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Original Research Article

Dento-alveolar distraction versus periodontal distraction: An in-vivo comparative study

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ABSTRACT

Various surgical techniques were developed to enhance orthodontic tooth movements. Two surgical techniques were compared and rate of orthodontic tooth movement were evaluated.

Material and Method :9 patients (5 females and 4 males years; range, 14 to 22 years) requiring orthodontic treatment with first premolar extraction, the Periodontal distraction (DD) and dent alveolar distraction (DAD) techniques were used on right and left sides respectively. The canines were moved rapidly into the extraction sites in 10 to 17 days, at a rate of 0.5-1 mm per day.

Results: Student T-test was used to compare the difference of duration (statistically significant), amount of rate of distraction. A meantime of 17.12 days respectively for the two distraction procedures employed.

Conclusions: The dent alveolar distraction technique is an innovative method that increase orthodontic tooth movement..

Key Words: distraction, canine retraction, anchorage loss.

INTRODUCTION

There are several psychological, biological and clinical differences between the orthodontic treatment of adults and adolescents. Adults have more specific objectives and concerns related to facial and dental aesthetics, the type of orthodontic appliance and the duration of treatment.[2]

Distraction osteogenesis is a method of inducing new bone formation by applying mechanical strains on the preexisting bone. The formation of new bone is achieved through stretching of the callus in the osteotomyor corticotomy gap with distraction devices. It is suggested that the formation of the new bone in the osteotomy or corticotomy site with a width of approximately 1 mm per day can be achieved by this method[1]. This method claims to have several advantages. These include a reduced treatment time, enhanced expansion, differential tooth movement, increased traction of impacted teeth and, finally, more post-orthodontic stability.[2]

Distraction osteogenesis was used as early as 1905 by Codivilla[2]and was later popularized by the clinical and research studies of Ilizarov[3]in Russia. Distraction osteogenesis was performed in the human mandible by Guerreroin 1990 and Mc-Carthy et al[4] in1992. Since then, it has been applied to various bones of the craniofacial skeleton.

In 2002, Kisnisci et al[6] introduced another technique for rapid canine retraction. In this approach, known as dentoalveolar distraction (DAD), the segment that contains the canine is transported as a bone block. It differs from the technique advanced by Liou and Huang to the extent that the periodontal ligament is not stretched. it is linear cutting technique in the cortical plates surrounding the teeth to produce mobilization of the teeth for immediate movement . Köle introduced a surgical procedure involving both osteotomy and corticotomy to accelerate orthodontic tooth movement, based on the concept that teeth move faster when the resistance exerted by the surrounding cortical bone is reduced via a surgical procedure They performed a bone separation from the bone block containing the canine using corticotomies to allow the tooth to move along with the bone that surrounds it through a distraction steogenesis process. Regardless of the

technique[7,8], Rapid Canine Retraction (RCR) has proven well suited for the following clinical situations: Severe crowding, Class II Division 1 malocclusions, bidentoalveolar protrusion, root shortening and malformation, as well as in patients presenting with periodontal problems. These indications are justified by the fact that, since tooth movement is accomplished very quickly, with the canine being completely retracted in about two to three weeks without anchorage loss, the remaining space can be used for the rapid resolution of crowding.

This an effective, comfortable, and safe procedure to accelerate tooth movement and significantly reduce the duration of orthodontic treatment.[6,9] The purpose of this study is to evaluate maxillary canine retraction with placement of distracters used in Rapid canine retraction, demonstrate through clinical cases the reduction in treatment time afforded by this new tooth movement protocol. A pragmatic approach has been made to compare the effects of tooth movements via two entirely different distraction techniques in the same individual.

AIMS & OBJECTIVE OF THE STUDY

1 To enhance orthodontic tooth movement using distraction osteogenesis and compare rate of tooth movement.

MATERIALS AND METHOD

Source of data:-

The sample size consists of the approximately 24 subjects attending the regular OPD at the Department of Orthodontics and Dentofacial Orthopedics for orthodontic treatment.

Inclusion criteria:-

- Patients in Passive growth period
- Skeletal Class II malocclusion
- Normal or mildly prognathic maxilla
- Presence of permanent dentition up to 2nd molars.
- Increased overjet, not less than 5 mm.
- Maximum crowding in dental arches.
- Severe proclination and crowding of anterior teeth

Exclusion criteria:-

- Subjects with a history of orthodontic treatment
- Anterior open bite
- Any systemic disease affecting bone and general growth
- Patient who fail to follow up or undergo complete treatment plan
- Patient with Nickel allergy

INFORMED CONSENT OF THE PATIENT AND AGREEMENT TO BE RANDOMISED

A valid, informed written consent of the patient or parent/ guardian and an agreement to be randomised will be obtained from the patient before registering the patient in this clinical study. Patient will be informed of all the theoretical risks and benefits of the interventions under test.

Both conventional and rapid canine distalization (DAD) procedures were explained to the patient and parents. Then, surgery, distraction osteogenesis protocol, and orthodontic procedures were described in detail, and an informed consent was signed by the patient and parent.

The treatment plan, therefore, consisted of initial leveling and aligning (in cases of mild crowding) followed by extraction of maxillary and mandibular first premolars and rapid canine retraction followed by fixed appliance orthodontic treatment, with no use of extra oral or intraoral anchorage appliances.

DISTRACTOR CONSTRUCTION

A custom-made intraoral distraction device was fabricated from a hyrax expander (11mm) which was trimmed, ground, and polished. After construction of the distractor screw, it was soldered to the bands of the first molars and the canines that had been previously transferred to a dental cast[7]. Before soldering to the bands, the distractor screw was opened an amount equal to the mesiodistal width of the premolar to be extracted.

SURGICAL PROCEDURE

(i) For Dentoalveolar Distraction

The surgery was performed in maxillary second quadrants according to the split-mouth technique. Surgery was performed on an outpatient basis, with the patient under local anesthesia.

Briefly, a horizontal mucosal incision was made parallel to the gingival margin of the canine and the premolar beyond the depth of the vestibule[6,4]. Cortical holes were made in thealveolar bone with a small, round, carbide bur from the canine to the second premolar, Fine osteotomes were advanced in the coronal direction. The first premolar was extracted and the buccal bone removed between the outlined bone cut at the distal canine region anteriorly and the second premolar posteriorly. Larger osteotomes were used to fully mobilize the alveolar segment that included the canine by fracturing the surrounding spongious bone around its root off the lingual or palatal cortex. The palatal shelf was preserved, but the apical bone near the sinus wall was removed, leaving the sinus membrane intact to avoidinterferences during the active distraction process. The transport dentoalveolar segment that includes the canine also includes the buccal cortex and the underlying spongy bone that envelopes the canine root, leaving anintact lingual or palatinal cortical plate and the bone around the apex of the canine.

The incision was closed with absorbable sutures, and an antibiotic and a nonsteroidal anti-inflammatory drug were prescribed for 6-8 days. The surgical procedure lasted approximately 60 minutes for each quadrant.

(ii) Surgical procedure for Distraction of Periodontal ligament

Right after the first premolar extraction, the interseptal bone distal to the canine was undermined with a bone bur, grooving vertically inside the extraction socket, along the buccal and lingual sides, and extending obliquely toward the base of the interseptal bone to weaken its resistance[5]. The interseptal bone was not cut through mesiodistally toward the canine. The depth of the undermining grooves was dependent on the thickness of the interseptal bone, as revealed on the periapical films.

STATISTICAL ANALYSIS

The observations recorded were put to statistical analysis

(a) Mean,

(b) Standard Deviation were calculated for comparison of duration of canine retraction by the two techniques.

(c) Student T-test (paired) was used to compare the difference between duration (Table I), amount of canine retraction achieved (Table II) and the anchorage loss between first and second quadrants.

RESULTS

The observations were tabulated as shown in (Tables I, II).

Table I: Duration of Distraction

PATIENT	TOOTH	DISTRACTION TIME(d)
1	13	13
	23	15
2	13	13
	23	14
3	13	17
	23	18
4	13	11
	23	14
5	13	19
	23	14
6	13	14
	23	17
7	13	16
	23	15
8	13	15
	23	13
9	13	14
	23	11

Student T –Test value (p-VALUE) is 0.0135

Since P<0.05 therefore significant 5 % level of significance

Table II: Distal Displacement of Canines in mm

PATIENT	TOOTH	MOVEMENT (mm)	TOOTH	MOVEMENT (mm)
1	13	6.9	23	7.1
2	13	6.5	23	6.9
3	13	7.1	23	6.2
4	13	7.2	23	7.2
5	13	6.8	23	7.1
6	13	6.2	23	6.2
7	13	6.4	23	7.2
8	13	7.1	23	7.1
9	13	6.9	23	7.0

Student T –Test value (p-VALUE) is 0.735

Since P>0.05 therefore not significant 5 % level of significance

DISCUSSION

The results of reduced duration of canine retraction with DAD was statistically significant lesser. Moreover, the changes in canine angulations post distraction and qualitative assessment of root resorption initiation are in accordance to a study by Kharkar VR, Kotrashetti SM, Kulkarni P (2010) Again, in terms of posterior anchorage preservation, the present study has revealed a precedence of DAD over that of PD when observed clinically. Statistically, there was no significant difference of anchorage loss . The PD technique requires dexterity in handling, being more of a blind procedure and explains the anchorage loss due to a relative ineffective osteotomy.

Selective buccal and lingual decortication of the alveolar bone is commonly used to accelerate orthodontic tooth movement.

Several studies suggest that bone response with corticotomy occurs by regional accelerated phenomenon (RAP).The alveolar corticotomy technique has been modified over the years to eliminate possible risks of the procedure, including periodontal damage, devitalization of the teeth and osseous segments because of inadequate blood supply.

In DAD, mucosal incisions and osteotomies are made only on the vestibular side of the alveolar bone, and the gingival margin, palatal mucosa, and palatal bone remain untouched, thus maintaining adequate blood supply for the transport dentoalveolar segment that includes the canine teeth[6,9].

There is basically no great difference between the tissue reactions observed in physiologic tooth movement and those observed in orthodontic tooth movement. However, because the teeth are moved more rapidly during treatment, the tissue changes elicited by orthodontic forces are more marked and extensive. It has been assumed that application of force will result in hyalinization caused partly by anatomic and partly by mechanicalfactors.[1] The hyalinization period usually lasts 2 or 3 weeks, and tooth movement continues at a rate of 1 to 1.5 mm in 4 to 5 weeks[1,3].On the other hand, with the custom-made, rigid, tooth-borne distraction device, the canines were retracted at a rate of approximately 0.5mm per day and moved into the socket of the extracted first premolars in compliance with distraction osteogenesis principles. Although every attempt was made to achieve bodily movement of the canines with distraction osteogenesis, a significant amount of tipping of the canines was observed. Therefore, the distal displacement of the canines was mainly a combination of tipping and translation. Full retraction of the canines was achieved, and the anchor teeth were able to withstand the retraction forces with minimal anchorage loss. However no saggital anchorage loss was observed in our study during rapid distraction of the canines.

Although the distractor was designed to be placed as high as possible on the buccal side of the canine tooth, some amount of tipping was observed. This can be attributed to application of the force occlusal to the center of resistance of the canine tooth caused by anatomic limitations of the vestibular sulcus.[9]

No clinical and radiographic evidence of complications, such as root fracture, root resorption, ankylosis, and soft tissue dehiscence, was observed in any of the patients. Although the fundamental causes of treatment-associated root resorption are still poorly understood, and the magnitude of resorption is almost unpredictable, an association between the duration of the applied force and increased root resorption has been reported. It is generally accepted that the best way to minimize root resorption is to complete the tooth movement in a short time. Root resorption begins 2 to3 weeks after the orthodontic force is applied and can continue for the duration of force application. [1,2]

CONCLUSION

Distraction osteogenesis for rapid orthodontic tooth movement is a promising technique. With this, anterior retraction is faster and in a shorter time period.

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