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Comparative evaluation of Dual Force Canine Retractor and Poul Gjessing spring for segmental maxillary canine retraction – A randomized clinical trial.

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Abstract

Objective: The frictionless mechanism of canine retraction in extraction space has always been intriguing. The aim of the present study was to compare the Dual Force Canine Retractor &Poul Gjessing (PG) spring for segmental maxillary canine retraction.

Materials and Method: Ten patients requiring extra ction of first premolar for their ortho dontic treat Ment were selected. The patient was divided into two groups, first group patients had Dual Force Canine retractor on right side while second group patients had it on left side. Poul Gjessing spring was placed on left side of first group patient while right side in second group. OPG, palatine rugae and photo graphs were assessed for angulation, rotation (degree) & vertical position of canine and molar.

Result: Both the appliances showed good canine retraction but PG spring showed greater rotation post treatment which was absent in case of Dual Force Canine Retractor. There was slight anchorage loss but no extrusion was seen in case of PG spring. Dual force Canine retractor has shown good control over axial movement of canine as well as molar.

Conclusion: Dual Force Canine Retractor retracted the canine significantly faster than the Poul Gjessing spring. The vertical control for both the retractors was good.

Keywords: Canine Retraction, Dual Force Canine retractor, Maxillary canine, Poul Gjessing spring.

Introduction

The space resulting from premolar extraction, presents a challenge as it may take a long time for closure; thus increasing the time for final treatment. Any discrepancy in the space closure mechanics may result in failure in achieving ideal occlusion. Once the extraction treatment gained popularity in 1930s, ortho dontists has devised various methods for canine retraction to achieve stable results.

The space closure should work around following aspects to accomplish best results:

1) Differential space closure-anchorage control
2) Minimum patient cooperation
3) Axial inclination control
4) Control of rotations and arch width
5) Optimum biological response
6) Operator convenience.[1]

The canine retraction is done by frictional or non-frictional approach.[2] The friction or sliding mechanics, by means of coil springs or elastics allows the brackets to slide on the orthodontic arch wire; thus closing the space. The non-frictional method uses loops and bends to generate the force and close the space. This allows differential moments in both active and reactive units.[1] The loops also provide the adequate moment to force ratio with better predictability and versatility.[1]

In 1985, Poul Gjessing [3] devised a canine retraction spring for frictionless mechanism. It has gained popularity in recent years because of its adaptability to the commonly used 0.018" pre-adjusted edgewise appliance system. It is efficient in design as well as rigid because of the stainless-steel wire giving it to a good stability.[4] Vyas and Alladwar described an indigenous canine retractor for maxillary canine (dual force cuspid retractor). They designed this so as to reduce the time of canine retraction as well as exert three-dimensional control over it.[5] The present study was conducted to compare the effectiveness of the Dual Force Canine Retractor & Poul Gjessing (PG) spring for segmental maxillary canine retraction.

Materials and Method

The study was done in split mouth design; where a total of 10 patients seeking treatment for malocclusion, were selected. Approval was sanctioned from Institutional ethical committee. The number for the same is RCDSR/ MDS/ SYNOPREG/03. The patients were well informed and consent was obtained from them. All the patients who were enrolled in the study were those having a Class II division 1 malocclusion who requires first premolar extraction so as to avoid bias.

Inclusion criteria were

1. Patients in the age group of 12-25 years of both the genders.
2. Patients with permanent dentition.
3. Patients indicated for maxillary first premolar extraction.
4. No history of previous orthodontic treatment.

The patients were excluded if they were medically compromised or periodontally compromised.

Study design

Selected patients were subjected to all the pre-treatment record takings which included preliminary impressions, ortho pantomo gram, photographs and study models were constructed. The patients then underwent first premolar extraction. Patients were then divided in two groups. In the first group, right side maxillary canine was retracted using Dual Force Canine Retractor and left side maxillary canine was retracted using PG Spring. In the second group right side maxillary canine was retracted using PG Spring and left side maxillary canine was retracted using Dual Force Canine Retractor. Thus, a total of 20 canines were retracted, in which 10 canines were retracted using Dual Force Canine Retractor and 10 canines were retracted using PG Spring.

Fabrication of PG spring

PG Spring a standardized stainless steel retraction spring was fabricated with 0.017”X0.025” Stainless Steel (SS) wire that is adjustable to fit with both 0.018” and 0.022” edgewise appliance. The anterior extension of the spring was engaged in the canine bracket. The posterior extension was engaged into premolar and molar brackets to obtain optimum transverse control of the canine and alignment of canine, premolar and molar. The anterior extension was pulled mesially so that the small circular helix contacted the distal aspect of the canine bracket. The spring was activated by pulling distal to the molar tube until the two loops separated. A 100 gram of force measured by Dontrix Gauge was applied for the retraction of canine. Reactivation of the spring to the initial configuration was done at regular intervals of time (every three weeks).

Fabrication of Dual Force Canine Retractor

Bands for canines were fabricated and preformed bands for the first molars were selected and triple tube with 0.022-inch slot (Roth) were welded on the buccal aspect in conventional manner. Three power arms of 0.021” X0.025” thickness and of equal length (10 mm) with built-in hooks were fabricated for the Dual Force Canine Retractor. Two power arms prepared in a ribbon arch mode were soldered on to the buccal and palatal aspect of the canine. The third power arm prepared in an edgewise mode was inserted in the auxiliary tube of the molar. An offset was given in all the power arms to prevent gingival impingement. Trans palatal arch with central omega loop and unilaterally distally directed hook was prepared at the level of the palatal power arm of canine. E chain applying 150 grams force on each side was engaged between the hooks of the power arms of canines and molar on buccal aspect & hook of TPA and power arm of canine on the palatal aspect, so a total of 300-gram force was applied on the canine.

Once any of canines was retracted on either side of the maxillary arch, alginate impressions, OPG, photographs were taken and models were constructed. This was repeated retraction of canine on the other side. In cases where canines of both sides were retracted at the same rate, records were made once. The records made were subjected to analysis by three methods: 1. Radiographic method (OPG) 2. Cast method (Palatine Rugae) 3. Photographic method

Analysis of Orthopantomogram

All the ortho pantomo grams were taken under standar dized conditions. The radio graphs were examined for inferior outlines of the orbit’s contours, canine and molar with their roots were traced on 0.003-inch acetate paper over each radiograph with a 0.5 mm lead pencil. Angular parameter was recorded with a protractor to nearest of 0.5º and linear parameter was recorded with a ruler to a nearest of 0.5 mm. A reference line passing through the inferior most points of the right and left orbits were obtained. The long axes of the canines and maxillary first molars were marked. To measure the amount of tipping of canine and molar, the internal angles formed by the reference lines and the line passing through the long axis of the canine and molar were measured. Measurements were performed by direct technique from panoramic radiographs obtained at pre-treatment (T0) and post-treatment (T1). Further vertical control over canines and molars were assessed using the reference lines passing through the inferior most points of the right and left orbits. The linear measurement from the reference line to the canine tip and from the reference line to the mesial cusp tip of the maxillary first molar were measured respectively for canine and molar at T0 and T1.

Analysis of Cast

The study models were used for the measurement of anchorage loss of the maxillary first molar. On each maxillary cast a line passing through the anterior raphe point and the posterior raphe point were used to construct a median reference line. The median end of the third palatal rugae, which is considered the most stable by Almeida et al [6] and Bailey et al,[7] was marked. The mesial occlusal pit of the first permanent molar was marked as a point for measurement. The distance between the two points was measured bilaterally at T0 and T1.

Analysis of Photographs

Rotational changes in canines were measured from the occlusal photograph using the method of Ziegler and Ingervall.[8] The angle formed between the line drawn through the distal and mesial point angles of the canine and the mid-palatal raphe was measured in both pre-retraction and post-retraction photograph.

Statistical Analysis

The data collected was analysed using Statistical Package for Social Sciences software for windows (SPSS Inc. Version 16, Chicago, Illinois, USA). The group means in retraction parameters were compared with paired t-test. The comparison of data for the inter group comparison was done by unpaired t-test.

Result

The result was calculated in terms of mean and standard deviation of the retraction of canine as well as molar movement. The intragroup comparison showed no statistically significant difference between angulation, rotation and vertical position of Dual force canine retractor pre and post treatment (Table 1); however, PG spring showed significant amount of canine rotation after the retraction (Table 2). In case of Dual force canine retractor, there was the significant amount of molar tipping after the retraction of canine; but no vertical and sagittal anchorage loss of molar after the retraction of canine was observed. PG spring has also shown significant molar tipping as well as anchorage loss after the retraction of canine but no significant vertical anchorage loss (Table 3). When the mean rate of retraction of canine was compared Dual Force canine retractor showed 1.65 mm per month which was significantly higher than the PG spring whose mean rate of retraction was 1.19 mm per month (Table 4).

Discussion

There are many factors which decide for the success as well as at the same time which determine the specific method to be used for space closure. The frictionless mechanism uses various springs or loops for this. The characteristics to be considered for using frictionless mechanism are retraction arch wire, low load/deflection and efficiency.[9] When a spring is used for canine retraction, it should generate enough closing force in addition to maintaining rotation and bringing the root apices together in the extraction.[10] PoulGjessing spring provides optimum force generating maximum cellular and biochemical response for tooth movement. It also has an advantage of anti-tip and anti-rotation bends.[10] Dual force canine retractor was designed in such a way to fulfil following objectives: a) It provides controlled tipping as it exert force from near the centre of resistance. b) As it applies force from both buccal and palatal aspect, rotation of canine during retraction is less expected. c) No untoward reaction is seen on incisor as they are free of any appliance. d) It stabilizes molars with trans-palatal arch and Nance button with application of force near to the Center of resistance of the molars.[5] These two canine retractors were compared for parameters regarding maxillary canines in the present study, they showed controlled tipping with any root movement (Table 1, 2 and 3). The rate of canine retraction was 1.65 ± 0.60 and 1.19 ± 0.32 mm/month by Dual Force Canine Retractor and PG spring, respectively, demonstrating a significant intergroup difference depicting that canine was retracted faster by Dual Force Canine retractor than the PG spring (Table 4). In terms of canine angulation, no statistically significant differences between Dual Force Canine Retractor (1.8±3.78) and the PoulGjessing Spring (5.6±8.42) were obtained. The movement produced by both is of did not show any bodily movement but tipping as mentioned earlier which was greater in PG spring. Eden &Waters [11] and Cetinsahin et al [12] also showed distal tipping of canine with PG spring.

In terms of canine rotation, PG spring showed 11.9 degree while 2.3-degree canine rotation was seen in case of Dual Force Canine Retractor; this can be due to better axial control due to equal force application from both buccal and palatal aspect. In a study done a Vyas, a 6.5 degree of canine rotation after retraction was observed by Dual Force Canine Retractor.[5] Similar results were seen with Ziegler and Ingervall, where they showed significant distopalatal rotation of the canines was found by both Dual Force Canine Retractor and PG spring.[8] Both the springs have shown good control of vertical positioning of canine at post-treatment. There was no significant difference found amongst the two appliances. This was in contrast to Cetinsahin et al,[12] who observed slight intrusion while retraction in their study.

The study compared anchorage loss and molar positioning too as anchorage is crucial for success of orthodontic treatment. The use of trans-palatal arch in the present study was to avoid any untoward anchorage loss; however slight loss along with molar tipping was observed with both the appliance. The values obtained were not statistically significant when compared amongst the group but the PG spring showed significant tipping and anchorage loss from pre-treatment to post treatment. The mean anchorage loss measured at the first molar crown was 0.5 mm by Dual Force Canine Retractor and 0.7 mm by PG spring. The amount of molar tipping while retracting canine was 5.9 degree by Dual Force Canine Retractor and 7.6 degree by PG spring. This was in accordance with study done by Dincer et al[13] who reported anchorage loss of 1.50mm and 1.63 mm by Dincer and is can.[14] Ziegler and Ingervall[8] found 0.60 mm anchorage loss for the upper molars with the PG retraction spring applied together with a Goshgarian palatal arch and headgear. Gjessing reported that anchorage loss can occur without side-effects, such as extrusion due to β-moment formed by the PG retraction spring.[3] The vertical movement of the molars was not statistically significant by either of the appliance.

The study is different from many other similar studies as it is comparing two methods of frictionless mechanism in a way that both the appliances were used in the same patient to avoid any patient related bias. The result of study has shown promising results for canine retraction. This is can be further strengthened by using a larger sample size in future.

Conclusion

The authors conclude that frictionless methods are produces good results for retraction of canine. Even though Poul Gjessing spring has shown good results; Dual Force Canine Retractor has better control over the axial movement because of dual force application from both buccal as well as palatal aspect as compared PoulGjessing spring. Since there was some amount of anchorage loss, a different anchorage device along with Dual Force Canine Retractor can be a suitable choice.

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Table 1: With in group comparison of values of the amount of canine angulation and rotation (degree) and vertical position (mm) of canine on the side of Dual force canine retractor.

Parameters	Pre-treatment values (T0)		Post-treatment values (T1)		T0-T1		P value
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Canine angulation	90.3	6.28	92.1	7.47	-1.8	3.78	0.627
Canine rotation	30.7	13.69	28.4	12.90	2.3	9.87	0.480

Vertical position of canine	50.9	3.98	50.9	3.96	0.0	0.47	1.000
Molar angulation	91.9	6.21	86.0	8.34	5.9	4.01	0.001*
Vertical position of molar	47.4	3.89	47.3	3.89	0.1	0.74	0.678
Anterior-posterior positioning of molar	15.2	2.15	14.7	1.94	0.5	0.97	0.138

* - statistically significant

Table 2: Within group comparison of values of the amount of canine angulation and rotation (degree) and vertical position (mm) of canine on the side of PG spring.

Parameters	Pre-treatment values (T0)		Post-treatment values (T1)		T0-T1		P value
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Canine angulation	90.6	4.45	96.2	6.60	-5.6	8.42	0.065
Canine rotation	32.4	6.42	20.5	8.95	11.9	5.8	0.001*
Vertical position of canine	51.0	3.33	51.0	3.33	0.0	0.0	1.000
Molar angulation	93.8	7.04	86.2	6.68	7.6	6.1	0.003*
Vertical position of molar	47.3	4.19	47.2	4.34	0.1	0.31	0.343
Anterior-posterior positioning of molar	15.0	0.94	14.3	0.67	0.7	0.95	0.045*

* - statistically significant

Table 3: Inter-group comparison of the amount of canine tipping, canine rotation and the vertical position of the canine after retraction by Dual force Canine Retractor and PG spring.

Parameters	Mean	Standard Deviation	P value
Canine angulation	5.0	7.51	0.104
Canine rotation	-9.6	12.72	0.665
Vertical position of canine	0.0	0.47	1.000
Molar angulation	-1.7	4.79	0.471
Vertical position of molar	0.0	0.47	1.000
Anterior-posterior positioning of molar	0.2	1.14	0.647

Table 4: Comparison of retraction rate of canine between Dual Force Canine Retractor and PG spring.

	Mean rate of retraction (mm per month)	Standard Deviation	P value
Dual Force Canine Retractor	1.65	0.60	0.047*
PG spring	1.19	0.32	