

Assessment of Root Resorption during Corticotomy Assisted Orthodontic Tooth Movement

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Abstract: *Introduction: Corticotomy-facilitated orthodontics provides a means for rapidly moving teeth purportedly with little damage to the periodontium and with reduced treatment duration. Our aim was to enhance the orthodontic tooth movement by reducing the cortical bone layer. The purpose of this study is to assess the amount of root resorption during corticotomy assisted enmasse retraction. Material and Method: 8 patients with angles class I and class II malocclusion with maxillary crowding requiring maxillary first premolar extraction were selected for the study. Full thickness flaps were raised. Corticotomy was performed in the maxillary anterior segment along with undermining of cortical bone distal to canine. Synthetic graft was placed and flap was repositioned with the help of sutures. Orthodontic force was applied 2 weeks later. Enmasse retraction was done using active tie-backs. Results: There was minimal root resorption during corticotomy assisted orthodontic tooth movement. Conclusion: CAOT is a promising technique that has many applications in the orthodontic treatment of adults because it helps to overcome many of the current limitations of this treatment, including lengthy duration, potential for periodontal complications, lack of growth and the limited envelope of tooth movement.*

Keywords: Corticotomy assisted orthodontics, PAOO, speedy orthodontics, wilckodontics, AOO.

1. Introduction

The development of corticotomy-assisted orthodontic treatment (CAOT) opened doors and offered solutions to many limitations in the orthodontic treatment of adults. This method claims to have several advantages. These include reduced treatment time, enhanced expansion, differential tooth movement, increased traction of impacted teeth and, finally, more post-orthodontic stability.

Surgically facilitated orthodontics is a 100 year old concept, first proposed by Cunningham that has evoked a progression of surgical refinements designed to accelerate orthodontic tooth movement, limit the quantity and pathologic potential of the inevitable bacterial load, enhance stability, and reduce the morbidity of orthognathic alternatives.

Kole in 1959 introduced a surgical procedure involving both corticotomy and osteotomy to accelerate orthodontic tooth movement, based on the concept that teeth move faster when the resistance exerted by the surrounding bone is reduced via a surgical procedure.¹

Duker performed Kole's study on dogs and stated that weakening the bone by surgery and consequent orthodontic treatment reduces the dangers of injury to periodontal attachment and pulp.²

First coined by Frost, the regional acceleratory phenomenon RAP is a collection of physiological healing events. Some of the features of RAP include accelerated bone turnover and decreased bone density. Yaffe et al suggests that RAP in humans begins with few days of surgery, typically peaks at 1 to 2 months and may take from 6 to 24 months to subside. They characterized the initial phase of RAP as increase cortical bone porosity because of increased osteoclastic activity and speculated that bone dehiscence might occur after periodontal surgery in an area where cortical bone is initially thin. They summarized that RAP might be contributing factor to increased mobility of the teeth after periodontal surgery.⁴

Suya in 1991 explained that most orthodontic tooth movement should be completed in the first three to four months after corticotomy and before the fusion of tooth-bone units³.

A more recent surgical orthodontic therapy was introduced by Wilcko et al. which included the innovative strategy of combining corticotomy surgery with alveolar grafting in a technique referred to as Accelerated Osteogenic Orthodontics (AOO) and more recently to as Periodontally Accelerated Osteogenic Orthodontics (PAOO). Reports indicated that this technique is safe, effective, and extremely predictable, associated with less root resorption and reduced treatment time, and can reduce the need for orthognathic surgery.⁵

Corticotomy and osteotomy were used in orthodontics primarily to resolve crowding in a shorter period of time. Several authors have described cases in which moderate and severe crowding was treated without extraction by corticotomy/ osteotomy-assisted orthodontics and in shorter periods of time. It has been shown that corticotomy is efficient in reducing the treatment time to as little as one-fourth the time usually required for conventional orthodontics.

Meeting the demands of adults for speedy orthodontic treatment, this futuristic technique has created a wave of interest amongst the patient as well as orthodontist. This has opened the windows for evaluating Corticotomy accelerated orthodontic treatment and its effect on root resorption. Hence the study was undertaken.

2. Method

8 orthodontic patients (5 females and 3 males) who needed orthodontic treatment with extraction of upper first pre molar were included. The patients aged ranged from 15 – 27 years.

Corticotomy was carried out in maxillary arches of all the patients after extraction of both upper first pre molars.

Selection Criteria

Inclusion Criteria

- 1) Patients were explained about the procedure and written consents were obtained for the same.
- 2) Patients with good periodontal condition were selected.
- 3) Patients with high density of bone were selected.
- 4) Patients with class I/II malocclusion with crowding were selected.
- 5) Patients requiring first premolar extraction as part of orthodontic treatment were selected.

Exclusion Criteria

- 1) Patients with poor periodontal health.
- 2) Patients above ASA II.
- 3) Patients with osteoporosis.
- 4) Treatment would be terminated on signs and symptoms of excessive pain, root resorption or devitalization.
- 5) Non co-operative patients.

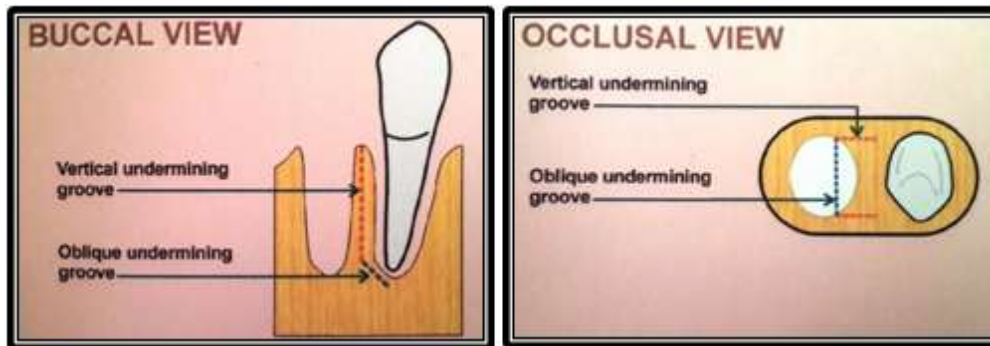
3. Clinical Procedure

8 orthodontic patients who were willing to take orthodontic treatment were taken for the study. 0.22 slot MBT prescription brackets were used in the study. Surgery was performed under local anesthesia.

First premolars were extracted. Sulcular incision full thickness mucoperiosteal flaps were reflected on buccal aspect, flaps were reflected beyond the apices of the anterior teeth.

Selective decortication was performed on buccal aspect with the help of no.1 or no.2 round bur of high speed handpiece, depth of the cuts was around 1.5 to 2 mm.

Vertical corticotomy cuts stopping just short of alveolar crest were made between the teeth and those cuts were connected beyond the apices of the teeth with scalloped horizontal corticotomy cut. Numerous corticotomy perforations were made in the cortical layer around 0.5mm in depth.



Apical and lateral root resorption of upper anterior teeth was assessed by taking OPG before treatment and after space closure.

4. Results

Rate of Root Resorption

Mean treatment duration for maxillary decrowding and space closure was 6 months. All four random examiners were independent given scores for external root resorption for individual tooth according to 4 grade ordinal scale.

Table 1: Scoring For Root Resorption

Score	Examiners Remarks
0	No external root resorption
1	Slight blunting of the root apex. Slightly irregular lateral root surface; not beyond one third of the dentine width between the distal side periodontal ligament and pulp chamber
2	Moderate resorption of the root apex beyond blunting and up to one fourth of the root length. Moderate irregular lateral root surface beyond one third and up to two thirds of the dentine width between the distal side periodontal ligament and pulp chamber
3	Excessive resorption of the root apex beyond one fourth of the root length. Excessive irregularity of the lateral root surface beyond two thirds of the dentine width between the distal side periodontal ligament and pulp chamber.

Mean ERR of right C. I. was 0.85 at the rate of 0.14/month.
 Mean ERR of left L.I. was 0.91 at the rate of 0.15/month.
 Mean ERR of right L.I. was 0.91 at the rate of 0.15/month.
 Mean ERR of left Ca. was 1.1 at the rate of 0.18/month.
 Mean ERR of right Ca. was 1.03 at the rate of 0.17/month.

$$\text{Rate of ERR of six maxillary Ant. Teeth} = \frac{\text{mean amount of ERR}}{\text{mean treatment time}}$$

$$= 0.92/\text{month}$$

Left (CI+LI=Ca)
 Mean 0.9367 ± 0.1518 (SD)
 SEM E- 0.0876

Right (CI+LI+Ca)
 Mean 0.88 ± 0.0424 (SD)
 SEM E – 0.03

Unpaired t- test between left and right side of six maxillary ant. teeth shows
 T value- 0.4914 (p= 0.6568) found statistically NS.

Mean ERR of left C. I. was 0.80 at the rate of 0.13/month.

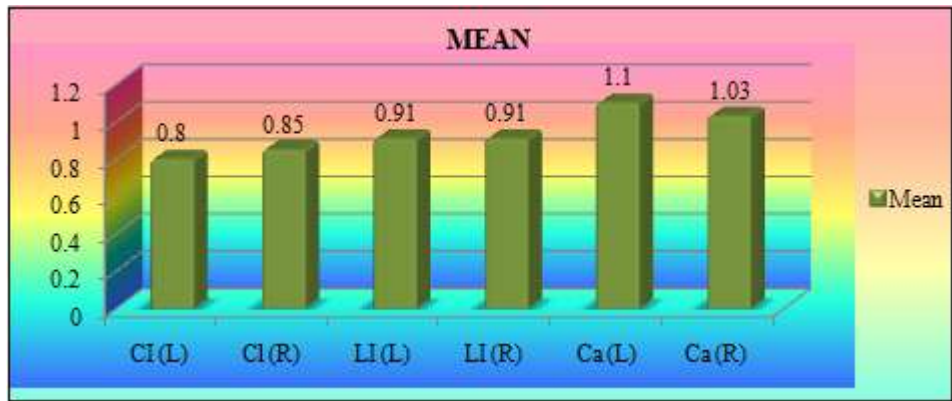
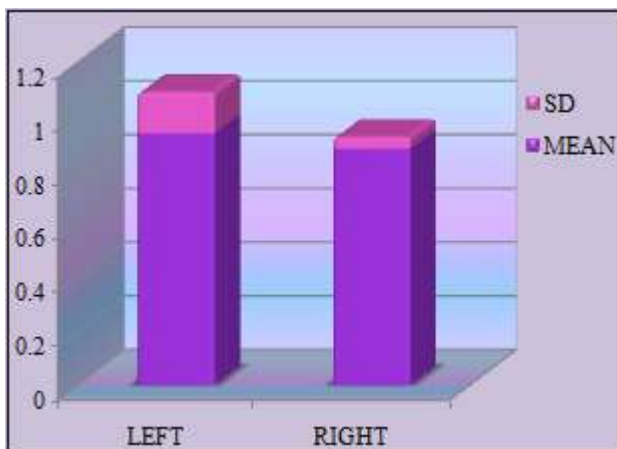


Table 6: Comparing root resorption between left and right side

	Mean	SD	SEM	P Value	T value	Results
Left	0.9367	0.1518	0.0876	0.6568	0.4914	NS
Right	0.88	0.0424	0.300			



Graph 7: Mean of root resorption between left and right side

5. Discussion

Literature evidence suggests that root resorption, an adverse side effect of orthodontic therapy, may be decreased under conditions of alveolar osteopenia, a condition characterized by diminished bone density and created secondary to alveolar corticotomy surgery.

Machado, D.J. Ferguson, M.T. Wilcko, W.M. Wilcko, And T. Alkahadra, conducted a study to compare root resorption of the upper central incisors following non-extraction orthodontic treatment with and without alveolar corticotomy surgery. The sample consisted of two groups as follows: corticotomy facilitated orthodontics (CORF) and conventional non-extraction orthodontics (CONV). All periapical radiographs were taken using the paralleling technique. Total length of right and left central incisors were measured by projecting and enlarging the periapical radiographs exactly 10X. Independent t-testing revealed a significant decrease in treatment time with CORF therapy (6.3 months) than CONV (25.9 months). Pre-treatment (T1) root lengths were not significantly different (p=.11) but CONV had significantly shorter roots at post treatment (T2) when compared to CORF at T2 (p=.02) and also when compared with the CORF retention (T3, p=.003) data. Paired t-testing revealed that orthodontic treatment resulted in

significant mean root shortening in both CORF (0.23mm, p=.007) and CONV (.52mm, p=.000). T-testing showed root resorption was significantly greater in CONV than in CORF (p=.048). In this study, corticotomy facilitated non-extraction orthodontic therapy resulted in half as much resorption at debanding and at long term retention than in conventional non-extraction orthodontics at debanding.⁷

Various authors like Harry MR, Sims MR, Kvam E. and Mc Fadden WM et al, have found an association between increased root resorption and duration of applied force.

As in CAOT duration of force applied is less, so the adverse effect like root resorption will decrease.

Wilcko et al published various articles on corticotomy and concluded that there is less root resorption due to decreased resistance of cortical bone.⁵

6. Method for evaluating root resorption

The apical root resorption was assessed by the following score:

0 = No root resorption. Smooth lateral root surface and periodontal ligament.

1 = Slight blunting of the root apex. Slightly irregular lateral root surface, not beyond one third of the dentine width between the distal side periodontal ligament and pulp chamber.

2 = Moderate resorption of the root apex beyond blunting and up to one fourth of the root length. Moderate irregular lateral root surface beyond one third and up to two thirds of the dentine width between the distal side periodontal ligament and pulp chamber

3 = Excessive resorption of the root apex beyond one fourth of the root length. Excessive irregularity of the lateral root surface beyond two thirds of the dentine width between the distal side periodontal ligament and pulp chamber.

Four different randomly selected examiners evaluated the films and gave scores accordingly.

All cases showed stable results efficient and speedy decrowding and space closure causing minimal root resorption.

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