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Root Resorption Concomitant with Two Different Canine Retraction Mechanics (A Prospective Clinical Study)

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ABSTRACT

Aim: Acceleration of orthodontic treatment and achieving the desired results is essential for the patients and orthodontist, which increases the importance of finding the best method to accelerate tooth movement. it seems important to compare the rate of root resorption when canine retraction is performed by two different mechanics assuming that there will be less root resorption with lingual retraction mechanics.. **Subjects and Methods:** This is a prospective randomized clinical study that 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. Group I: Thirteen orthodontic patients were treated with Roth brackets 0.022-inch slot for a labial orthodontic appliance with palatal retraction force. Group II: Thirteen orthodontic patients were treated with Roth brackets 0.022-inch slot for a labial orthodontic appliance with labial retraction force.. **Results:** There is statistically non-significant difference in canine length and canine root resorption between the two studied groups.. **Conclusion:** Both methods of retraction with labial or palatal force could be effective in canine retraction.

KEYWORDS

Root Resorption, Canine Retraction, CBCT, Lingual Orthodontic, tooth movement

INTRODUCTION

Acceleration of orthodontic treatment and achieving the desired results is essential for the patients and orthodontist, which increases the importance of finding the best method to accelerate tooth movement.[1]

A lot of bracket prescriptions and brands has been developed after Andrew's invented his straight wire system, all of those bracket systems aimed to accelerate the treatment time and achieving the best finishing and occlusion.[2]

Several cases need the extraction to enhance both appearance and occlusion; space closure mechanics are various and requires special attention and care to avoid early space closure by anchorage loss.[3]

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Since the invention of lingual orthodontics, it becomes a new era of tooth movement. Space closure, anchorage control, and faster rate of the tooth movement all were provided with the modification of the lingual appliance biomechanics as it passes very closely to the tooth center of resistance, which provides more bodily movement.[4-7] It is accepted that there is anchorage control because the direction of forces during space closure which creates a degree of buccal root torque adjunct with distopalatal rotation of molar crown, which in turn produces empowered cortical bone anchorage.[6-8] Torque is not easy to highly controlled in lingual orthodontics.[4,9,11,12] This limitation of torque control by retraction in lingual orthodontics required the use of labial appliances accompanied with lingual force instead of the lingual appliance with lingual force.[6,14]

Takemoto [6,8] compared the anchorage loss in cases with bimaxillary protrusion subjects treated with both labial and lingual appliances. He concluded that a minimal amount of 0.1–0.5 mm of anchorage loss was produced with retraction of up to 7.9 mm with lingual appliances.[6,8,10,13] This was possible because the use of lingual force application that is palatal to the center of resistance of the incisors and distally rotating forces on molars resulting in high anchorage control.

Makhlouf[33] compared ten patients (seven females, three males) who required the extraction of the 1st premolars extraction and space closure by two different retraction mechanics, one side with T-loops which fabricated of 0.017 X 0.025 TMA wires while the other side with NiTi closed coil spring with 150 gm, the cone beam showed non significantly difference in the amount of root resorption between the two mechanics.

From the previous studies, it seems important to compare the rate of root resorption when canine retraction is performed by two different mechanics assuming that there will be less root resorption with lingual retraction mechanics.

SUBJECTS AND METHODS

This is a prospective randomized clinical study that 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 whom seeking orthodontic treatment in the orthodontic clinic, Faculty of Dental Medicine, Al-Azhar University, Cairo, Egypt. In this study Sample size calculation was undertaken with G power test version 3.1 statistical software based on previous pre-established parameters: an 80% power, the 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 the 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.

- ***Inclusion criteria:***

The patients included in the study in case they have the following:

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

- ***Exclusion criteria:***

The patients were excluded if they have the following:

1. Systemic diseases and/or on medications that could interfere with orthodontic tooth movement.
2. Poor oral hygiene or periodontally compromised patients.
3. Craniofacial anomalies or previous history of trauma, bruxism or parafunctions.
4. Previous orthodontic treatment.

- ***Discontinuation criteria:***

1. Lack of patient compliance.
2. Repeated missing appointments and repeated broken appliances to the extent that affects the achievement of objectives of the study and/ or the proposed treatment plan.

Groups:

The patients enrolled in this study were 26 extractions, orthodontic patients. Those patients of the study were randomly divided into two equal groups:

- Group I: Thirteen orthodontic patients were treated with Roth brackets 0.022-inch slot for a labial orthodontic appliance with palatal retraction force.
- Group II: Thirteen orthodontic patients were treated with Roth brackets 0.022-inch slot for a 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 the 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 were initiated by utilizing a 0.012″ nitinol orthodontic archwire that was followed by an ordinary sequence of nitinol orthodontic archwires (0.014” & 0.016”). This was followed by 0.016” x 0.022” nitinol orthodontic archwire to allow almost passive placement of rectangular 0.016″x0.022″ stainless steel orthodontic archwire 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

The maxillary canine retraction started in both groups on 0.016 × 0.022-inch stainless steel 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 was bonded on the palatal surface of canines. The Trans palatal arch was modified with a wire projection for the engagement of the NiTi coil spring. The canine retraction commenced by applying NiTi coil spring with the force values 200 g [15,16] in each quadrant, from the palatal surface of the canines (using lingual cleats) to the palatal surface of the molars (that is modified trans palatal arch). No forces on the buccal side of the arches were applied (Fig. 1). The force was determined using a YDM 5N YS-31 tension gauge.

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

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 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).

E) Canine root length was measured linearly from the cup tip to the root apex after CBCT orientation as presented in.

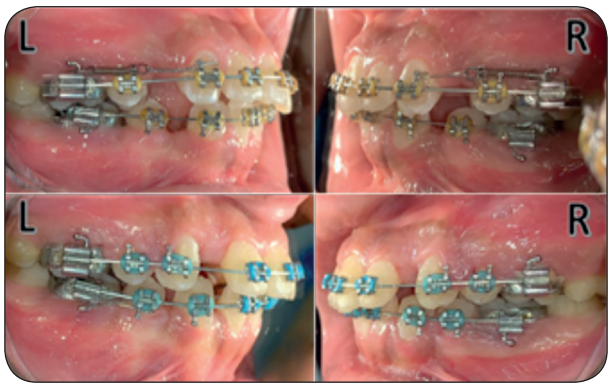

Fig. (1): Group II, NiTi coil spring was attached between the canine hook and molar hook, with the force values of 200 g in each quadrant. (a) & (b): Pre-canine retraction. (c) & (d): Post canine retraction.

RESULTS

Canine length (canine root resorption):

Root integrity of upper canines was evaluated using a standardized linear method on the post-canine retraction CBCT images.

The collected data concerning the canine root resorption shows parametric distribution according to the Kolmogorov-Smirnov.

Group I:

The mean canine length on the right side was 28.20mm ±2.08 pre-canine retraction and 27.40mm ±2.33 post-canine retraction. On the left side, the mean canine length was 28.29mm ±2.24 pre canine retraction and 27.47mm ±2.46 post canine retraction.

Group II:

The mean canine length on the right side was 27.75mm ±2.77 pre-canine retraction and 27.25mm ±2.81 post-canine retraction. On the left side, the mean canine length was 27.92mm ±2.64 pre-canine retraction and 27.45mm ±2.76 post-canine retraction.

The mean maxillary canine length after canine retraction, on either side, in both studied groups, showed a statistically significant decrease in comparison with the canine length before canine retraction (Table 1a).

The statistical comparison of the canine length between the two studied groups revealed the following (Table 1b):

- Pre canine retraction: There was a statistically non-significant difference in canine length between the two studied groups on sides.
- Post canine retraction: There was a statistically non-significant difference in canine length between the two studied groups on sides.
- The mean change of canine length from before canine retraction to after canine retraction in the two studied groups was statistically compared. It revealed the following:
- Right side: The reduction in canine length was 0.79mm ±0.36 in Group I while it was 0.51mm ±0.22 in Group II.

  The statistical comparison between the two studied groups revealed a statistically non-significant difference in the mean change of canine length.
- Left side: The reduction in canine length was 0.82mm ±0.60 and 0.46mm ±0.34 in Group I and Group II, respectively.

The statistical comparison between the two studied groups revealed a statistically non-significant difference in the mean change of canine length.

Table (1a): *Statistical comparison of the canine length (root resorption) between pre and post-canine retraction.*

		Pre		Post		t	p
		Mean	SD.	Mean	SD.		
Group I	Right	28.20	2.08	27.40	2.33	5.360*	0.003*
	Left	28.29	2.24	27.47	2.46	3.333*	0.021*
Group II	Right	27.75	2.77	27.25	2.81	5.586*	0.003*
	Left	27.92	2.64	27.45	2.76	3.307*	0.021*

t: Paired t-test
p: p-value for comparing between pre canine retraction and post-canine retraction
*: Statistically significant at $p \leq 0.05$

Table (1b): *Statistical comparison of canine length (root resorption) between the two studied groups.*

		Group I		Group II		Test of Sig.	p
		Mean	SD.	Mean	SD.		
Pre	Right	28.20	2.08	27.75	2.77	t=0.314	0.760
	Left	28.29	2.24	27.92	2.64	t=0.268	0.794
Post	Right	27.40	2.33	27.25	2.81	t=0.104	0.919
	Left	27.47	2.46	27.45	2.76	t=0.013	0.990

t: Student t-test
p: p-value for comparing between the studied groups
Significance level at ≤ 0.05

DISCUSSION

Extractions is one the solution to treat many cases as crowding and bimaxillary protrusion cases. All clinicians aim to achieve it with the most faster and accurate techniques.

Invention of lingual orthodontics opened a new hope and huge area in orthodontic techniques.[4] Labial orthodontics and lingual brackets systems differs in their biomechanics.[7] Lingual orthodontic bracket system provides superior anchorage control and a faster retraction rate due to its positional biomechanical advantage.[4,6,8]

In lingual orthodontic appliances, the point of force application positioned on the lingual side, and this difference in the aspect of point of force application is considered the key reasons of why the teeth are responding differently to this systems.[11, 17,18]

Quraishi et al.[14] compared labial appliance with lingual force. The rate of retraction was faster, also anchorage loss was less with labial appliance with lingual force.

Canine root resorption in both studied groups occurred nearly at the same magnitude that present in other studies.[29-31]

The root resorption concomitant with orthodontic tooth movement is not uncommon and of no significant effect.[32-34]

The etiology of root resorption is still one of the most problems facing orthodontist and has a lot of many reasons such as individual genetic, tooth anatomy structure, severity of malocclusion, or systemic factors such as allergy, asthma and diabetes. The orthodontist mechanics is one of the most important way to avoid the occurrence of root resorption by enhancing the retraction mechanics and rapidity of tooth movement.[35-39]

CONCLUSION

1. Both methods of retraction with labial or palatal force could be effective in canine retraction.
2. There is statistically non-significant difference in canine length and canine root resorption between the two studied groups.

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تآكل الجذور المصاحب لطريقتين مختلفتين ميكانيكيا لإرجاع الأنياب، دراسة سريرية مستقبلية

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الملخص :

الهدف: تسريع علاج تقويم الأسنان وتحقيق النتائج المرجوة أمر ضروري للمرضى وأخصائي تقويم الأسنان مما يزيد من أهمية إيجاد أفضل طريقة لتسريع حركة الأسنان

المواد والاساليب: هذه دراسة سريرية عشوائية مستقبلية تم إجراؤها على عينة إجمالية من 26 مريضًا لتقويم الأسنان موصى بها لاستخراج الضاحك الأول العلوي كجزء من خطة علاج تقويم الأسنان الخاصة بهم. تراوحت أعمار المريض بين (16-26) سنة. • المجموعة الأولى: ثلاثة عشر مريضًا من مرضى تقويم الأسنان تم علاجهم باستخدام أقواس روث بفتحة مقاس 0.022 بوصة لجهاز تقويم الأسنان الشفوي بقوة تراجع حنكي. المجموعة الثانية: لقد تم علاج ثلاثة عشر مريضًا بتقويم الأسنان بفتحة روث بقوس 0.022 بوصة لجهاز تقويم الأسنان مع قوة سحب الشفوية

النتائج: لا يوجد فروق احصائيه بين المجموعتين.

الخلاصة: يمكن أن تكون كلتا طريقتي التراجع بقوة شفوية أو حنكية فعالة في تراجع الانياب

الكلمات المفتاحية: تأكل الجذور, ارجاع الناب, الاشعه المقطعيه المخروطيه , التقويم اللسانى , حركه الاسنان.