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ORIGINAL RESEARCH

Comparison of Rate of Canine Retraction into Recent Extraction Site with and without Gingival Fiberotomy: A Clinical Study

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ABSTRACT

Aim: Retraction of maxillary canines after first premolar extractions is a very common orthodontic task in cases of crowding or for the correction of large overjet. Many studies have been done to increase the rate of retraction. The aim is to compare the rate of canine retraction into recent extraction site with and without circumferential supracrestal fiberotomy.

Materials and methods: The rate of movement of the canines into the recent extraction site of the first premolar with or without circumferential supracrestal fiberotomy was measured in 14 patients aged 13 to 22 years. The study was done on 9 maxillary and 5 mandibular arches. The appliance used in the present study was the preadjusted edgewise (0.022 inch Roth prescription) and retraction performed by frictionless mechanics using Composite T Loop. The distalization of canines was measured at regular intervals (T1, T2, T3 and T4). Recordings of the positions of the canines at the beginning and at different intervals were made from dental casts.

Results: The mean difference between the two sides for the total time span T1-T4, for maxillary arch was 0.36 mm and for mandibular arch was 0.60 mm respectively.

Conclusion: There can be various factors that affect the rate of tooth movement. Factors like bone density, bone metabolism, and turnover in the periodontal ligament, amount of force applied may be responsible for the variation.

Clinical significance: No clinically significant increased rate of retraction of cuspids in the recent extraction site with fiberotomy was found in comparison to the retraction in recent extraction site without fiberotomy.

Keywords: Canine retraction, Fiberotomy, Circumferential supracrestal fiberotomy, T loop, Rate of retraction.

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INTRODUCTION

The purpose of orthodontic treatment is to move teeth as efficiently as possible with minimal adverse effects on teeth and supporting tissue. Numerous methods of canine retraction are currently in common use. Force can be applied through the elastics, closed coil springs, wire loops of numerous designs, and a number of headgear types currently available.

The principles for retraction currently used in preadjusted edgewise mechanics can be described as either: (a) a frictional system in which the canine is expected to slide distally along a continuous archwire, (b) a frictionless mechanics in which loops (springs) are incorporated in a continuous or a segmental archwire to retract teeth. The sliding mechanism in any application other than simple tipping movement has two disadvantages: (i) friction (ii) force magnitudes cannot be easily determined since the amount of friction is relatively unknown and unpredictable.[7]

Retraction of teeth for closing spaces can be made possible in two ways:

1. *En masse* retraction
2. Segmental retraction, i.e. retraction of canines is achieved first which is then followed by the retraction of incisors.

Various methods have been employed to fasten the rate of retraction. The method experimented were the use of drugs [Collins MK and Sinclair PM (1988)], electromagnetic fields [Stark TM and Sinclair PM (1987)] and other different ways to speed up were by changing the supporting environment.[13,18,19]

Not much is known regarding the biological factors influencing the procedure. Factors like variation in structure of bone, the periodontal ligament surrounding the tooth root and the magnitude of force may be responsible for tooth

movement.[16] Hasler et al (1997)[18] in his clinical study has found that tooth movement is faster into recent than into a healed extraction site. The other factor that is thought to be influencing the retraction is the periodontal attachment. Periodontal fibers have been found to be the main causative agents that are responsible for the relapse.[3,5] The relationship between gingival connective tissue forces and relapse of orthodontic tooth movement has been well documented. Surgical removal of fibers by circumferential supracrestal fiberotomy has been clinically proved as the treatment of rotated teeth.[6,8,14] No clinical report comparing tooth movement into a recent extraction site with fiberotomy and only recent extraction site has been found.

Aim of the present study will attempt to compare the rate of tooth movement into recent extraction site with and without circumferential supracrestal fiberotomy.

AIMS AND OBJECTIVES

1. To compare the rate of canine retraction into recent extraction site with and without circumferential supracrestal fiberotomy.
2. To compare the rate of canine retraction during each of the above procedures in maxillary and mandibular arch.

MATERIALS AND METHODS

The present clinical study was conducted on 14 patients aged between 13 and 22 years. The study was done on 9 maxillary and 5 mandibular arches.

Criteria for selection of cases:

1. The patient in which the canines were upright.
2. The patient in which the extraction of first premolars was indicated for treatment.
3. All teeth mesial to second molars were fully erupted.
4. The patient had no history of trauma and injury to facial structures.
5. The patient with healthy tooth supporting tissue.
6. No evidence of root resorption before orthodontic treatment.

MECHANOTHERAPY

In the present study the appliance used was the preadjusted edgewise. The system used was 0.022 inch Roth prescription (American Orthodontics; Master series).

The separate canine retraction was carried out by the 'composite T-loops'. The composite T-loop were custom-made as per the Burstone's segmented arch approach to space closure (1966,[2] 1982,[10] 1984[12]) and Kuhlberg and Burstone (1997).[17] The composite T-loop was made with 0.018 inch round and 0.017 × 0.025 inch rectangular TMA wire (Ormco) (Fig. 1). The T-loop was activated for 6 mm delivering a distal force of 200 gm at the start of retraction (Fig. 2). Canine retraction was started before any leveling and aligning.

Treatment Procedure

Bilateral extraction of first premolar was carried out and fiberotomy was done on cuspid of any one side. Fiberotomy was done by Bald-Parker blade no. 11. The blade was inserted into the gingival sulcus till the alveolar crest was hit. The circumferential supracrestal fiberotomy (sulcular incision) was performed.[3] This being a blind study the operator was not aware of which side the fiberotomy has been performed. Records, i.e. impressions of the upper and lower arches were collected after one day of extraction (T1). All records were collected at interval of 30 (T2), 60 (T3) and 90 (T4) days after initiation of canine retraction.

At T1, the first molars in both the arches were banded and were reinforced with Nance holding arch in maxilla and lower lingual arch in the mandible. Brackets were

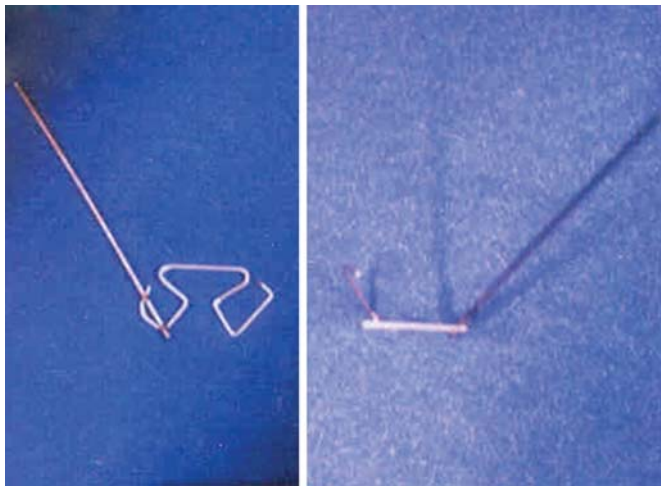


Fig. 1: Composite 'T'-loops

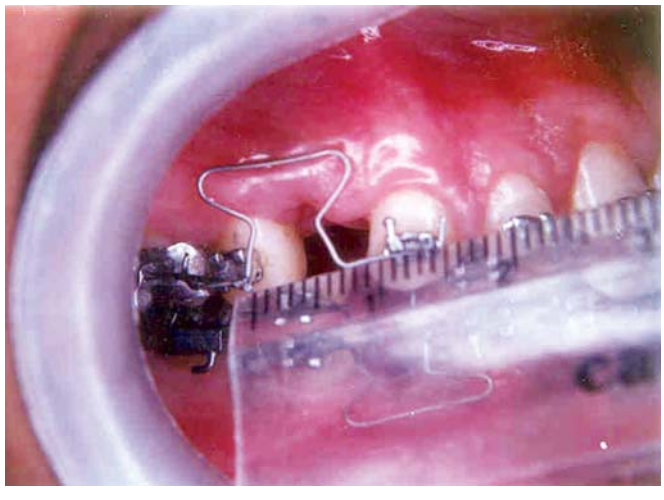


Fig. 2: Pretreatment photograph showing 6 mm of activation

bonded to the canines. The composite T-loop was placed without engagement of second premolars. The retraction was initiated by activating T-loop for 6 mm (Fig. 3). The spring was activated at times T2 and T3. Final reading to measure the amount of canine retraction was taken at the end of 90 days (T4) (Fig. 4).

Records

Study models were used for the measurement of distal displacement of the canines and anchorage loss of first molars during treatment. Measurements on casts were made with a new method, which is a modification of Faber (1992). Instead of making photocopy of the models, the orthodontic study model was scanned and is a 1:1 reproduction of the occlusal surface of plaster models. The image was then transferred to the software (Adobe Photodeluxe), where a new layer is selected on which the measurements were carried out (Fig. 5).

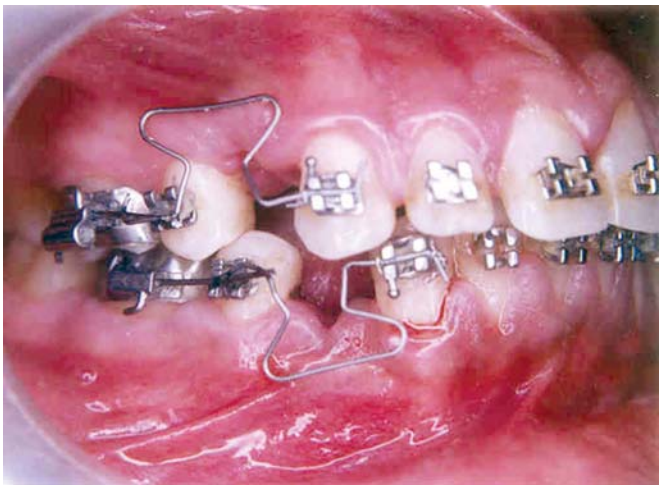


Fig. 3: Pretreatment photograph with activated composite 'T'-loops in place

Fig. 4: Amount of retraction after 90 days

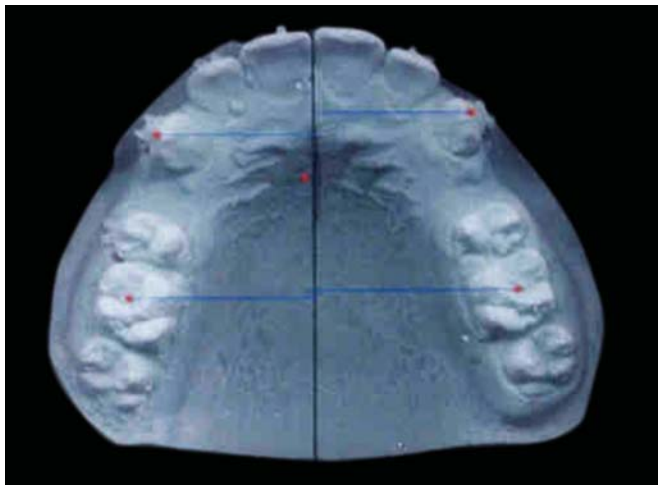


Fig. 5: Method and software employed to measure canine retraction

Statistical Analysis

A statistical comparison between the two groups, fiberotomy and nonfiberotomy side was done by using nonparametric test, i.e. Wilcoxon's two sample rank test. Paired t-test was used for within group comparison.

RESULTS

The anteroposterior movements of the canine and the first molar on the fiberotomy side (site of first premolar extraction with CSF done on canine-XF) and nonfiberotomy side (side of only first premolar extraction-X) during the phases of observation (T1, T2, T3 and T4) are given in Tables 1, 2, 5 and 6.

The values obtained at different time intervals, i.e. T1, T2, T3 and T4 were computed. Table 1 and Graph 1 summarizes the results obtained on both, i.e. fiberotomy and nonfiberotomy sides in the maxillary arch. On an average canines on the fiberotomy side moved about 2.50 mm, whereas on the nonfiberotomy side it moved about 2.14 mm. Table 2 and Graph 2 summarizes the results obtained on both, i.e. fiberotomy and nonfiberotomy sides in the mandibular arch. On an average canines on the fiberotomy side moved about 2.04 mm, whereas on the nonfiberotomy side it moved about 1.44 mm.

The mean difference between the two sides for the total time span T1-T4, for maxillary arch was 0.36 mm and for mandibular arch was 0.60 mm respectively. There was no statistically significant difference between the two sides in both maxillary and mandibular arches (Table 3). On comparing the canine retraction in the fiberotomy sides of the maxillary and mandibular arch, no significant difference was seen (Table 4 and Graph 3). In the maxillary arch, on an average the retraction of canine was about 2.50 mm

Table 1: Maxillary arch canines

Sl. no	Extraction with fiberotomy					Extraction				
	T1	T2	T3	T4	Diff. (T1-T4)	T1	T2	T3	T4	Diff. (T1-T4)
1	10	10	9	8	2	9	9	8	8	1
2	6	5.5	5	3	3	6	5.5	5.5	5.5	0.5
3	10	9.5	8	7.5	2.5	11	11	9.5	9	2
4	7	6	6	5.5	1.5	7.5	7.5	6	5	2.5
5	12	12	11.5	10	2	13	12	11	10.5	2.5
6	7	5.5	5	4	3	8	8	6	6	2
7	9	9	8.5	7	2	11	10	10	8.5	2.5
8	6.5	6	4	4	2.5	8	7.5	7	5.5	2.5
9	9	9	8.5	5	4	9.8	9.8	9.3	6	3.8
Mean	8.5	8.06	6.75	6	2.5	9.26	8.92	8.03	7.11	2.14
SD	2	2.36	1.96	2.28	0.75	2.16	2.01	2.01	1.93	0.96

Table 2: Mandibular arch canines

Sl. no	Extraction with fiberotomy					Extraction				
	T1	T2	T3	T4	Diff. (T1-T4)	T1	T2	T3	T4	Diff. (T1-T4)
1	11.7	11	10.5	10	1.7	10.2	10.2	10.2	10	0.2
2	7	7	5.5	5.5	1.5	8	8	7.2	6.3	1.7
3	12	8	8	7.5	4.5	11.3	10	9	8.5	2.8
4	7.5	7	6.7	6	1.5	4	4	3.5	3	1
5	4.5	4.2	4	3.5	1	6.5	6	5.7	5	1.5
Mean	8.54	7.44	6.94	6.50	2.04	8	7.64	7.12	6.56	1.44
SD	3.23	2.44	2.48	2.42	1.40	2.91	2.65	2.65	2.77	0.96

Table 3: Comparison between retraction of canines in site with extraction and fiberotomy site and with only fiberotomy site

		T1-T4 difference		Significance*
		Mean ± SD	Range	
Maxillary	Ext. with fiberotomy	2.50 ± 0.75	1.5-3.0	T = 33 NS
	Extraction	2.14 ± 0.96	0.5-3.8	
Mandibular	Ext. with fiberotomy	2.04 ± 1.40	1.0-4.5	T = 10 NS
	Extraction	1.44 ± 0.96	0.2-2.8	

NS: Non Significant

Table 4: Comparison between retraction of canines in maxillary and mandibular arches into different sites

		T1-T4 difference	Significance
		Mean ± SD	
Ext. with fiberotomy	Maxillary	2.50 ± 0.75	T = 7.5 NS*
	Mandibular	2.04 ± 1.40	
Extraction	Maxillary	2.14 ± 0.96	T = 16.5 NS
	Mandibular	1.44 ± 0.96	

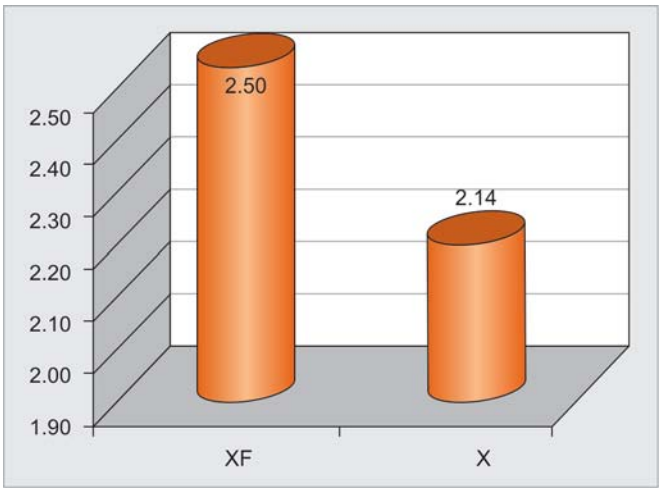
NS: Non Significant

Table 5: Maxillary molars

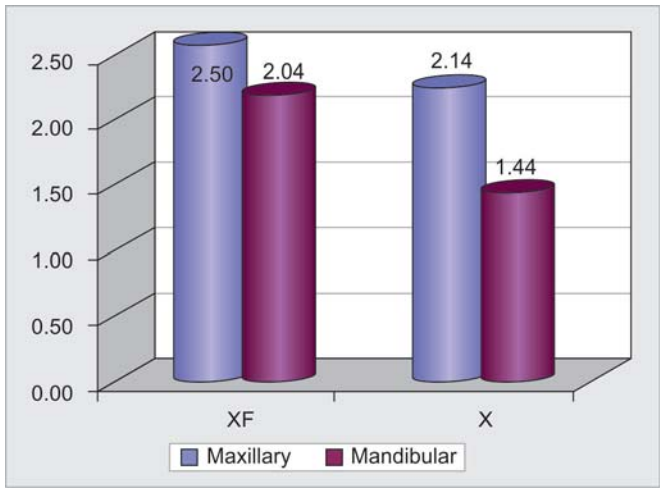
Sl. no.	Extraction with fiberotomy					Extraction				
	T1	T2	T3	T4	Diff. (T1-T4)	T1	T2	T3	T4	Diff. (T1-T4)
1	13	13	13	13	0	16	16	16	16	0
2	18	18	18	18	0	17	17	17	17	0
3	12	12	12	12	0	12	12	12	12	0
4	17	17	16	16	1	16	16	16	16	0
5	11	11	11	11	0	11	11	11	11	0
6	16	16	16	16	0	17	16	16	16	1
7	14	14	14	14	0	14	13.5	13.5	13.5	0.5
8	15	15	15	15	0	14	14	14	14	0
9	12	12	12	12	0	12	12	12	12	0
Mean	14.22	14.22	14.11	14.11	0.11	14.33	14.17	14.17	14.17	0.16
SD	2.44	2.44	2.32	2.32	0.33	2.29	2.18	2.18	2.18	0.35

Table 6: Mandibular molars

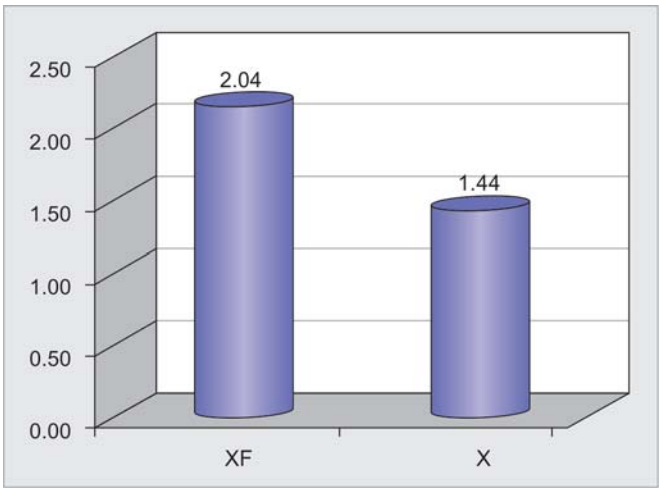
Sl. no.	Extraction with fiberotomy					Extraction				
	T1	T2	T3	T4	Diff. (T1-T4)	T1	T2	T3	T4	Diff. (T1-T4)
1	12	12	12	12	0	12	12	12	12	0
2	11	11	11	11	0	11	11	11	11	0
3	13	13	13	13	0	12	12	12	12	0
4	15	14	14	14	1	14	13.5	13.3	13	1
Mean	12.75	12.50	12.50	12.50	0.25	12.25	12.25	12.25	12.0	0.25
SD	1.71	1.29	1.29	1.29	0.5	11.26	1.26	1.26	0.82	0.5



Graph 1: Amount of maxillary canine retraction in fiberotomy (XF) and non-fiberotomy site (X)



Graph 3: Comparison of maxillary and mandibular canine retraction in fiberotomy (XF) and non-fiberotomy site (X)



Graph 2: Amount of mandibular canine retraction in fiberotomy (XF) and non-fiberotomy site (X)

whereas in mandibular it was about 2.04 mm. The mean difference between the two sides was 0.46 mm, which is statistically nonsignificant.

To see the amount of anchorage loss the positions of molars were also recorded at different time intervals, i.e. T1, T2, T3 and T4 during canine retraction. In maxillary arch, on an average the mesialization of molars on fiberotomy site was about 0.11 mm whereas on the nonfiberotomy site it was 0.16 mm (Table 5). In the mandibular arch, on an average molars on the fiberotomy side moved about 0.25 mm, whereas on the nonfiberotomy side it moved about 0.25 mm (Table 6). There was no statistically significant difference between the two sides in both maxillary and mandibular arches.

DISCUSSION

Retraction of the maxillary canines after first premolar extractions is a very common orthodontic task in cases of crowding or the correction of a large overjet. Since, early period movement of the teeth were carried out by applying force by various methods. Other factors than magnitude of force are involved in determining the rate of subsequent tooth movement. Individual differences in bone density, bone metabolism, and turnover in the periodontal ligament may be responsible for the variation.[9,16]

Although resorption of alveolar bone is necessary for a tooth to move, it is possible that the resistance of connective tissue fibers to remodeling may play a more important role than that of the alveolar bone in determining the rate of orthodontic tooth movement. The earliest and most comprehensive set of guidelines to study the role of periodontal fibers in orthodontic treatment was formulated

by HE Thompson in 1955. Also to assess the gingival tissue resistance to remodeling in determining the rate of orthodontic tooth movement has been studied.[11,13]

Animal studies have proved that surgical elimination of gingival fibers enhances the rate of tooth movement.[11,13] In the past the early initiation of retraction procedures in the fresh extraction sites has been incorporated into orthodontic treatment in order to decrease treatment time. The clinical utilization of a surgical defect to speed up tooth movement has been demonstrated by Holland (1956), Revell (1964) and Talbot (1888), Murphey (1970).[4] Starting retraction immediately after premolar removal, the operator obtains a more rapid movement by taking advantage of the distal extraction site.[18]

Thus, the early initiation of retraction along with circumferential supracrestal fiberotomy procedure has been studied, whether the two in combination lead to increase in the rate of retraction for space closure.

The findings of this study showed that, during the study period of 90 days on an average the canine tooth in the maxillary arch moved distally 2.50 ± 0.75 mm on the recent extraction site with fiberotomy whereas on the only recent extraction site it was retracted 2.14 ± 0.96 mm. In the mandibular arch canine on the recent extraction site with fiberotomy was retracted 2.04 ± 1.40 mm whereas on the only recent extraction site it moved distally 1.44 ± 0.96 mm. The difference in average movement of tooth in recent extraction site with fiberotomy and only recent extraction site in both maxillary and mandibular arches is 0.36 and 0.60 mm, which is nonsignificant statistically.

On comparison the difference in the average rate of canine retraction in the recent extraction site with fiberotomy in maxillary and mandibular arches was 0.46 mm, which is nonsignificant statistically. Chumbley (1981) and Yamasaki et al (1982) had shown that inflammatory response of the tissue may potentially influence the rate of tooth movement but our study failed to show any such effect of inflammatory response on the rate of canine retraction. Even Tuncay and Killiany (1986)[13] have reported that perhaps severing of gingival tissues one time is not adequate for elimination of this tissue's resistance to remodeling. Gingival tissue may increase in resistance as it bunches up in front of a moving tooth and thus removal of this thickened tissue might enhance the rate of tooth movement.

The retraction was carried out by Burstone's composite T loops retraction spring.[10] The advantages of the T-loop design are that it produces a higher M/F ratio, a lower load-deflection rate, and delivers a more constant force and M/F ratio.[7] The force applied was approximately 201 gm on 6 mm of activation of the loop,[10] which according to some authors is appropriate for canine retraction [Quinn and Yoshikawa (1985)]. Hixon et al (1970) stated that when total forces of 300 gm or less are applied, the average rate of tooth movement increased as the load per unit area of the periodontal ligament increased, no matter whether the tooth was being tipped or bodily moved. Reitan (1957)[1] stated that the initial force application should be light, because this produces desirable biologic effects. The lighter forces produce less extensive hyalinized tissue that can be readily replaced by cellular elements. He stated that an appropriate force of 150 to 250 gm for maxillary canines and 100 to 200 gm for mandibular canines should be used for translatory movement. Therefore we decided to keep the spring force at 200 gm, which is suitable for maxillary and mandibular canines.

Anchorage loss was a secondary question investigated in this study. Mesial movement of the molars in the maxillary arch was 0.11 mm on the recent extraction side with fiberotomy and 0.16 mm on the only recent extraction side whereas in mandibular arch it was 0.25 mm on both the sides. The anchorage loss results were inconclusive and no statistically significant mesialization was found. All these measurements were carried out from the median point of third palatal rugae from the study models of the patients. The stability of median rugae point as reference structures has been verified by Van der Linden (1978), Ziegler and Ingerval (1989) and most recently by Almeida et al (1995)[15] and Hoggan BR, Sadowsky C (2001).[20]

Thus, routine fiberotomy for the enhancement of tooth movement cannot be recommended for human orthodontic patients for ethical and other reasons. As the study was done for a short period of time this might also affect the outcome of our result; thus a study with longer duration should be carried out using larger samples. The long-term effects of this procedure need to be studied. Also use of light forces needs to be evaluated with this method.

CONCLUSION

The development of new appliances or mechanics has dramatically changed the treatment planning. The appointments are shorter and the amount of wire bending has decreased dramatically.

Retraction of anterior teeth is an important treatment modality, which is frequently the treatment of choice for correction of crowding and reduction of increased overjet. Many methods have been employed to further shorten the treatment time, like the use of drugs, electromagnetic fields or by altering the tooth supporting environment. But one must not fail to recognize that we are dealing with a biologic system, and that each person responds in a variable fashion,

regardless of the type of appliance used. Teeth do not have the ability to recognize the type of mechanics or appliance or the amount of force applied. Different experiments regarding the use of mechanics or optimal force claim that a particular appliance is superior or a particular amount of force is optimal. Since the body, which governs the overall treatment time should be considered.

The conclusions drawn from the present study are:

1. No effective increased rate of retraction of cuspids in the recent extraction site with fiberotomy was found in comparison to the retraction in recent extraction site without fiberotomy.
2. No significant difference in the rate of canine movement in between maxillary and mandibular arch.
3. No significant mesial movement of the molars both in maxillary and mandibular arches were found.

The rate of tooth movement would have been affected because of various factors:

a. The character of the bone.
b. Periodontal scarring after doing CSF.
c. Presence of less cells with a potential for bone resorption.
d. The amount of force applied.

The reason for the tooth movement between the sites can only be speculated upon, because no histologic examination was carried out. Further histologic studies are essential for studying the reaction of supporting structures during the movement of the teeth in the recent extraction site with CSF are needed.

CLINICAL SIGNIFICANCE

This study showed that doing circumferential supracrestal fiberotomy once does not enhance or significantly increase the rate of retraction of cuspids in the recent extraction site. Also no one factor if altered might increase the rate of retraction. So, it is not recommended that circumferential supracrestal fiberotomy be done on human subjects to increase the rate of canine retraction as inadequate knowledge of the consequences of such procedures on the overall health of the supporting structures of teeth.

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