Original Article

Class II malocclusion treatment effects with Jones Jig and Distal Jet followed by fixed appliances

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ABSTRACT

Objectives: To compare the skeletal, dentoalveolar, and soft tissue changes in Class II malocclusion patients treated with Jones Jig and Distal Jet distalizers followed by fixed appliances.

Materials and Methods: The experimental groups comprised 45 Class II malocclusion subjects divided into two groups. Group 1 consisted of 25 patients treated with the Jones Jig, and group 2 consisted of 20 patients treated with the Distal Jet. Group 3 comprised 19 untreated Class II subjects. Cephalograms were analyzed before and after orthodontic treatment. For intergroup comparisons, one-way analysis of variance and post hoc Tukey tests were performed.

Results: During treatment, the experimental groups exhibited significant increases in occlusal plane inclination and maxillary second molar mesial tipping. Additionally, the molar relationship improved and overjet decreased significantly in the experimental groups. The Jones Jig group showed greater mandibular incisor proclination and greater overbite reduction than the control group. No significant intergroup differences in nasolabial angle changes were found.

Conclusions: Treatment protocols using the Jones Jig and Distal Jet followed by fixed appliances were effective in correcting Class II malocclusion by means of dentoalveolar changes without significant skeletal and soft tissue changes. The experimental groups showed occlusal plane clockwise rotation and greater mesial tipping of maxillary second molars when compared to the untreated group. (*Angle Orthod.* 2018;88:10–19.)

KEY WORDS: Malocclusion; Angle Class II; Cephalometry; Orthodontic appliance

INTRODUCTION

Several protocols have been proposed for treatment of Class II malocclusions. In nonextraction protocols, maxillary molar distalization can be used to correct molar relationships in patients with maxillary dentoalveolar protrusion and minor skeletal discrepancies.[1]

Maxillary molars can be moved distally by force systems that require patient compliance, including headgear[2] and the Wilson maxillary bimetric distalizing arch system.[3] However, protocols that require minimal dependence on patient compliance may produce more predictable results.[4,5] Various appliances to move maxillary molars distally have been proposed as an alternative to reduce the need for patient cooperation, including magnets,[6] superelastic nickel-titanium wires,[7] Pendulum,[8] Distal Jet,[9] Jones Jig,[10] or First Class.[11]

These appliances are easy to install and promote distal movement of the maxillary molars without the effect of maxillary orthopedic restriction.[9] However, with most of these intraoral methods, the major disadvantage is the undesirable reciprocal anchorage loss in the premolars and incisors during distal molar movement.[1,12] In addition, molar tipping is frequently observed in most of the cases.[5,13–15]

Most of the studies[1,5,14,15] to date have been limited to analysis of changes after molar distal movement. There is little information about outcomes after complete orthodontic treatment including a second phase with fixed appliances.[13,16,17] Therefore, the aim of this study was to compare the dentoalveolar, skeletal, and soft tissue effects in Class II malocclusion patients treated

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with the Distal Jet and Jones Jig distalizers followed by fixed appliances and an untreated control group.

MATERIALS AND METHODS

This retrospective study was approved by the ethics in research committee of Bauru Dental School, University of São Paulo, Brazil. The parents or legal guardians of all patients provided informed consent allowing treatment to be performed.

Sample size calculation was performed based on an alpha level of significance of 5% and a beta of 20% to achieve a power of 80% of the test to detect a mean difference of 1 mm between the groups, with a standard deviation of 1.05 mm, according to a previous pilot study. The results showed that a minimum of 18 patients was necessary in each group.

The experimental sample comprised 45 subjects (29 male, 16 female) who were treated at the Department of Orthodontics, Bauru Dental School, University of São Paulo, Brazil. Additionally, the records of 19 untreated Class II malocclusion subjects (10 male, 9 female) obtained from the files of the same department were used as the control group. These records belonged to a historical control sample. The selection criteria were that the patients presented with bilateral dental Class II malocclusion, all permanent teeth up to the first molars erupted, no severe mandibular crowding, and no previous orthodontic treatment. Each group was treated at different times. The patients were selected for each of the groups if they satisfied the selection criteria.

Group 1 comprised 25 subjects (14 male, 11 female) at an initial mean age of 12.90 years (standard deviation [SD] = 1.43 years), presenting with a minimum of one-quarter cusp Class II molar relationship,[18] treated with the Jones Jig appliance (Figure 1). The original nickel-titanium (NiTi) coil spring (American Orthodontics, Sheboygan, Wisc) that exerted 70–75 g of force was replaced by another NiTi coil spring (G&H Wire Co, Greenwood, Ind). Although it produced a continuous force of 125 g, it was activated 5 mm every 4 weeks to maintain its effective length. A modified Nance button, attached to the second premolars, was used as anchorage, as recommended.[10]

Group 2 comprised 20 subjects (15 male, 5 female) with an initial mean age of 12.77 years (SD = 1.22 years), presenting with a minimum of one-quarter cusp Class II molar relationship.[18,19] Patients in this group were treated with the Distal Jet, as recommended by Carano and Testa[9] (Figure 2). Bands were fitted on the maxillary first premolars and first molars.[5] The Distal Jet was seated as one unit and cemented with glass ionomer cement. For patients with erupted second molars, 240 g of force was applied, and 180 g was used in those without erupted second molars. The Distal Jet appliance was activated on both sides, sliding the collar distally to fully compress the open-coil spring. To maintain the force level, the appliance was reactivated in the same manner once a month. After distal movement was complete, the Distal Jet was converted to a Nance holding arch.

Two graduate students treated all patients. One treated only patients with the Jones Jig and the other treated only patients with the Distal Jet. All treatments were supervised by the same professor. In both groups, the molar distalizing appliances were used until overcorrection of the Class II molar relationship (super Class I) was achieved.[6,20] The mean distalization time was 0.85 years (SD = 0.30 years) and 1.20 years (SD = 0.32 years) for the Jones Jig and Distal Jet appliances, respectively. Subsequently, a second phase of comprehensive preadjusted fixed appliances was performed. Both experimental groups used the same preadjusted bracket prescription. All cases were treated using the same protocol after the distalization phase. All patients used a Nance button placed on the distalized molars in association with night use of headgear for anchorage until complete individual retraction of the maxillary premolars was achieved.[20–22] In the maxillary anterior retraction phase, the Nance button was removed and Class II elastics were used to reinforce anchorage to perform maxillary anterior retraction.[21] Lingual crown torque was similarly controlled in both groups. Headgear was used to upright the first molar roots, as recommended in previous studies.[20–22] Maxillary second molars were bracketed only after anterior retraction, which also aided in uprighting the first molars. The average total treatment time was 4.09 years for the Jones Jig and 4.15 years for the Distal Jet.

The control group (group 3) consisted of 19 untreated Class II malocclusion subjects (10 male, 9 female) at an initial mean age of 12.91 years (SD = 1.22 years) and followed up during an average period of 3.61 years presenting with a minimum of one-quarter cusp Class II molar relationship.[18,19] These subjects belonged to a historic "Growth Study" sample from the same orthodontic department.

Cephalograms of all patients were taken before (T1) and after (T2) orthodontic treatment. Cephalometric tracings and landmark identification were performed by one investigator on acetate paper and then digitized (AccuGrid XNT, A30TL.F, Numonics, Montgomeryville, Pa). The data were stored in a computer and analyzed with Dentofacial Planner software (version 7.02, Dentofacial Planner, Toronto, Ontario, Canada). Bilateral structures of interest were averaged.[23] The cephalometric variables are described in Table 1 and illustrated in Figures 3 and 4. Treatment changes were calculated as T2–T1. The software corrected the magnification factor of the radiographic images that were between 6% and 9.8%.

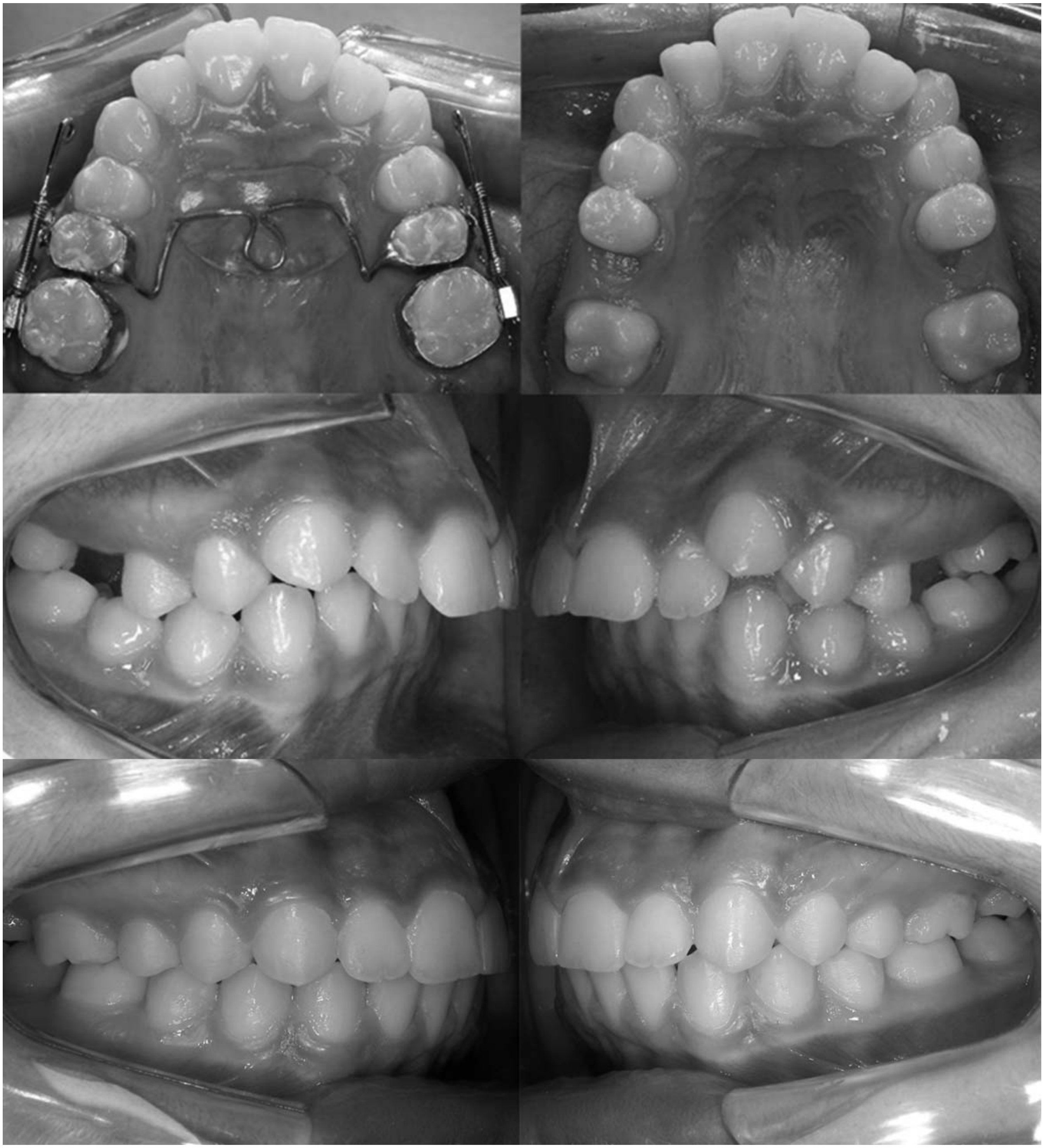

Figure 1. Jones Jig appliance: maxillary molar distalization and final results.

Error Study

Within a month interval of the first tracings, 20 randomly selected cephalograms were retraced by the same examiner (MPP). The random errors were evaluated with Dahlberg's formula, $S^2 = \Sigma d^2/2n$, where S^2 is the error variance and d is the difference between two determinations of the same variable. The systematic errors were estimated with dependent t-tests at $P < .05$. The random errors varied from 0.26 to 1.01 mm and from 0.44° to 1.75°, and only two variables demonstrated significant systematic errors (Table 2).

Figure 2. Distal jet appliance: maxillary molar distalization and final results.

Statistical Analyses

Intergroup sex distribution and pretreatment severity of the Class II malocclusion were compared with Chi-square tests.

All variables were found to be normally distributed according to Kolmogorov-Smirnov normality tests. Therefore, one-way analysis of variance (ANOVA) followed by a Tukey test was used for intergroup comparisons of initial and final ages, treatment time, the cephalometric measures at the pre- and posttreatment stages, and the treatment changes.

All statistical analyses were performed with Statistica software (Statistica for Windows, version 6.0, Statsoft,

Table 1. Cephalometric Measurements

SNA, °	Angle formed by the intersection of SN line and NA line
A-PTV, mm	Linear distance from A point to the pterygoid vertical plane (PTV)
SNB, °	Angle formed by the intersection of SN line and NB line
B-PTV, mm	Linear distance from B point to PTV
ANB, °	Angle formed by the intersection of NA line and NB line
FMA, °	Angle formed by the intersection of Frankfurt plane and Go-Me
SN.occlusal plane	Angle formed by the intersection of SN line and occlusal plane
ANS-Me, mm	Linear measurement from anterior nasal spine to menton (lower anterior face height)
Mx1.SN, °	Angle formed by the intersection of the long axis of the maxillary central incisor and the SN line
Mx1-PTV, mm	Linear distance from the tip of the maxillary central incisor perpendicular to the PTV
Mx1.NA, °	Angle between maxillary incisor and NA line
Mx1-NA, mm	Linear distance from maxillary incisor to NA line
Mx4.SN, °	Angle formed by the intersection of the long axis of the maxillary first premolar and the SN line
Mx4-PTV, mm	Linear distance from the centroid of the maxillary first premolar perpendicular to the PTV
Mx5.SN, °	Angle formed by the intersection of the long axis of the maxillary second premolar and the SN line
Mx5-PTV, mm	Linear distance from the centroid of the maxillary second premolar perpendicular to the PTV
Mx6.SN, °	Angle formed by the intersection of the long axis of the maxillary first molar and the SN line. The first molar long axis was determined by a line passing through the central point between the two root apices and the centroid point
Mx6-PTV, mm	Linear distance from the centroid of the maxillary first molar perpendicular to the PTV
Mx7.SN, °	Angle formed by the intersection of the long axis of the maxillary second molar and the SN line. The second molar long axis was determined by a line passing through the central point between the two root apices and the centroid point
Mx7-PTV, mm	Linear distance from the centroid of the maxillary second molar perpendicular to the PTV
Md1.NB, °	Angle between mandibular incisor and NB line
Md1-NB, mm	Distance from mandibular incisor to NB line
Md6-PTV, mm	Linear distance from the centroid of mandibular first molar to the PTV
NLA, °	Angle formed by the intersection of Cm-Sn and Sn-Ls
Molar relationship, mm	Linear distance from MI to MS. Negative values means more favorably Class I molar relationship. Positive values or zero means Class II tendency
Overjet, mm	Linear horizontal distance from incisal of maxillary incisor to incisal of mandibular incisor
Overbite, mm	Linear vertical distance from incisal of maxillary incisor to incisal of mandibular incisor

Tulsa, Okla), and the results were considered significant at $P < .05$.

RESULTS

The groups were comparable with regard to sex distribution, Class II malocclusion severity, initial and final mean ages, and treatment time (Table 3).

Before treatment, the Distal Jet group had a significantly flatter Frankfort mandibular angle and occlusal plane than the other groups (Table 4). The maxillary first molars were more upright in the Distal Jet group, and the second molars were progressively more distally tipped in groups 2 (Distal Jet), 3 (untreated), and 1 (Jones Jig), respectively. The nasolabial angle (NLA) was significantly greater in the untreated control group.

During treatment, there were significant differences in the changes that occurred between the treatment groups and the control with regard to the occlusal plane inclination. In the treatment groups it increased, while it decreased in the control group (Table 5). The maxillary second molars of the experimental groups had significant mesial tipping as compared to the control group. The Jones Jig group displayed signifi-

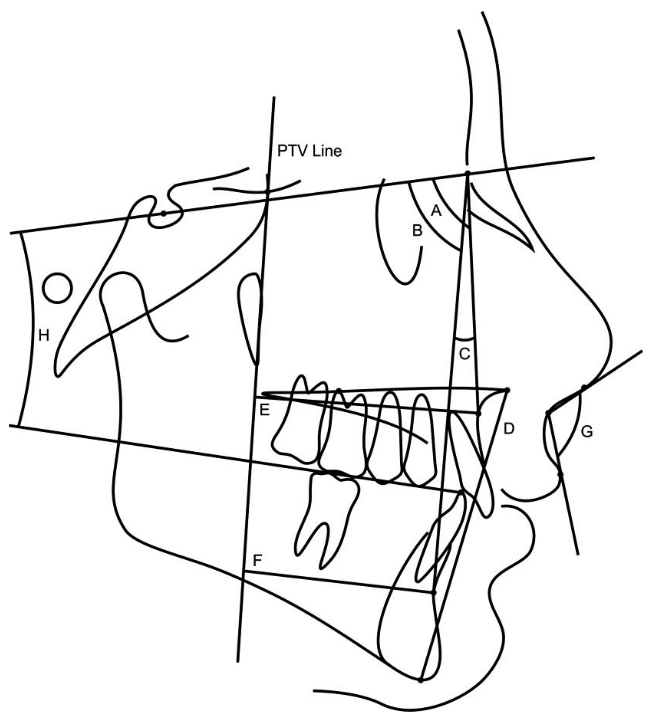

Figure 3. Skeletal and soft tissue cephalometric variables: (A) SNA; (B) SNB; (C) ANB; (D) ANS-Me; (E) A-PTV; (F) B-PTV; (G) nasolabial angle; and (H) SN.occlusal plane.

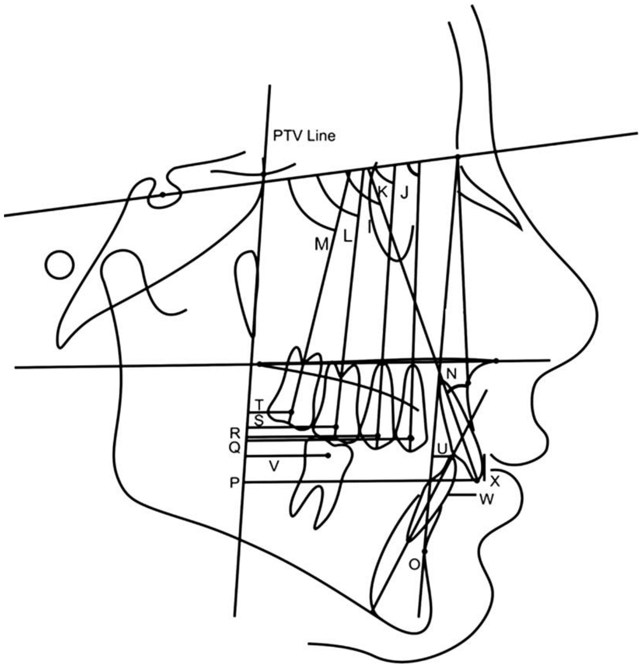

Figure 4. Dental variables: (I) Mx1.SN; (J) Mx4.SN; (K) Mx5.SN; (L) Mx6.SN; (M) Mx7.SN; (N) Mx1.NA; (O) Md1.NB; (P) Mx1-PTV; (Q) Mx4-PTV; (R) Mx5-PTV; (S) Mx6-PTV; (T) Mx7-PTV; (U) MD1-NB; (V) MD6-PTV; (W) overjet; and (X) overbite.

cantly greater protrusion (forward linear movement) of the mandibular incisors than did the control group. The molar relationship improved significantly more in the Jones Jig group than in the Distal Jet group, and both treated groups showed more correction than did the untreated control patients. Overjet decreased significantly more in the treated groups, and overbite decreased significantly more in the Jones Jig patients than in the untreated control group.

DISCUSSION

Studies comparing treatment effects from molar distal movement have usually been performed only during the distalizing phase.[1,5,14,15] Few studies[13,16,17] evaluated the effects of these appliances at the end of complete orthodontic treatment. To evaluate the overall effects, including leveling and alignment, retraction of the anterior teeth after distal movement of the molars, and finishing, this study compared complete treatment performed with the Jones Jig and Distal Jet distalizers followed by fixed appliances. The number of subjects included in each group was similar to that of previous studies[1,5,17] that used samples ranging between 13 and 26 subjects. The treatment time of the groups was greater in this study than has previously been reported. This is probably because the Class II malocclusion severity of these samples was greater than others reported.[12,17] Some studies[5,13,14] did not describe the Class II malocclusion severity or involved very mild Class II malocclusion severity. It is more difficult to correct a more severe Class II malocclusion than a milder one.[24]

It could be argued that selection bias was present because of the retrospective study design and the use of historical controls. However, the groups were quite similar at the pretreatment stage in terms of sex, age, Class II malocclusion severity, and the majority of skeletal and dental characteristics, which reduces this bias somewhat (Tables 3 and 4). The horizontal growth pattern of the Distal Jet group and the greater distal inclination of the first and second molars of the Jones Jig group (Table 4) were inherent characteristics of the groups and should not have interfered with the results of treatment change comparisons because they did not alter the performance of the appliances.

Skeletal Changes

Changes of the skeletal variables were similar in all groups (Table 5), showing that these treatment protocols did not promote significant skeletal changes, in agreement with the findings of previous studies.[14,15]

The patients in treated groups showed a significantly greater clockwise occlusal plane rotation than did the untreated group, possibly because of the effects of Class II elastics used with fixed appliances during retraction of the anterior maxillary dentition. These effects could have produced the combined protrusion and labial tipping of the mandibular incisors and caused relative intrusion of these teeth. Additionally, elastics can extrude the mandibular molars and the maxillary incisors. Therefore, the clockwise rotation of the occlusal plane may have occurred as a result of a combination of these effects.[25,26]

Dentoalveolar Changes

The use of intraoral distalizing appliances is commonly associated with undesirable effects, such as molar distal tipping, premolar mesial movement, and incisor protrusion.[9,12,14] However, similar changes in these teeth were observed in all groups since the adverse effects were reversed during the subsequent orthodontic treatment. In previous studies,[13,14] the maxillary incisors and premolars recovered their initial positions at the end of corrective treatment.

Mesial movement of the maxillary molars was similar in all three groups. Nevertheless, it is important to note that the molars were moved distally into a Class I relationship and that correction was maintained until the end of treatment, as reported in previous studies.[13,16,17,21] This may have resulted from favorable anterior facial growth since patients displayed growth potential (Table 5). The mandibular

Table 2. Results of Random and Systematic Errors Between the First and Second Measurements (Dahlberg and *t*-Test)

Variables	First Measurement (N = 20) Mean (SD)	Second Measurement (N = 20) Mean (SD)	Dahlberg	*P*
Maxillary and mandibular skeletal				
SNA, °	83.17 (4.64)	83.80 (4.56)	0.85	.023*
A-PTV, mm	49.40 (3.50)	50.32 (3.76)	0.29	.004*
SNB, °	78.69 (3.25)	78.80 (3.52)	0.44	.502
B-PTV, mm	47.67 (4.45)	48.15 (4.67)	0.97	.394
ANB, °	4.46 (2.35)	5.01 (2.38)	0.87	.062
Vertical skeletal				
FMA, °	30.14 (4.70)	30.04 (4.58)	0.85	.743
SN.occlusal plane, °	9.68 (4.05)	10.12 (3.77)	0.70	.064
ANS-Me, mm	62.45 (4.84)	62.55 (4.83)	0.59	.640
Maxillary dentoalveolar				
Mx1.SN, °	105.45 (5.49)	105.30 (6.06)	1.22	.824
Mx1-PTV, mm	56.75 (4.32)	57.31 (4.80)	0.87	.252
Mx1.NA, °	22.28 (5.40)	21.77 (5.44)	0.97	.123
Mx1-NA, mm	4.20 (2.01)	3.55 (1.96)	1.01	.057
Mx4.SN, °	80.85 (4.89)	81.34 (4.43)	0.74	.051
Mx4-PTV, mm	37.80 (3.06)	37.91 (2.89)	0.64	.647
Mx5.SN, °	78.03 (3.67)	78.44 (3.67)	1.15	.509
Mx5-PTV, mm	31.38 (3.07)	31.71 (3.14)	0.99	.341
Mx6.SN, °	64.15 (2.81)	63.40 (3.63)	1.05	.147
Mx6-PTV, mm	23.05 (3.04)	23.15 (2.94)	0.58	.784
Mx7.SN, °	50.62 (5.87)	51.36 (4.81)	1.35	.076
Mx7-PTV, mm	12.93 (2.20)	13.56 (2.57)	0.56	.124
Mandibular dentoalveolar				
Md1.NB, °	27.17 (3.93)	27.52 (3.91)	1.16	.392
Md1-NB, mm	5.05 (1.64)	5.12 (1.60)	0.42	.641
Soft tissue				
NLA, °	106.35 (9.74)	107.25 (9.92)	1.42	.140
Interdental				
Molar relationship, mm	−0.36 (0.75)	−0.58 (1.05)	0.89	.493
Overjet, mm	4.60 (1.65)	4.58 (1.78)	0.26	.852
Overbite, mm	4.64 (1.68)	4.62 (1.87)	0.46	.944

* Statistically significant at $P < .05$.

molars moved mesially as well (Table 5). The Class II molar relationship was corrected by interrupting the natural dentoalveolar compensation using the distalizing appliances. This correction, along with the growth potential that patients displayed, was able to maintain the Class I molar relationship once it was achieved.[27]

The maxillary second molars in the experimental groups showed an increase in mesial angulation, as compared to the control group (Table 5). It was

Table 3. Intergroup Comparison of Sex and Class II Malocclusion Severity Distribution, Initial and Final Ages, and Treatment Times

Variable	1: Jones Jig n = 25 (%)		2: Distal Jet n = 20 (%)		3: Control n = 19 (%)		*P*
Sex							
Male	14 (56)		15 (75)		10 (52.6)		.866[a]
Female	11 (44)		5 (25)		9 (47.4)		
Occlusal malocclusion severity							
¼ cusp Class II	11 (44)		4 (20)		9 (47.4)		.100[a]
½ cusp Class II	7 (28)		13 (65)		5 (26.3)		
¾ cusp Class II	3 (12)		3 (15)		3 (15.8)		
Full cusp Class II	4 (16)		0 (0)		2 (10.5)		
	Mean	SD	Mean	SD	Mean	SD	
Initial age	12.90 A	1.43	12.77 A	1.22	12.91 A	1.43	.935[b]
Final age	16.99 A	1.87	16.92 A	1.37	16.52 A	2.27	.688[b]
Treatment time	4.09 A	0.99	4.15 A	0.66	3.61 A	1.64	.282[b]

[a] Chi-square test.
[b] Analysis of variance. Different capital letters indicate statistically significant differences.

Table 4. Pretreatment Intergroup Cephalometric Comparison (ANOVA, Followed by Tukey Tests)

Variable	1: Jones Jig Means (SD)	2: Distal Jet Means (SD)	3: Control Means (SD)	P
Maxillary and mandibular skeletal				
SNA, °	82.35 (4.13) A	81.74 (5.12) A	81.14 (2.51) A	.627
A-PTV, mm	47.82 (4.17) A	48.39 (2.59) A	47.91 (3.03) A	.847
SNB, °	78.82 (3.09) A	77.85 (3.22) A	78.20 (2.01) A	.515
B-PTV, mm	46.87 (5.47) A	48.83 (3.42) A	47.41 (4.55) A	.366
ANB, °	3.53 (3.08) A	3.88 (2.66) A	2.94 (2.18) A	.558
Vertical skeletal				
FMA, °	29.87 (4.43) A	25.90 (3.92) B	27.00 (3.20) A	.003*
SN.GoGn, °	31.54 (4.05) A	31.59 (3.91) A	29.89 (3.34) A	.284
SN.occlusal plane, °	9.77 (4.13) A	6.05 (2.81) B	9.54 (3.07) A	.001*
ANS-Me, mm	61.81 (5.19) A	61.59 (5.26) A	58.37 (3.30) B	.042*
Maxillary dentoalveolar				
Mx1.SN, °	107.84 (5.90) A	103.88 (6.51) A	104.66 (4.96) A	.059
Mx1-PTV, mm	55.44 (4.95) A	56.33 (3.76) A	54.71 (3.24) A	.477
Mx1.NA, °	25.48 (6.09) A	22.15 (7.11) A	23.72 (5.50) A	.213
Mx1-NA, mm	4.94 (2.86) A	4.42 (3.21) A	4.50 (2.31) A	.797
Mx4.SN, °	82.76 (4.99) A	81.82 (3.80) A	80.06 (4.09) A	.135
Mx4-PTV, mm	36.20 (3.74) A	37.28 (2.55) A	35.16 (3.20) A	.137
Mx5.SN, °	78.49 (5.46) A	79.58 (4.20) A	77.99 (4.07) A	.557
Mx5-PTV, mm	29.80 (3.71) A	30.52 (2.72) A	29.01 (3.32) A	.370
Mx6.SN, °	65.70 (4.65) A	72.42 (3.63) B	66.98 (4.48) A	<.001*
Mx6-PTV, mm	21.68 (3.61) A	22.41 (2.78) A	20.93 (3.59) A	.397
Mx7.SN, °	50.92 (6.31) A	62.42 (3.48) B	56.65 (5.02) C	<.001*
Mx7-PTV, mm	11.98 (3.02) A	13.25 (2.42) A	11.71 (3.05) A	.198
Mandibular dentoalveolar				
Md1.NB, °	25.64 (5.99) A	23.41 (7.55) A	24.41 (4.50) A	.482
Md1-NB, mm	4.45 (2.20) A	4.09 (2.52) A	3.37 (1.39) A	.247
Md6-PTV, mm	20.99 (4.27) A	22.12 (2.82) A	21.28 (4.05)A	.702
Soft tissue				
NLA, °	103.13 (10.35) A	104.56 (13.45) A	114.09 (11.11) B	.007*
Interdental				
Molar relationship, mm	−0.42 (1.02) A	−0.85 (0.57) A	−0.93 (0.78) A	.147
Overjet, mm	4.67 (1.55) A	5.11 (1.37) A	4.48 (1.95) A	.471
Overbite, mm	3.92 (1.48) A	3.22 (1.82) A	4.04 (1.53) A	.224

* Different capital letters indicate statistically significant differences. Statistically significant at $P < .05$.

observed that the maxillary second molars showed distal angulation at pretreatment due to their natural distally angulated eruption path.[28] Therefore, the mesial angulation observed at posttreatment was likely consequent to the preadjusted appliance prescription regarding the angulation of these teeth, since they were included in the orthodontic treatment phase with fixed appliances.[18,29] Since the control group did not receive treatment, the maxillary second molars continued to display their naturally distal angulation after the observation period.[28]

In the current study, the mandibular incisors showed greater labial tipping in the Jones Jig group when compared with the control group.[13] This may have occurred as a result of a longer time period wearing Class II elastics.[25]

As expected, molar relationship improved significantly in the treated groups as compared to the control group, and both experimental groups achieved and maintained Class I molar relationships until the end of treatment.[13,17] The greater change in the Jones Jig group compared to the Distal Jet group might be related to a slightly larger Class II severity in the Jones Jig group at the pretreatment stage.

The overjet decreased significantly more than in the control group at the end of corrective treatment in both experimental groups, while the overbite decreased more in the Jones Jig group than in the control group. The overjet improvement was predictable and occurred by means of dental compensation.[25] The significantly greater overbite decrease in the Jones Jig group, when compared only with that in the control group, could be expected because of the greater mandibular incisor labial tipping that occurred. This could have produced relative intrusion of the mandibular incisors that contributed to the overbite decrease. It is important to state that the overjet and overbite changes were generally similar between the experimental groups.

Treatment times with the Jones Jig and with the Distal Jet were 0.85 years and 1.20 years, respectively, while the total treatment times were 4.09 and 4.15 years, respectively. This long treatment time could be

Table 5. Intergroup Treatment Changes Comparison (ANOVA, Followed by Tukey Tests)

Variable	1: Jones Jig Mean (SD)	2: Distal Jet Mean (SD)	3: Control Mean (SD)	P
Maxillary and mandibular skeletal				
SNA, °	0.02 (1.85) A	0.03 (2.62) A	−0.67 (3.43) A	.629
A-PTV, mm	1.15 (2.29) A	1.13 (1.63) A	1.08 (3.62) A	.996
SNB, °	0.74 (2.28) A	0.29 (2.19) A	−0.35 (2.24) A	.283
B-PTV, mm	2.03 (2.70) A	1.47 (2.88) A	1.69 (5.09) A	.871
ANB, °	−0.72 (2.19) A	−0.24 (1.96) A	−0.11 (3.03) A	.757
Vertical skeletal				
FMA, °	1.72 (2.62) A	1.73 (1.69) A	0.31 (4.48) A	.254
SN.GoGn, °	0.23 (2.45) A	0.95 (2.50) A	1.16 (5.47) A	.666
SN.occlusal plane, °	1.70 (3.32) A	2.28 (2.11) A	−1.22 (5.47) B	.011*
ANS-Me, mm	5.60 (2.82) A	4.75 (3.03) A	3.48 (5.38) A	.197
Maxillary dentoalveolar				
Mx1.SN, °	−1.63 (6.65) A	−3.99 (5.47) A	−1.87 (4.32) A	.342
Mx1-PTV, mm	1.26 (3.12) A	0.67 (2.00) A	1.63 (4.49) A	.660
Mx1.NA, °	−1.63 (6.77) A	−4.04 (4.68) A	−1.43 (4.74) A	.262
Mx1-NA, mm	0.12 (2.55) A	−0.63 (2.48) A	−0.18 (2.33) A	.601
Mx4.SN.4, °	−1.83 (4.69) A	1.69 (3.90) A	0.59 (3.23) A	.111
Mx4-PTV, mm	2.20 (2.09) A	1.77 (2.04) A	2.10 (4.49) A	.884
Mx5.SN, °	1.76 (4.61) A	0.60 (3.99) A	0.06 (3.05) A	.131
Mx5-PTV, mm	2.22 (2.00) A	1.82 (2.15) A	1.81 (4.56) A	.864
Mx6.SN, °	1.55 (4.85) A	3.25 (3.80) A	0.20 (5.65) A	.148
Mx6-PTV, mm	1.82 (1.89) A	1.42 (2.29) A	1.98 (4.60) A	.839
Mx7.SN, °	5.44 (7.31) A	4.51 (4.75) A	−0.76 (5.81) B	.004*
Mx7-PTV, mm	1.42 (1.91) A	1.02 (2.08) A	1.47 (4.00) A	.845
Mandibular dentoalveolar				
Md1.NB, °	2.52 (5.56) A	2.69 (5.44) A	−0.73 (3.28) A	.056
Md1-NB, mm	1.41 (1.89) A	1.12 (1.71) AB	0.06 (0.85) B	.021*
Md6-PTV, mm	2.83 (2.23) A	1.59 (1.87) A	2.42 (3.14) A	.798
Soft tissue				
NLA, °	1.60 (7.54) A	3.25 (6.57) A	2.36 (8.51) A	.878
Interdental				
Molar relationship, mm	−2.36 (1.36) A	−1.31 (0.56) B	−0.22 (1.24) C	<.001*
Overjet, mm	−1.90 (1.69) A	−1.83 (1.45) A	−0.14 (2.00) B	.002*
Overbite, mm	−1.56 (1.51) A	−1.12 (1.64) AB	−0.13 (1.94) B	.025*

* Different capital letters indicate statistically significant differences. Statistically significant at $P < .05$.

attributed to the adverse effects of these appliances and the need for anchorage reinforcement.[12,30] Consequently, Class II elastics and headgear were used during the subsequent phase of treatment. Therefore, most of the effects observed at the end of treatment seem to be consequent with the use of these devices. This is the reason why skeletal anchorage is often advocated to be used with these intraoral distalizers.[30,31]

Soft Tissue Changes

As most of the dentoalveolar changes were not significantly different between the experimental groups, there were no significant differences in nasolabial angle changes between them and between the experimental groups and the control group, as expected.[13]

Some limitations of this study were the retrospective study design, which might have generated some selection bias, and the lack of cephalometric variables evaluating mandibular growth.

CONCLUSIONS

- Nonextraction treatment with the Jones Jig and Distal Jet followed by fixed appliances (including the use of headgear and Class II elastics) was effective in correcting Class II malocclusion by means of dentoalveolar changes.
- Both the Jones Jig and Distal Jet groups showed occlusal plane clockwise rotations and greater mesial tipping of the maxillary second molars when compared to the untreated group.
- There were no significant intergroup differences in terms of soft tissue changes.

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