COMPARISON OF THE DISTALIZATION EFFECTS OF THE JONES JIG, DISTAL JET AND PENDULUM APPLIANCES: pilot study

Nowadays, it is known that the class II malocclusion is not just a simple syndrome, but a group of many subtypes. It could be the result either of a dental or a bone discrepancy: maxillary protrusion, mandible retrusion or both (Henry, 1957; Moyers, 1991; Bowman, 1998).

Considering all kinds of class II malocclusion treatment from the last 100 years, especially in those cases which the bone component is minimum or does not exist, the distalization of the upper molars is desirable.

In the literature is described many appliances which were designed to distalize upper molars. The first one is the extra(oral) introduced by Kingsley, in Gould (1957), which is much used and respected by the researchers. Although, they can cause eye and facial lesions. It is a removable appliance, so, many patients refuse to wear it, not cooperating with the success of the treatment. In order to solve of this problem, orthodontists started thinking about appliances that need no or minimum cooperation of the patients.

The intraoral mechanisms more studied were: the Herbst, Jasper Jumper, magnets, NITI coins, Jones Jig and Pendulum. Even though, this appliances require less or minimum cooperation, many of those produce side effects such as: upper molar crown inclination and loss of anchorage.

Since the lack of information available in the literature about the efficiency of these appliances: Jones Jig, Pendulum and Distal Jet, it was decided the present study. So, it was developed a pilot study which aimed determine the effects caused by the use of these 3 appliances on the anchorage teeth and on the incisors regarding mandible position and soft tissue profile.

Advantages and disadvantages of intraoral distalization methods with minimum cooperation

Advantages of the alternatives methods of distalization, when compared to the extraoral traction are: (1) aesthetic factor; (2) minimum cooperation (3) application of continuous forces (4) rapid movement of the teeth.

The disadvantages are: (1) mesial inclination of premolars; (2) incisors forward inclination; (3) extrusion of maxillary molars (4) no control of the rotation center during the molars distalization (Armstrong, 1971; Takami et al., 1991; Bondermark e Kurol, 1992; Locatelli et al., 1992; Sugino, Furquim e Ramos, 2000); (5) larger number of procedures in order to install the appliance (6) difficult to clean. Besides, there are solid reasons to believe that they are not able to produce orthopedic effects.

Indications

These appliances are indicated to be used (1) dental class II malocclusion caused by rotation of maxillary molars; (2) slight skeletal class III malocclusion associated to a dental class II malocclusion when the patient presents a concave profile with a maxillary retrusion; (3) patients with dental class II malocclusion who refused to wear extraoral appliance (4) asymmetric mechanics (unilateral class II) (5) dental class II malocclusion with class I facial pattern (Jones e White, 1992).

It is not indicated these kind of appliances when the patient presents a vertical growing pattern, because extrusion of maxillary molars can not be controlled.

Appliances:

- Distal Jet:

The Distal Jet was developed by Carano and Testa (1996) is also used to distalize the maxillary molars and it has been able to eliminate the disadvantages presented by the intraoral mechanisms of distalization such as inclination and rotation of the molars.

It is easy to install and the effect is activated quickly, without damage to the soft tissues. It is well tolerated by patients (Carano e Testa, 1996). Distal Jet is illustrated in figure 1, on an oclusal view.
On their researches, Carano and Testa (1996) observed a body distal movement of the maxillary molars (translation) of 2 to 5mm in 4 months of treatment, not occurring any extrusion of the molars and not producing the opening of the bite neither a mandible rotation. After distalization is completed, the maxillary molars should be left anchored by the Nance appliance avoiding a mesial movement while the anterior teeth are moved distally.

- Pendulum:

It was designed by Hilgers in 1992. It is comfortable because there is no acrylic among teeth, so it does not interfere on the talking. Besides it is easy to make it. But it usually cause opening of the bite and should not be worn by high facial lower height (Ghosh e Nanda, 1996). Figure 2 illustrates a standard Pendulum appliance with the coins inserted in the maxillary molars tubes.

Hilgers in 1992 observed a distalization of the maxillary molars of 5mm in 3 to 4 months. According to him, the distalization is better when the second molars have not erupted.

- Jones Jig:

It was introduced by Jones and White in 1992. It is made by a NITI opened coin which produces a 70-75gr compression force over the maxillary molars. During the distalization, a modified Nance appliance is inserted in the first premolars and second premolars. Figure 3 illustrates an occlusal view of the appliance.
MATERIAL AND METHODS:

In order to eliminate the deficiency on the sample found in many previous researches, this study was done with patients who had to fill strict requirements to be included:

1) Lack of any inflammatory gum process, determined by lack of bleeding in the gengival sulk
2) Lack of cavity lesions.
3) No previous orthodontic treatment
4) Bilateral dental Class II relation
5) Skeletal class I malocclusion or slight skeletal class II malocclusion according to values by Silva Filho (1984);
6) Normal vertical skeletal pattern according to Silva Filho (1984);
7) Treatment plan without tooth extraction
8) Use of Distal Jet, Pendulum or Jones Jig on the first part of the orthodontic treatment to produce the distalization of the maxillary first molars.
9) No appliance damage during treatment
10) Good quality radiographs

The clinical part of the research was done with 18 Brazilian white patients (9 males and 9 females) treated in the orthodontics post graduation course of Itauna University Dental School. The age ranged from 12.1 to 14.4 years old. The absence of the second molar was not relevant.

Appliances:

- **Distal Jet:** It was worn this appliance with a double screw on the activation ring, as designed by Bowman (1998) by AMERICAN ORTHODONTICS. The size and shape of Nance button was standard. All the patients from the sample, the first premolars were the anchorage unit. A 240 grams nickel-titanium coin was used bilaterally.

- **Pendulum:** The maxillary molars were banded with 0.045” tubes (edgewise) on lingual and buccal surfaces. The retention were fixed on the first and second maxillary premolars with light cured bonding. At the time of the insertion on the tubes, the coins were already activated. The first maxillary molars were distalized after 3.6 months average and it was not necessary another activation. The pendulum was removed when the buccal medial cusp were 1mm posterior the buccal sulk of the first mandible molars (super class I relation)

- **Jones Jig:** The patients were this appliance from a national company named MORELLI (Jones AX-82X). The Nance button was modified and made by an operator only. The maxillary second premolars were banded, so the anchorage unit could be better and the projection of the anterior teeth minimized. The nickel-titanium coin was compressed about 5mm, liberating a 75 grams force. The coin was not totally compressed to avoid excessive force and consequently loss of anchorage. As the first maxillary molars moved distally, it was necessary another activation. It was done every 4 week period. The treatment time average was 3.6 months. The appliance was removed when the buccal medial cusp were 1mm posterior the buccal sulk of the first mandible molars (super class I relation)

Methods:

Cephalometrics radiographies were taken, in the beginning of the orthodontic treatment (first fase), and immediately after the predicted result was activated. They were done by the same operator, in all the patients of the research. The time between the interruption of the treatment and the final radiography was less than 24 hours.

The cephalometric analysis was based on Ghosh and Nanda research (1996). They were traced on a acetate sheet of paper .003” thickness by UNITEK, with a graphite of 0.5mm from FABER CASTELL. Each of them was done twice in a 2 week break. The Wilcoxon test showed no significant difference (p> 0.05).
Many different plans were done on the cephalometric tracing. So, linear and angular measures were obtained. Figure 5 illustrates these planes and the cephalometric measures used on this study.

![Figure 5](image)

FIGURE 5 – Mostra os planos e as medidas cefalométricas (de tecidos moles, esqueléticas e dentárias) usados nesse estudo: (1) Lábio superior – Plano E; (2) Lábio inferior – Plano E; (3) Ângulo SN – Plano palatino; (4) Ângulo SN – Plano occlusal; (5) Ângulo Frankfurt – Plano mandibular; (6) PTV – Ponto A; (7) PTV – Ponto B; (8) ANS – Me; (9) SN – Incisivo superior; (10) SN – Primeiro pré-molar superior; (11) SN – Primeiro molar superior; (12) SN – Segundo molar superior; (13) PTV – Centróide primeiro pré-molar superior; (14) PTV – Centróide segundo molar superior; (15) PTV – Centróide primeiro molar inferior; (16) PTV – Centróide primeiro molar inferior; (17) PP – Borda incisal do incisivo superior; (18) PP – Centróide primeiro pré-molar superior; (19) PP – Centróide primeiro molar superior; (20) PP – Centróide segundo molar superior e (21) MP – Centróide primeiro molar inferior.


The statistic analyze used was the Wilcoxon test to compare the measures from the 2 tracings done of each radiography, as well as the measures obtained pre and pos treatment.

RESULTS:

- Distal Jet

The active period of the distalization lasted around 4,5 months, varying from 3,5 to 5,8 months. The mean, median, standard deviation, maximum, minimum of the measures pre and post treatment which showed statistic difference (p<0.05) are presented on table 1. It suggests that the distal jet was able to move the first and the second maxillary molars, tipping distally, only, the maxillary second molar without significant loss of anchorage.

<table>
<thead>
<tr>
<th>MEDIDAS CEFALOMÉTRICAS</th>
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<td>Mínimo</td>
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<td>Dentárias angulares (graus)</td>
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<td>SN – 2º molar superior</td>
<td>Pré</td>
<td>56,0</td>
<td>72,0</td>
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<td>Pós</td>
<td>52,5</td>
<td>68,0</td>
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<td>Dentárias lineares (mm)</td>
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<td>PTV – Centróide 1º molar superior</td>
<td>Pré</td>
<td>17,5</td>
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<td></td>
<td>Pós</td>
<td>14,0</td>
<td>27,0</td>
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<tr>
<td>PTV – Centróide 2º molar superior</td>
<td>Pré</td>
<td>9,5</td>
<td>17,0</td>
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<td>Pós</td>
<td>6,5</td>
<td>15,5</td>
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NOTA : O valor de p refere-se à probabilidade de significância do teste de Wilcoxon.
- Pendulum:

Table 2 shows the pre and post cephalometric measures of Pendulum which were statistically different (p<0.05). It showed that an distal tipping of the first maxillary molars occurred.

**TABLE 1 – Analyses of pre and post cephalometric measures of Pendulum which were statistically different.**

<table>
<thead>
<tr>
<th>MEDIDAS CEFALOMÉTRICAS</th>
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<td>Dentárias angulares (graus)</td>
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<td>Pós</td>
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<td>71,5</td>
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**NOTA:** O valor de p refere-se à probabilidade de significância do teste de Wilcoxon.

- Jones Jig:

Table 3 shows the analyses of pre and post cephalometric measures of Jones Jig which were statistically different. It was demonstrated that only crown tipping of the first and second maxillary molars occurred.

**TABLE 3 – Analyses of pre and post cephalometric measures of Jones Jig which were statistically different.**

<table>
<thead>
<tr>
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<tr>
<td>Dentárias angulares (graus)</td>
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<tr>
<td>SN – 1º molar superior</td>
<td>Pré</td>
<td>59,0</td>
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<td>58,0</td>
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<td></td>
<td>Pós</td>
<td>36,0</td>
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</table>

**NOTA:** O valor de p refere-se à probabilidade de significância do teste de Wilcoxon.

**DISCUSSION:**

It should be emphasized the difficulty in finding a standard sample when humans are the being studied. Some parameters are not able to be measured such as growing potential and biochemical constitution of the tissues involved. So, this research shows a sample more standardized than others presented in the literature. Ghosh and Nanda (1996); Runge, Martin and Bukai (1998); Gulati, Kharbanda and Parkash (1998); and Ngantung, Nanda and Bowman (2001) did not mentioned padronization of the skeletal, vertical and sagittal characteristics in their samples.

Unfortunately, this study shows a small number of patients, 6 for each appliance tested. Although, the statistic analyses used were for small samples, it is known the possibility of questionable results. Even though, Bondemark and Kurol (1992), and Gulati, Kharbanda and Parkash (1998) studied repellent magnets and Jones Jig, using a 10 patient sample respectively.

- Distal Jet: it was found that the distalization of the first and second maxillary were 3.1mm and 2.2mm respectively in 4.5 months. These values were significant statistically, with p=0.036. Ngantung, Nanda and Bowman (2001) found 2.12mm and 2.58mm for the first and second maxillary molars respectively after
6.7 months. The distalization difference between their research and this study can be explained by the use of fixed appliance during the distalization period with Distal Jet by Ngantung, Nanda and Bowman (2001) making the distal movement more difficult.

The results showed that the Distal Jet is superior when compared with Pendulum and Jones Jig tipping of the first maxillary molar. This tooth presented a distal crown tipping of 2.2°, insignificant statistically \((p=0.10)\). It indicates a body distal movement of the teeth as affirmed by Carano e Testa (1997). It is more desirable than 8.36° and 14.5° found by Ghosh and Nanda (1996) and Byloff and Darendeliler (1997) respectively for the Pendulum; 7.4° and 8.0° for the repellant magnets (ITOH et al., 1991; Bondemark and Kurol, 1992); and 11° for Jones Jig (Freitas et al., 1995). The second maxillary molar distal crown tipping observed was 6.3°, significant statistically \((p = 0.036)\). Ngantung, Nanda e Bowman (2001) found 11.79°. No vertical movements were found in this study, as did Ngantung, Nanda e Bowman (2001).

There were not any loss of anchorage statistically significant

- **Pendulum**: this appliance is cheaper and the installation process is faster than Jones Jig and Distal Jet. Most of the results pre and post the distalization of the molars were not statistically significant. Only SN-first maxillary molar was different. It proves that the crown of the first maxillary molar tipped distally after the use of the Pendulum.

  The loss of anchorage was not statistically significant. But one of the patients complained that his anterior teeth seemed to be a little projected.

  Ghosh and Nanda (1996) used Pendulum to correct dental class II malocclusion. The sample was with 41 patients and the distalization obtained was of 3.37mm, with crown tipping go 8.36°. The loss of anchorage was of 2.55mm. The facial height become higher 2.79mm. All these changes can be explained by the fact the patients were treated by 3 different orthodontists, in 3 different office and the sample age ranged from 9 to 17 years old.

- **Jones Jig**: this appliance did not accomplish skeletal statistically significant changes only dental. Jones and White (1992), Freitas et al. (1995) and Haydar e Üner (2000) researches about Jones Jig obtained the same results. The only statistically significant result was the crown tipping of the first and second maxillary molars, 8.2° and 9.1° respectively. The first maxillary molar moved distally 1.1mm and the second maxillary molar 1.3mm. Figure illustrates the distalization of the first maxillary molars by the use of Jones Jig.

![Figure 6](image)

**FIGURE 6**: the distalization of the first maxillary molars by the use of Jones Jig.

As well as Jones and White (1992) and Haydar e Üner (2000) findings, the first maxillary molar just tipped distally, not having body movement.

**CONCLUSION:**

Based on the results of the tested appliances, the Distal Jet was considered the most efficient one to correct dental class II malocclusion though the distalization of maxillary molars. It was observed a body movement, it means, the crown tipping was less than with Pendulum or Jones Jig. Besides, the loss of anchorage with Distal Jet was considered smaller than Pendulum and Jones Jig.

It is necessary more studies with these 3 appliances using a bigger sample.
REFERENCES: