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Original Research Article **Orthodontics**

Evaluation of the Effect of Two Different Activation Protocols of Periodontal Distractor on the Periodontal Health after Rabid Canine Retraction

Alaa M. El Driny[1*], Ahmed A. Salama[2], Osama S.El-Shal[3], Maha M. Mohamed[4]

[1]Assistant Lecturer of Orthodontics, Faculty of Dental Medicine, for Girls, Al Azhar University, Cairo, Egypt
[2]Professor of Orthodontics, Faculty of Dental Medicine, for Girls, Al Azhar University, Cairo, Egypt
[3]Professor of Oral Medicine, periodontology, Diagnosis and Radiology, Faculty of Dental Medicine, for Girls, Al Azhar University, Cairo, Egypt
[4]Lecturer of Orthodontics, Faculty of Dental Medicine, for Girls, Al Azhar University, Cairo, Egypt

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***Corresponding author:** Alaa M. El Driny
Assistant Lecturer of Orthodontics, Faculty of Dental Medicine, for Girls, Al Azhar University, Cairo, Egypt

Abstract

Aim: To evaluate the effect of two different activation protocols of periodontal distractor on periodontal health after rabid canine retraction. ***Objectives:*** 1) to evaluate the periodontal health of two activations/day of periodontal distractor. 2) To evaluate the periodontal health of four activations/day of periodontal distractor. 3) To compare between two different activation protocols of periodontal distractor on periodontal health. ***Methods:*** The study was carried out on 32 canine of 16 female patients (16-22 years of age) requiring extraction of bilateral maxillary first premolars and maximum anchorage. They were divided into two groups. (Group I): Canine retraction was done by periodontal distractor with twice activations per day. (Group II): Canine retraction was done by periodontal distractor with four activations per day. Periodontal distractor was cemented after bilateral maxillary premolar extraction and inter septal bone corticotomy was done. The periodontal health of maxillary canines was evaluated using these parameters before and after retraction: (gingival index, periodontal index and probing depth). All data were explored for normality by using Shapiro Wilk and Kolmogorov Normality test which revealed that all data originated from non-parametric data. ***Results:*** for periodontal index and probing depth there was insignificant difference between them in before and after in both groups. For gingival index there was insignificant difference between them in before, while in after group II was significantly higher than group I**.** ***Conclusion:*** In this study, there was increase in all periodontal health parameters including (gingival index, periodontal index and probing depth) after using of periodontal distractor with both protocols of activations denoting gingivitis. The 2 activations/day was better than 4 activations/day for periodontal health during canine retraction by periodontal distractor.

Keywords: Canine retraction, periodontal distractor, periodontal heath.

INTRODUCTION

Orthodontic treatment is frequently referred to as a lengthy process, since it typically takes 18 to 24 months to complete an effective orthodontic treatment. Long-term orthodontic treatment includes numerous drawbacks, including negative psychosocial impacts on patients, white spots, long-term enamel damage, gingival recession and root resorption [1, 2].

One of the main determinants of orthodontic treatment time is the rate of tooth movement that can be achieved. Many researches have been done to quantify the rate of orthodontic tooth movement. Most of these studies showing approximately 1mm of tooth movement per month [3, 4].

Therefore, a primary issue in orthodontic research is to find treatment approaches that shorten treatment time without compromising results [5, 6].

The methods for accelerating tooth movement rely on triggering a biological tissue reaction. These procedures can be divided into two categories based on how intrusive they are: conservative (biological, physical, and biomechanical methods) and surgical techniques [7].The most commonly biological agents are prostaglandins [8], interleukins [9], leukotriene [10],

vitamin D [11] platelet rich plasma [12]. Mechanical or physical approach include direct electrical current [13], pulsed electromagnetic field [14], low-energy laser [15-17], and Vibration [18, 19]

Oral surgical procedures quicken orthodontic treatment by affecting the continuity of the alveolar bone resulting in a decrease in bone density and a corresponding reduction in the bone's resistance to orthodontic tooth movement [20, 21]. Surgical approach depends on Regional Acceleratory Phenomenon (RAP) which is a method to speed up orthodontic treatment by accelerating bone remodeling rates and bone density. The RAP is a series of tissue reactions that occur as a damaged bone heals [22, 23]. These surgical methods including corticotomy [24, 25], Osteoperforation [26], Distraction osteogenesis is also one of surgical methods that allow rapid canine retraction [27, 28].

The technique of distraction of the periodontal ligament (PDD) was introduced for rapid tooth movement [29] then, dento alveolar distraction (DAD) was performed to achieve rapid tooth movement using the principles of distraction osteogenesis [30].

Previous Studies of periodontal distractor have been mainly focused on the assessment of the rate and angular changes on retracted canine [31-33]. Hence, the periodontal status and pain perception during canine retraction should be investigated. The aim of this study is to examine periodontal health on rabid canine retraction by using two different activation protocols of periodontal distractor.

MATERIALS

The study was conducted in a sample of 32 canines on 16 female patients attending the Faculty of Dental Medicine for Girls, Al Azhar University, seeking for orthodontic treatment. Their age was ranged from 16 to 22 years. This prospective study was approved by Research Ethic Committee (REC), Faculty of Dental Medicine for Girls, Al Azhar University with this code (REC-OR-21-01). All study participants have signed on written informed consent prior to enrollment. The steps of the study, the aim, the potential benefits, and hazards, all were discussed with the patients.

Patient Records

After patient selection, routine records of all the patients such as a detailed case history, pre treatment study model, extraoral and intraoral photographs, panorama and lateral cephalometric radiographs were acquired. Research related records including (gingival index, periodontal index and probing depth) of canine before and after retraction.

Inclusion Criteria:

1. Orthodontic Patients need extraction of first permanent premolar for orthodontic reasons (dentoalveolar maxillary protrusion, Class II div 1 malocclusion)
2. No history of previous orthodontic treatment.
3. Absence of any systemic disease.
4. Good oral hygiene and healthy gums look, with no signs of redness, edema, or bleeding during brushing (periodontal inflammation)
5. Highly motivation and cooperation.

Exclusion criteria:

1. Medically compromised patients.
2. Patients with periodontally compromised teeth.
3. Uncooperative patients.
4. Long-term use of antibiotics, phenytoin, cyclosporine, anti-inflammatory drugs, Systemic corticosteroids, and calcium channel blockers.
5. History of previous orthodontic treatment.
6. Use of medication that may affect tooth movement during the period of the study.

All the patients in the study required bilateral first premolar extraction. They were divided into two groups (Group I): Canine retraction was done by periodontal distractor with twice activations per day. (Group II): Canine retraction was done by periodontal distractor with four activations per day.

Sample size calculation:

A minimum total sample size of 32 samples in both groups will be sufficient to detect the effect size of 0.66 according to Cohen (1988) as group I (2.89 ± 0.62) and group II (4.32 ± 2.38) according to (Gürgan *et al*.,) [34], at a power (1-β=0.95) of 95% at a significance probability level of ($p<0.05$).

Pilot study:

A pilot study was carried out before the start of the main study to be familiar with all procedures, data collection forms, methodology, and outcome.

Study phases: This study included three phases:

Phase I: Extraction and inter septal bone corticotomy phase.

Patients were referred to the clinic of Oral and Maxillofacial Department, Faculty of Dental Medicine for Girls, Al Azhar University to extract first maxillary premolars with written referral note. The post extraction instructions were firm and clear not to use NSAIDs drugs for analgesia, paracetamol drugs were prescribed.

The second step consisted of performing corticotomies (grooves) in the interseptal bone distal to the canine with bur. Initially, two vertical grooves were done inside the extraction socket, along the buccal and lingual sides then, another groove that was extended obliquely toward the base of the interseptal bone to weaken its resistance (Fig). The depth of the undermining grooves was dependent on the thickness of

the interseptal bone, as revealed on the Periapical films. Corticotomy was done by surgical bur on straight hand piece using normal saline for irrigation to prevent adverse thermal changes in the periodontium Fig. (1).

Fig 1: Inter septal bone Coricotomy with surgical bur on straight hand piece

Phase II: Periodontal distractor construction and placement:

A Hyrax screw was modified to form a distractor. Bands on molar and canine with a lingual button welded on canine band are made. The screw was opened slightly more than the width of premolar to be extracted and extended arms were bent to desirable shape to be soldered on molar and canine bands. The distractor was placed and cemented by glassionmer cement Fig (2).

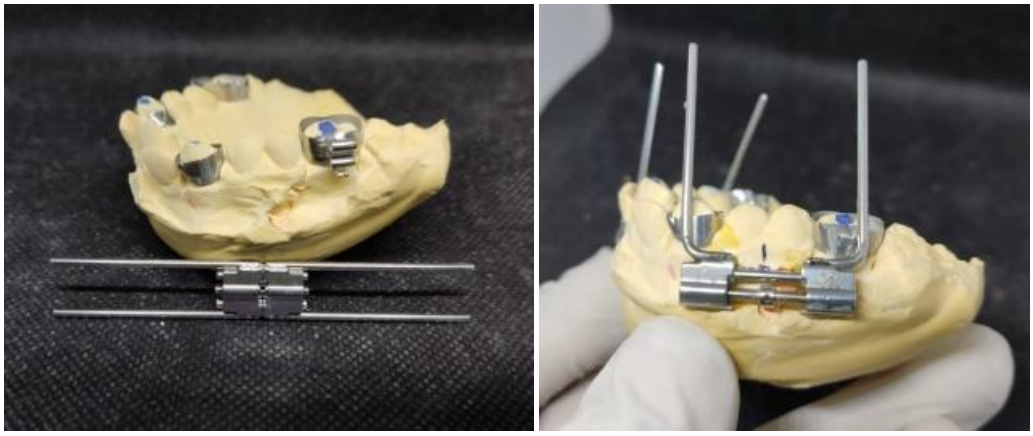

Fig 2: Steps of periodontal distractor appliance construction from hyrax screw

Phase III: Activation of periodontal Distraction Fig (3):
Group I: The canine was distracted twice per day for a total about 0.4 mm per day.
Group II: four activations of 0.2 mm each for a total about 0.8 mm per day.

The distractor was activated till the distal surface of canine became in contact with the mesial surface of second premolar Fig (4).

Fig 3: Activation of periodontal distractor with key

Fig 4: Before and after complete canine retraction by periodontal distractor

Measurement of periodontal health:

The periodontal indices were measured for the maxillary canine at two times; once just before canine retraction was done, then the 2nd measurement was done after canine retraction All these indices were measured twice by the main operator and other operator (rather than the main investigator) who was blind for the assignment of the type of intervention then the mean of measures were calculated.

Plaque index: 0 No plaque, 1 thin plaque layer at the gingival margin, only detectable by scraping with probe, 2 Moderate layer of plaque along the gingival margin; interdental spaces free, but plaque is visible to the naked eye. 3 Abundant plaque along the gingival margin; interdental spaces filled with plaque.

Gingival index: 0 normal gingiva; no inflammation; no discoloration(erythema); no bleeding, 1 Mild inflammation; slight erythema; minimal superficial alterations, no bleeding, 2 Moderate inflammation; erythema , bleeding on probing, 3 Sever inflammation; sever erythema and swelling; tendency to spontaneous bleeding; possible ulceration.

Probing depth: It was measured on the apical end of the sulcus of the canine at six sites (Mesio-buccal, buccal, disto-buccal, and palatal) Fig. (5), Healthy: PD equal 1 Gingivitis: PD between 2 to 3, Periodontitis: PD more than 3, radiographic bone loss.

Fig 5: Measurement of probing depth with periodontal probe

Statistical analysis:

Statistical analysis was performed with SPSS 20®, Graph Pad Prism® and Microsoft Excel 2016.

All data were explored for normality by using Shapiro Wilk and Kolmogorov Normality test which revealed that all data originated from non-parametrium data (non-parametric tests used), all data were presented as minimum, maximum, mean and standard deviation values.

RESULTS

Effect of time was calculated by comparing between before and after by using Wilcoxon signed rank test (nonparametric data) which revealed significant increase in all parameters as $P<0.05$ (before was significantly lower than after).

Effect of material was calculated by comparing between different groups by using Mann Whitney test (Nonparametric) which revealed that:

Plaque index: there was insignificant difference between them in before ($P=0.95$) and after (0.34) respectively.

Probing depth: there was insignificant difference between them in before and after regarding mesial, distal, buccal and lingual as P>0.05.

Gingival index: there was insignificant difference between them in before (P=0.079), while in After group II was significantly higher than group I (P=0.01*).

Table 1: Minimum, maximum, mean and standard deviation of periodontal parameters in both groups and comparison between them

			Before				After				P value
			Min	Max	M	SD	Min	Max	M	SD	
Plaque index		Group I	0.00	1.50	0.82	0.46	0.00	2.50	1.3500	0.49	0.0001*
		Group II	0.00	1.50	0.85	0.43	1	3	1.55	0.59	0.0001*
		P value	0.95				0.34				
Gingival index		Group I	0.00	1.50	0.80	0.50	0.50	2.00	1.38	0.51	0.0001*
		Group II	0.50	2.00	0.90	0.50	1.00	3.00	1.98	0.70	0.0001*
		P value	0.79				0.01*				
Probing depth	Mesial	Group I	1.00	3.00	1.60	0.68	1.00	3.00	2.15	0.49	0.001*
		Group II	1.00	2.00	1.40	0.50	1.00	3.00	2.15	0.59	0.0009*
		P value	0.46				0.99				
	Distal	Group I	1.00	2.00	1.45	0.51	2.00	3.00	2.55	0.51	0.0001*
		Group II	1.00	2.00	1.60	0.50	2.00	3.00	2.75	0.44	0.0001*
		P value	0.52				0.32				
	Buccal	Group I	1.00	1.00	1.00	0.00	1.00	2.00	1.45	0.51	0.03*
		Group II	1.00	2.00	1.10	0.31	1.00	2.00	1.60	0.50	0.006*
		P value	0.48				0.52				
	Palatal	Group I	1.00	1.00	1.00	0.00	1.00	2.00	1.60	.50	0.0005*
		Group II	1.00	1.00	1.00	0.00	1.00	2.00	1.30	.47	0.03*
		P value	1.000				0.11				

Min: minimum Max: maximum
*M: mean SD: standard deviation *Significant difference as P<0.05*
Mean with different superscript letters were significantly different as P<0.05.
Mean with the same superscript letters were insignificantly different as P>0.05.

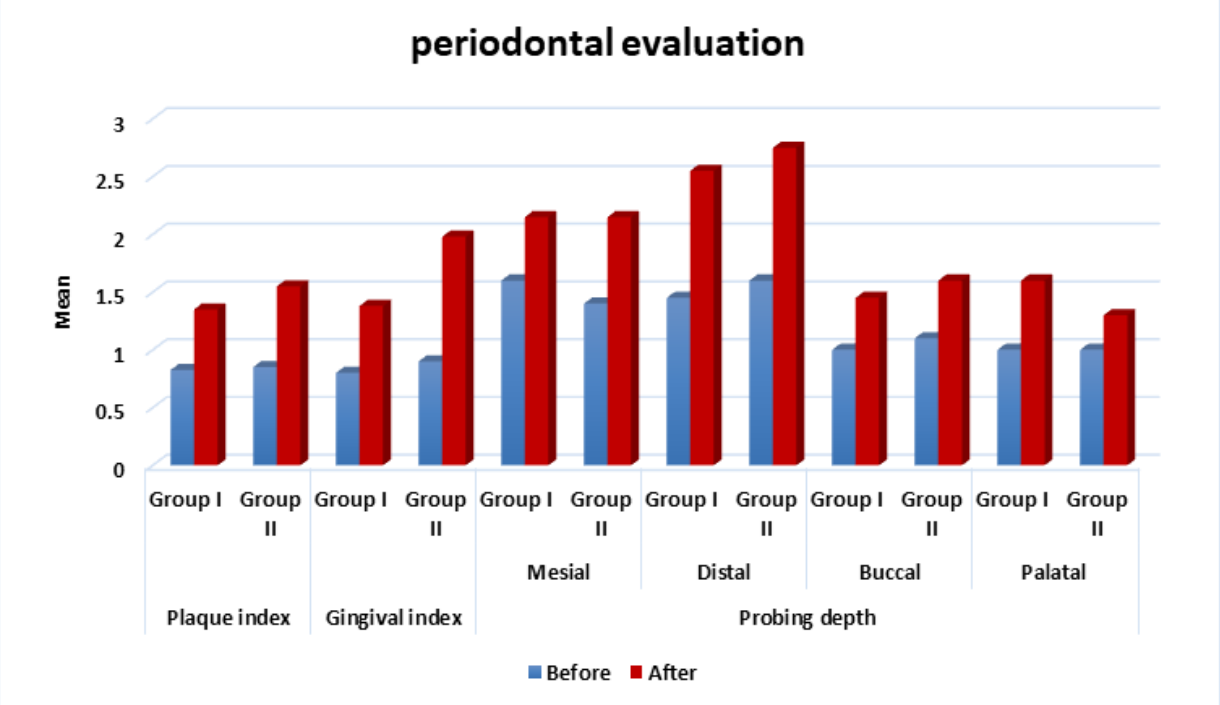

Figure 1: Bar chart showing different periodontal parameters in both groups

DISCUSSION

The duration of orthodontic treatment is one of the aspects of orthodontics about which there are more complaints, and many attempts have been made to decrease the time of orthodontic tooth movement [35]. Distraction osteogenesis has gained popularity as a method of treating craniofacial deformities and may be used to cure dentoalveolar discrepancies as well. Consequently, a method of rapid canine retraction using the concept of distraction osteogenesis has been developed and applied [29].

In this concept, two vertical and one oblique osteotomies locating in the interseptal bone distal to the canines are carried out to achieve rapid movement of the canines within the dentoalveolar segment, in compliance with distraction osteogenesis principles. The effects of periodontal distractor on the dentofacial structures have been previously reported and the effects of dentoalveolar distractor on the gingival tissues have been also previously reported however, no comparing data regarding the effects of different activation of periodontal distractor on the gingival tissues are available. Most of previous studies concentrated on the rate of canine retraction and angular changes [30-33]. Moreover, there are few comparable published data regarding changes in periodontal health around canine moved into an extraction site with rapid canine retraction.

Orthodontic treatment is known to affect the equilibrium of oral micro flora by increasing bacterial retention. In a study done by Ristic *et al*., [36] an increase in the periodontal indices and growth of pathogenic bacteria were observed in adolescent patients undergoing fixed orthodontic treatment.

Some reports support the fact that the fixed orthodontic treatment may result in localized gingivitis, which rarely progresses to periodontitis [37]. Gingival inflammation around orthodontic bands leads to pseudo pockets, which usually disappear immediately with debanding of the brackets. However, this is usually occurs within weeks of debanding. However, some of the published researches have reported reduced risk of gingivitis in the absence of plaque, orthodontic forces, and tooth movements [38-40].

Limitations of Study:

1. It had a sample size of 16 patients, and the result obtained from this study must be verified with a larger sample.
2. Only female patients were used for the study. Gender-based comparison is needed.
3. No study was conducted on effect of the periodontal distractor on molar periodontal distractor.

CONCLUSION

In this study, the periodontal health (before and after canine retraction using periodontal distractor with twice or four activations per day) was measured and tabulated.

*Our results indicated that there was increase in all periodontal health parameters including (gingival index, periodontal index and probing depth) after using of periodontal distractor with both protocols of activations denoting gingivitis.

*The 2 activations/day was better than 4 activations/day for periodontal health during canine retraction by periodontal distractor.

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