ORIGINAL ARTICLE POJ 2018:10(1) 19-26

Evaluation of Vertical Skeletal Changes Consequent to Maxillary Molars Distalization with Distal Jet Appliance

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Abstract

Introduction: The most common presentation for orthodontic treatment is Class II malocclusion. Distalization of maxillary molars is a popular non-extraction treatment alternative in some patients with Class II malocclusion. Hence the objective of the present study was to evaluate mean increase in vertical skeletal pattern after distalization by using distal jet appliance

Material and Methods: Study was conducted at Orthodontic Department, de'Montmorency College of Dentistry from May 2014 to April 2015. All pretreatment records including clinical and radiographic evaluation, study casts and photographs were taken for each patient. Distal jet was fabricated according to manufacturer's instructions, fixed with glass ionomer cement and activated on monthly visits until desired distalization was achieved. The same records were repeated for all patients to assess postdistalization effects.

Results: A total of 40 patients (23 girls, 17 boys) with mean age of 13.15±0.60 years having Angle's Class II malocclusion were included in this study. There was a significant decrease in PTV Max. 1st Molar Centroid after distalization. This reflects mean measurement of distalization. The mean PP Max. 1st Molar Centroid was 17.03±1.22mm at baseline which was increased to 17.73±1.32mm after distalization. The mean increase in this measurement was 0.69±0.36mm. This reflects mean measurement of vertical skeletal change secondary to distalization.

Conclusions: The current study provides the basis to evaluate vertical skeletal changes by using linear and angular cephalometric measurements after distalization with distal jet appliance. The results of this study also provide guidance for selection of patients with Class II malocclusion for distalization of molars.

Keywords: Distalization; distal jet appliance; malocclusion; skeletal pattern

Introduction

The most common presentation for orthodontic treatment is Class II malocclusion.[1] The primary goal of orthodontic treatment is to achieve an ideal occlusion.[1,2] According to Moyers et. al. type A Class II malocclusion is characterized by absence of skeletal involvement, requiring distalization of maxillary teeth for normal molar and incisor relationships without changing skeletal relationship.[3] Distalization of maxillary molars is a popular non-extraction treatment alternative in some patients with Class II malocclusion.[4,5,16]

There are numerous methods to move teeth distally. Extra-oral traction with headgears, removable appliances with springs and Class II inter-maxillary elastics are highly compliance dependent. Noncompliance methods include a variety of intramaxillary appliances e.g. Jones jig, distal jet, pendulum appliance, frog appliance, Keles slider, repelling magnets, compressed coil springs, molar distalizing bows and currently orthodontic implant supported distalizing appliances.[6,7,8] Non-compliance appliances are superior to those demanding co-operation. Distal jet is one of the most popular and effective distalizing appliance.[3,5,9.10,11,12]

Clinical studies on distal jet have confirmed mesial-inward rotation, distal tipping and

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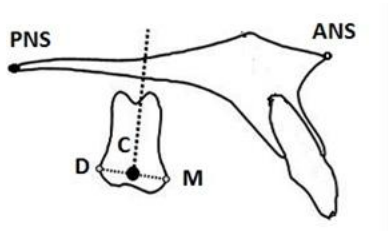
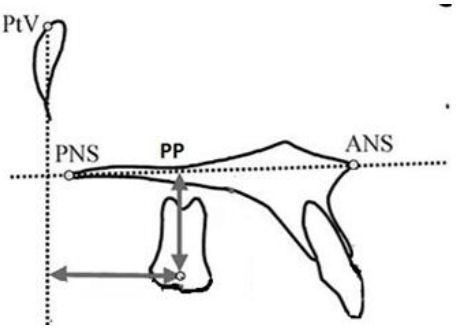
distalization of maxillary molars.[1,13] Distal jet also leads to mild extrusions and distal tipping of molar crowns leading to backward rotation of mandible.[3] Molar distalization is contraindicated in hyperdivergent patients because when maxillary molars are distalized into the wedge of occlusion, they will prop open the bite. This effect along with backward rotation of mandible leads to increase in vertical dimension. Distalization of maxillary molars and eventually the entire upper dental arch retraction is considered non-extraction treatment. Distal movement of maxillary first molars is a common goal in treatment of Class II molar relationship and in resolution of tooth size-arch length discrepancy in maxillary arch.[14]

The rationale of this study was to evaluate mean increase in vertical skeletal pattern that occurs after distalization with distal jet appliance in Class II malocclusion patients. The current study will contribute for an efficient and better treatment planning that can be devised in Class II malocclusion especially in patients with already increased vertical dimensions.

Material and Methods

This quasi experimental study was conducted after ethical approval at Orthodontic Department, de'Montmorency College of Dentistry from May 2014 to April 2015. A total of forty patients with an age range of 12-14 years were selected. Sample size of 40 cases was calculated with 95% confidence level, d = 0.13 and taking expected mean ± S.D. of increase SN.MP (°) i.e. 0.47 ± 0.40 in vertical skeletal pattern. The patients were included based on bilateral angle class-II malocclusion (3mm / End-on molars selected clinically and by diagnostic models), mild skeletal class-II with ANB 4-5° and normal or low angle vertical pattern. Moreover, patients with all second molars fully erupted having no other orthodontic treatment or molar distalization procedure were included in the study. Patients with class II molar relationship due to retrognathic mandible, severe carious lesions, flat palate, ectopic maxillary canines, anterior open bite, vertical growth pattern and parafunctional habits were excluded from the study.





C: centroid. **PtV- maxillary first molar centroid (mm)**

M: mesial height of contour of maxillary first molar. **PP- maxillary first molar centroid (mm)**

D: distal height of contour of maxillary first molar.

Figure 1: A. Dental landmarks **B. Linear Dental Measurements**

A complete set of baseline pretreatment records including history, clinical examination, upper/lower study casts, extra-oral/intraoral photographs, OPG/lateral cephalometric radiograph were taken for each patient and same records were repeated after achievement of desired distalization. Lateral cephalograms were used as diagnostic aid to evaluate changes in vertical dimensions with distalization (Figure 1). The predistalization lateral cephalograms (P1) and postdistalization lateral cephalograms (P2)

were taken under the same standardized conditions at radiology department of Punjab Dental Hospital, Lahore.

In the current study, distal jet was fabricated according to manufacturer instructions (American Orthodontics) i.e. two bilateral tubes were embedded in a modified acrylic Nance button. The Nance button was anchored by supporting wires to first premolars. A bayonet wire was inserted into lingual sheath of each first molar band and its free end was inserted into the tubes. A nickel-titanium open coil spring and an activation collar (i.e. screw clamp) were placed on each tube. A distally directed force was generated by compressing the coil spring. Same type of distal jet was used in all patients and was cemented with glass ionomer luting cement (Figure 2 , 3). Activation protocol on monthly visits was followed till desired results were achieved and maxillary first molars were moved to supra-class-I relationship. The same distal jet was converted to Nance holding appliance for retention of distalized molars.

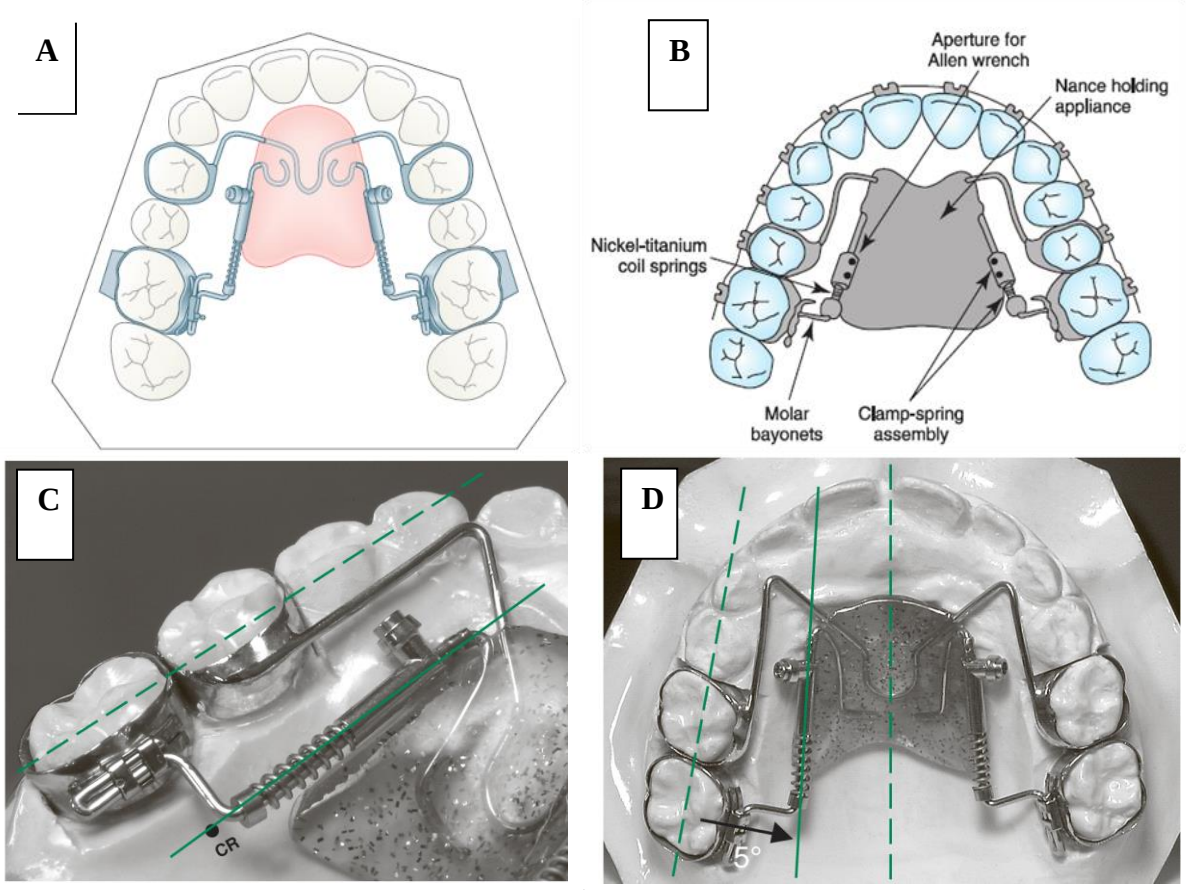


Figure 2:
A. Illustration of Distal Jet. B. Components of distal jet C. Design of Distal Jet D. Activation of Distal Jet.

The data were evaluated in SPSS version 17.0. Quantitative data like age and baseline measurements (P1) of vertical skeletal pattern (i.e. FMA° , SN.Gn° , SN.MP°) and after distalization measurements (P2) were presented in the form of mean ± S.D. Qualitative variables like gender were presented in the form of frequency and percentage. Mean increase in vertical skeletal pattern was obtained by subtracting post distalization measurements from baseline. A p-value of less than 0.05 will be considered significant.

Results

A total of 40 patients with Angle's Class II malocclusion and age range of 12-14 years (mean age 13.15±0.60 years) were included in this study. There were 17 (42.5%) males and 23 (57.5%) female patients (Figure 4). Pre and post distalization lateral cephalometric analysis was done and values were calculated in millimeters and degrees. Chief complaint of all patients was mal-positioning of teeth.

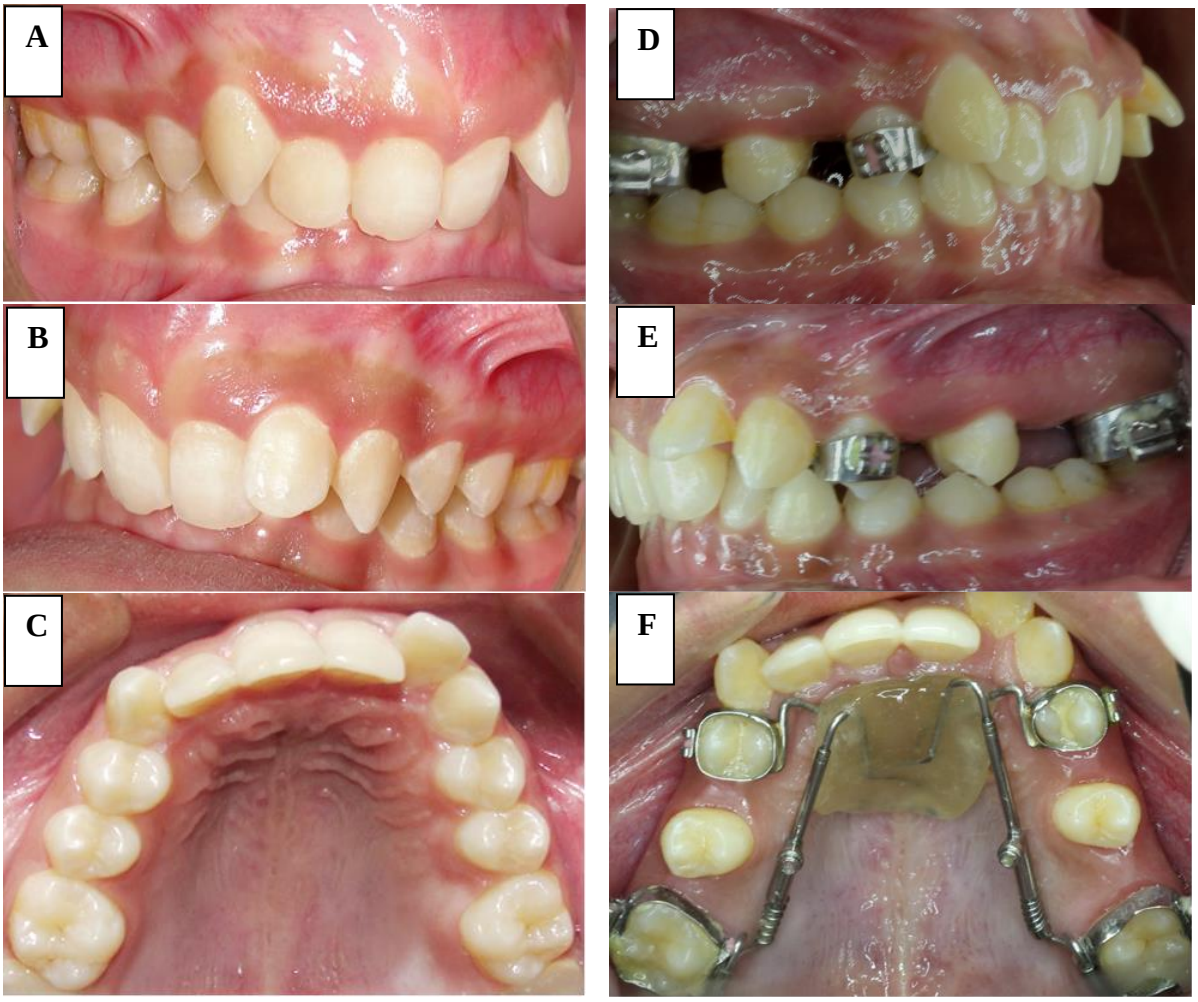


Figure 3:
Treatment with Distal Jet. Pre-distalization clinical photographs
A. Right view B. Left view C. Occlusal view
Post-distalization clinical photographs
D. Right view E. Left view F. Occlusal view

The mean treatment time period to achieve a supra Class I molar relationship was about 6.8 months. The mean PtV Max. 1st Molar Centroid was 21.67±1.66mm at baseline which was decreased to 18.04±1.84mm after distalization. The mean decrease in this linear measurement was 3.63±0.81mm which was found to be significant (P<0.05) (Table I). This reflects mean measurement of distalization. The figure showing that maximum number of patients showed decreased at 3.8mm (Figure 5).

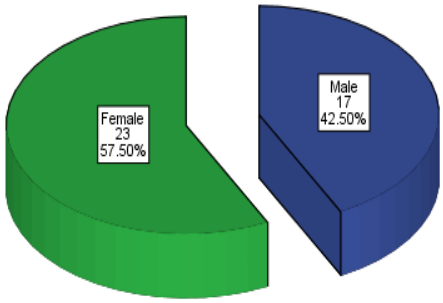


Figure 4: Gender distribution of patients

Table I: Descriptive statistics of PtV

	PtV at baseline	PtV after distalization	PtV decrease
N	40	40	40
Mean	21.67	18.04	3.63
SD	1.66	1.84	0.81
Minimum	17	14	0.7
Maximum	28.5	26	5

Paired sample t-test = 28.290 p-value = 0.000 (Significant)

Table II: Descriptive statistics of PP

	PP at baseline	PP after distalization	PP increase
N	40	40	40
Mean	17.03	17.73	0.70
SD	1.22	1.32	0.36
Minimum	12	13	0.1
Maximum	20	21.8	2.1

Paired sample t-test = 12.187 p-value = 0.000 (Significant)

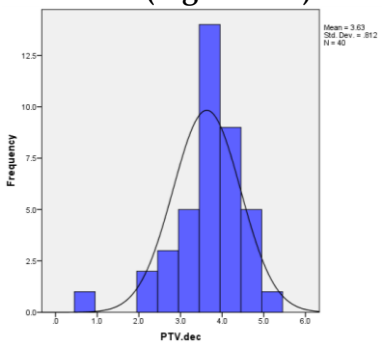


Figure 5: Histogram of distribution of PtV decrease after distalization

Discussion

Symptoms associated with Angle's Class II malocclusion are common complaints of patients which compel them to present to orthodontists for treatment and account for about in 15% to 40% of population.[15] Orthodontic Department of de'Montmorency College of dentistry/ Punjab Dental Hospital, Lahore is one of the well renowned Orthodontics units in Pakistan and not only caters the patients from all over Lahore but also adjacent areas and remote areas of Punjab province. Being a tertiary care centre, most of the patients presented here are referred from remote areas and are usually presented with aggressive orthodontic problems as well as different educational, social, cultural and financial status.

In current study, we used distal jet for distalization of maxillary molars and included 40 children of bilateral Class II malocclusion. The mean distalization in our study was 3.63±0.81mm, which was achieved in 6.8 months. It has been observed that maximum number of patients showed 3.8mm distalization. This was a sufficient amount of distalization achieved to correct molar class II from ends-on to supra class I and also comparable with other studies conducted with distal jet.[16]

Bolla et al. study showed 3.2 mm maxillary first molar distalization with 1.3˚ distal tipping and 0.9 mm molar extrusion.[17] The results of Ghosh and Nanda showed 5.7 mm molar distalization, 10.6˚ distal tipping and 0.7 mm extrusion with pendulum appliance.[18] Keles and Sayinsu evaluated the effects of intraoral bodily molar distalizer and concluded 5.23 mm maxillary first molar distalization without any tipping or extrusion.[19] A study conducted with distal jet in the same center showed 3.88 mm distalization during 7.11 months with 0.2 mm extrusion of maxillary first molars.[12] Another study showed an increase in vertical skeletal pattern with mean increase in FMA of 0.99 ± 0.15^{o}, NS.Gn of 0.46 ± 0.24^{o} and SN.MP of 0.47

± 0.40°.[3] These findings are compatible with our study showing that vertical change occurred as an increase in vertical dimension by moving mandible downward and backwards.

In a study by Chiu et al, upper first molars were extruded 0.5-1.0 mm which is greater extrusion than our study and also a significant mean increase in lower anterior facial height 2.4-2.5 mm and mean increase in FMA was 0.7°-1.3° which is almost same as in our study.[20]

In a recent retrospective study, maxillary first molars were distalized 2.16 ± 0.84 mm and a significant clockwise rotation of mandible i.e. 1.97° ± 1.32° and a significant increase in lower anterior facial height 3.35 ± 1.48 mm was observed but these changes in vertical dimensions had a negligible impact on clinical appearance.[21]

In another recent overview of 214 articles on noncompliance distalization appliances, showed mean maxillary first molar distalization of 6.4 mm and an increase in vertical facial dimension of 1.5° to 1.8° which is greater than our mean vertical angular measurements.[22] In a recent meta-analysis on effects of intraoral distalizers on conventional and skeletal anchorage, molar distalization was shown to be effective with both anchorage systems. The distal molar movement with conventional anchorage was 3.34 mm and 5.10 mm with skeletal anchorage system. The conventional anchorage system showed significant anchorage loss but skeletal anchorage system showed negligible anchorage loss. Decreased anchorage loss results in decreased extrusion of maxillary molars and negligible vertical skeletal effects.[23]

Recently Cozzani M. et al. did a comparative study on distal jet by comparing skeletally anchored (DS) with conventional distal jet (DJ). The findings showed maxillary molar distalization 4.7 ± 1.6 mm with skeletal anchored and 4.4 ± 2.5 mm with conventional distal jet in full cusp class II patients. Molar extrusion with respect to palatal plane was 0.7 ± 1.9 mm in DS group and 0.4 ±5 mm in DJ group.[10] Vertical skeletal variables included in our study were very important angular cephalometric findings regarding diagnosis, treatment planning and prognosis of orthodontic treatment. In our study, mean age was 13.15 months, at this age boys are usually at their growing age. So individuals who are growing at start of treatment with vertically low to normal angle can compensate vertical skeletal changes consequent to distalization by increase in mandibular ramus height with growth and end up with no clinically significant vertical change.[24]

Our study was dependent on variable anatomical points like sella, nasion, porion and orbitale on cephalometrics. These points were baseline for mandibular plane and Frankford horizontal plane construction so could result in incorrect conclusion from analysis. There are many previous studies which include vertical skeletal linear measurements like lower anterior facial height which in most of the studies increased after distalization. When S point is positioned downwards, inclination of SN plane will be increased and appeared to be large SN-MP angle and Y-axis even than mandibular plane is at normal inclination, while lower anterior facial height is independent of SN plane.[25]

The current study has proven that distal jet is an efficient appliance to distalize maxillary molars bodily which is helpful to correct Angle Class II malocclusion by non-extraction treatment. Present and the previous studies have shown a significant extrusion of maxillary first molars which is considered a corrective phenomenon in Class II Division II by opening the bite and also unlock mandible by forward movement in growing patients. This effect of distal jet also needs to be explored for better non-extraction treatment options in Class II Division II patients in our community. This study may prove to be a way post in our community for orthodontists to take an accurate decision for non-extraction

treatment planning in individuals with normal or low angle and also provides space to broaden the research on evaluation of vertical skeletal change by using skeletonized or implant supported distal jet in our community.

Conclusions

The current study provides the basis to evaluate vertical skeletal changes by using linear and angular cephalometric measurements after distalization with distal jet in our community. Our study was focused only on skeletal changes occurred in vertical pattern of patients who were with low to normal vertical proportions at start of treatment. Therefore, results of this study provide guidance for selection of patients with Class II malocclusion for distalization of molars. Moreover, cross comparative and randomized control trials with larger sample size are required to further explore this topic to develop final conclusion in this regard.

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