock to place the mandible forward to stimulate class II correction.[4]
- Clear aligner therapy is becoming a more desired treatment option due to the increased desire for more esthetic options, and the evolving mentality of patient's active participation in their own health care.
- Due to the novelty of clear aligners, in particular the mandibular advancement feature, there has been minimal research to compare MA treatment to other class II correction methods.

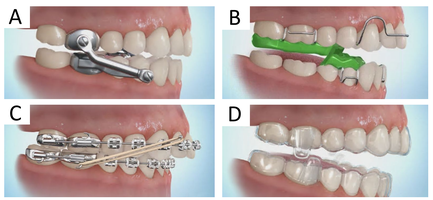

Fig. 1 – Herbst (A), Twin Block (B), Elastics (C), Mandibular Advancement (D) appliance photos adopted from Dolphin Aquarium 3.5.

OBJECTIVES

This study aimed to compare 1) treatment outcome, 2) treatment time, and 3) treatment effects in regards to dental and skeletal changes of class II molar correction in growing patients between cases using Invisalign mandibular advancement (MA) and class II elastic simulation jump.

HYPOTHESIS

In growing patients with class II malocclusion undergoing clear aligner therapy, there is no difference in treatment time, treatment outcome, or treatment effects between Invisalign mandibular advancement and class II elastic simulation jump.

METHODS

A total of 44 growing patients with Class II malocclusion were included, with 17 patients in the class II elastic group and 27 in the Invisalign MA group. Molar relationships on the digital casts at pre-treatment (T1) and end-of-active-treatment (T2) for each treatment group were obtained. 3Shape software was used to measure the amount of Class II correction by comparing molar relationship, overjet (OJ), and overbite (OB) at T1 and T2 respectively. Molar relationship was measured by tracing the distance from the upper first molar mesiobuccal cusp tip to the lower first molar mesiobuccal groove for both the right and left sides. Overjet (OJ) and overbite (OB) were analyzed by using 2D cross sections through the middle of the upper and lower central incisors to trace the distance from the upper incisal edge to lower incisal edge, with the x-axis roughly assessing OJ and y-axis assessing OB. To ensure accuracy, each measurement was taken separately by 2 students, and averaged before data analysis.

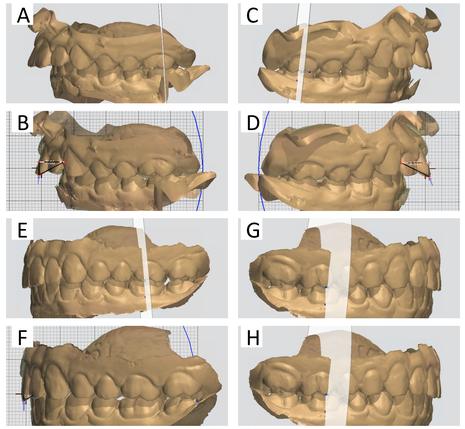

Fig. 2 – (A,C) Left and right first molar relationships on pre-treatment casts. (B,D) Left and right overjet and overbite measurements on pre-treatment casts. (E,G) Left and right first molar relationships on post-treatment casts. (F, H) Left and right overjet and overbite measurements on post-treatment casts.

RESULTS

- **Treatment Outcome:** The average molar relationship at T1 was **2.87 ± 1.18 mm** and **3.58 ± 1.22 mm** for the elastics group and MA group, respectively. The average molar relationship at T2 was **0.01 ± 1.21** and **0.11 ± 1.32** for the elastics group and MA group, respectively, and these differences were not statistically significant. The average amount of molar correction for the elastics group and MA groups respectively was **-2.88 ± 1.43 mm** and **-3.48 ± 1.47 mm** (the negative sign indicates correction to Class I), with the molar correction amount being greater in the MA group.
- **Treatment Time:** Treatment time was longer in the MA group, averaging **33.13 ± 12.91 months** while the elastics group averaged **26.05 ± 12.93 months**, but the difference was not statistically significant.
- **Overjet:** The average overjet at T1 was slightly greater in the MA group than the elastics group, with the groups averaging **6.24 ± 1.86 mm** and **5.03 ± 1.97 mm**, respectively, the difference not being statistically significant. The average overjet at T2 was **2.87 ± 0.61 mm** for the elastics groups and **3.03 ± 0.71 mm** for the MA group. The average overjet correction was **-2.16 ± 1.79 mm** for the elastics groups and **-3.20 ± 1.83 mm** for the MA group, with the MA group performing better.
- **Overbite:** The average overbite at T1 was **3.71 ± 1.01 mm** and **4.13 ± 1.27 mm** for the elastics group and the MA group, respectively. The average overbite at T2 for the elastics and MA groups, respectively, was **2.22 ± 0.62 mm** and **2.12 ± 0.86 mm**. The average overbite correction was slightly greater in the MA group than in the elastics group with the values being **-2.01 ± 1.21** and **-1.49 ± 1.06 mm**, respectively.

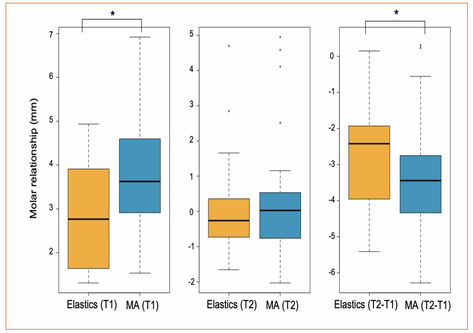

Fig. 3 – Average molar relationships at T1, T2, and T2-T1. Statistically significant differences (p<0.05) are marked with *.

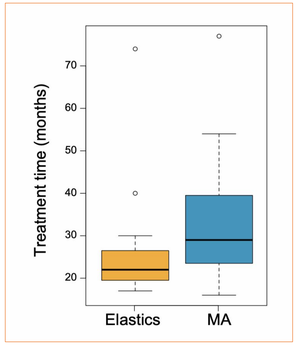

Fig. 4 – Average treatment time for the two groups. Statistically significant differences (p<0.05) are marked with *.

OJ Comparison			
	Elastics	MA	*P*
T1	5.03 ± 1.97	6.24 ± 1.86	0.0471
T2	2.87 ± 0.61	3.03 ± 0.71	0.4519
T2-T1	–2.16 ± 1.79	–3.20 ± 1.83	0.0707

Table 1 – Average overjet at T1, T2, and T2-T1. $P < 0.05$ is considered to be statistically significant.

OB Comparison			
	Elastics	MA	*P*
T1	3.71 ± 1.01	4.13 ± 1.27	0.2580
T2	2.22 ± 0.62	2.12 ± 0.86	0.6793
T2-T1	– 1.49 ± 1.06	– 2.01 ± 1.21	0.1541

Table 2 – Average overbite at T1, T2, abd T2-T1. $P < 0.05$ is considered to be statistically significant.

DISCUSSION

- While this study is not yet complete and more data will be obtained regarding skeletal versus dental correction and treatment side effects, insights gained from this research can help solidify treatment planning decisions for growing class II patients and encourage the option of clear aligner technology with orthodontic practitioners.
- A preliminary analysis of 10 patients from each group indicates that ANB and Wits had a more significant decrease for MA group than elastics.
- In addition, patients in the mandibular advancement group had a statistically significant more severe Class II molar relationship and future research could also focus on comparing this sample with a control group.

CONCLUSIONS

- Both mandibular advancement and class II elastic jump using clear aligner therapy successfully corrected class II malocclusion.
- Invisalign MA performed significantly better at correcting molar relationships, but its ability to correct overjet and overbite compared to the elastic jump method is statistically insignificant.
- While Invisalign MA requires longer treatment time on average, the difference is statistically insignificant.
- This information may be applied in practice to determine the clear aligner treatment modality best suited for growing class II patients.

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