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Comparing the rate of retraction in canines in males and females

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ABSTRACT

There are multiple factors that affect the treatment duration and the rate of canine retraction between males and females. A difference in the levels of calcitonin and the maintenance of the appliance by both genders varies the treatment duration. Hence this study was conducted to analyse the difference in the rate of canine retraction between males and females using two different bracket systems, synergy and self-ligating. The study was designed as a prospective randomized controlled split-mouth clinical trial, which included 16 subjects, 8 males and 8 females, of ages 12-30 years, divided into 2 groups, the left and the right quadrants receiving Self Ligating and Synergy brackets based on simple randomization, along with a 19*25" SS wire and closed coil springs for individual canine retraction. The patients were reviewed every 21 days for four appointments and records were taken for each review. Digital Vernier calliper was used to measure the amount of canine retraction, and statistical analysis was conducted. The values were calculated and tabulated, and independent 't' test was used to analyse the statistical difference. There was no significant statistical difference between the two genders. There are various factors that affect the rate of canine retraction and gender of the patient undergoing orthodontic treatment is one of them. With increased amounts of calcitonin in males, making the alveolar and basal bone denser when compared to women, would likely increase the treatment time in males, when compared to females. Hence this study was conducted to compare the difference and showed that there is no statistical difference between males and females in the rate of canine retraction.



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INTRODUCTION

When conducting an initial consultation, every clinician is called upon to answer questions regarding the duration of the treatment proposed. The answer to this question usually depends, among other factors, on the clinician's experience and this,

in turn, might depend on his educational background, technical skills, and practice management methods. Success in orthodontic practice is influenced by an accurate prediction of treatment duration. The literature states that there are multiple factors that affect the duration of the treatment.

The selection of any treatment, whether a technique, spring or appliance design should be based on the desired tooth movement. Orthodontists have been able to believe that two-step closure – first cuspid retraction followed by, anterior retraction is less detrimental to the anchorage when compared to the method of en masse retraction of all six anterior teeth (Kuhlberg AJ, 2001).

One of the biomechanical alternatives to space closure is the retraction of canines with sliding mechanics performed prior to incisor retraction. The

Table 1: Showing the independent 't' test comparing both the genders under Group 1

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
RCR1ST	0.942	0.340	-0.491	30	0.627	-0.11875	0.24193	-0.6128	0.37535
RCR2ND	0.351	0.558	0.812	30	0.423	0.24687	0.30402	-0.3740	0.86778
RCR3RD	1.779	0.192	3.588	30	0.001	1.23313	0.34368	0.53123	1.93502
RCR4TH	0.574	0.455	5.098	30	0	1.61875	0.31753	0.97027	2.26723
			5.098	29.110	0	1.61875	0.31753	0.96943	2.26807

Table 2: Showing the independent 't' test comparing between both the genders under Group 2

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
RCR1ST	0.331	0.570	0.067	30	0.947	0.0162	0.2428	-0.4797	0.5122
RCR2ND	1.968	0.171	-0.770	30	0.447	-0.2343	0.3043	-0.8559	0.3872
RCR3RD	2.781	0.106	-0.707	30	0.485	-0.2881	0.4074	-1.1203	0.5440
RCR4TH	1.019	0.321	-0.828	30	0.414	-0.3550	0.4289	-1.2309	0.5209
			-0.828	29.392	0.415	-0.3550	0.4289	-1.2317	0.5217

The most common approach is a sequential procedure in which the canines and incisors are retracted in two separate and distinct steps. In the first step, the canine in each quadrant is retracted till full contact with the tooth distal to the extraction space is achieved. In the next subsequent step, the canines are fastened to the teeth distal to them. The resulting grouping is then used as a single anchorage unit to retract the incisors. This procedure has been called the '2-step' technique. However, there are some conceivable disadvantages to the 2-step approach. Closing space in two steps rather than one step might make treatment take a longer time. To note, when canines are retracted individually in quadrants, they tend to tip and rotate more when compared to when the anterior teeth are retracted as a single unit, thus requiring additional time and effort to re-level and re-align (Ziegler and Ingervall, 1989).

Therefore, an alternative treatment approach called "en-masse retraction" came into use in which the anterior (i.e. incisors and canines) are retracted as a single unit. One treatment technique

that uses this approach is the MBT system developed by Bennett and McLaughlin. This en-masse technique has gained popularity because of its mechanical simplicity. But, in theory, it might be expected to tax the posterior anchorage more than the 2-step technique (Ziegler and Ingervall, 1989).

In friction or sliding mechanics, the force is applied via elastomeric modules or coil springs from the anchor unit to the posts soldered to archwires. Sliding mechanics required minimum wire bending and decreased chairside time.

Frictionless mechanics is based on incorporation of loops in archwire. In situations where canine retraction is necessary, a loop may be incorporated into a section of an archwire extending from the anchor teeth to the canine on each side, passing through the main archwire tube of the molar and the slot of the second premolar bracket. The loops are activated to retract the canines alone. The loops, when made in continuous archwires, can be used for en-masse retraction of the anterior teeth or protraction of posterior teeth (Rhee et al., 2001).

Table 3: The mean amount of rate of canine retraction for both males and females in Group 1 and Group 2 (in mm)

S no	Group 1 – Synergy Bracket		Group 2 – Self-Ligating Bracket	
	Female	Male	Female	Male
1	0.79	2.30	1.035	0.46
2	2.562	4.42	2.47	2.432
3	2.52	3.96	0.9	2.167
4	2.646	4.68	0.74	2.47
5	2.574	2.45	2.172	1.127
6	1.722	4.86	0.852	1.605
7	2.298	2.99	3.222	1.772
8	1.84	4.61	1.852	1.472

Treatment mechanics and their efficiency are necessary to ensure optimal results in lesser clinical time and shorter treatment duration. With the advent of the straight wire appliances, the sliding mechanics have reduced the need for wire bending that was so predominant in the standard edgewise appliances. The principal of the mechanics behind moving the teeth is that there will be friction between the archwire, bracket surface and ligature surfaces, which is estimated as 50 per cent of the force is applied to overcome the friction in the system.

In recent years, scientific studies have further mitigated the situation by documenting that bracket design is one of the several variables capable of affecting tooth movement (Krishnan *et al.*, 2015; Sheibaninia *et al.*, 2011).

The concept of self-ligating brackets was proposed to eliminate this force of friction. It was to provide a friction-free environment which would allow better sliding mechanics and thereby reduce the treatment time (Kulshrestha *et al.*, 2015).

Recently came the evolution of Synergy brackets. Synergy bracket is one of the commercially available brackets that is most versatile and active. It brings about the increased amount of treatment control options than conventional edgewise brackets, reduces the frictional resistance drastically and also reduces the total treatment duration. All of this comes together in a very low profile patented Synergy design.

Testing shows that Synergy brackets have significantly lower friction and binding than self-ligating brackets. Synergy's patented rounded arch walls, and floor significantly reduces friction and binding for a gentler, more continuous force. Additionally, these features increase inter-bracket distance for more efficiency. Synergy is well known for its increased bond strength due to its mesh present at the bonding base, and low profile is unlike bulky

self-ligating brackets which have occlusal interference and bond failures (Cricoli *et al.*, 2013; Krishnan *et al.*, 2017; Ravichandran and Dinesh, 2017; Samantha *et al.*, 2017; Yeh *et al.*, 2007).

There are various factors that influence space closure and the rate of canine retraction. They are as follows (Avdagić *et al.*, 2009; Nieves *et al.*, 2005):

1. PHYSICAL
 - a. Archwire
 - (1) Cross section of the wire
 - (2) Material
 - (3) Surface texture
 - (4) Stiffness
 - b. Ligation
 - (1) Ligature wires
 - (2) Elastomerics
 - (3) Self-ligation
 - c. Brackets
 - (1) Material
 - (2) Manufacturing process
 - (3) Slot dimensions
 - d. Orthodontic appliance
 - (1) Inter-bracket distance
 - (2) Level of bracket slots between the adjacent teeth
 - (3) Forces applied for retraction
2. BIOLOGICAL
 - a. Saliva
 - b. Plaque
 - c. Acquired pellicle
 - d. Corrosion
3. OTHER FACTORS
 - a. Age
 - b. Gender
 - c. Bone density
 - d. Periodontal status

Studies have proven that the factors as mentioned above have played a role in influencing the rate of canine retraction. But there hasn't been much literature on gender. Hence this study is conducted to see if there is any gender difference in the rate of canine retraction.

MATERIALS AND METHODS

This study conducted is a prospective randomised control trial – split-mouth study, conducted in the Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College, Chennai, Tamil Nadu, India, also approved by the Institutional review board of human ethical committee. The sample size was based on the statistical evaluation of the previous study with 90% power, with the actual sample size of 16. The patients included were selected based on the inclusion criteria with their consent to take part in the study.

The inclusion criteria are as follows: Subjects with permanent dentition, Patients who required upper first premolar extraction.

The exclusion criteria include patients suffering from systemic illness, patients with TMD and craniofacial anomalies, patients who have previously undergone dental treatment for the upper canines or have undergone previous orthodontic treatment and, patients with any periodontal diseases.

This study comprised of 16 patients, in which each upper arch was split into two groups, group 1 being Self Ligating and group 2 being synergy.

All patients were strapped with 0.022" slot MBT prescription. Initial levelling and aligning were performed with MBT brackets, later the left and right canine brackets were replaced with Self Ligating and Synergy brackets randomly. Anchorage was augmented using trans-palatal arch. This would reduce anchorage loss during individual canine retraction. As the orthodontic treatment progressed to the levelling and aligning stage, photographs and study model casts were prepared. Each patient was reviewed every 28 days for four appointments. Impressions were taken every appointment, and the models were prepared.

Continuous archwire of dimension 0.019 × 0.025-inch SS wire was customized on a Sym-grid template, taking a cue from the patient's pre-treatment arch form. 0.019 × 0.025-inch SS wire is used to achieve bodily retraction of canine and to establish torque completely.

The canines were ligated to the arch-wire. A 0.019 × 0.025-inch stainless steel wire was placed in the upper arch, and individual canine retraction was initiated by placing Closed Coil Niti springs [GDC] from molar hook to the canine hook on both sides. Closed coil springs applied a force of 150g. The amount of force application was measured with the help of the Dontrix tension gauge. The Closed coil Springs[GDC] were stretched whenever required to maintain an optimum force of 150 gm.

The duration for retraction is four months in this study. The rate of retraction was measured as the

distance travelled, divided by four months of canine retraction which was recorded in millimetres. The maxillary model was taken for each review appointment. Measurements were performed by direct-technique from stone casts using digital Vernier calliper obtained before and at the completion of retraction for each canine. The landmarks used in measuring were cusp tip of the canines and central fossa of the molars which is consistent and reliable.

RESULTS

The results obtained from the statistical evaluation are given in the following tables. Dahlberg's method of error determination did not show any intra operator error [correlation coefficient <0.001] (Dahlberg, 1940).

DISCUSSION

There are various factors that affect the treatment duration in genders, between males and females. The amount of calcitonin present is more in males than in females, which makes the basal bone and the alveolar bone denser in males, which would tend to result in longer treatment duration in males (Felsenfeld and Levine, 2015). Other factors would also include the maintenance of oral hygiene, which is more better in females than in males, as they are more conscious about their aesthetics, which would prompt them to be more regular for their appointments (Avdagić *et al.*, 2009; Naganathan and Sambrook, 2003; Nieves *et al.*, 2005).

Self-ligation was by far the subject assessed by the majority of included trials and has reported advantages both in terms of treatment duration and friction. However, these claims have been contradicted, and various factors have been attributed to it. It has been proved that self-ligating brackets do provide an environment with lesser friction, but their efficiency to influence the outcome has not Keeping in mind, that there aren't many in-vivo studies on gender comparison between males and females, this study was undertaken to assess any difference during individual canine retraction in fixed orthodontics, in two groups, Self-Ligating brackets and Synergy brackets.

The methodology, results and observations from our study are discussed as follows.

Sixteen patients were selected based on the inclusion and exclusion criteria, eight males and eight females and based on simple randomisation the brackets were assigned to the 1st and 2nd quadrant canines.

An individual canine retraction was done (Kuhlberg AJ, 2001) using Niti coil springs over

elastomeric chain as it was proven to be better in literature. The patients received 150g of force which was measured using a Dontrix gauge, and the coil spring was engaged from the 1st molar tube hook to the canine bracket hook (Sonis, 1994).

Various methods for evaluation of canine retraction are lateral cephalograms and dental casts. Lateral cephalograms have intrinsic limitation such as image distortion, magnification, superimposition structures and also increases the risk of radiation exposure. For the evaluation of canine retraction in this study, dental casts at every review were used. The rate of canine retraction was measured using a digital Vernier calliper in millimetres measuring the distance between the distal end of canine and the mesial end of the 1st molar. The anchorage loss was recorded as the amount of movement in millimetres that occurred in the direction opposite to the direction of the resistance applied. This method was considered easier and accurate and did not subject patients to excessive radiation exposure (Lotzof *et al.*, 1996).

Constituent material and orthodontic arch-wire diameter can influence tooth movement during sliding mechanics. It is known that stiffer wires can better resist the tendency of teeth tilting during sliding (Kojima *et al.*, 2006). Therefore, thicker Stainless Steel wires would be best suited for these mechanics (Ehsani *et al.*, 2009). For this reason, 0.019 X 0.025-inch Stainless steel arch-wire was selected.



Figure 1: Synergy canine bracket, with MBT prescription - 0°/±7° torque, RMO®



Figure 2: Rounded arch slot floor reduces friction since the archwire contacts the floor at only two points. Synergy®, RMO®

During canine retraction, there was mild rotation control loss in the canines that received synergy brackets, as only the central wings were ligated. Bracket re-bonding was never required. None of the Ni-Ti coil springs was broken or lost, and none required replacement before the scheduled appointment.

The rate of canine retraction between genders was evaluated at every appointment between both the groups, Synergy and Self Ligating group. The mean values were taken at every appointment, and a bar graph was plotted between the two genders under Group 1 and Group 2 as shown in Graph 2 and 3. There was no statistical difference between the two genders in both groups. been established (Harradine and Birnie, 1996; Kapur R *et al.*, 1998) (Loftus *et al.*, 1999). However, Thorstenson and Kusy (Thorstenson and Kusy, 2002) proved that resistance to sliding is observed in both bracket types, SLB and conventional brackets, due to the angulation of the arch-wire in the slot and that the arch-wire binding-releasing phenomenon plays a much greater role than the bracket-arch-wire friction as believed (Fansa *et al.*, 2009; Southard *et al.*, 2007). Treatment duration may be influenced by various factors like extractions, appliance design *etc.* (Mavreas and Athanasiou, 2008).

The Empower bracket (American Orthodontics) is a dual activation system of self-ligating brackets (Fig 8.1). Dual Activation brackets combine interactive anterior brackets with a passive posterior for a hybrid system that minimizes ligation forces, frictional resistance, while still offering full anterior control for precise finishing.



Figure 3: Diagrammatic representation of variations in ligature tie

Considering the fact that reduced friction reduces the treatment time, a search for a system with less friction was undertaken. Some in-vitro studies showed that Synergy brackets had low friction (Ehsani *et al.*, 2009).

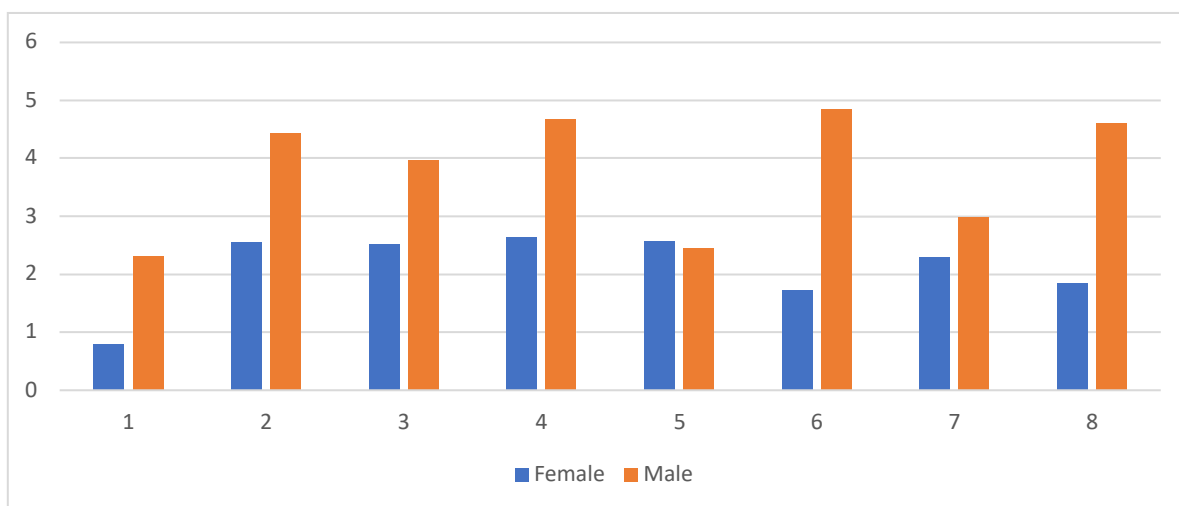


Figure 4: The rate of canine retraction between males and females in Group 1

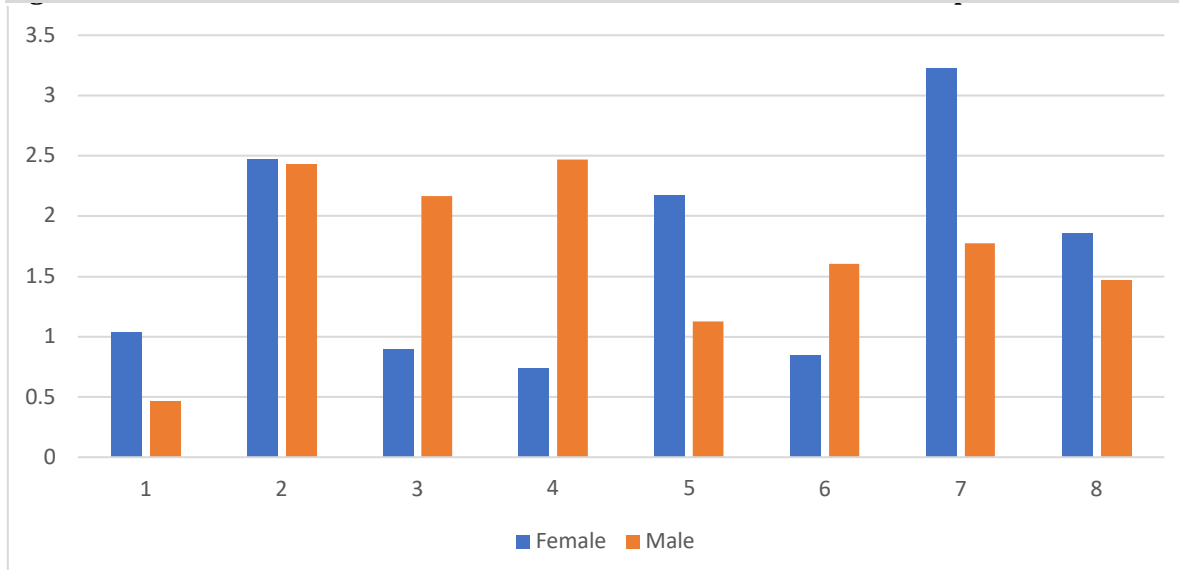


Figure 5: The rate of canine retraction between males and females in Group 2

Synergy conventional low frictional bracket system was recently introduced by, RMO (Rocky Mountain Orthodontics), the reduced friction appliance system. Synergy brackets have six tie wings with a rounded arch slot walls and floor (Fig 3 and Fig 4), which is said to reduce the friction giving a gentler, more continuous force. Treatment time is claimed to be reduced and is more comfortable for the patient (RMO®).

Another advantage of the synergy system is the friction selection control, where based on the variations of ligation, the force varies. The variations are as follows (Fig 5):

1. For reduced friction, only the central two wings are engaged.
2. For moderate rotation, four tie wings are engaged.
3. For maximum rotation, the corner two tie wings are engaged
4. For maximum control, the corner tie wings on either side are engaged with a figure of 8 ligation
5. For conventional control, all the six tie wings are included (RMO®).

Among the methods as mentioned above, ligation placed around the inner tie-wings yields the best performance (Crincoli *et al.*, 2013).

CONCLUSION

Various factors affect the rate of canine retraction and gender of the patient undergoing orthodontic treatment is one of them. With increased amounts of calcitonin in males, making the alveolar and basal bone denser when compared to women, would likely increase the treatment time in males, when compared to females. Hence this study was conducted to compare the difference and showed that there is no statistical difference between males and females in the rate of canine retraction.

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