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MAXILLARY CANINE RETRACTION RATE USING TWO DIFFERENT ORTHODONTIC MECHANICS (A PROSPECTIVE CLINICAL STUDY)

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ABSTRACT

Objective: The objective of this study is to compare the rate of canine retraction between conventional labial retraction force versus palatal retraction force with labial appliance. **Materials and Methods**: This prospective randomized clinical study was conducted on a sample of 26 patients recommended for upper first premolar extraction as part of their orthodontic treatment plan. The patient ages ranged from (16-26) years. Patients were randomly divided into two groups; Group I: Thirteen patients, treated with Roth brackets 0.022-inch slot for labial orthodontic appliance with palatal retraction force. Group II: Thirteen patients, treated with Roth brackets 0.022-inch slot for labial orthodontic appliance with labial retraction force. **Results:** The canine retraction rate was measured clinically using dental vernier at monthly intervals. The distance measured was between maxillary canine cusp tip and maxillary first molar mesiobuccal cusp tip. Measurement was done till closure of the extraction space (when both canines touch the mesial surface of the upper second premolars). **Conclusion:** Both methods of retraction with labial or palatal force could be effective in canine retraction. There is no significant difference between both ways on the rate of canine retraction.

KEY WORDS: Extractions, Canine retraction, CBCT, Anchorage, Bimaxillary protrusion.

INTRODUCTION

The duration of orthodontic treatment is the primary concern of almost all the patients. Therefore, this increases the demand to find the best method to increase the rate of tooth movement with the least possible disadvantages [1].

Ever since the Andrew's straight wire appliance was introduced commercially, many new bracket prescriptions and techniques have been developed. All these developments are to create a force system that can work efficiently to shorten the orthodontic treatment period [2].

Extractions are frequently indicated in orthodontics to correct various malocclusions. Space closure is one of the most important steps in treatment after extraction. Orthodontic appliances are activated by the clinicians to produce these forces [3].

The introduction of lingual orthodontics opened new horizons in orthodontic treatment[4]. Labial orthodontics and lingual orthodontics differ considerably in their biomechanics [5-7]. Lingual orthodontics provides evidence of superior anchorage values and faster rate of retraction due to its positional biomechanical advantage [4,6,8]. Unlike the labial appliances, the applied force in the lingual appliance passes close to the center of resistance of the tooth [9]. It is accepted that there is superior anchorage control because the direction of forces during space closure creates a degree of buccal root torque and

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distopalatal rotation of molar crown, which in turn produces cortical bone anchorage [4]. As a consequence, torque is more difficult to control in lingual orthodontics [4,9,11,12]. This limitation of torque control during retraction in lingual orthodontics has been overcome by the use of labial appliance with lingual force instead of lingual appliance with lingual force [6,14].

Takemoto[6,8] compared the anchorage loss in bimaxillary protrusion subjects treated with labial and lingual appliances and concluded that a minimal amount of 0.1–0.5 mm of anchorage loss was observed with retraction of up to 7.9 mm with lingual appliances [6,8,13]. This was possible due to lingual force application palatal to the center of resistance of the incisors and distally rotating forces on molars resulting in high anchorage availability.

Since the era of Edward Angle, numerous orthodontists have combined active labial appliances with lingual appliances such as Mershon (lingual arch), Goshgarian (transpalatal arch), Ricketts (quad helix) and Wilson (3D modular-enhanced orthodontics) [10]. Taking these references and also the advantages of lingual biomechanics into consideration, in this study, biomechanical principles of lingual orthodontics will be utilized in labial orthodontic appliance in an attempt to reduce the treatment time and to get the force vectors close to the center of resistance, to compare the rate of canine retraction and anchorage loss between conventional labial orthodontic retraction force and labial orthodontic appliance with palatal retraction force.

MATERIALS AND METHODS

This prospective randomized clinical study was conducted on a total sample of 26 orthodontic patients recommended for upper first premolar extraction as part of their orthodontic treatment plan. The patient ages were ranged from (16-26) years. The sample was selected from patients seeking orthodontic treatment in the orthodontic clinic, Faculty of Dental Medicine (Boys branch), Al-Azhar University, Cairo, Egypt. Sample size calculation was undertaken with G power test version 3.1 statistical software based on the following pre-established parameters: an 80% power, sample size for unpaired t-test, significance level (alpha) = 0.05 (two-tailed). The estimated minimum sample needed to have adequate power to detect a difference was twenty-six. The G power test was based on the result of study of Shpack N. [15] titled "Duration and anchorage management of canine retraction with bodily versus tipping mechanics."

Randomization:

Patients were assigned to a palatal retraction group (Group I) and a buccal retraction group (Group II) with an allocation ratio of 1:1. The process of randomization and group allocation was undertaken using Random Allocation Software, Version 1.0, May 2004.

Eligibility of criteria:

- ***Inclusion criteria:***

The patients were included in the study if they have the following:

1. An age ranges from 16 to 26 years.
2. Full permanent dentition (3rd molars excluded).
3. Indication for bilateral extraction of maxillary first premolars.
4. Mild form of crowding.

Groups:

The patients enrolled in this study were 26 extraction orthodontic patient. These patients were randomly divided into two equal groups:

- Group I: Thirteen orthodontic patients were treated with Roth brackets 0.022-inch slot for labial orthodontic appliance with palatal retraction force.
- Group II: Thirteen orthodontic patients were treated with Roth brackets 0.022-inch slot for labial orthodontic appliance with labial retraction force.

Treatment steps:

A) Orthodontic appliance

1. Direct bond orthodontic brackets (0.022″) from maxillary 2nd premolar to maxillary 2nd premolar (Canine and premolars brackets with hooks) were bonded using light cure orthodontic adhesive.
2. Ready made orthodontic bands with triple tubes were cemented to maxillary first molars with trans-palatal arch soldered to the bands.

B) Leveling and alignment

Initial leveling and alignment was initiated by utilizing 0.012″ nitinol orthodontic arch wire that was followed by ordinary sequence of nitinol orthodontic arch wires (0.014" & 0.016"). This was followed by 0.016" x 0.022" nitinol orthodontic arch wire to allow almost passive placement of rectangular 0.016″x0.022″ stainless steel orthodontic arch wire for starting canine retraction.

C) The first CBCT was taken for each patient after leveling, alignment and extraction of upper 1st premolars.

D) Canine retraction

Maxillary canine retraction was started in both groups on 0.016 × 0.022-inch stainless steel as a working wire using sliding mechanics. The maxillary canine retraction was undertaken in both groups (I & II) using NiTi coil spring on both sides according to a standardized protocol.

- In Group I, lingual cleats were bonded on the palatal surface of canines. Trans- palatal arch was modified with a wire projection for the engagement of NiTi coil spring. Canine retraction was done by applying NiTi coil spring with the force values of approximately 200 g [15,16] in each quadrant, from the palatal surface of the canines (lingual cleats) to the palatal surface of the molars (modified trans palatal arch). No forces on the buccal side of the arches were applied (Fig. 1).

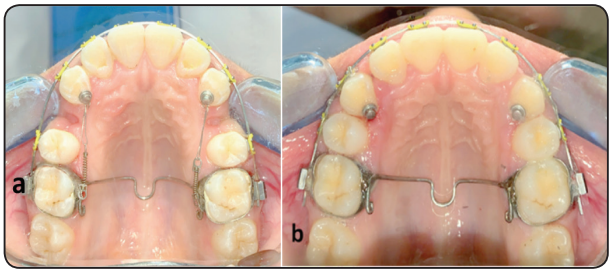

FIG (1) Group I, at which canines were retracted through palatal retraction force. (a): Pre canine retraction. (b): Post canine retraction.

The force was determined using YDM 5N YS-31 tension gauge.

- In Group II, NiTi coil spring was attached between maxillary canine hook and maxillary molar hook, with the force values of approximately 200 g in each quadrant (Fig. 2).

E) The second CBCT was taken when both canines touch the mesial surface of the upper second premolar.

F) The canine retraction rate was measured clinically using dental vernier at monthly intervals, the distance measured was between the maxillary canine cusp tip and maxillary first molar mesiobuccal cusp tip [15]. Measurement was done till closure of the extraction space (the extraction space is considered closed when both canines touch the mesial surface of the upper second premolar).

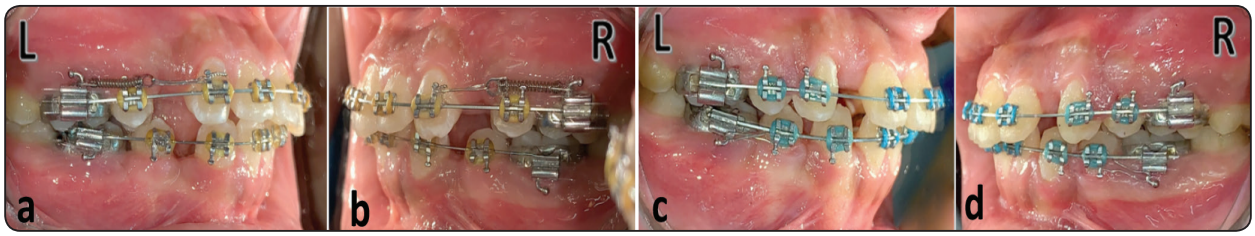

FIG (2) Group II, NiTi coil spring was attached between canine hook and molar hook, with the force values of approximately 200 g in each quadrant. (a) & (b): Pre canine retraction. (c) & (d): Post canine retraction

RESULTS

The canine retraction rate was measured clinically using dental vernier at monthly intervals. The distance measured was between the maxillary canine cusp tip and maxillary first molar mesiobuccal cusp tip. Measurement was done till closure of the extraction space (the extraction space is considered closed when both canines touch the mesial surface of the upper second premolars)

The collected data concerning the canine retraction rate shows parametric distribution according to Kolmogorov-Smirnov test (Table 1a). The descriptive statistics of the canine retraction rate in each studied group is illustrated in (Table 1b).

TABLE (1A): Kolmogorov-Smirnov test

Canine retraction rate (Clinical evaluation)	Group I		Group II	
	p	Sig.	p	Sig.
Right				
T1	0.003*	S	0.200	NS
T2	0.200	NS	0.200	NS
T3	0.056	NS	0.036*	S
T4	0.200	NS	0.200	NS
T5	0.161	NS	0.200	NS
T6	-	-	-	
Total difference	0.200	NS	0.190	NS
Rate in total retraction time	0.200	NS	0.141	NS
Left				
T1	0.100	NS	0.200	NS
T2	0.200	NS	0.200	NS
T3	0.200	NS	0.143	NS
T4	0.117	NS	0.026*	S
T5	0.026*	S	-	-
T6	-		-	-
Total difference	0.015*	S	0.200	NS
Rate in total retraction time	0.001*	S	0.200	NS

Group I:

The mean canine retraction distance per month on the right side was 1.13 mm/m ±0.19 and on the left side was 0.90 mm/m ±0.46.

Group II:

The mean canine retraction distance per month on the right side was 1.02 mm/m ±0.20 and on the left side was 1.20 mm/m ±0.31.

TABLE (1B): Descriptive statistics of canine retraction rate in both studied groups.

	Time	Side	Canine retraction rate						
			Min.	Max.	Mean	±SD	Median	95% CI	
								LL	UL
Group I	T2	Right	0.50	2.0	1.42	0.66	1.50	1.0	2.0
		Left	0.0	2.50	1.0	0.84	1.0	0.5	1.0
	T3	Right	1.0	2.0	1.67	0.52	2.0	1.0	2.0
		Left	0.0	2.0	1.33	0.82	1.50	1.0	2.0
	T4	Right	1.0	2.0	1.33	0.52	1.0	1.0	2.0
		Left	0.0	2.0	1.17	0.75	1.0	1.0	2.0
	T5	Right	0.0	2.0	1.20	0.84	1.0	1.0	2.0
		Left	1.0	2.0	1.20	0.45	1.0	1.0	2.0
	T6	Right	1.0	1.0	1.0	-	1.0	-	-
		Left	1.0	1.0	1.0	-	1.0	-	-
	T7	Right	1.0	1.0	1.0	-	1.0	-	-
		Left	1.0	1.0	1.0	-	1.0	-	-
	Rate per total retraction time	Right	4.0	7.0	5.75	0.99	6.0	5.5	6.0
		Left	0.0	7.0	4.83	2.50	5.25	5.0	5.0
	Rate per month	Right	0.86	1.40	1.13	0.19	1.15	1.0	1.20
		Left	0.0	1.30	0.90	0.46	1.0	1.0	1.10
Group II	T2	Right	1.0	2.0	1.83	0.41	2.0	2.0	2.0
		Left	1.0	2.0	1.83	0.41	2.0	2.0	2.0
	T3	Right	1.0	3.0	1.58	0.80	1.25	1.0	2.0
		Left	1.0	3.0	1.83	0.75	2.0	1.0	2.0
	T4	Right	0.50	2.0	1.30	0.67	1.0	1.0	2.0
		Left	1.0	2.0	1.20	0.45	1.0	1.0	1.0
	T5	Right	0.0	2.0	0.70	0.84	0.50	0.0	1.0
		Left	1.0	2.0	1.40	0.55	1.0	1.0	2.0
	T6	Right	0.0	1.0	0.50	0.71	0.50	0.0	1.0
		Left	0.0	1.0	0.50	0.71	0.50	0.0	1.0
	T7	Right	0.0	0.0	0.0	-	0.0	-	-
		Left	0.0	0.0	0.0	-	0.0	-	-
	Rate per total retraction time	Right	3.0	8.0	5.25	1.60	5.0	5.0	5.5
		Left	4.0	8.0	6.0	1.67	5.50	5.0	8.0
	Rate per month	Right	0.71	1.33	1.02	0.20	1.0	1.0	1.10
		Left	0.71	1.60	1.20	0.31	1.27	1.0	1.33

Table (1c) shows statistical comparison of the canine retraction rate between the two studied groups:

Results showed a statistically non-significant difference in canine retraction rate, between the two studied groups, on both sides either at each monthly interval or in total canine retraction time.

TABLE (1C): Statistical Comparison of canine retraction rate between the two studied groups.

			Group I		Group II		t	p
			Mean	SD.	Mean	SD.		
Difference	T2	Right	1.42	0.66	1.83	0.41	1.309	0.226
		Left	1.0	0.84	1.83	0.41	2.193	0.053
	T3	Right	1.67	0.52	1.58	0.80	0.214	0.835
		Left	1.33	0.82	1.83	0.75	1.103	0.296
	T4	Right	1.33	0.52	1.30	0.67	0.093	0.928
		Left	1.17	0.75	1.20	0.45	0.087	0.933
	T5	Right	1.20	0.84	0.70	0.84	0.945	0.372
		Left	1.20	0.45	1.40	0.55	0.632	0.545
	T6	Right	1.0	–	0.50	0.71	0.092	0.921
		Left	1.0	–	0.50	0.71	0.089	0.939
	T7	Right	1.0	–	0.0	–	–	–
		Left	1.0	–	0.0	–	–	–
	Rate in total retraction time	Right	5.75	0.99	5.25	1.60	0.650	0.530
		Left	4.83	2.50	6.0	1.67	0.949	0.365
Rate per month		Right	1.13	0.19	1.02	0.20	0.910	0.384
		Left	0.90	0.46	1.20	0.31	1.322	0.215

t: Student t-test

p: p value for comparing between the studied groups

**: Statistically significant at $p \leq 0.05$*

DISCUSSION

In orthodontic therapy, extractions are frequently indicated to correct various malocclusions. Space closure is one of the most important steps in treatment after extraction. Orthodontic appliances are activated by the clinicians to produce these forces.

The introduction of lingual orthodontics opened new horizons in orthodontic treatment.[4] Labial orthodontics and lingual orthodontics differ considerably in their biomechanics.[7] Lingual orthodontics provides evidence of superior anchorage values and faster rate of retraction due to its positional biomechanical advantage [4,6,8] .

The biomechanics involved in lingual orthodontics is different from labial orthodontics. [17] In lingual orthodontics, the point of force application is on the lingual side and this difference in the aspect of point of force application and its varying distances from the center of resistance in both sagittal and vertical planes, are the key reasons why teeth respond differently to lingual technique[11, 18].

Quraishi et al.,[14] compared between labial appliance with lingual force and conventional labial appliance. The rate of retraction was faster and anchorage loss was lower with labial appliance with lingual force, thus indicating that this new technique

of space closure utilizes biomechanical advantage of lingual force in conventional labial appliance.

In the present study, the canine retraction rate was measured clinically using dental vernier at monthly intervals. In comparison between the two studied groups according to canine retraction rate, results showed a statistically non-significant difference in canine retraction rate, between the two studied groups, on both sides either at each monthly interval or in total canine retraction time. This is in contrast to the study done by Romano and Kumar RR et al. [6,8] This difference in findings might be because of the "bowing effect" and unexpected tooth movements which has been confirmed to happen with application of single lingual retraction force [19-21] .As a result this increased the critical contact angle between bracket slot and arch wire with the increasing possibility of binding that may lead to notching which in turn increase the resistance to the sliding along the arch wire decreasing rate of canine retraction in group I [22-27].

Knowledge of the biomechanics of lingual appliance, particularly where it differs from labial orthodontics, is essential. Lingual treatment can be as successful and as satisfying as the latter. Maintenance of aesthetics during treatment is a major issue in orthodontics, particularly for adult patients, and it is imperative on clinicians to be aware of the necessity to fulfil the patients' concerns and expectations not only relative to the final result, but also in their desire to receive the most aesthetically available or rather invisible appliance. Thus, thorough Knowledge and application of the biomechanical principles governing lingual orthodontic appliance is essential for delivering efficient and successful orthodontic treatment.

CONCLUSION

From the current study, the following could be concluded:

1. Extraction is very effective method of treated bimaxillary cases to achieve a better esthetic and occlusion.
2. Both methods of retraction with labial or palatal force could be effective in canine retraction.
3. There is no significant difference between both ways on the rate of canine retraction.

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