

THREE DIMENSIONAL EVALUATION OF THE EFFECT OF DISCISION ON CANINE RETRACTION

Mohamed Alaa El-Din Abd El-aziz ^{1*}, Wael Mobarak Refaei ², Kareem Maher Mohamed ³

Abstract

The discision technique was developed as a minimally invasive alternative method to piezocision technique, and the authors suggest that this new method yields good outcomes in achieving rapid tooth movement. The efficacy of this newly developed technique should be proved by performing controlled clinical trials comparing this technique with powerchain retraction method method¹.

Introduction

One of the latest techniques in accelerating tooth movement is the Piezocision technique. Dibart ² was among the first to apply the Piezocision technique which starts with primary incision placed on the buccal gingiva followed by incisions by Piezo surgical knife to the buccal cortex ². Piezocision technique did not cause any periodontal damage as reported by Hassan ³. Another benefit of this technique is that it can be used with Invisalign, which leads to a better aesthetic appearance and less treatment time as reported by Keser³. Piezocision is a promising tooth acceleration technique because of its various advantages on the periodontal, aesthetic, and orthodontic aspects.

The discision method may provide an alternative to the piezocision approach. The

technique has been recently used successfully in an adolescent patient who had moderate crowding in both arches and involves the use of a disc saw bur attached to a micromotor device, which is commonly used for arranging or cutting the ridge crest in dental implant surgery. Disc saws can be more ergonomic and economical than piezosurgery devices. Therefore, the purpose of this clinical study was to investigate the efficacy of discision method on accelerated orthodontic tooth movement in comparison to the piezocision method. We tested the hypothesis that there will be similar effects of these two methods on orthodontic treatment duration due to similar osteogenic impact on moderate crowding orthodontic cases .

Discision is comparable to piezocision in terms of tooth movement acceleration, pain level, and periodontal status. The discision seems to be effective in reducing the time of orthodontic treatment ⁴.

Surveying the literature, little was found the efficacy of this technique on the rate of the orthodontic tooth movement and canine retraction. Accordingly, this study was conducted to assess this aim.

¹ Department of Orthodontic, faculty of Dentistry, Minia University, Minia 61519, Egypt;

² Head of Department of Orthodontic, faculty of Dentistry, Minia University, Minia 61519, Egypt;

³ Associate prof. Of Department of Orthodontic, faculty of Dentistry, Minia University, Minia 61519, Egypt;

*Corresponding author: Mohamedalaa9931@gmail.com

Patients and methods: This study was performed over 10 subjects who were selected from the outpatient clinic of department of orthodontics, Faculty of Dentistry, Minia University.

Ethical regulations:

The study was approved by the Research Ethics Committee of the Faculty of Dentistry, Minia University, Egypt. All the procedures

were explained to the patients. An informed consent was signed by the patients.

Sample size calculation:

An adequate sample size carried out to estimate the population prevalence with a good precision. The sample size should depend on the research context, including the researcher's objectives and proposed analyses.

The following formula was used to calculate the required sample size in this study;

$$n = \frac{Z^2 P (1 - P)}{d^2}$$

Where n is the sample size, Z is the statistic corresponding to level of confidence, P is expected prevalence, and d is precision (corresponding to effect size). The level of

confidence was 95%. By using this equation the sample size was 10 sample in each group (i.e. 20 sample in the two groups).

After diagnosis we have chosen these patients to perform research:

1- **Class I** : patient should has bi maxillary protrusion to extract first premolars in upper and lower arch.

2- **Class II** : patient that has class II molar relationship and class II canine has been qualified to extract upper first

premolars and lower second or first premolars according to crowding lower or molar relationship.

The study was conducted and maintained on 10 patients out of 13 (3 patients have been excluded). Age of the participants ranged from 18-24 years. Sixty percent were female and 40% were male.

Table 1: Demographic data

		Descriptive statistics N=10
Age	<i>Range</i>	(18-24)
	<i>Mean ± SD</i>	20.4±2.2
Sex	<i>Male</i>	4(40%)
	<i>Female</i>	6(60%)

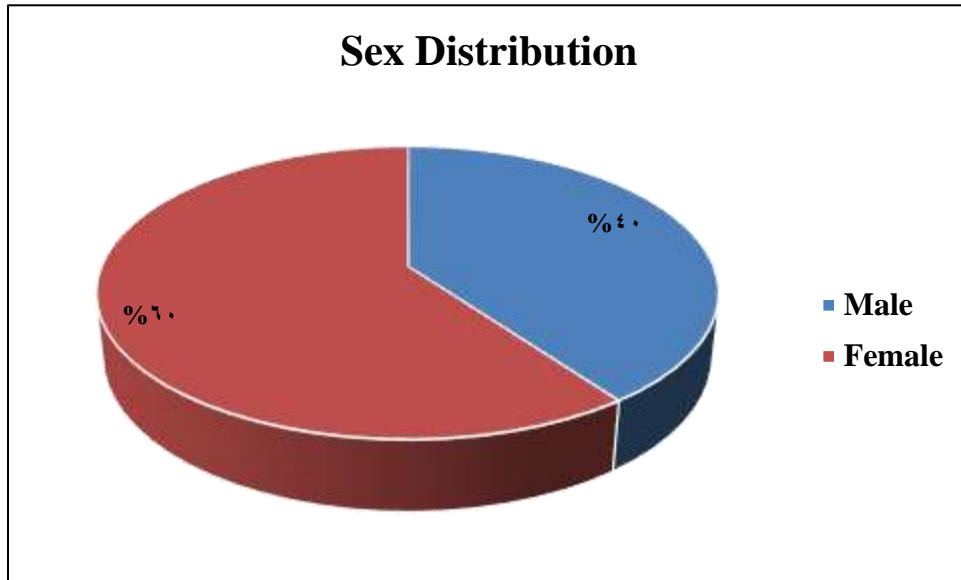


Figure 1 : Randomized sex distribution





Figure 2: Pre-treatment photos of class II patient

Materials :

- 1- Fixed bondable brackets
- 2- Disc that has been used for discision with .03 mm thickness and 6 mm diameter and its shaft act as a stopper during discision so the cutting depth is 3mm only .
- 3- Micro-motor and low speed contra that were used for discision procedure .
- 4- Open coil spring was used in retraction canines
- 5- Force guage was used to use the same retraction force in right and left canines
- 6- CBCT xray for 3 dimensional evaluation of retracted canines

Discision procedure :

- Local anaesthesia was given
- A 7 mm length incision was performed using the disc .
- Vertical incisions started 1 mm below the free gingivae crossing the mucogingival line .
- The shaft of the disc act as a stopper guide to standardization of all cases in incision depth .
- There was no sutures after the procedure as it a flapless technique .
- Irrigation was used during whole procedure .
- The patients were advised to take analgesics such as paracetamol if necessary⁶⁹.



Figure 3: right and left side after discision was made in the right side in the same day of extraction

CBCT scan criteria for evaluation:

- 1- The scan should be standardized before and after procedure with the same points to permit fairly evaluation of the retracted right and left canine .
- 2- The main points or areas were (maxillary arch – floor of the orbit – external auditory meatus).

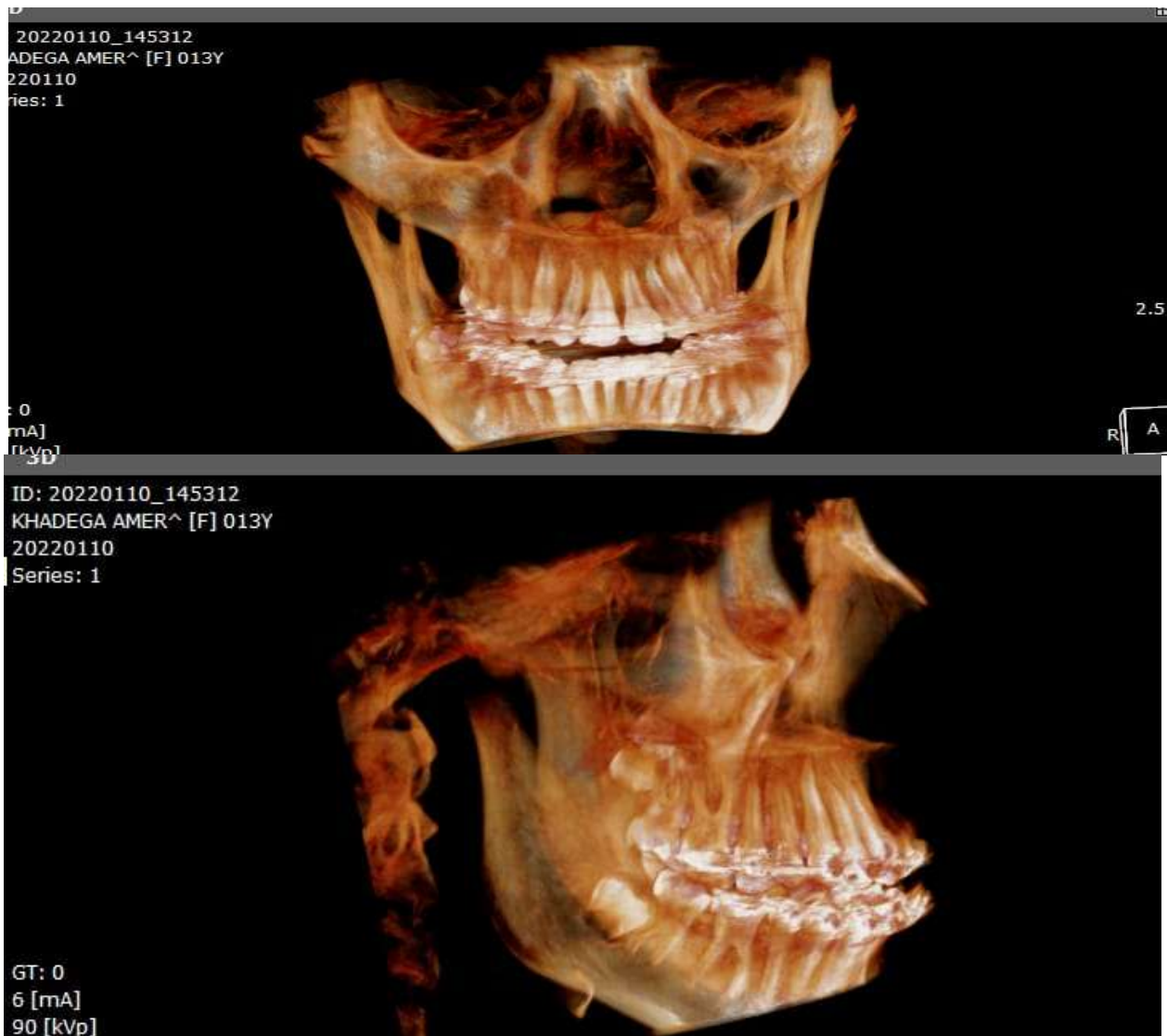


Figure 10: photos from CBCT scan

3D views for the areas we need in the scan

- 3- Scan was taken with the same xray machine before and after procedure
(planmeca promax)

Planmeca promax xray

4- Scan was reviewed and analyzed in the same day it was taken to confirm that all points we need in evaluation is present .

Analysis of scans (by mimics software)

1- Marking points :

Point	Point name
Or R	Floor of the right orbit
Or L	Floor of the left orbit
Po R	Porion right
Po L	Porion left
A L C	Apex of the left canine
T L C	tip of the left canine
A R C	apex of the right canine
T R C	tip of the right canine

Table 2 : points used in mimics

marking planes :-

a- Frankfort plane	(porion right and left – the most inferior point in the floor of the orbit right and left).
b- Posterior plane (imaginary plane)	which is perpendicular on Frankfort in porion points right and left.

Table 3 : planes used in mimics

From the aforementioned landmarks, lines, and planes, the following measurements were conducted to evaluate the three-dimensional canine movement and show the difference between retraction in right and left side :

Po – ALC	Posterior plane to apex of the left canine
Po – TLC	Posterior plane to tip of the left canine
Po-ARC	Posterior plane to apex of the right canine
Po-TRC	Posterior plane to tip of the right canine

Table 4 : distances that measured in mimics to evaluate differences

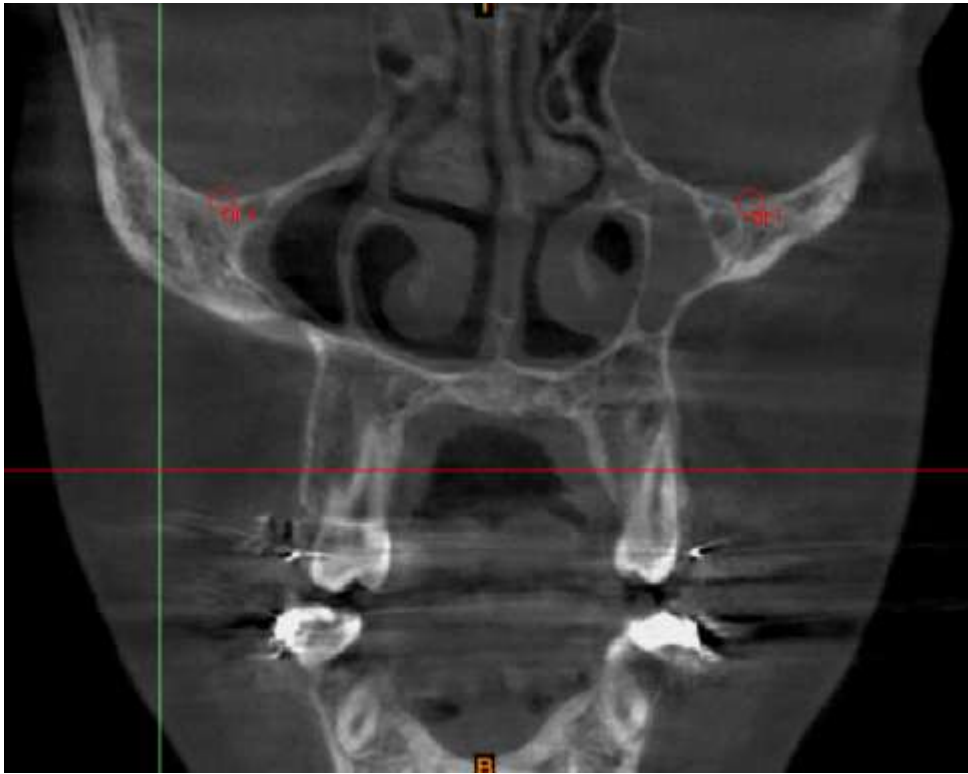


Figure 11: orbital points in mimics software

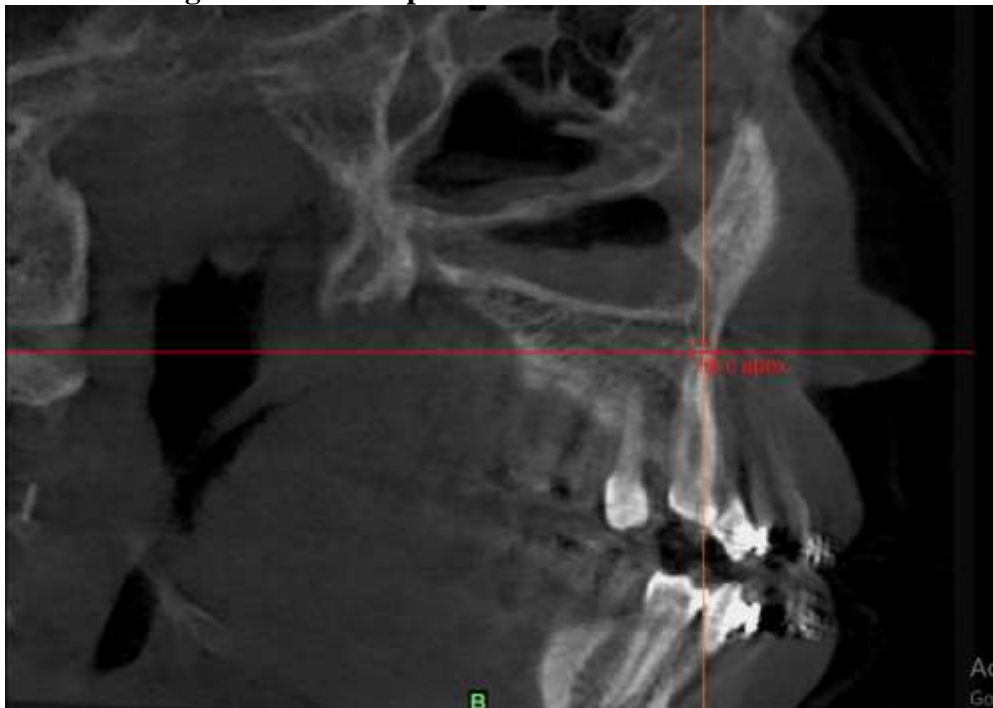


Figure 12: upper left canine apex

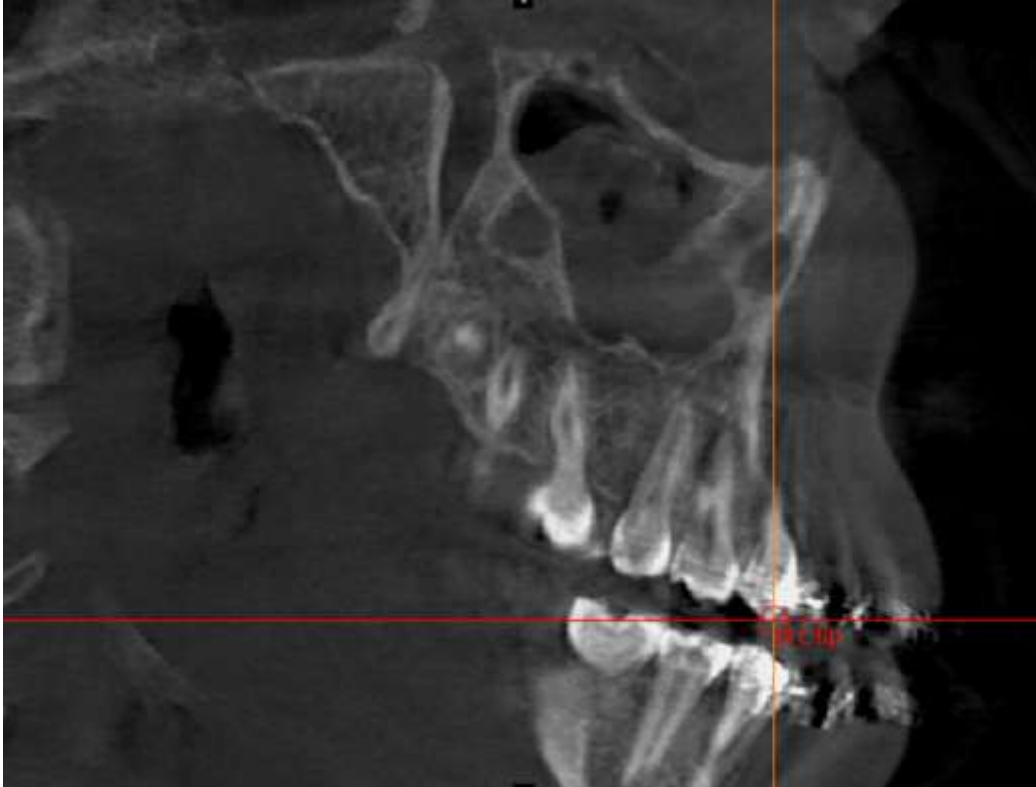


Figure 12: upper left canine tip

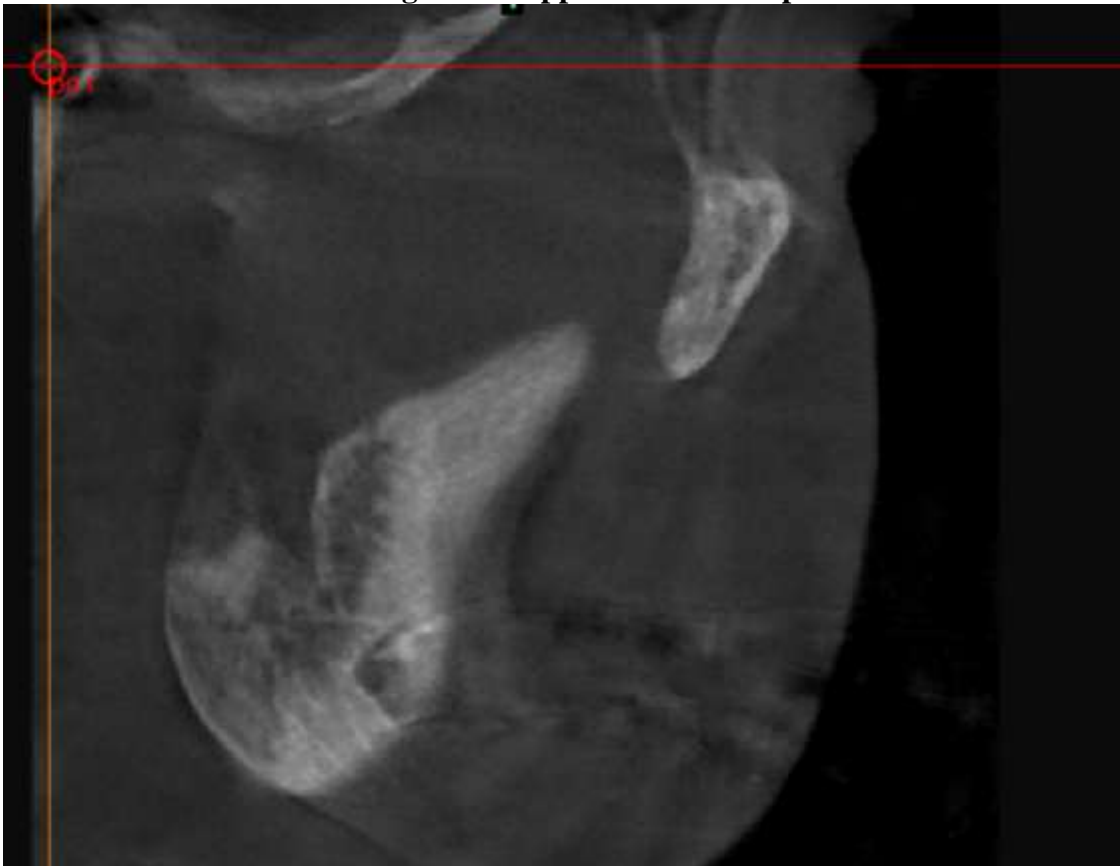


Figure 13: porion point on right side to evaluate posterior plane for evaluation of canine movement

All data were collected and analysed for results .

Results

Statistical analysis:

Data were analyzed using IBM SPSS software (version 24.0). Data were described quantitatively using mean and standard deviation of the normally distributed data.

Dependent t-test was used for the comparison of the independent populations of the normally distributed data.

Significance test results were quoted as two-tailed probabilities. Significance of the obtained results was judged at the 5% level .



Figure 4: the difference between canine movement in right and left side after 3 months of canine retraction with closed coil spring

Table 2: Measurement area at the upper canine tip between the two sides pre and post treatment

		LT side	RT side	P value
		N=10	N=10	
Upper canine tip pre	Range	(74.3-82.9)	(72.2-84.1)	0.704
	Mean ± SD	77±2.7	77.5±3.4	
Upper canine tip post	Range	(71.3-79.4)	(67.1-78.7)	0.004*
	Mean ± SD	74.3±2.9	72.8±3.5	
P value		<0.001*	<0.001*	

- Paired Samples T test for quantitative data between the two sides (split mouth design) and between pre and post treatment
- *: Significant level at P value < 0.05

Regarding measuring area at the upper canine tip there was insignificant difference between the two side pre-treatment, while the measuring area showed significant decrease at the RT side

post treatment, Also the measuring area showed significant decrease post treatment in each side (table 2)

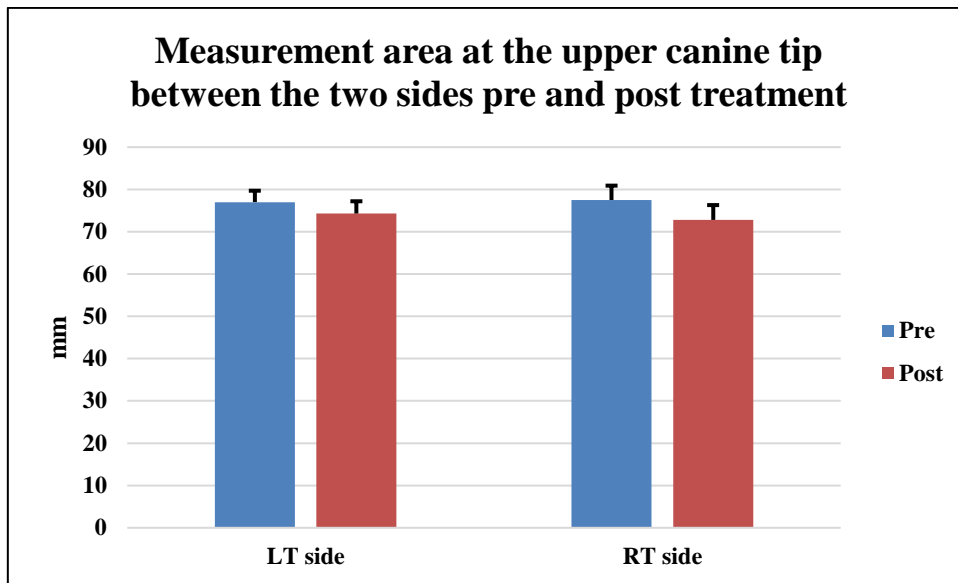


Figure 5 :Measurement area at the upper canine tip between the two sides pre and post treatment



Figure 6 : occlusal view after 3 months of canine retraction

Table 3 : Distance moved by the upper canine tip between the two sides

		LT side	RT side	P value
		N=10	N=10	
Distance at canine tip	Range	(0.8-3.5)	(3.1-5.7)	<0.001*
	Mean ± SD	2.7±0.8	4.7±0.8	

- Paired Samples T test for quantitative data between the two sides (split mouth design)
- *: Significant level at P value < 0.05

As regarding distance moved by the upper canine tip there was significant increase at the RT side

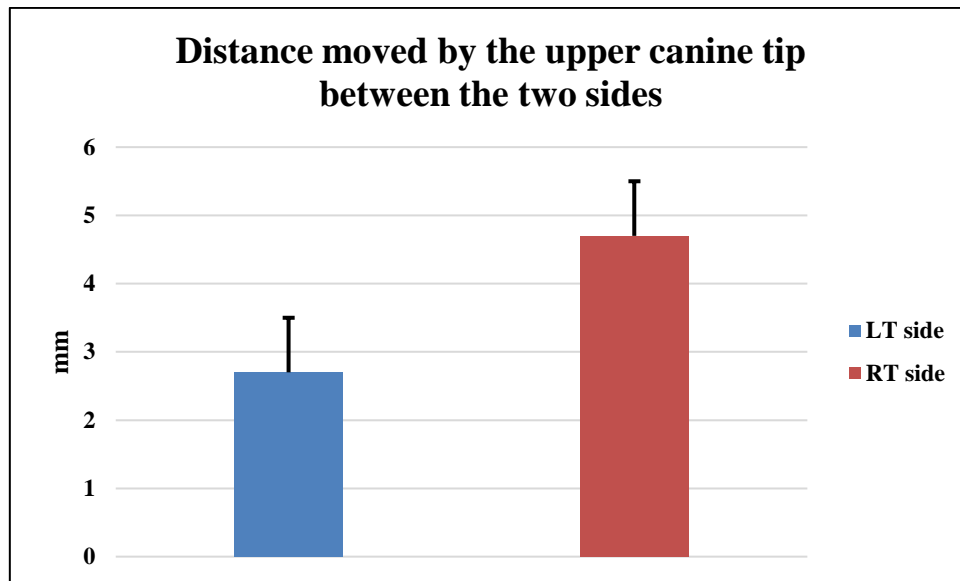


Figure 7 : Distance moved by the upper canine tip between the two sides

Table 4: Measurement area at the upper canine apex between the two sides pre and post treatment

		LT side	RT side	P value
		N=10	N=10	
Upper canine apex pre	Range	(84.3-87.6)	(84.1-88.8)	0.774
	Mean ± SD	86.5±1.1	86.6±1.4	
Upper canine apex post	Range	(81.5-85.2)	(79.4-85.4)	0.001*
	Mean ± SD	83.8±1.3	82.6±1.7	
P value		<0.001*	<0.001*	

- Paired Samples T test for quantitative data between the two sides (split mouth design) and between pre and post treatment
- *: Significant level at P value < 0.05

As regarding measuring area at the upper canine apex there was insignificant difference between the two side pre-treatment, while the measuring area showed significant decrease at the RT side post treatment, Also the measuring area showed significant decrease post treatment in each side

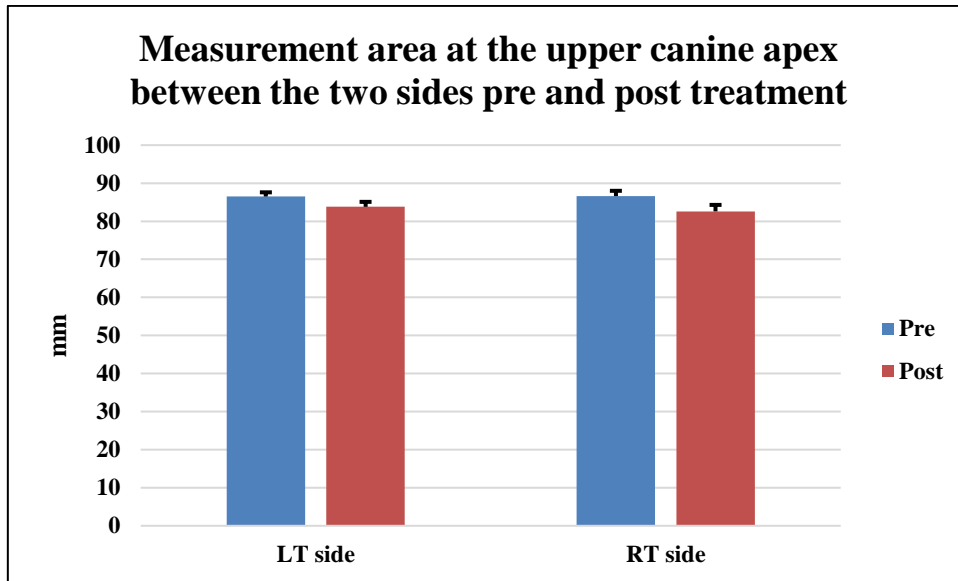


Figure 8: Measurement area at the upper canine apex between the two sides pre and post treatment

Table 5: Distance moved by the upper canine apex between the two sides

		LT side	RT side	P value
		N=10	N=10	
Distance at canine apex	Range	(1.3-3.6)	(2.5-5.3)	<0.001*
	Mean ± SD	2.7±0.6	4±0.8	

- Paired Samples T test for quantitative data between the two sides (split mouth design)
- *: Significant level at P value < 0.05

As regarding distance moved by the upper canine apex there was significant increase at the RT side

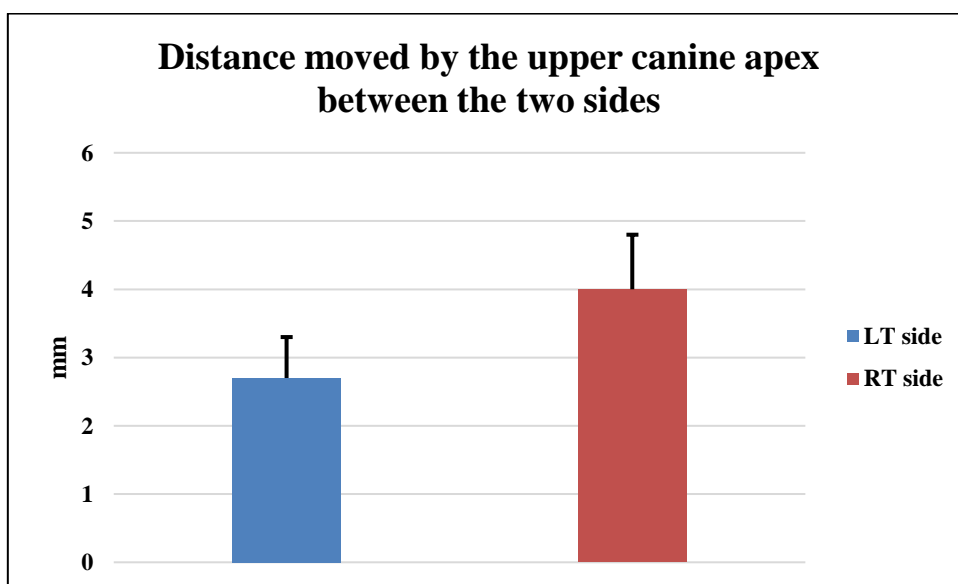


Figure 9: Distance moved by the upper canine apex between the two sides

Discussion

Fixed orthodontic treatment requires a long duration of about 2–3 years, which is a great concern and poses high risks of caries, external root resorption and decreased patient compliance. Thus, accelerating orthodontic tooth movement and the resulting shortening of the treatment duration would be quite beneficial.

Normally, when a traumatic force was applied on a bone, a biological process is initiated in the bone, and the bone turnover increases, and regional bone density decreases^{5, 6}.

This biological process was defined as regional acceleratory phenomenon (RAP) by Harold Frost

Following wound healing in the cortical bone, RAP allows remodeling of hard and soft tissues by strengthening tissue reorganization⁵⁻⁷.

In this study (RAP) was performed in right side only in maxillary arch after extraction of right and left first premolar in to assist the difference of canine movement between two sides(split mouth technique).

Ten patients were included in the study. An adequate sample size calculation was carried out by using adequate equation according to Chow et al 2003⁸ to estimate the population prevalence with a good precision .

We have chosen patients with closed age to identify a critical outcome that have the same growth and bone remodeling . as stated by alikhani et al about various factors that can affect tooth movement and bone remodeling⁹. Bridges T et al who mentioned the necessity of age and growth remnants on tooth movement¹⁰

. In this study we were seeking for equal gender distribution due to sex hormones which was mentioned by Haruyama N et al and its effect in tooth movement¹¹, Alikhani et al⁹. stated the gender distribution as an important factor .

Occlusal forces should be equal in two sides and the patient uses two sides in chewing and eating to equalify occlusal forces which was mentioned by Usumi-Fujita R et al¹² which can alter the speed of tooth movement by affecting bone density and remodelling .

We have chosen these groups of patients for discision and extraction if the case need as stated before by Sebaoun ,Dibart et al Patients with moderate or severe crowding associated with Class I or II are the most appropriate cases for corticotomy indications¹³.

Patients included in the study were periodontally healthy and there was no statistical difference in periodontal status between groups. This is an expected outcome for patients with cooperation and good oral hygiene and is consistent with the results of other studies Charavet et al¹⁴ .

Orthodontic tooth movement is one of the causes of gingival recession. It is not known whether rapid tooth movement increases gingival recession. Charavet et al¹⁴. reported that overall recession scores did not increase after treatment in both accelerated group and control group

In our study, there was no statistical difference between experimental groups in any periodontal parameters , Casetta et al¹⁵, treated ten patients with severe dental crowding with clear aligners and corticotomy-facilitated orthodontics and they found that there was no

difference between the pre-treatment and post-treatment periodontal indices.

Buccal incisions only were performed without any palatal incisions because it is expected to lead to maxillary constriction and crossbites for posterior teeth especially in maxilla as stated by S. Aksakalli et al⁹, RAP effect can lead to a pliable environment specially after two sided incisions buccally and palatally in maxilla (spongy bone)which may lead to crossbite .

Discision is a flapless technique which no need for flap elevation as mucoperiosteal adapt after days of surgery and underlying tissue persists for 6 to 24 months as mentioned by Dibart et al in a similar study used piezocision technique .¹⁶

This study is a split mouth technique one to evaluate the difference of canine distalization rate In premolar extraction site between two sides as done by Gun and Cakirer in (2013)¹⁷.

The fastest rate of canine retraction achieved by conventional methods as reported in the literature is about 2 mm/month as stated by Daskalogiannakis J, McLachlan KR¹⁸. Thus, it takes a minimum time period of 4-6 months to retract the canines completely into the first premolar extraction space by the current conventional methods as stated by Lotzof LP, Fine HA, Cisneros GJ^{19,20} . So we have to reduce the time of retraction to 3 months only for evaluation of the difference of canine movement in both sides before canine close all spaces of extraction and then we will not be able to evaluate which side has been moved faster than the other.

We used niti closed coil spring for retraction because it can give us a constant force during retraction and no need for using higher initial force in elastomeric chains to compensate the loss of elasticity and force biodegradation as stated by Haya Barsoum et al²¹ .

Force of canine retraction was adjusted according to allocated side between (150 – 300 g) with niti closed coil spring and it was measured and adapted as the same in both sides with force gauge as used by Albelasy et al 2022²².

CBCTs were used to assess changes in the movement of canines due to difficulty and inaccuracy of superimposing subsequent models in or using digital calipers which can lead to random errors as stated by Baumgaertel et al , who said that CBCT scan is the most accurate and reliable method that can be used in evaluation of tooth movement²³.

According to results . Discision method is considered as a new method that shortens orthodontic tooth movement with a simple technique without complicated surgical procedure (flapless technique) and without special surgical tools like piezocision (piezo-electrical knife) which is less discomfort for the patient , less expensive and less complication than piezocision²⁴.

When the bone is injured, a very dynamic healing process occurs at the site of the bone injury that is proportional to the extent of the surgical insult. The RAP begins within a few days of the surgery and usually peaks in 1–2 months and then slows down and disappears as remineralization sets in. Similar research has been done to show

the effects of Piezocision on the alveolar bone and tooth movement²⁵. It has been shown that a similar RAP effect is produced when decortications are done by the piezoelectric knife.

Once the bone has been demineralized following the use of burs for corticotomy, there is a 3–4 month window of opportunity to move teeth rapidly through the demineralized bone matrix before the alveolar bone remineralizes²⁵.

Therefore in addition to accelerating the treatment, the RAP changes the orthodontic treatment planning in two major ways: (1) in anchorage planning, by creating a transient osteopenia, and (2) the treatment timing and progress during the “window of opportunity,” where the teeth move faster⁵.

Canine tip in right side (trial group) was moved 2 mm more than left side (control group) while canine apex in right side was moved 1.3 more than left side. Although canine was ligated with stainless-steel ligature wire, this difference between canine tip and apex movement is due to long roots of canine and its morphology which make it impossible to retract the canine without tipping as stated with Babu SH (2005)²⁶.

Conclusion

1- Acceleration of canine movement can be done with discision due to osteopenia that had happened in bone after discision that lead to less resistance to canine movement during retraction thus need less time than conventional rtraction without discision

Reference

- 1) Z. Davidovitch, O. Nicolay, P. Ngan, and J. Shanfeld, "Neurotransmitters, cytokines, and the control of alveolar bone remodeling in orthodontics," *Dental Clinics of North America*, vol. 32, pp. 411-435, 1988.
- 2) S. Dibart, J. Surmenian, J. D. Sebaoun, and L. Montesani, "Rapid treatment of Class II malocclusion with piezocision: two case reports," *Int J Periodontics Restorative Dent*, vol. 30, pp. 487-93, Oct 2010.
- 3) E. I. Keser and S. Dibart, "Piezocision-assisted Invisalign treatment," *Compend Contin Educ Dent*, vol. 32, pp. 46-8, 50-1, Mar 2011.
- 4) M. C. Yavuz, O. Sunar, S. K. Buyuk, and A. Kantarcı, "Comparison of piezocision and discision methods in orthodontic treatment," *Progress in orthodontics*, vol. 19, pp. 1-7, 2018.
- 5) W. M. Wilcko, M. T. Wilcko, J. Bouquot, and D. J. Ferguson, "Rapid orthodontics with alveolar reshaping: two case reports of decrowding," *International Journal of Periodontics and Restorative Dentistry*, vol. 21, pp. 9-20, 2001.
- 6) S. S. Baloul, L. C. Gerstenfeld, E. F. Morgan, R. S. Carvalho, T. E. Van Dyke, and A. Kantarci, "Mechanism of action and morphologic changes in the alveolar bone in response to selective alveolar decortication–facilitated tooth movement," *American Journal of Orthodontics and Dentofacial*

Orthopedics, vol. 139, pp. S83-S101, 2011.

7) S. Dibart, J. Surmenian, J. David Sebaoun, and L. Montesani, "Rapid treatment of Class II malocclusion with piezocision: two case reports," *The International journal of periodontics & restorative dentistry*, vol. 30, p. 201.

8) S. Chow and J. Shao, "WangH. Sample Size calculation in clinical Research," ed: New York: Chapman and Hall/CRC Press, Taylor & Francis, 2003.

9) M. Alikhani, M. Raptis, B. Zoldan, C. Sangsuwon, Y. B. Lee, B. Alyami, *et al.*, "Effect of micro-osteoperforations on the rate of tooth movement," *American Journal of Orthodontics and Dentofacial Orthopedics*, vol. 144, pp. 639-648, 2013.

10) T. Bridges, G. King, and A. Mohammed, "The effect of age on tooth movement and mineral density in the alveolar tissues of the rat," *American Journal of Orthodontics and Dentofacial Orthopedics*, vol. 93, pp. 245-250, 1988.

11) N. Haruyama, K. Igarashi, S. Saeki, M. Otsuka-Isoya, H. Shinoda, and H. Mitani, "Estrous-cycle-dependent variation in orthodontic tooth movement," *Journal of dental research*, vol. 81, pp. 406-410, 2002.

12) R. Usami-Fujita, J. Hosomichi, N. Ono, N. Shibutani, S. Kaneko, Y. Shimizu, *et al.*, "Occlusal hypofunction

causes periodontal atrophy and VEGF/VEGFR inhibition in tooth movement," *The Angle Orthodontist*, vol. 83, pp. 48-56, 2013.

13) M. S. Jean-David, J. Surmenian, and S. Dibart, "Accelerated orthodontic treatments with Piezocision: a mini-invasive alternative to alveolar corticotomies," *Orthodontie Française*, vol. 82, pp. 311-319.

14) V. Vannala, A. Katta, M. S. Reddy, S. R. Shetty, R. M. Shetty, and S. S. Khazi, "Periodontal accelerated osteogenic orthodontics technique for rapid orthodontic tooth movement: a systematic review," *Journal of pharmacy & bioallied sciences*, vol. 11, p. S97, 2019.

15) M. Cassetta, M. Giansanti, A. Di Mambro, S. Calasso, and E. Barbato, "Minimally invasive corticotomy in orthodontics using a three-dimensional printed CAD/CAM surgical guide," *International journal of oral and maxillofacial surgery*, vol. 45, pp. 1059-1064, 2016.

16) J. M. Anholm, "Corticotomy facilitated orthodontics," *Journal of the California dental association.*, 1986.

17) I. Gun and B. Cakirer, "Canine distalization with Piezocision," *Pilot study. Part of PhD thesis, Marmara University, Istanbul*, 2013.

18) P. S. Fleming, Z. Fedorowicz, A. Johal, A. El-Angbawi, and N. Pandis, "Surgical adjunctive procedures for accelerating orthodontic treatment,"

Cochrane database of systematic reviews, 2015.

19) C. Leethanakul, S. Kanokkulchai, S. Pongpanich, N. Leepong, and C. Charoemratrote, "Interseptal bone reduction on the rate of maxillary canine retraction," *The Angle Orthodontist*, vol. 84, pp. 839-845, 2014.

20) R. Bouzeyen, M. Haoues, M.-R. Barbouche, R. Singh, and M. Essafi, "FOXO3 transcription factor regulates IL-10 expression in Mycobacteria-infected macrophages, tuning their polarization and the subsequent adaptive immune response," *Frontiers in immunology*, p. 2922, 2019.

21) H. A. Barsoum, H. S. ElSayed, F. A. El Sharaby, J. M. Palomo, and Y. A. Mostafa, "Comprehensive comparison of canine retraction using NiTi closed coil springs vs elastomeric chains: A split-mouth randomized controlled trial," *The Angle Orthodontist*, vol. 91, pp. 441-448, 2021.

22) N. F. Albelasy and Y. L. Abdelnaby, "Impact of retraction force magnitudes on mobility of maxillary canines: a split-mouth design," *Progress in orthodontics*, vol. 23, pp. 1-6, 2022.

23) S. Baumgaertel, J. M. Palomo, L. Palomo, and M. G. Hans, "Reliability and accuracy of cone-beam computed tomography dental measurements," *American Journal of Orthodontics and Dentofacial Orthopedics*, vol. 136, pp. 19-25, 2009.

24) E. E. H. Hlaing, Y. Ishihara, N. Odagaki, Z. Wang, M. Ikegame, and H. Kamioka, "The expression and regulation of Wnt1 in tooth movement-initiated mechanotransduction," *American Journal of Orthodontics and Dentofacial Orthopedics*, vol. 158, pp. e151-e160, 2020.

25) S. Dibart, C. Yee, J. Surmenian, J. D. Sebaoun, S. Baloul, E. Goguet-Surmenian, *et al.*, "Tissue response during Piezocision-assisted tooth movement: a histological study in rats," *European journal of orthodontics*, vol. 36, pp. 457-464, 2014.

26) N. Al-Sayagh and A. J. Ismael, "Evaluation of space closure rate during canine retraction with nickel titanium closed coil spring and elastomeric chain," *Al-Rafidain Dental Journal*, vol. 11, pp. 146-153, 2011.