COMPARISON OF JONES JIG AND DISTAL JET MOLAR DISTALIZING APPLIANCES

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ABSTRACT

The purpose of the present study was to evaluate and compare the effects of Jones jig and distal jet appliance during class-II molar correction with maxillary first molar distalization, its tipping, extrusion, rotation as well as anchorage loss at premolar-incisor unit. Sixty patients were selected from Orthodontics department de,Montmorency College of Dentistry, Lahore, Pakistan and pre and post distalization lateral cephalograms and study casts were used as evaluation tools. Distal jet group showed 3.88 mm space creation during 7.11 months, out of which 2.93 mm (75.52%) was molar distalization while 0.93 mm (24.48 %) was premolar mesialization as anchorage loss. There was 3.41° molar tipping with 0.20 mm extrusion and 7.33 ° distal tipping with 0.90 mm second cuspid extrusion whereas incisors had 1.65 ° labial tipping. Right and left upper molars showed 1.30° and 1.18° rotation respectively.

In the Jones jig group, the maxillary first molars were distalized to 3.30 mm on each side and tipped 6.70° distally. The maxillary second premolars moved mesially 2.00 mm with tipping of 7.48°. Therefore a total space created between first molar and second premolar was 5.30 mm i.e. 62.26 % from first molar distalization while 37.74% from second premolar mesialization. In addition maxillary first molar extruded 0.70 mm and second bicuspid extruded 1.58 mm. Both right and left first molars were also disto-palatally rotated by 2.00° and 2.55° respectively though upper incisors showed 2.25° proclination during distalization.

Distal jet appliance was found to be a more effective and predictable method for the maxillary first molar distalization through bodily translation with minimum tipping, extrusion, and rotation as well as anchorage loss.

Key words: *Molar Distalization, Distal Jet, Jones jig, Molar correction*

INTRODUCTION

The primary goal of orthodontic treatment is to achieve an 'ideal occlusion' that involves molars placement in class I relationship which was first defined by Angle and later refined by Andrews. The most common presentation for orthodontic treatment is Class-II malocclusion frequently accompanied by a pre-normal molar relationship.[1] Maxillary molar distalization is a common goal in treatment of Class-II molar relationship and resolution of tooth size arch length discrepancy. Literature reveals numerous modalities for Class-II molar correction from compliance oriented headgear to non compliance treatment using intra-oral devices to distalize maxillary molars to class- I occlusion.[2, 3] Magnets have also been used since 1978 for the same purpose[4-7] followed by several other appliances such as super elastic nickel-titanium coil springs[8-10], K-loop[11], Pendulum[12--20], Keles slider[21], ACCO[22], Jones jig[23-26] and distal jet.[2,27-29]

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Anchorage is considered as most critical factor during maxillary molar distalization and anterior tooth retraction. Researchers have developed many modifications to minimize its loss. Most fixed distalizing appliances rely on Nance button for anchorage reinforcement.[2,3,13,14,20] Recently mini screw implants have been proposed to use clinically as temporary anchorage for orthodontic movements because they provide absolute anchorage.[30,31,32,33,34]

Jones jig appliance contains 15 mm nickel titanium coil spring as an active force component that can be activated by 1.00-5.00 mm compression to exert optimum force for distalization. In this technique Jones jig is applied on buccal surfaces of molars and premolars. Modified Nance is used from maxillary first premolars or second premolars or second deciduous molars for anchorage.[23-26]

The distal jet appliance is applied on palatal surface and nickel titanium spring (180 or 240 grams) is used as a force component. Modified Nance is attached to maxillary first premolars or second premolars or second deciduous molars and is incorporated in this appliance for anchorage requirements. An alternative skeletonized distal jet appliance supported by mini screws may be used.[29, 30] The distal jet is a palatal appliance which produces bodily distal movement of maxillary molars bilaterally or unilaterally in permanent as well as mixed dentition. After distalization, appliance is converted to a Nance holding arch by removing the coil spring and locking the activation collar over tube junction and piston wire.[2, 27-28]

No previous study directly compared treatment effects of Jones jig and distal jet appliances. Therefore we aimed to compare the dentoalveolar effects of treatment with Jones jig and distal jet appliances for molar distalization to correct class II molar relationship.

METHODOLOGY

Sixty patients with an age range of 12-14 years as per laid down criteria were selected from Orthodontics department de,Montmorency College of Dentistry, Lahore, Pakistan. An informed consent was obtained from patient or guardian.

Patients with the following criteria were included in this study:

Class-II division I with mild proclination and Class-II division II with mild crowding

Class I or mild Class-II skeletal pattern with ANB 4-5 degrees

Non-extraction treatment plan

Normal or low angle vertical pattern

No orthodontic treatment or molar distalization performed before or during the study

Fully erupted maxillary second molars

Selected patients were divided into two groups of 30 each. Group A was treated with Jones jig appliance[23-25] while Group-B with distal jet appliance.[2, 27-29]

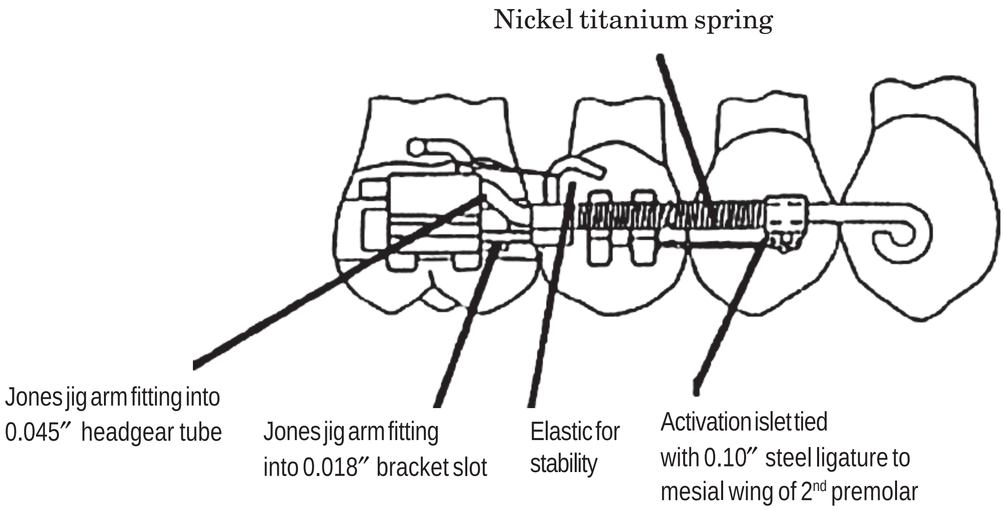


Fig 1: Jones Jig Appliance

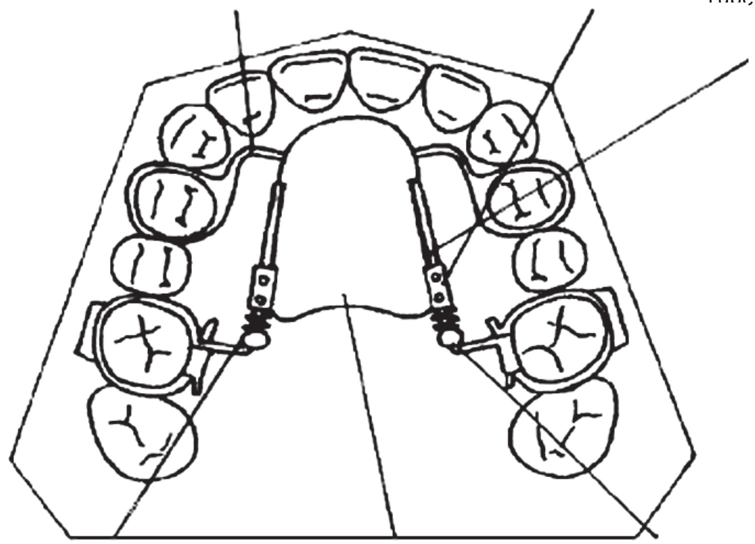


Fig 2: Distal Jet Appliance

The study casts and lateral cephalometric radiographs were taken at pre (T1) and post (T2) distalization under standard condition. Cephalometric radiographs were traced manually and all planes and angles were constructed. All double images were traced with the distal and smaller outline of the structure. The term centroid was used for analysis that is located at the midpoint of a line drawn from the mesial and distal greatest convexity of molars and premolars.[3,7] All the measurements were made nearest to 0.5° for angular and 0.1mm for linear changes.[7]

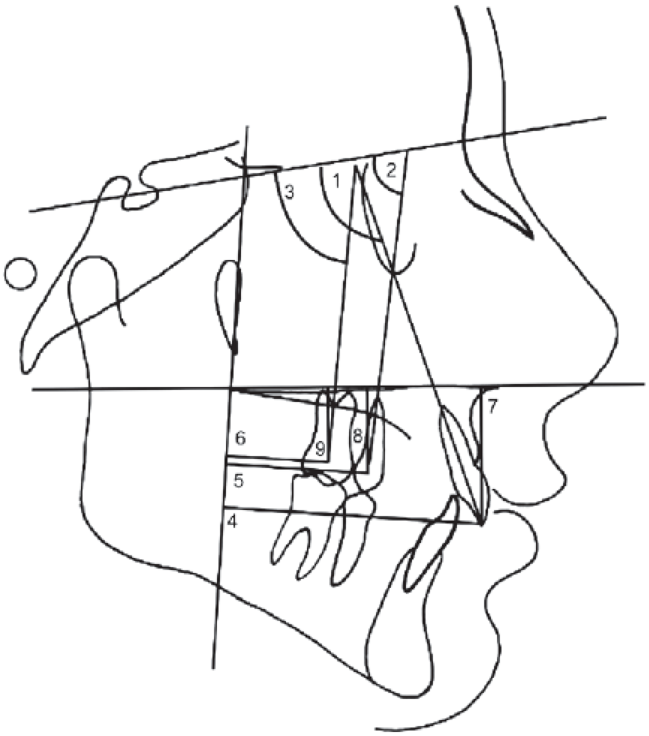
The Pterygoid vertical (PTV) was used as reference plane to evaluate dental linear changes in sagittal plane by constructing lines from PTV- plane to centroid of maxillary first molar, second premolar and incisor tip. Dental changes in vertical plane as extrusion of maxillary first molar and second premolar were assessed by measuring the vertical distance from palatal plane to centroid of these teeth (Fig 3).

Angular measurements for molar and premolar inclination were evaluated by angle formed between a vertical line through centroid to SN plane. The inclination of maxillary central incisor was measured by joining a line through the long axis of tooth to SN plane (Fig 3).

Study cast were analyzed to determine mesial and distal rotations of the maxillary first molars.[2,7,17] The models were photocopied to 1:1 ratio.[35] The angle formed between midline and a line passing through the mesiobuccal and mesiopalatal cusp tips of maxillary first molars determined their rotation (Fig 4). All

TABLE 1: CEPHALOMETRIC AND STUDY CAST MEASUREMENTS

Cephalometric Dental Linear measurements (60)	
1	PTV- maxillary first molar centroid (mm)
2	PTV- maxillary second premolar centroid (mm)
3	PTV- maxillary central incisor tip (mm)
4	PP- maxillary first molar centroid (mm)
5	PP- maxillary second premolar centroid (mm)
Cephalometric Dental Angular Measurements (60)	
6	SN- Maxillary central incisor long axis (degrees)
7	SN- Maxillary first molar long axis (degrees)
8	SN- Maxillary second premolar long axis (degrees)
Study cast Measurements (60)	
9	Palatal midline- Right maxillary first molar
10	Palatal midline- Left maxillary first molar



1 SN-maxillary central incisor
2 SN-maxillary second molar
3 SN-maxillary first molar
4 PTV-maxillary incisor tip
5 PTV-maxillary second premolar centroid
6 PTV-maxillary first molar centroid
7 PP- maxillary central incisor
8 PP -maxillary second premolar centroid
9 PP -maxillary first molar centroid

Fig 3: Cephalometric Dental Linear and Angular Measurements

measurements were made nearest to 0.5° for angular changes.[28]

The data was analyzed in SPSS 17 for Windows to deduct mean, standard deviation for group A and B at T1 and T2. A paired t-test was applied to analyze intra group differences between pre-treatment and post-distalization variables to determine significant changes. Inter groups (A and B) comparisons were analyzed using student's t-test. The level of significance was chosen at:

P< 0.01= significant

P< 0.001= highly significant

NS = non significant

All cephalometric and cast variables were re-evaluated for casual error by applying paired t-test to determine significance of difference. None of the variables showed an error of statistical significance at p<0.05.

RESULTS

The average age of the entire sample was 12 years10 months (154.26 ±2.04 months) with a range of 12.00-14.00 years including 28 males of 13 years 1 month (157.16±1.37 months) and 32 females having 12 years 11 months (155±1.26 months). Gender differences were not considered because of the short-term use of the distalizing appliances.

Both groups were analyzed for Cephalometric and study cast values as T1-T2 changes. The mean treatment time for group A was 5.65 months and that of group B was 7.11 months. Table 2 shows the difference of T1 and T2 cephalometric variables with significance level for group A and table 3 shows the difference of pre and post distalization cephalometric variables with significance level for group B. Table 4 shows the difference of T1 and T2 cephalometric variables with significance level for both groups. Table 5 shows the study cast variables difference of T1and T2 means with the significance level for group A and B. Table 6 shows the mean rotation on study cast between group A and B with significant level. Similarly the Table 7 shows over all treatment changes achieved with Jones jig and distal jet appliances.

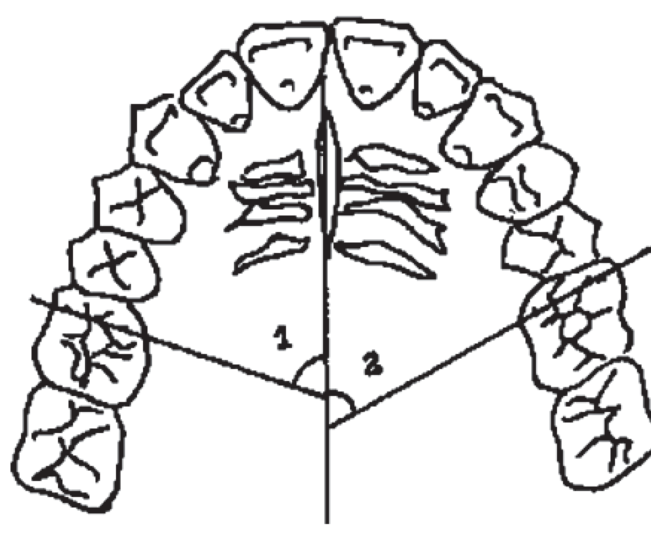


Fig 4: Maxillary Model Analysis

TABLE 2: GROUP A DENTAL LINEAR AND ANGULAR MEASUREMENTS INCLUDING MEAN TREATMENT TIME, MEAN T1±SD, MEAN T2±SD, DIFFERENCE OF MEANS AND P-VALUE (T1 - T2)

MEASUREMENTS	Rx time Months	Pre Rx Mean T1	Post Rx Mean T2	Diff	P value
Dental linear (30)					
PTV- maxillary first molar centroid (mm)	5.65	24.80±2.75	21.50±2.64	3.30	P<0.001
PTV- maxillary premolar centroid (mm)	5.65	33.60 ±2.61	35.60±2.76	2.00	P<0.001
PTV- maxillary incisor tip (mm)	5.65	55.20±2.41	56.90±2.93	1.70	P<0.01
PP- maxillary first molar centroid (mm)	5.65	21.00±2.53	21.70±2.58	0.70	NS
PP- maxillary pre molar centroid (mm)	5.65	21.40±2.79	22.98±2.68	1.58	NS
Dental angular (30)					
SN-maxillary incisor (degrees)	5.65	103.25±5.17	104.50±5.50	3.25	P<0.001
SN-maxillary premolar centroid (degrees)	5.65	71.60±3.68	78.30±3.93	6.70	P<0.001
SN-maxillary first molar centroid (degrees)	5.65	71.10±3.54	63.70±3.57	7.40	P<0.001

N.S= non significant difference

P<0.01= significant difference

P<0.001= highly significant difference

TABLE 3: GROUP B DENTAL LINEAR AND ANGULAR MEASUREMENTS INCLUDING MEAN TREATMENT TIME, MEAN T1±SD, MEAN T2±SD, DIFFERENCE OF MEANS, SD AND P-VALUE (T1-T2)

MEASUREMENTS	Rx time Months	Pre Rx T1mean	Post Rx T2mean	Diff	P-value
Dental linear (30)					
PTV-maxillary first molar centroid (mm)	7.11	22.30±1.74	19.37±1.75	2.93	P<0.001
PTV- maxillary premolar centroid (mm)	7.11	31.52±1.84	32.47±2.91	0.95	NS
PTV- maxillary incisor tip (mm)	7.11	53.58±2.58	56.68±3.20	3.1	P<0.001
PP- maxillary first molar centroid (mm)	7.11	18.58±1.73	18.78±1.72	0.20	NS
PP- maxillary pre molar centroid (mm)	7.11	19.26±1.64	20.16±1.41	0.90	NS
Dental angular (30)					
SN-maxillary incisor (degrees)	7.11	101.63±6.34	103.28±6.55	1.65	NS
SN-maxillary premolar (degrees)	7.11	75.40±4.58	68.07±4.81	7.33	P<0.001
SN-maxillary first molar (degrees)	7.11	74.52±4.65	71.11±4.26	3.41	P<0.001

N.S = non significant difference

P<0.001= highly significant difference

TABLE 4: GROUP A VS. GROUP B DENTAL LINEAR AND ANGULAR MEASUREMENTS INCLUDING MEAN CHANGES, T-VALUE AND P-VALUE OF DIFFERENCES OF CHANGES AT T1-T2 CEPHALOMETRIC MEASUREMENTS

MEASUREMENTS	Group	Rx Time Months	Mean	t-value	P-value
Dental linear (60)					
PTV- maxillary first molar centroid (mm)	A	5.65	3.30		
	B	7.11	2.93	1.54	NS
PTV- maxillary second premolar centroid (mm)	A	5.65	2.00		
	B	7.11	0.95	24.75	P<0.001
PTV- maxillary incisor tip (mm)	A	5.65	1.70		
	B	7.11	1.42	2.33	P<0.01
PP- maxillary first molar centroid (mm)	A	5.65	0.70		
	B	7.11	0.20	2.35	P<0.01
PP- maxillary second premolar centroid (mm)	A	5.65	1.58		
	B	7.11	0.90	2.18	NS
Dental angular (60)					
SN-maxillary incisor (degrees)	A	5.65	0.75		
	B	7.11	1.65	0.99	NS
SN-maxillary second premolar (degrees)	A	5.65	6.70		
	B	7.11	7.33	2.70	P<0.001
SN-maxillary first molar (degrees)	A	5.65	7.40		
	B	7.11	3.41	17.90	P<0.001

N.S=non significant difference p<0.01=significant difference
P<0.001=highly significant difference

TABLE 5: STUDY MODEL MEAN DIFFERENCES VALUES WITH STANDARD DEVIATION AND P- VALUE AT T1 -T2 FOR GROUP A AND B

MEASUREMENTS		Mean±SD	p-value
Model Analysis (A) 30			
Right maxillary first molar (degrees)	T1	56.33±3.74	
	T2	58.33±4.13	N.S
Left maxillary first molar (degrees)	T1	56.58±3.62	
	T2	59.13±4.32	P<0.001
Model Analysis (B) 30			
Right maxillary first molar (degrees)	T1	56.03±3.72	
	T2	57.33±3.55	N.S
Left maxillary first molar (degrees)	T1	56.40±3.71	
	T2	57.58±3.61	NS

N.S=non significant difference
P<0.001=highly significant difference

TABLE 6: COMPARISON OF MEAN EFFECT ON STUDY MODELS BETWEEN GROUP A & B WITH P-VALUE

MODEL ANALYSIS	Group	Mean rotation(Degrees)	P-value
Right maxillary first molar	A(30)	2.00	
	B(30)	1.30	P<0.001
Left maxillary first molar	A(30)	2.55	
	B(30)	1.18	NS

N.S=non significant difference
P<0.001=highly significant difference

TABLE 7: COMPARATIVE EFFECTS OF JONES JIG AND DISTAL JET APPLIANCE

CHANGES	Group	
	A	B
Treatment duration (months)	5.65	7.11
Total space created (mm)	5.30	3.88
Maxillary first molar		
Distalization (mm)	3.30	2.93
Percentage (%age)	62.26	75.52
Rate per month (mm/month)	0.58	0.54
Tipping (Degrees)	6.70	3.41
Extrusion (mm)	0.70	0.20
Right molar rotation (Degrees)	2.00	1.3
Left molar rotation (Degrees)	2.55	1.18
Anchorage loss (second premolar)		
Mesial movement (mm)	2.00	0.95
Percentage (%age)	37.74	24.48
Mesial(-), distal (+) tipping (Degrees)	-7.48	+7.33
Extrusion (mm)	1.58	0.90
(Maxillary incisors)		
Proclination (Degrees)	2.25	1.65

DISCUSSION

In this study maxillary first molars were distalized to 3.30 mm per side with distal tipping of 6.70° and 0.70 mm extrusion by Jones jig appliance in 5.65 months time. These changes are similar but slightly differ from those of Brickman et al[24] where maxillary molar was distalized 2.51 mm and tipped distally 7.53° with 0.10 mm insignificant extrusion. Haydar and Uner [26] found 2.20 mm molar distalization with 7.96° distal tipping and 0.72 mm extrusion. Similarly molar distalization per month seen was 0.19 mm in Brickman et al [24], 0.89 mm in Hayder and Uner[26], 0.35 mm in Runge et al[37] and 0.92 mm in Gulati et al[36] but was more (0.58 mm per month) in this study that may be due to 100 grams force used as compared to 70-75 grams.

With Jones jig appliance 5.30 mm space between maxillary first molar and second premolar was created. The second premolar was mesialized to 2.00 mm, tipped mesially 7.58° and extruded 1.58 mm which is similar to findings of Brickman et al[24] (2.00 mm mesialization, 4.76° mesial tipping and 1.88 mm extrusion) and Gulati et al[36] (2.23 mm mesialization, 2.60° mesial tipping). In another investigation[45] maxillary second premolars showed greater mesial tipping, extrusion and anchorage loss during molar distalization with Jones jig appliance.

Likewise anchorage loss in our study at second premolars is less than studies by Runge[37], Gulati[36], Brickman[24] and Hayder [26] that may be due to large size Nance acrylic button of one inch diameter in our study as compared to ½ inch in other studies.

The maxillary central incisor was proclined an average of 0.75° that was statistically insignificant but was less than 2.60° reported by Brickman et al[24], 3.00° by Runge et al[37] and 1.00° found by Hayder and Uner.[26] Moreover the incisor tipping found was much less than the 6.00° reported by Bondemark and Kurol[7] and 3.8° by Itoh[5] with repelling magnets.

The distal jet appliance distalized the maxillary first molars to 2.93 mm per side with distal tipping of 3.41° and 0.20 mm extrusion. These changes are similar but slightly differ from other studies carried out with same appliance. Patel[39] showed 1.9 mm distalization with 2.2° distal tipping and Heurter [40] 3.1 mm maxillary first molar distalization with 5.6° distal tipping. Similarly Ngantung et al[43] exhibited 2.1 mm distalization with 3.3° distal tipping and Lee[41] 3.2 mm maxillary first molar distalization with 2.8° distal tipping.

Davis[38] found 3.0 mm distalization with 6.0° distal tipping and Chiu PP[29] presented 3.4 mm and 3.0 mm maxillary first molar distalization with 3.8° & 5.0° distal tipping. The results of Bolla et al [42] demonstrated 3.2 mm molar distalization with 1.3° distal tipping. Pendulum appliance and intraoral bodily molar distalizer showed greater magnitude of molar distalization with tipping as compare to our findings as results of Ghosh and Nanda[3] showed 5.7 mm distalization with 10.6° tipping and 0.7 mm extrusion. Bussick and McNamara[15] found 5.7 mm distalization with 10.6° tipping with pendulum appliance and Keles and Sayinsu[21] evaluated 5.23 mm maxillary first molar distalization by intraoral bodily molar distalizer with insignificant tipping or extrusion. These findings are identical to our results.

There was more maxillary molar distalization rate (0.54 mm per month) in comparison to 0.18 mm in Patel[39], 0.45 mm in Huerter[40], 0.31 mm in Ngantung et al[43], 0.45 mm in Lee[41], 0.32 mm in Davis[38] , 0.30 mm & o.32 mm per month in Chiu[29] and 0.64 mm in Bolla et al[42] with distal jet appliance.

The maxillary second premolar was mesialized 0.95 mm, tipped distally 7.33° and extruded 0.90 mm in this study but other studies with distal jet appliance exhibited more anchorage loss. The results of Patel[39] showed 2.8 mm mesialization, 3.0° distal tipping of maxillary second premolar and Huerter[40] found 2.10 mm mesial movement and 1.3° distal tipping. Ngantung et al[43] noted 4.3 mm mesial movement and 4.3° distal tipping of maxillary second premolars.

Likely Lee[41] found 2.0 mm and 2.3° distal tipping and Chiu[29] noted 2.4 mm mesial movement with 2.4° distal tipping of maxillary second premolars. Bolla et al[42] noted 1.3 mm mesialization and 2.8° distal tipping of maxillary second premolars. Our results showed comparatively less anchorage loss at second premolar as compared to above studies with distal jet appliance.

Ghosh and Nanda[3] found 2.55 mm mesial translation with 1.29° tipping and 1.77 mm extrusion of maxillary premolars and Bussick and McNamara[15] found 1.8mm mesial movement with 1.5° mesial tipping with pendulum appliance. Results of Keles and Sayinsu[21] with distalizer showed 4.33 mm mesial movement of maxillary first premolars with 2.73° distal tipping.

The maxillary central incisor was proclined to 1.65Ú relative to SN line that was statistically insignificant but more to by Bolla et al[42] and Davis[38] studies and less to Nantung et al.[43] Correspondingly Patricia et al[44] displayed significant flaring of incisors with distel jet and pendulum appliances that is contrary to our findings.

In comparison with other distalizing appliances this study exhibited less incisor labial tipping as reported by Ghosh and Nanda[3] with the pendulum appliance and by Keles and Sayinsu [21] with intraoral molar distalizer.

CONCLUSION

Both distal jet and Jones jig produced Maxillary first molar distalization through bodily movement.

The Jones jig appliance exhibited more anchorage loss i.e. mesial movement of maxillary second premolar than distal jet.

There was more tipping of maxillary first molar with Jones jig as compared to the distal jet.

There was no significant difference in rotation of right and left maxillary first molars with Jones jig and distal jet appliance.

Less extrusion of maxillary first molar was noted with distal jet as compared to Jones jig appliance.

In final conclusion distal jet appliance was found to be a more effective and predictable method for the maxillary first molar distalization through translation with minimum tipping, extrusion, and rotation as well as anchorage loss.

REFERENCES

1 Atherton GA, Glenny AM and O'Brien K. Development and use of a taxonomy to carry out a systematic review of the literature on methods described to effect distal movement of maxillary molars. J Orthod 2002; 29:211-16

2 Carano A, Testa M. The distal jet for upper molar distalization. J Clin Orthod 1996; 30: 374-90

3 Ghosh J, Nanda RS. Evaluation of an intraoral maxillary molar distalization technique. Am J Orthod Dentofacial Orthop 1996; 110: 639-46

4 Bleckman A. Magnetic force system in orthodontics. Am J Orthod 1985; 87:201-10

5 Itoh T, Tukoda T, Kiyosue S, Hirose T, Matsumoto M, Chaconas SP. Molar distalization with repelling magnets. J Clin Orthod 1991; 25:611-17

6 Gianelly AA, Vaitas AS, Thomas WM. The use of magnets to move molars distally. Am J Orthod Dentofacial Orthop 1989; 96: 161-67

7 Bondemark L and Kurol J. Distalization of the maxillary first and second molars simultaneously with repelling magnets. Eur J Ortod 1992; 14:264-72

8 Erverdi N, Koyuturk O, Kucukkeles N. Nickel-titanium coil springs and repelling magnets: a comparison of two different intra-oral molar distalization techniques. Br J Orthod 1997; 24: 47-53

9 Giancotti A, Cozza P. Nickel titanium double-loop system for simultaneous distalization of first and second molars. J Clin Orthod 1998; 32: 255-60

10 Gianelly AA, Bednar J, Dietz VS. Japanese NiTi coils used to move molars distally. Am J Orthod Dentofacial Orthop 1991; 99: 564-66

11 Kalra V. The K-loop molar distalizing appliance. J Clin Orthod.1995; 29:298-330

12 Hilgers JJ. The pendulum appliance for Class II non-compliance therapy. J Clin Orthod 1992; 26:706-14

13 Byloff FK, Darendeliler MA. Distal molar movement using the pendulum appliance. Part 1: clinical and radiological evaluation. Angle Orthod 1997; 67:249-60

14 Byloff FK, Darendeliler MA, Clar E, Darendeliler A. Distal molar movement using the pendulum appliance. Part 2: the effects of maxillary molar root uprighting bends. Angle Orthod 1997; 67:261-70

15 Bussick TJ, McNamara JA. Dentoalveolar and skeletal changes associated with the pendulum appliance. Am J Orthod Dentofacial Orthop 2000; 117:333- 43

16 Joseph AA, Butchard CJ. An evaluation of the pendulum "distalizing" appliance. Semin Orthod 2000; 6:129-35

17 Kinzinger GSM, Syree C, Fritz UB, Diedrich PR. Molar distalization with different pendulum appliances: in vitro registration of orthodontic forces and moments in the initial phase. J Orofac Orthop 2004; 65:389-409

18 Kinzinger GSM, Wehrbein H, Diedrich PR. Molar distalization with a modified pendulum appliance-in vitro analysis of the force systems and in vivo study in children and adolescents. Angle Orthod 2005; 75:558-67

19 Fuziy A, Almeida RR, Janson G, Angeliere F, Pinzan A. Sagittal, vertical and transverse changes consequent to maxillary molar distalization with the pendulum appliance. Am J Orthod Dentofacial Orthop 2006; 130:502-10

20 Echarri P, Scuzzo G, Cirulli N. A modified pendulum appliance for anterior anchorage control. J Clin Orthod 2003; 37:352-59.

21 Keles A, Sayinsu K. A new approach in maxillary molar distalization: Intraoral bodily molar distlalizer. Am J Orthod Dentofac Orthop 2000; 117: 39-48.

22 Cetlin NM and Ten Hoeve A. Nonextraction treatment. J Clin Orthod 1983; 17:396-400.

23 Jones R, White JM. Rapid Class-II molar correction with an open-coil jig. J Clin Orthod 1992; 26: 661-64.

24 Brickman CD, Sinha PK, Nanda RS. Evaluation of Jones jig appliance for distal molar movement. Am J Orthod Dentofacial Orthop 2000; 118:526-34.

25 Hamid MWU, Haq AU. Effects of Jones Jig Appliance in Maxillary First Molar Distalization. Pakistan Oral & Dent. Jr. 26 (2) Dec. 2006; 203-10.

26 Haydar S, Uner O. Comparison of Jones Jig molar distalization appliance with extraoral traction. Am J Orthod Dentofacial Orthop 2000; 117:49-53.

27 Carano A, Testa M. Clinical applications of the distal jet in Class-II non-extraction treatment. Vir J Orthod 2001; 3.4: [6 screens] from URL: http:/www.vjo.it/034/djing.htm.

28 Haq AU, Hamid WU, Chaudry NA. Effects of distal Jet appliance in class II molar correlation. PODJ 2010; 30: 146-53.

29 29. Chiu PP, McNamara JA, Franchi L. A comparison of two intraoral molar distalization appliances: distal jet versus pendulum. Am J Orthod Dentofacial Orthop 2005; 128: 353-65.

30 Karaman AI, Basçiftçi FA, Polat O. Unilateral distal molar movement with an implant-supported distal jet appliance. Angle Orthod 2001; 72:167-74.

31 Kinzinger GSM, Diedrich PR, Bowman SJ. Upper molar distalization with a miniscrew-supported distal jet. J Clin Orthod 2006; 40:672-78

32 Kinzinger G, Wehrbein H, Byloff KF, Yildizhan F, Diedrich P. Innovative anchorage alternatives for molar distalization an overview. J Orofac Orthop 2005; 66:397-413

33 kinzinger GSM, Iden NGU, Yildizhan F, Diedich PR. Efficiency of a skeletonized distal jet appliance supported by miniscrew anchorage for noncompliance maxillary molar distalization. Am J Orthod Dentofacial Orthop 2009; 136: 578-86

34 Papadopoulos MA, Tarawneh F. The use of miniscrew implants for temporary skeletal anchorage in orthodontics: a comprehensive review. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007; 103:6-15

35 Champagni M. Reliability of measurements of photocopies of study models. J Clin Orthod 1992; 26:648-50

36 Gulati S, Kharbanda OP, Parkash H. Dental and skeletal changes after intraoral molar distalization with sectional jig assembly. Am J Orthod Dentofacial Orthop 1998; 114: 319-27

37 Runge ME, Martin JT, Bukai F. Analysis of rapid maxillary molar distal movement without patient cooperation. Am J Orthod Dentofacial Orthop 1999; 115: 153-57

38 Davis EC. A Comparison of two maxillary molar distalization appliances [Unpublished master's thesis]. St Louis, Mo: department of orthodontics, Saint Louis University; 2001

39 Patel AN. Analysis of the distal jet appliance for maxillary molar distalization. Oklohoma City: department of orthodontics, University of Oklahoma; 1999

40 Heurter G. A retrospective evaluation of maxillary molar distalization with the distal jet appliance. St Louis, Mo: Department of Orthodontics, Saint Louis University; 2001

41 Lee SH. Comparison of the Treatment Effects of Two molar Distalization Appliances. St Louis, Mo: Department of Orthodontics, Saint Louis University; 2001

42 Bolla E, Muratore F, Carano A, Bowman SJ. Evaluation of maxillary molar distalization with the distal jet: a comparison with other contemporary methods. Angle Orthod 2002; 72: 481-94

43 Ngantung V, Nanda RS, Bowman SJ. Posttreatment evaluation of the distal jet appliance. Am J Orthod Dentofacial Orthop 2001; 120:178-85

44 Patricia P. Chiu, James A. McNamara Jr,b, Lorenzo F. A comparison of two intraoral molar distalization appliances: Distal jet versus pendulum. Am J Orthod Dentofacial Orthop 2005; 128:353-65

45 Mayara PP, Guilherme J, José F, Castanha H, Renato RA, Marcos RF, Arnaldo P, Karina MSF. Comparative distalization effects of Jones jig and pendulum appliances. Am J Orthod Dentofacial Orthop 2009; 135:336-42