European Journal of Molecular & Clinical Medicine, 7(2): 242–250

Research Article

Comparison of Mesial Molar Migration Associated with Different Depths of Micro-Osteoperforation Assisted Canine Retraction

Arya S Prasad[1], Aravind Kumar Subramanian[2*], Remmiya Mary Varghese[3]

Arya S Prasad[1], Aravind Kumar Subramanian[2*], Remmiya Mary Varghese[3]

[1]Postgraduate Student, Bachelor of Dental surgery, Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India
Email: aryasprasad7@gmail.com

[2*]Professor & Head of the Department, Master of Dental Surgery, M Orth RCPS(Glasg), M Orth RCS (Ed), Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India

[3]Senior Lecturer, Master of Dental Surgery, Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India, Email: remmiya@gmail.com

Correspondence:
Aravind Kumar Subramanian
E-mail: aravindkumar@saveetha.com

History:
- Received: Jun 23, 2020
- Accepted: Aug 21, 2020
- Published: Oct 11, 2020

DOI: https://doi.org/10.31838/ejmcm.07.02.39

ABSTRACT

Objectives: Micro-osteoperforation is a minimally invasive procedure to accelerate orthodontic tooth movement. Accelerated orthodontics can sometimes lead to migration of the anchor teeth. The objective of this randomised control study was to compare the amount of mesial molar migration between different depths (3 millimetre and 6 millimetre) of micro-osteoperforation assisted canine retraction.

Methods: Ten adult patients requiring extraction of maxillary first premolar for orthodontic treatment were enrolled for this split mouth study. The micro-osteoperforation of varying depth (3 millimetre and 6 millimetre) were made using a mini implant. Direct anchorage was taken with the help of a mini implant to retract the canine teeth. The patients were divided into two groups - 3 millimetre depth and 6 millimetre depth of micro-osteoperforation. The primary outcome was to compare the mean mesial molar migration between the two groups for three months.

Results: The mean mesial molar migration with 3 millimetre depth of micro osteoperforation was 0.49 ± 0.20 millimetre and with 6 millimetre depth it was 0.39 ± 0.18 millimetre, which was statistically insignificant (P >0.350).

Conclusion: Micro-osteoperforations of different depths do not cause a significant difference in mesial molar migration and are not clinically significant. When it comes to clinical situations even a slight mesial movement of molar can have high significance in the treatment outcome.

Keywords: Micro-osteoperforations, molar mesial migration, canine retraction, mini-implant, MOPs

INTRODUCTION

Longer treatment duration time in orthodontics is undesirable for both the patient and clinician (Moresca, 2018). Usually, an average course of orthodontic treatment with fixed appliances requires less than 2 years to complete (Tsichlaki et al., 2016). So, to accelerate tooth movement, there are various surgical and non-surgical procedures in orthodontics. Surgically assisted accelerated orthodontic procedures produce better results than non-surgical accelerated orthodontics procedures however procedures like corticotomies,distraction are invasive, traumatic, and require skill of clinician as well as increased cost makes them a little less viable option for the patients (Shirude et al., 2018). So, to overcome the shortcomings of corticotomies, non-invasive surgical methods like micro-osteoperforation have come into existence (Clinical Guide to Accelerated Orthodontics - With a Focus on Micro-Osteoperforations | Mani Alikhani | Springer, n.d.; Uribe et al., 2014). Micro-osteoperforation (MOP) is a minimally-invasive option able to accelerate tooth movement and it yields very little or minimal discomfort to the patient (Alikhani et al., 2013; Alkebsi et al., 2018; Chou and Alikhani, 2017; Zamora Escobar and Murillo Samper, 2017).

Controlling anchorage has been one of the challenges when it comes to orthodontics (Kuroda and Tanaka, 2014). Anchorage control is very essential to achieve a desired treatment outcome especially in severe proclination cases where losing anchorage can have detrimental effects on treatment outcome (Zhang et al., 2019). The molars are considered to be the most important teeth when it comes to anchorage during retraction of the anterior teeth and any mesial migration of these anchor teeth can lead to anchorage loss (Teng et al., 2019). With the advent of mini implants the term absolute anchorage has now become possible as it can provide resistance to unwanted tooth movements (Jain et al., 2014; Sivamurthy and Sundari, 2016; Vikram, 2017). Also it has provided a paradigm shift in the envelope of discrepancy in terms of different orthodontic treatment mechanics (Sumathi Felicita, 2018). The mini implants can be used as direct anchorage or indirect anchorage (Cozzani et al., 2016). However a previous study has suggested that indirect mini-implant anchorage provided better sliding mechanics compared to direct anchorage (Zhang et al., 2019). In direct anchorage the force vector is upward and backward as a result it can produce more friction which can have an effect on the posterior anchor teeth as well (Zhang et al., 2019). So this has to be taken into consideration while retracting the anterior teeth.

MOP facilitates faster tooth movement by inducing Regional Acceleratory Phenomenon (RAP). Another clinical advantage of micro-osteoperforation is the ability to titrate the rate of tooth movement by establishing "Biological Anchorage" while accelerating the movement of target teeth (Chou and Alikhani, 2017). Application of micro-osteoperforation on particular locations can selectively decrease the bone density around the target tooth while the bone density around the anchor unit remains unchanged. Since micro-osteoperforation works on the RAP phenomenon its effect on other teeth and anchorage devices also need to be studied.

Previously our team had conducted numerous clinical trials, animal studies, and in-vitro studies (Dinesh et al., 2013; Felicita et al., 2012; Felicita and Sumathi Felicita, 2017a, 2017b, 2018; Jain et al., 2014; Kamisetty et al., 2015; Krishnan and Saravana Pandian, 2015; Kumar et al., 2011; Rubika et al., 2015; Samantha, 2017; Saravana Pandian et al., 2018; Sivamurthy and Sundari, 2016; Vikram et al., 2017; Viswanath et al., 2015). Since there is no literature available about the effect of different depths of micro-osteoperforations on the amount of mesial molar migration during canine retraction, the idea for this randomised control trial was procured from the trending demand for accelerated orthodontics nowadays and its growing interest among the orthodontists. The aim of this split-mouth study was to assess the amount of mesial molar migration associated with different depths (3 millimetre and 6 millimetre) of micro-osteoperforation assisted canine retraction.

MATERIALS AND METHODS

The study design was a split-mouth randomized controlled trial with one observation subsequent to the initial baseline observation. The study procedures and ethical approval were approved by the Scientific Research Board of Saveetha Dental College of Hospitals, Chennai,Tamil Nadu,India. The subjects were selected from the outpatient clinic of the Department of Orthodontics,Saveetha Dental College and Hospitals, Chennai, Tamil Nadu, India. The sample size was calculated from the previous study based on the mesial movement of molar (0.48 ± 0.11), 5% probability of error and 80% statistical power (Kundi et al., 2020). The sample consisted of 10 adult patients (6 females and 4 males) between the age of 18- 35 years requiring therapeutic extraction of the first maxillary premolars. The subjects with missing teeth, periodontally compromised condition, systemic conditions were excluded from the study. Before the start of the treatment informed consent was obtained from all patients.

The numbers of the subjects were kept in opaque sealed envelopes until the commencement of canine retraction. All subjects received a straight wire appliance (McLaughlin Bennett Trevisi prescription 0.022″ slot bracket system, 3M victory series brackets) on their upper and lower arches. After initial leveling and alignment, self-drilling temporary anchorage devices of size 1.4 × 6 millimetre were placed buccally between upper 2nd premolar and first molar bilaterally to be used as direct anchorage. Alginate (Tropicalgin, Zhermack) impressions before micro-osteoperforation (T0) were taken.

After disinfecting the area with betadine, local anaesthesia was administered using 2% Lidocaine with 1:100,000 Epinephrine. Two mini implants (Favanchor, 1.6 millimetre diameter x 8 millimetre length) were added with composite stops to differentiate between different depths and this was used to make the perforations through the gingiva 3 millimetre away from the disto labial aspect of canine (Figure 1) (Figure 2). Three perforations were placed on each side based on the varying depth. The 0.017 X 0.025 stainless steel wire was placed .and canine retraction was commenced immediately after micro-osteoperforation using 9 millimetre nickel-titanium closed-coil springs (3M Unitek; 9 millimetre) connecting the miniscrews between the maxillary second premolar and first molar to the power arm bonded to the maxillary canine tooth around the bracket to the mini implant using direct anchorage (Figure 3). A force of 150 gram was given and it was measured by using a Dontrix gauge (Correx; Dentaurum, Ispringen, Germany) on the day of application to ensure a constant and equal force in all subjects. Post operatively subjects were advised to rinse with chlorhexidine mouthwash twice a day daily. The patients were recalled once every month post the procedure was completed with a follow up period of three months. At each followup period the force levels were measured and the mesial migration of the molar was measured. Alginate impressions were taken at T0 (initial) and T1 (after 3 months of retraction) for superimposition to assess the mesial molar migration.

Outcome assessment

The maxillary stone model (T0 and T1) was scanned using Medit i500 (South Korea) to obtain the. stl format of the digital maxillary model (Figure 4). The digital model taken before Initial stage (T0) was superimposed on to the digital model obtained after three months of retraction(T1) using 3-point superimposition taking three common reference points selected on the third rugae (Ziegler and Ingervall, 1989) (Figure 5). The distance between mesiobuccal cusp tip of the molar of the initial model (T0) to the mesiobuccal cusp of the molar of the final model (T1) is superimposed and measured to obtain the mesial molar migration using 3 shape software (3-Shape Ortho Analyzer) (Figure 6).

STATISTICAL ANALYSIS

The statistical analysis was done using SPSS (version 17) software. The variables were described by the mean, range (minimum–maximum), standard deviation (SD) and 95% confidence interval of the mean values. Independent sample t test was done to compare the amount of anchorage loss between different depths of MOP.

RESULTS

All 10 patients had successfully completed the 3 months duration of the study without any dropouts. The mean anchorage loss of the upper first molars in the 3 millimetre micro-osteoperforation side and 6 millimetre micro-osteoperforation side were 0.49 ± 0.20 millimetre and 0.39 ±

0.18 millimetre respectively (Table 1) (Figure 7). Independent sample t test showed that there was no statistically significant difference in the mean molar mesial migration between 3 millimetre and 6 millimetre depth of micro-osteoperforation (p = 0.350).

Test/ retest reliability

A high degree of reliability was found between the measurements. The average measure intra class correlation coefficient was 0.997 with a 95%confidence interval from 0.994to 0.999 (F (19,19) = 379.57, P<.001) (Table 2) (Figure 8)

DISCUSSION

This study evaluated the amount of molar mesial migration associated with different depths of micro-osteoperforation during individual canine retraction. The mean mesial molar migration with 3 millimetre depth of micro osteoperforation was found to be 0.49 ± 0.20 millimetre and with 6 millimetre depth it was found to be 0.39 ± 0.18 millimetre, which was statistically insignificant (P >0.350). The different depths of micro-osteoperforation did not seem to produce significant molar mesial migration during canine retraction. Frost et al have mentioned the amount of severity of the bone injury and accelerated bone turnover at the surgical site (Frost, 1989). The micro-osteoperforation facilitates tooth movement in a similar way by activating the osteoclasts through regional acceleratory phenomenon thereby decreasing the bone density. So, the various depths of micro-osteoperforation can also have an effect on regional acceleratory phenomenon based on the severity of perforations. The theory behind micro-osteoperforation is explained by the biphasic theory where the activation of osteoblasts by osteoclasts is observed during tooth movement and the bone resorption phase of tooth movement (catabolic phase) is followed by a bone formation phase (anabolic phase) to prevent bone loss during tooth movement. It is said that deeper micro-osteoperforations cause more catabolic activity and shallow micro-osteoperforations cause more anabolic activity (Alikhani, 2017).

The findings from previous studies have shown that anchorage loss or the mesial molar migration with micro-osteoperforation was insignificant (Alkebsi et al., 2018; Alqadasi et al., 2019; Ibrahim, 2015; Kundi et al., 2020). Lee et al., & Sebaoun et al., have reported the systemic and histological evidence supporting the theory that the alveolar responses to corticotomy is localized in the injury site and doesn't extend to further teeth (Lee et al., 2008; Sebaoun et al., 2008). In our study there was no mini implant failure during the time this trial was conducted. Therefore, direct anchorage from mini implants can be safely done along with accelerated orthodontics procedures like micro-osteoperforation.

When retraction is being done the elimination of undesired mesial molar movement is the key issue in preserving the anchorage. Even with the usage of mini implants there can be minor anchorage loss (El-Beialy et al., 2009). The success of mini implants also depends on their primary stability and loading quality and quantity (Ren, 2009). A study comparing conventional and mini implant aided retraction has shown that the mini implant aided retraction had no mesial molar migration seen. However, the superimposition of the results was based on lateral cephalograms which won't give accurate results like digital model superimposition does. In our study we measured the molar mesial migration using digital models and we found there was mesial molar migration despite the use of direct anchorage. Even though the results were statistically insignificant, the molar mesial migration should be taken into consideration whenever faster tooth movement is achieved through accelerated orthodontics. A primary concern in orthodontics is to adequately preserve anchorage by preventing the migration of the anchor teeth. In a study on corticotomy in conjunction with mini-screws it was found that corticotomy can dramatically augment posterior anchorage, which is of prime importance since effective anchorage would greatly improve orthodontic treatment results (Thiruvenkatachari et al., 2006). Accelerating tooth movement by micro-osteoperforation procedure causes potential decrease in the anchorage value of the target teeth, which will be helpful in the cases requiring differential expansion or intrusion (Babanouri et al., 2020).

There are a few limitations in the present study, first was that our study had a short evaluation period and there was no conventional control group. Secondly, the sample size was smaller and also we feel that this study should be more standardised based on various kinds of malocclusion, growth pattern being treated. Since most of the movements take place after micro-osteoperforation during the first three months, the study duration was limited to 3 months. However, a long-term study needs to be performed.

Micro-osteoperforation reduces cortical resistance and increases bone remodeling of the target teeth alone which allow safer and stable retraction of the anterior segment without overloading the posterior segment (Bolat, 2019). Hence, we can infer from our study that varying the depths of micro-osteoperforations does not tax the anchorage and there was no clinically significant molar mesial migration.

CONCLUSION

The mean mesial molar migration was minimal and there was no statistically significant difference between mesial molar migration with different depths of micro-osteoperforations.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

FUNDING

This was a self-funded project.

ACKNOWLEDGMENTS

The authors would like to thank the Department of Orthodontics and Dentofacial Orthopaedics, Saveetha Dental College, Chennai, Tamil Nadu for this project.

SOURCES OF SUPPORT

Equipment support from Saveetha Dental College and Hospitals

REFERENCES

1. Alikhani M (2017) *Clinical Guide to Accelerated Orthodontics: With a Focus on Micro-Osteoperforations*. Springer.
2. Alikhani M, Raptis M, Zoldan B, et al. (2013) Effect of micro-osteoperforations on the rate of tooth movement. *American journal of orthodontics and dentofacial orthopedics: official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics* 144(5): 639–648.
3. Alkebsi A, Al-Maaitah E, Al-Shorman H, et al. (2018) Three-dimensional assessment of the effect of micro-osteoperforations on the rate of tooth movement during canine retraction in adults with Class II malocclusion: A randomized controlled clinical trial. *American journal of orthodontics and dentofacial orthopedics: official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics* 153(6): 771–785.
4. Alqadasi B, Aldhorae K, Halboub E, et al. (2019) The effectiveness of micro-osteoperforations during canine retraction: A three-dimensional randomized clinical trial. *Journal of International Society of Preventive and Community Dentistry* 9(6). Medknow Publications and Media Pvt. Ltd.: 637.
5. Babanouri N, Ajami S and Salehi P (2020) Effect of mini-screw-facilitated micro-osteoperforation on the rate of orthodontic tooth movement: a single-center, split-mouth, randomized, controlled trial. *Progress in orthodontics* 21(1): 7.
6. Bolat E (2019) Micro-Osteoperforations. In: Işık Aslan B and Deniz Uzuner F (eds) *Current Approaches in Orthodontics*. IntechOpen.
7. Chou MY and Alikhani M (2017) A successful story of translational orthodontic research: Micro-osteoperforation-from experiments to clinical practice. *APOS Trends in Orthodontics* 7(1). Wolters Kluwer: 6–11.
8. Clinical Guide to Accelerated Orthodontics - With a Focus on Micro-Osteoperforations | Mani Alikhani | Springer (n.d.). Available at: https://www.springer.com/gp/book/9783319433998 (accessed 22 March 2020).
9. Cozzani M, Fontana M, Maino Giuliano, et al. (2016) Comparison between direct vs indirect anchorage in two miniscrew-supported distalizing devices. *The Angle orthodontist* 86(3). Allen Press: 399–406.
10. Dinesh SPS, Arun AV, Sundari KKS, et al. (2013) An Indigenously Designed Apparatus for Measuring Orthodontic Force. *Journal of clinical and diagnostic research: JCDR* 7(11). JCDR Research & Publications Private Limited: 2623.
11. El-Beialy AR, Abou-El-Ezz AM, Attia KH, et al. (2009) Loss of anchorage of miniscrews: A 3-dimensional assessment. *American journal of orthodontics and dentofacial orthopedics: official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics* 136(5): 700–707.
12. Felicita A, Shanthasundari KK and Chandrasekar S (2012) Determination of craniofacial relation among the subethnic Indian population: A modified approach - (Sagittal relation). *Indian Journal of Dental Research*. DOI: 10.4103/0970-9290.102210.
13. Felicita AS and Sumathi Felicita A (2017a) Orthodontic management of a dilacerated central incisor and partially impacted canine with unilateral extraction – A case report. *The Saudi Dental Journal*. DOI: 10.1016/j.sdentj.2017.04.001.
14. Felicita AS and Sumathi Felicita A (2017b) Quantification of intrusive/retraction force and moment generated during en-masse retraction of maxillary anterior teeth using mini-implants: A conceptual approach. *Dental Press Journal of Orthodontics*. DOI: 10.1590/2177-6709.22.5.047-055.oar.
15. Felicita AS and Sumathi Felicita A (2018) Orthodontic extrusion of Ellis Class VIII fracture of maxillary lateral incisor – The sling shot method. *The Saudi Dental Journal*. DOI: 10.1016/j.sdentj.2018.05.001.
16. Frost HM (1989) The biology of fracture healing. An overview for clinicians. Part I. *Clinical orthopaedics and related research* (248): 283–293.
17. Ibrahim G (2015) Comparison of the Amount of Anchorage Loss of the Molars with and without the Use of Implant Anchorage during Anterior Segment Retraction Combined with Alveolar Corticotomies. *Journal of Dental Health, Oral Disorders & Therapy*. DOI: 10.15406/jdhodt.2015.02.00067.
18. Jain RK, Kumar SP and Manjula WS (2014) Comparison of intrusion effects on maxillary incisors among mini implant anchorage, j-hook headgear and utility arch. *Journal of clinical and diagnostic research: JCDR* 8(7). JCDR Research & Publications Private Limited: ZC21.
19. Kamisetty SK, Verma JK, Arun SS, et al. (2015) SBS vs Inhouse Recycling Methods-An Invitro Evaluation. *Journal of clinical and diagnostic research: JCDR* 9(9). JCDR Research & Publications Private Limited: ZC04.
20. Krishnan S and Saravana Pandian AKS (2015) Effect of bisphosphonates on orthodontic tooth movement—an update. *Journal of clinical and diagnostic research: JCDR* 9(4). JCDR Research & Publications Private Limited: ZE01.
21. Kumar KRR, Ramesh Kumar KR, Shanta Sundari KK, et al. (2011) Depth of resin penetration into enamel with 3 types of enamel conditioning methods: A confocal microscopic study. *American Journal of Orthodontics and Dentofacial Orthopedics*. DOI: 10.1016/j.ajodo.2010.10.022.
22. Kundi I, Alam MK and Shaheed S (2020) Micro-osteo perforation effects as an intervention on canine retraction. *The Saudi Dental Journal* 32(1): 15–20.
23. Kuroda S and Tanaka E (2014) Risks and complications of miniscrew anchorage in clinical orthodontics. *The*

Japanese dental science review 50(4): 79–85.

24. Lee W, Karapetyan G, Moats R, et al. (2008) Corticotomy-/Osteotomy-assisted Tooth Movement microCTs Differ. *Journal of dental research* 87(9). SAGE Publications Inc: 861–867.
25. Moresca R (2018) Orthodontic treatment time: can it be shortened? *Dental press journal of orthodontics* 23(6). Dental Press: 90–105.
26. Ren Y (2009) Mini-implants for direct or indirect orthodontic anchorage. *Evidence-based dentistry* 10(4): 113–113.
27. Rubika J, Sumathi Felicita A and Sivambiga V (2015) Gonial Angle as an Indicator for the Prediction of Growth Pattern. *World Journal of Dentistry*. DOI: 10.5005/jp-journals-10015-1334.
28. Samantha C (2017) Comparative Evaluation of Two Bis-GMA Based Orthodontic Bonding Adhesives - A Randomized Clinical Trial. *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH*. DOI: 10.7860/jcdr/2017/16716.9665.
29. Saravana Pandian K, Krishnan S and Aravind Kumar S (2018) Angular photogrammetric analysis of the soft-tissue facial profile of Indian adults. *Indian journal of dental research: official publication of Indian Society for Dental Research* 29(2). Medknow Publications and Media Pvt. Ltd.: 137.
30. Sebaoun JD, Kantarci A and Turner JW (2008) Modeling of trabecular bone and lamina dura following selective alveolar decortication in rats. *Journal of*. Wiley Online Library. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1902/jop.2008.080024?casa_token=vcj9MwfSaY4AAAAA:HHhthx6pqxC-wsTdeZV4Y4qXgWam7VdzsRrdOHXZhhTjTwxg4Ijy23NBhXJszUpFGx2bVWYeLX8Llyg.
31. Shirude SS, Rahalkar JS, Agarkar S, et al. (2018) Interventions for Accelerating Orthodontic Tooth Movement: A Systematic Review. *Journal of Indian Orthodontic Society*. DOI: 10.4103/jios.jios_72_17.
32. Sivamurthy G and Sundari S (2016) Stress distribution patterns at mini-implant site during retraction and intrusion—a three-dimensional finite element study. *Progress in orthodontics* 17(1): 4.
33. Sumathi Felicita A (2018) Complications of mini-implant anchorage. *International Journal of Orthodontic Rehabilitation* 9(4). Medknow Publications and Media Pvt. Ltd.: 133.
34. Teng F, Du F-Y, Chen H-Z, et al. (2019) Three-dimensional analysis of the physiologic drift of adjacent teeth following maxillary first premolar extractions. *Scientific reports* 9(1): 14549.
35. Thiruvenkatachari B, Pavithranand A, Rajasigamani K, et al. (2006) Comparison and measurement of the amount of anchorage loss of the molars with and without the use of implant anchorage during canine retraction. *American Journal of Orthodontics and Dentofacial Orthopedics*. DOI: 10.1016/j.ajodo.2005.12.014.
36. Tsichlaki A, Chin SY, Pandis N, et al. (2016) How long does treatment with fixed orthodontic appliances last? A systematic review. *American journal of orthodontics and dentofacial orthopedics: official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics* 149(3): 308–318.
37. Uribe F, Padala S, Allareddy V, et al. (2014) Patients', parents', and orthodontists' perceptions of the need for and costs of additional procedures to reduce treatment time. *American journal of orthodontics and dentofacial orthopedics: official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics* 145(4 Suppl): S65–73.
38. Vikram NR (2017) Ball Headed Mini Implant. *Journal of clinical and diagnostic research: JCDR*. DOI: 10.7860/JCDR/2017/24358.9240.
39. Vikram NR, Prabhakar R, Kumar SA, et al. (2017) Ball Headed Mini Implant. *Journal of clinical and diagnostic research: JCDR* 11(1). JCDR Research & Publications Private Limited: ZL02.
40. Viswanath A, Ramamurthy J, Dinesh SPS, et al. (2015) Obstructive sleep apnea: Awakening the hidden truth. *Nigerian journal of clinical practice* 18(1): 1–7.
41. Zamora Escobar Y and Murillo Samper FJ (2017) Micro-osteoperforations for accelerating tooth movement during canine distalization, split-mouth study. Case report. *Revista Mexicana de Ortodoncia* 5(4): e201–e209.
42. Zhang L, Lin Y, Guo R, et al. (2019) Comparison of Direct and Indirect Mini-implant Anchorage in Adults with Maxillary Protrusion: A Randomized Controlled Trial. *Indian journal of pharmaceutical sciences*. OMICS International: 13–20.
43. Ziegler P and Ingervall B (1989) A clinical study of maxillary canine retraction with a retraction spring and with sliding mechanics. *American journal of orthodontics and dentofacial orthopedics: official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics* 95(2): 99–106.

Table 1: Mean distribution and comparison of molar mesial migration. This table represents the mean molar mesial migration between two groups. Independent t test was done to determine the mean mesial migration of the molar between different depths of micro-osteoperforation # P value- >0.05; hence statistically not significant.

Molar Mesial Migration	N	Mean ± Standard deviation	p Value
3 millimetre	10	0.49 ± 0.20	0.350#
6 millimetre	10	0.39 ± 0.18	

Table 2: **Intraclass correlation coefficient. This table represents the reliability test between mean molar mesial migration measurements done at two sessions between two groups. A high degree of reliability was found between the measurements. The average measure intra class correlation coefficient was 0.997 with a 95%confidence interval from 0.994to 0.999 (F (19,19) = 379.57, P<.001)**

	Intraclass Correlationb	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.995[a]	.987	.998	379.578	19	19	.000
Average Measures	.997	.994	.999	379.578	19	19	.000

Figure 1: **Image represents micro-osteoperforation being done using mini implant**

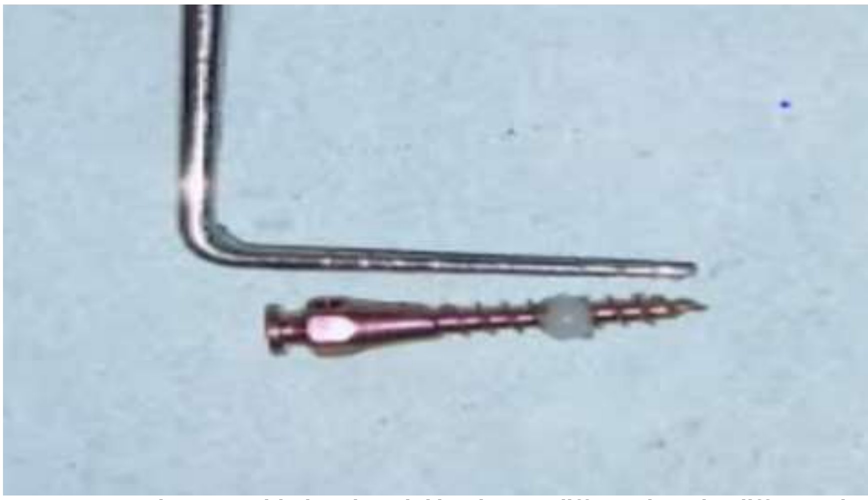

Figure 2: **Composite stop added to the mini implant to differentiate the different depths**

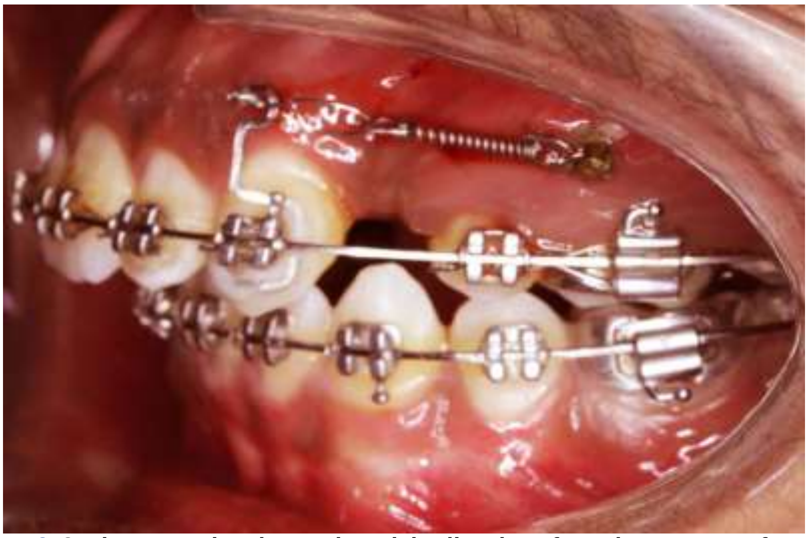

Figure 3: Canine retraction done using NiTi coil spring after micro-osteoperforation

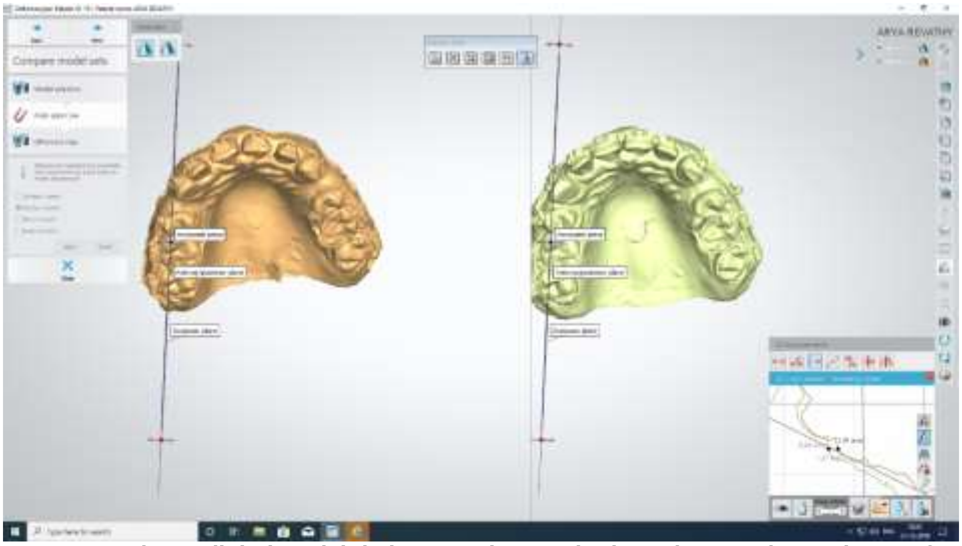

Figure 4: Pre and post digital models being superimposed using 3shape Ortho Analyzer software

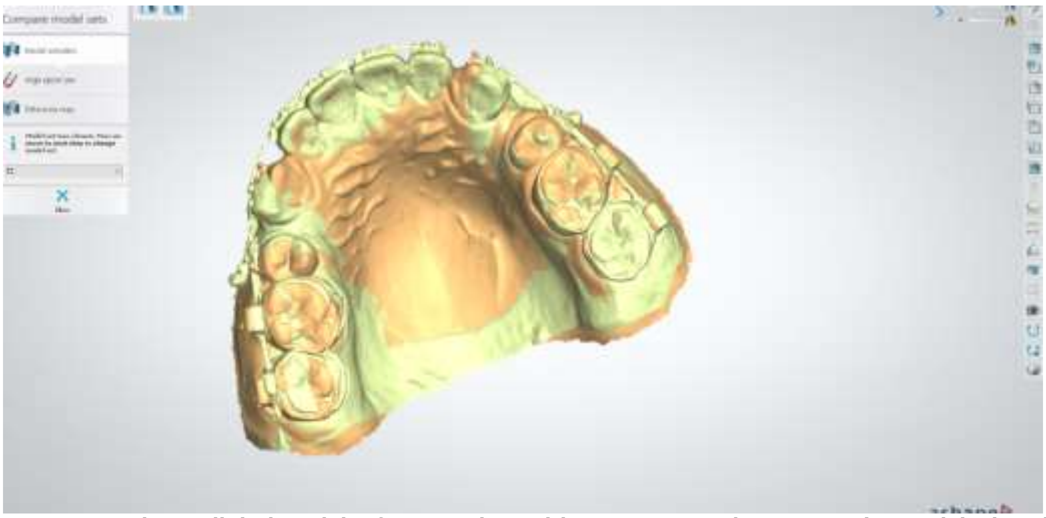

Figure 5: Pre and Post digital models after superimposition to measure the mean molar mesial migration

Figure 6: Measuring mean molar mesial migration from digital model superimposition

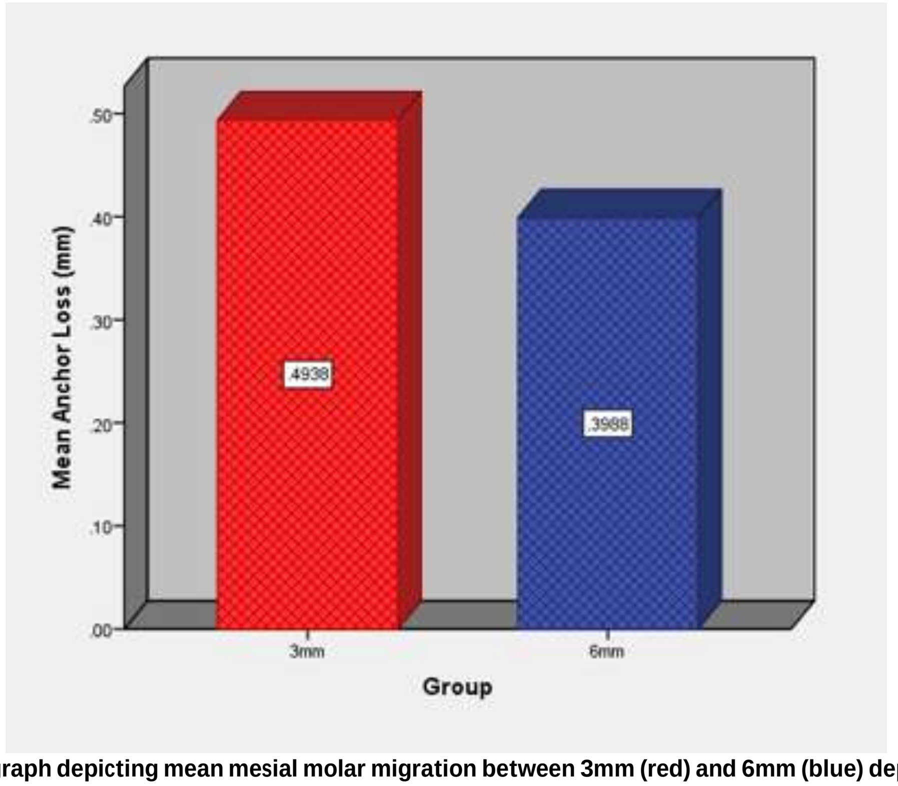

Figure 7: Bar graph depicting mean mesial molar migration between 3mm (red) and 6mm (blue) depths of micro-osteoperforation. X axis depicts the groups 3mm and 6mm depth of micro-osteoperforation and y axis depicts mean anchor loss in millimetre. The mean values of the mesial molar migration are statistically insignificant with p=0.350 (p<0.05 statistically significant). Different depths of micro-osteoperforation does not have a significant effect on mean mesial molar migration.

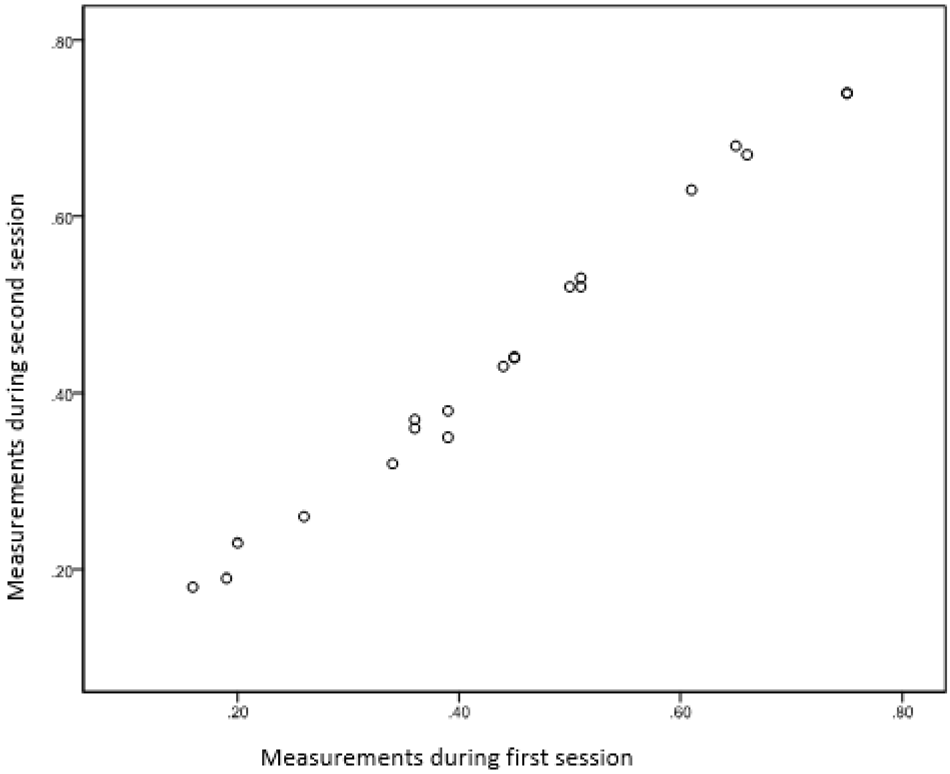

Figure 8: **Scatter plot depicting the molar mesial migration measurements during first session plotted against molar mesial migration measurements during second session showing a positive correlation.**

Cite this article: Aravind Kumar Subramanian. 2020. Comparison of Mesial Molar Migration Associated with Different Depths of Micro-Osteoperforation Assisted Canine Retraction. European Journal of Molecular & Clinical Medicine, 7(2), pp. 242 – 250, DOI: https://doi.org/10.31838/ejmcm.07.02.39