Accelerated Orthodontic Canine Retraction Using Minimally Invasive Orthocision: An in vivo study

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Background and objectives: The contemporary demand for an accelerated orthodontic treatment associated with the disadvantage of complicated and difficult surgical procedures and corticotomies. The aim of this study was to evaluate the more conservative orthocision technique as a way for accelerating orthodontic treatment.

Methods: Ten patients that matched the inclusion criteria were included in the study, which required orthodontic distalization of canines. The contralateral side of each patient used as a control for the experimental side with vertical incisions and decortication of bone with piezo knife both mesial and distal to the retracted canine after alignment and before starting retraction with power chain on 0.017*0.025 inch stainless steel wire. The pre- and post- treatment photographed cast superimpositions were used to quantify the canine distalization and molar anchorage loss and Muhelmans index was used for evaluating pre- and post- retraction tooth mobility in this study.

Results: Statistical analysis showed a highly significant difference between the control side and orthocision side regarding canine distalization distance and time duration and molar anchorage loss. A non-significant result revealed regarding mobility scoring between control and orthocision sides, also a highly significant difference was present between control side and experimental side regarding transverse changes.

Conclusions: Orthocision is an effective and a non-invasive way to accelerate orthodontic treatment.

Keywords: accelerated orthodontics, canine retraction, orthocision.

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Introduction

An increasing number of patients are seeking orthodontic treatment for more attractive appearance and/or a better function.[1] The most frustrating challenges of orthodontic treatment faced by both patients[2] and orthodontists is the treatment duration. The rate of biological orthodontic tooth movement is approximately 1 mm over 1 month. Accordingly, in cases of upper premolar extraction and maximum anchorage, distalization of canines can take almost 7 months, leading to total treatment duration of 2 years.[2] To overcome this challenge, many surgical procedures have been developed and attempted, including periodontal ligament distraction,[3] micro-osteoperforations,[4] and piezopuncture or orthocision.[5] Recently, Kim et al.[6] and Dibart et al.[7] introduced a minimally invasive technique as an alternative to induce surgical damage to the alveolar bone without any flap surgery. This technique, also known as piezocision or orthocision, involved the insertion of a scalpel into the gingiva and the placement of bony incisions using an ultrasonic tool (orthocision). The local bone injuries are responsible for the initiation of a primary demineralization process called the regional acceleratory phenomenon (RAP). The transient osteopenia associated with this phenomenon causes rapid tooth movement because the teeth move in a soft medium.[8,9] Because of the induced RAP effect, a soft medium is expected after orthocision,[4,7] which can lead to maxillary collapse and/or cross-bites for posterior teeth.

Elastomeric power chains are usually used in orthodontic practice, specifically for closing spaces, with the advantages of no patient cooperation required, low cost, smooth surface, and their irritation-free nature.[10,11] Compared with conventional burs, a piezoelectric knife facilitates bone healing without causing osteonecrotic damage and enhance the preservation of root integrity because of its accurate, selective cutting action.[12] Furthermore, because the piezoelectric knife works only on hard tissues, it protects the soft tissues and their blood supplies.

Orthocision has successfully been used for the accelerated treatment of Class II[13] and Class III[14] patients and has been successfully applied with lingual orthodontics[15] and the Invisalign system[16] to achieve both esthetic and reduced treatment durations.

Because few studies have addressed the effects of orthocision on canine retraction, this study was performed to investigate the potentials of orthocision to accelerate canine retraction and to evaluate the effectiveness of piezocision-assisted canine distalization using intra-cast measurements and to assess the transversal changes and mobility scores.

Patients and Methods

The scientific and ethical committee at college of dentistry/Hawler medical University approved this study. Patients indicated for maxillary first premolar extraction and bilateral canine distalization were selected from those with half or more unit Class II malocclusion. All patients had to fulfill the inclusion criteria, which was: healthy systemic condition and no previous orthodontic treatment. All patients were also required to have good oral hygiene, no loss of periodontal attachment, and no radiographic evidence of bone loss.

Twenty maxillary canines of 10 patients fulfilled all the inclusion criteria and were included. The mean age of the patients was 14.5-19 years, including three female and seven male patients.

Roth's prescription edgewise brackets (3M, USA) with 0.022-inch slots were used. The teeth were leveled and aligned before canine distalization on (0.017*0.025 -inch stainless steel) wire with moderate anchorage.

Before canine distalization and after the alignment and leveling phases, orthocision was performed on the experimental side. Following the induction of local anesthesia, two vertical interproximal incisions were placed through the periosteum and below the interdental papilla at attached gingiva on the mesial and distal sides of the maxillary canines using a No. 11 blade (Figure 1).

Figure 1: Two vertical incisions before insertion of piezo-surgery knife.

A piezo-surgery knife (BS1 insert, Piezotome, Satelec Acteon, Merignac, France) was used to create cortical alveolar incisions with a depth of 3 mm. The depths were verified by the millimetric signs on the piezo-surgery knife. The upper 0.017* 0.025 -inch stainless steel arch wire was ligated. The distalization phase was initiated after orthocision on the experimental side using elastomeric chains with an approximate force of 150 g measured using a force gauge. For the control side, distalization was started at the same time with the same mechanics. Patients were examined at 2-week intervals, and the elastomeric chains were replaced at each appointment until ideal Class I canine relationships were established. Both canines of each patient were planned to be distalized in terms of millimeters.

Pre- and post-distalization model casts were obtained and photographed for analysis. The models were superimposed, and the changes in the models were evaluated for canine distalization changes. The super-impositions were performed by selecting the medial end of the third palatal rugae as a reference points (Figure 2). The usage of these points has been performed in similar researches.[17,18] The canine and molar positions were defined in superimposed views, and the pre- and post-distalization distances were measured. The pre- and post-distalization mobility scores for the canines was also evaluated and scored. The Muhleman's index was used to assess mobility in our study[19] as per the following scoring system: 0, no mobility; 1, .0.5 and 1 mm of mobility buccolingually; 2, 1 mm and 2 mm of mobility buccolingually; 3, 2 mm of mobility buccolingually; and 3+, both vertical and buccolingual mobility.

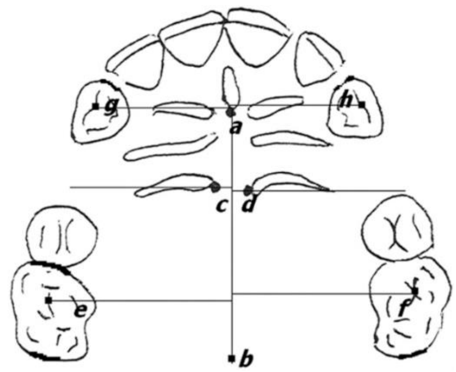

Figure 2: Transverse changes measurements in canine and molar region (Hoggan and Sadowsky, 2001).

The transversal changes in the models were evaluated by using a midline plane following the incisive papilla and midpalatal raphe as described by Hoggan and Sadowsky (Figure 2).[17] The distance from the canine cusp tip to the midline plane and the first molar mesiobuccal cusp tip to the midline plane was measured for pre- and post distalization models on two separate occasions by a single examiner.

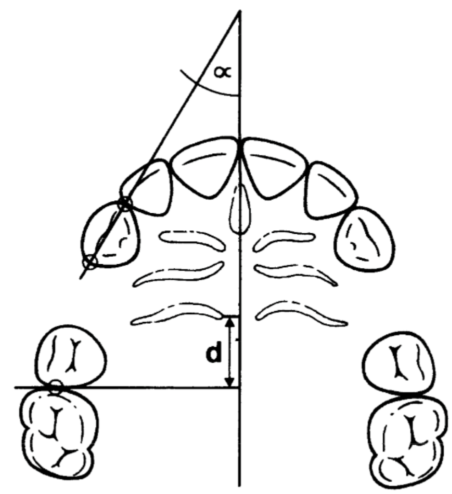

Figure 3: Antero-posterior movement of the canines and the first molars (Zigler and Ingervall, 1989).

Dental casts were used for the quantification of the anteroposterior movement of the canines and the first molars (Figure 3) with the method described by Ziegler and Ingervall.[20]

Descriptive statistics were computed for the variables of tooth movement (canine retraction and molar anchorage loss). A paired *t*-test was used to determine the statistical significance of the difference between the control and experimental sides for preoperative and postoperative measurements.

Results

As shown in Table 1 Orthocision-assisted canine distalization decreased the total treatment duration by approximately 3 months and revealed a highly significant difference (p=0.001) compared with control side. Similar results obtained regarding the distalization distance with a highly significant difference (p=0.001) on the orthocision side (2.45 mm) compared to control side (1.35 mm). Anchorage loss in the molar region also revealed a highly significant difference (p=0.001) being more (3.61 mm) on control side than the orthocision side (2.5 mm).

Regarding mobility scoring a non-significant difference (p=0.447) found between the orthocision side and control side both being within normal limit. Transverse plane analysis showed a highly significant difference in both canine and molar regions between the orthocision and control side (p=0.013 and p=0.001 respectively).

Table 1: Statistical analysis (descriptive and paired t-test) for both groups.

Groups	Mean	N	SD	SE	Significance *t*-test
Dist. Orthocision	2.450	10	.4275	.1352	0.001
Dist.Control	1.350	10	.4089	.1293	
Anhor. Orthocision	2.500	10	.3830	.1211	0.001
Anchor.Control	3.610	10	.3784	.1197	
Dist. Orthocision Time	2.900	10	.3944	.1247	0.001
Dist.Control Time	5.750	10	.4859	.1537	
Mobility. Orthocision	.35	10	.473	.150	0.447
Mobility.Control	.20	10	.422	.133	
Inter-canine Orthocision	1.370	10	.2584	.0817	0.013
Inter-canine Control	1.150	10	.2273	.0719	
Inter-molar Orthocision	.4550	10	.17865	.05649	0.001
Inter-molarControl	.1950	10	.07976	.02522	

P 0.05

Discussion

In this study, null hypothesis was that the orthocision technique could be used to reduce treatment time by facilitating tooth movement. Orthocision has been proposed to dramatically reduce the treatment time because the resistance of the dense cortical bone to orthodontic tooth movement is removed.[21-24] In this study, orthocisions were made in the buccal cortical plate of bone only without vertical or subapical cuts and without the reflection of a palatal flap. The reason of this is the idea that the RAP induced by the buccal orthocision would readily involve the non orthocised palatal side. Moreover, the main purposes of adopting this conservative technique were to reduce operation time and postoperative patient discomfort by eliminating exposure of the patient to the risks of an additional palatal surgery.[25] These modifications attempted to optimize the treatment outcome of the surgical procedure with minimal effort on the periodontium.

Elastomeric chains can be preferred for space closures.[10] Dixon et al.[10] studied power chains and nickel titanium coil springs and concluded that although coil springs gave more rapid tooth movement, power chains were effective on space closure and they were a cheaper option for orthodontic treatment. It was also stated that nickel titanium coil springs, power chains, elastic threads, and magnets are all able to provide optimum tooth movement.[26]

The results of the current study revealed that the rate of tooth movement in the control side was similar to the rate of biological tooth movement.[2] Statistical analysis revealed an accelerated canine distalization procedure in the orthoocision group approximately two times faster than the control group. This result is in accordance with Aboul-Ela et al.[27] Leethanakul et al.[28] reported a canine distalization of 5.4 mm over 3 months when interseptal bone reduction was performed before distalization. In the current research, the canine distalization phase was completed in 2.9 months in the orthocision side. Similarly, Aboul-Ela et al.[27] reported that a Class I canine relationship was established in 2 or 3 months in the experimental sides with corticotomy. The results of these studies are therefore similar, although orthocision is less traumatic and easier to perform compared with interseptal bone reduction.

The amount of canine distalization was 2.45 mm in the orthocision side. These results were significantly higher than the control side. Aboul-Ela et al.[27] found that a 1.89 mm corticotomy assisted canine distalization for the first month and a 1.83 mm corticotomy for the second month in their accelerated tooth movement study. Sousa et al.[29] revealed 1.16 mm laser-assisted canine distalization for the first month and 0.89 mm distalization for the second month in their accelerated tooth movement study with a diode laser.

The cusp tips of the teeth were chosen as the measuring landmarks instead of the labial surfaces of the teeth. Gianelly[30] used labial surfaces to determine the widest widths to prevent confusion when selected cusp tips were not distinct. These measurement points can have reasonable effects but should not be used for every study. In a similar study performed by Sukurica et al.,[31] cusp tips were used. In the current study, the cusp tips were selected because of their good visibility and easy use with the model analysis s. This research was undertaken to determine the effect of orthoocision-assisted canine distalization on transverse dimensions. The distance from the canine/midline plane increased after distalization, and this result is consistent with a similar study performed by Luppanapornlarp and Johnston.[32] Paquette et al.[33] found an increase of approximately 1.0 mm in the mandibular intercanine width after extraction therapy. This is also in accordance with the current results. The difference in midline plane/first molar distance increased after distalization. The usual expectation is that the posterior region of the maxillary arch becomes narrower as the molars move anteriorly into the narrower part of the arch during space closure. However, Gianelly[30] found no change for intermolar widths after extraction therapy. In the current study, slight increases were detected for the midline plane/first molar width after canine distalization. Similarly, Johnson and Smith[34] stated that transverse arch width was maintained or slightly enlarged after extraction.

The Muhleman’s index was used to assess mobility in our study.[19] There was no difference in pre- and post- distalization mobility scores between the two groups, although the scores increased after distalization in both groups. These results are in agreement with similar rapid tooth movement research performed with corticotomies.[27,35,36]

In the current study, no complications or side effects were observed. Similarly, there have been no complications related to orthocision reported in the dental literature until now. Because orthocision is similar to corticosion techniques, there can be interdental bone loss or periodontal defects.[37]

The orthocision technique proposed here resulted in clinical outcomes that were similar to those of the classic decortication approach, but the orthocision technique had the additional advantages of being minimally invasive, precise, and less traumatic for the patient. However, this technique was time-consuming because of the decreased cutting efficiency of the piezotome blades relative to conventional burs.

Conclusions

1. Orthocision-assisted canine distalization increases the speed of canine distalization and decreases the overall treatment duration and it is also helpful for posterior anchorage control. It aids in maintaining the molars in a more stable position compared with conventional distalization.
2. There was no difference in the mobility index before and after distalization in our study, indicating that orthocision does not negatively affect periodontal health.

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