COMPARISON OF RATE OF RETRACTION OF CANINE ON ROUND AND RECTANGULAR WIRES

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ABSTRACT

Objective: To compare the mean rate of canine retraction on round and rectangular stainless steel arch wires.
Study Design: Quasi experimental study.
Place and Duration of Study: Orthodontics department, Armed Forces Institute of Dentistry, Rawalpindi, from May 2017to Jul 2018.
Methodology: Forty patients were inducted requiring fixed orthodontic therapy with first premolar extractions. After initial alignment and premolar extractions, canine retraction was initiated on customized arch wires having a round wire segment on one side and a rectangular wire segment on another. The distance between lateral incisor and canine were measured before starting retraction and 1-month post. Difference between the two measurements was recorded and data was analyzed using IBM SPSS 21.0 and paired sample t-test was applied.
Results: Forty patients (80 teeth) with 21 males (52.5%) and 19 females (47.5%) were included. The mean rate of maxillary tooth movement observed on the experimental side was 0.51 ± 0.1549 mm over a period of one month. Whereas, on the control side 0.20 ± 0.1086 mm movement was recorded. There was a difference of 0.31 ± 0.2036 mm per month in the rate of space closure between the two sides (p=0.01).
Conclusion: Mean rate of canine retraction was significantly greater in round wire segment as compared to the rectangular wire segment.

Keywords: Rate of tooth movement, Rectangular stainless steel wires, Round wires.

INTRODUCTION

As the awareness of aesthetic perception and self-awareness is increasing, it is causing a surge in the need of orthodontic treatment. The first question that the patient asks from an orthodontist is the amount of time it is going to take to finish the treatment. Increased treatment duration of 24-36 months[1] is the main dilemma of orthodontic treatment.

During the course of orthodontic camouflage treatment, premolars are the most commonly preferred teeth for extraction. The process of canine retraction usually begins after this. In the pre-adjusted edgewise appliance system, Canine retraction can be carried out using sliding/ frictional mechanics or by means of friction less mechanics[2]. Sliding mechanics is a popular method employed in space closure owing to its simplicity and ease in chair side fabrication and installation of assembly[3].

Main arch wires used for retraction of canines in sliding mechanics are the heavy rectangular stainless steel wires such as 17x25 Stainless Steel and heavy round stainless steel wires such as 0.20 SS. Retraction of canines include relative motion of canine bracket with the archwire which generates friction and binding. If these frictional forces are excessive it may lead to dissipation of forces and limited or no tooth movement, this phenomenon is excessively observed with heavy rectangular stainless steel archwires[4].

Round stainless steel wires have greater clearance within the bracket slot thus leading to lesser friction compared to heavy rectangular stainless steel archwires[5]. The purpose of this study was to compare the rate of retraction of canine on round and rectangular stainless archwires along with associated effects observed

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using a split mouth design so as to reduce the bias.

METHODOLOGY

A protocol was drawn and approval from the ethical committee of AFID Rawalpindi was taken (905/Trg-ABP1K3). Non probability consecutive sampling technique was used. The study was a Quasi experimental study, carried out from May 2017 to July 2018. Randomization was done by lottery method. A sample size of 40 was calculated using the software G power by considering the values of alpha as 0.05, beta as 0.2 and effect size as 0.4. Fifty-two patients with an age range of 11-19 years were included reporting to AFID orthodontic department requiring maxillary first premolars extractions. It was ensured that the patient was not taking any medications which affects orthodontic tooth movement such as NSAID's, corticosteroids, antibiotics. Forty eight patients were assessed for eligibility criteria and were invited to participate in this trial; 6 patients declined to participate, 4 patients did not meet the inclusion criteria. Thus, 80 patients were enrolled in the trial. Informed consent was collected from all patients and their parents. The details are given in the patients flow diagram (figure).

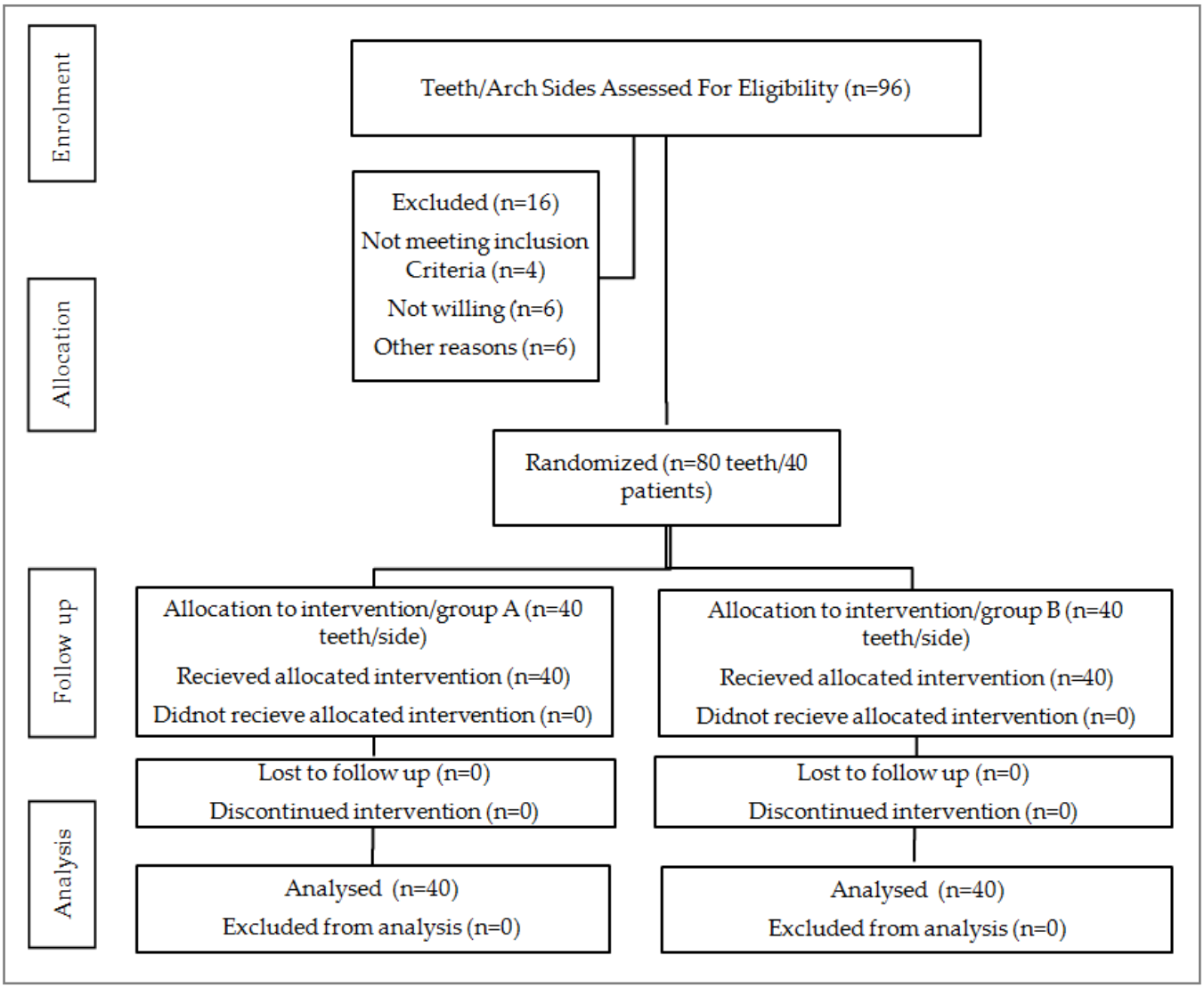

Figure: Patients flow diagram.

Before retraction of canines the intraoral distance between lateral incisors and canines were recorded using Vernier caliper on both sides of the maxillary arch at incisal, middle and cervical thirds of the teeth and their mean was recorded. Modified arch wire was inserted into patient's maxillary arch wire for retraction of canine. This wire consisted of a half rounded 0.20 ss portion and other half of rectangular 17 x 25 Stainless Steel portion soldered in the middle of right and left central incisor region. Canine retraction was carried out using 6mm NiTi coil springs on both sides. Both canines were ligated with the arch wire using steel ligatures. Each patient served as his/her own control (the side with rectangular wire portion) and experimental group (the side with rounded wire portion). Whether the right or left side served as control or experimental was determined by lottery method. Patients were recalled after 4 weeks and the measurements were taken again between lateral incisors and canines at mid, cervical and incisal of the teeth and their mean was recorded. The difference between pre retraction and post retraction values were recorded on both sides. These showed the rate of tooth movement in one month.

Data was analyzed using IBM SPSS version 21. Frequency and percentage was calculated for qualitative variables. Mean and standard deviation was calculated for quantitative variables like rate of tooth movement and age. Difference in the tooth movement of two groups was calculated using paired sample t test. where *p*-value of ≤0.5 was considered significant.

RESULTS

Forty patients (80 teeth) with 21 males (52.5%) and 19 females (47.5%) were inducted into the study. The age of the patients ranged from 11 to 19 years with a mean age of 14.5 ± 3.3 years.

The mean rate of tooth movement observed on the side of the maxillary arch, where canine retraction was carried out on round wire was 0.51 ± 0.1549 mm over a period of one month. Whereas, the mean rate of tooth movement on the other side of the maxillary arch where canine retraction was carried out on rectangular wire was 0.20 ± 0.1086 mm in one month. There was a difference of 0.31 ± 0.2036 mm per month in the rate of space closure between the two sides.

Table: Difference in the mean of tooth movement between two groups.

	Minimum movement mm	Maximum movement mm	Mean ± SD	*p*-value
Round wire (n=40)	0.2	0.8	0.51 ± 0.1549	0.001
Rectangular wire (n=40)	0.1	0.5	0.20 ± 0.1086	

The minimum and maximum rates of tooth movement in one month in the former group were 0.2 mm and 0.8 mm. Whereas, in the latter group the minimum and maximum rates were 0.1 mm and 0.5 mm, respectively. Distal tipping of canines was observed on 3 (12%) patients on round wires as demonstrated by a difference in the distances measured at incisal, mid and cervical region pre and post activation.

The mean rate of tooth movement of the two groups was compared using paired sample t-test. The difference in the mean rate of tooth movement between the two groups was found to be statistically significant with a *p*-value of 0.001. Hence, the null hypothesis was rejected. It was proved that rate of retraction of canine was faster when carried out on round wires as compared to rectangular wires (table).

DISCUSSION

With increasing demand of orthodontic treatment clinicians are keen to know the modalities which can help in increased rate of orthodontic tooth movement[6,7] without any considerable side effects. Various methods of canine retraction that are currently being utilized include the use of various types of accessories,

source of force application, wire configurations and wire sizes[5]. Canine can be moved distally by using sectional buccal loops or springs eliminating the possible effects of friction but sacrificing teeth positional control in three planes of space. Another way of canine retraction is by sliding it distally along a continuous archwire which may be round or rectangular[8].

Rectangular wires offer control in all three planes of space where as round wires give control in two planes only. We used the 17x25 SS wire for retraction because it is the most suitable wire due to its dimension and necessary play required for efficient tooth movement and compared it with 0.20 SS because it is the highest diameter round wire available. On the contrary rectangular wires offer greater resistance to sliding due to greater binding and friction, as compared to the round wires thus decreasing the effective force transmission and slowing the rate of orthodontic tooth movement[9]. As shown in this study the rate of retraction of canine on rectangular segment was comparatively less as observed on the round wire segment.

Friction plays a major role in the slowing down of orthodontic tooth movement. Various factors affecting the frictional forces generated include the type of brackets used, material and cross section of archwires used, methods of ligation, plaque accumulation and saliva etc. Andreason and quevado *et al* in 1970 in their research showed that as the size of the archwires are progressively increased a considerably greater force will be required to overcome friction[10]. The reason behind this was decrease in clearance between the bracket slot and wire. Bracket width and slot dimension also have considerable effect on friction and binding. To decrease friction and facilitate rapid tooth movement a combination of larger bracket slot and a round wire can be used. However, it does result in greater distal tippingof canine. As the tooth tips the wire starts to binds on the ends of the bracket slots and pressure is exerted on the archwire[11]. Thus the bracket will not move any further until there is some distal movement of the root.

Ziegler and Ingervall postulated that the response to different methods of canine retraction was not dependent on the type of force rather than on individual metabolic responses[12]. Optimum force for movement had a nonspecific range as shown by a systematic review by Kulshrestha *et al*[5]. Force duration was considered an important factor influencing biological tooth response. However Yoshikawa and Quinn suggested that a range of 100-200 grams force is sufficient in commencing tooth movement[13].

In our study mean rate of canine retraction observed on round wire was 0.51 ± 0.1549 whereas on rectangular wire was 0.20 ± 0.1086, a statistically significant mean difference of 0.31 ± 0.2036 was observed. Maximum rate of retraction observed after one month was 0.8mm. This was explained owing to a greater frictional resistance offered by heavy rectangular stainless steel wires. Garner *et al* showed that the differences in frictional resistance observed in different wires was due to ease with which the wires slid through the brackets. The least frictional force was observed with 0.016 x 0.022 inch stainless steel and the greatest force was found in the 0.017 x 0.025 inch beta titanium alloy[14].

In the previous studies, heavy rectangular stainless steel wires were preferred over round stainless steel wires for retraction of canines, due to better rotational control and enhanced posterior anchorage value at the cost of increased frictional resistance. In our study only 3 (12%) patients showed distal tipping of canine on round wire as shown by greater distance at the incisal region where as lesser difference was noted at the cervical region, this was due to the loosening of the metal ligature placed over the canine bracket. While retracting canine on round wire posterior anchorage can be enhanced using TAD's. In a study conducted by Shpack *et al*, anchorage loss measured by mesial molar movement was 1.2 ± 0.3mm observed with tipping movement which

was comparatively lesser than that observed in bodily movement group 1.4 ± 0.5mm.

Currently, fixed orthodontic treatment requires a long duration of about 2–3 years[1], which is a great concern and carries high risks of caries[15], root resorption (external) and decreased compliance by the patient[16]. This is the era of rapid orthodontics, so greater consideration is being given to various methods of accelerating orthodontic tooth movement which include surgical (corticotomies[17], micro osteoperforation, piezocision, dentoalveolar or periodontal distraction) and non-surgical methods (low level laser therapy[18], pulsed electromagnetic radiations, ultrasound).

In our study the canine retraction on round wire was 2.5 times faster than the retraction carried out on rectangular wires. In a study performed by Masood *et al* microosteoperforation significantly increased the rate of tooth movement by 2 folds[19]. Saritha *et al* reported a mean overall canine retraction of 4.16 mm with MOP and 3.06 mm in the control group with no intervention[20]. In conclusion MOP groups depicted significantly greater canine retraction than the control group.

PDL Distraction for retraction of canines is a newly emerging way of accelerating orthodontic tooth movement. In a study performed by Sethi *et al* the canines were retracted completely in 20.33 ± 1.87 and mean rate of movement was 5.2mm[21]. Invasive nature of such modalities and associated side effects such as root resorption makes them less preferred approaches. So varying the dimension of the orthodontic wires seems like a viable alternative which may result in greater rate of canine retraction with negligible side effects. Thus it remains a simple yet effective mean of achieving faster tooth movement.

Rohit *et al* in his systematic review suggested that the scientific evidence was too weak to evaluate the efficacy of various canine retraction methods employed during space closure because various contradictions exist in the literature. So in order to prove the efficacy of one method over the other a larger sample size is required[5]. One limitation of our study is that, when there is more friction there tends to be tipping of the incisors during canine retraction, it would have been better if the canine distalization was measured from some other stable structure such as TAD or third palatine ruggae.

CONCLUSION

Canine retraction was a time limiting step in patients with extraction cases. Reduction of treatment time by using various modalities have always been an attractive field for orthodontists which include complex techniques such as lasers, corticotomies etc. to a mere simple modality as changing the wire cross section. Faster rate of retraction of canine was observed on heavy round stainless steel wires with minimal tipping observed.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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