Original Article

Evaluation of the periodontal status of uprighted mandibular second molars using microscrews placed in the retromolar area: A comparison of two surgical techniques

Shailesh Deshmukh[1,2,3,4], **Rajesh Kshirsagar**[5]

[1]Diplomate Indian Board of Orthodontics, [2]Professor, Department of Orthodontics and Dentofacial Orthopedics, Bharati Vidyapeeth Deemed University Dental College and Hospital, [3]Consultant, Deenanath Mangeshkar Hospital, [4]Director, Dashabhuja CBCT Centre, [5]Department of Oral and Maxillofacial Surgery, Bharati Vidyapeeth Deemed University, Dental College and Hospital, Pune, Maharashtra, India

Abstract

Objective: Permanent mandibular second molar impaction can lead to dental problems including periodontal pockets. In this study, uprighting of impacted mandibular second molars was carried out. Two surgical techniques were compared for time taken to upright the impacted mandibular second molar and if any periodontal pocket was formed on the distal aspect of the uprighted molar due to the surgical removal of bone distal to the impacted second molar after uprighting. **Materials and Methods:** A total of 20 subjects with impacted mandibular second molars were chosen from our orthodontic practice for this study. All the second molars were mesio-angularly impacted and unerupted. The subjects were divided into two groups. Group I comprised ten subjects with the cementoenamel junction (CEJ) of the unerupted impacted second molar apical to the level of the alveolar ridge. Group II comprised ten subjects with the CEJ of the unerupted impacted second molars at or coronal to the level of the alveolar ridge. 1.8 mm diameter and 10 mm length self-drilling microscrews (3M Unitek temporary anchorage devices) were placed into the retromolar area distal to the impacted second molars. Groups II and I underwent surgical exposure of the impacted second molars and placement of 10 mm length microscrews. In Group I subjects, bone was removed from the entire distal aspect (furrowing) of the impacted second molar. Group II subjects did not undergo any removal of bone on the distal aspect of the impacted second molars. One button each was bonded on the buccal and lingual surfaces of the surgically exposed second molars. Elastomeric chains were attached from the microscrew head to the buccal and lingual buttons so as to bodily upright the molar. After complete uprighting, a single examiner (periodontist) who was blinded to the type of surgical technique evaluated the periodontal status of the second molar by clinical probing of the sulcus depth (SD). The comparison of the significance of the difference of average duration and average SD between the two study groups was tested using Mann–Whitney U-test (a nonparametric test). The value of $P < 0.05$ is considered to be statistically significant. **Results:** Average duration of uprighting was significantly longer in Group II compared to Group I ($P < 0.001$). SD on an average is significantly deeper in Group I (furrowing) as compared to Group II (no furrowing) at distal surfaces

Access this article online	
Quick Response Code:	Website: www.apospublications.com
	DOI: 10.4103/apos.apos_15_17

Address for Correspondence:
Dr. Shailesh Deshmukh,
Devikripa, Shri Dashabhuja Ganesh Coop. Hous. Soc., Karve Road, Paud Phata, Pune - 411 038. Maharashtra, India.
E-mail: deshmukhorthodontic@gmail.com

How to cite this article: Deshmukh S, Kshirsagar R. Evaluation of the periodontal status of uprighted mandibular second molars using microscrews placed in the retromolar area: A comparison of two surgical techniques. APOS Trends Orthod 2017;7:80-6.

($P < 0.001$ for all distal sites). Average SD did not differ significantly between Groups II and I at mesial surfaces ($P > 0.05$ for all mesial sites). **Conclusion:** In Group I subjects, uprighting was hastened in comparison to Group II subjects where the CEJ was at or coronal to the alveolar bone. The furrowing of the bone does cause a deepening of the SD on the distal surface of the second molar, but this is not clinically significant. This deepening cannot be termed as a periodontal pocket as it is well within normal limits.

Key words: Furrowing, mandibular impacted second molars, microscrews, periodontal pocket, sulcus depth, uprighting

INTRODUCTION

The famous scholar Archimedes (287–212 BC) was once quoted as saying, "Give me a lever and I will move the world." Humankind has been aware of the need of anchorage and establishing equilibrium in all walks of life since prehistoric times. With the advent of temporary anchorage devices (TADs) in mainstream orthodontic treatment, the need for preparing anchorage for orthodontic tooth movement drastically reduced. Tooth movements that were hitherto not possible with conventional orthodontic mechanics suddenly came into the realm of the routine. Orthodontic practitioners certainly face plenty of clinical challenges on a day-to-day basis. Permanent mandibular second molar impaction can lead to dental problems including periodontal pockets. Incidence is 0.6/1000–3/1000 - (0.05%–1%).[1,2] One of the most challenging of these is the correction of impacted mandibular second molars [Figure 1]. Clinicians have approached this challenge innovatively and successfully[2-7] but correction of impacted lower second molars is a time-consuming process. Development of microscrews led to the uprighting of impacted mandibular second molars becoming more predictable [Figure 2].[8-14] Microscews are TADs that are temporarily fixed to bone for the purpose of enhancing orthodontic anchorage either by supporting the teeth of the reactive segment or by eliminating the need for the reactive segment altogether, and which are subsequently removed after use.

Comparison of two surgical techniques was carried out to evaluate the time taken to upright the impacted mandibular second molar and to observe if any periodontal pocket was formed on the distal aspect of the uprighted molar.

This study was conducted to answer two questions:

1. Does the creation of a "furrow" (surgical removal of bone-ditching) on the distal aspect of the impacted mandibular second molar hasten the uprighting process?
2. What is the impact on the periodontium surrounding the uprighted second molar when "furrowing" is carried out on the distal surface of the impacted second molar?

MATERIALS AND METHODS

Twenty subjects with impacted mandibular second molars (aged 12–18 years) were selected from our orthodontic practice for this study. Informed consent was obtained from all subjects. Cases were selected based on the following criteria:

- Absence of third molars. Third molars, if present, were extracted in all cases
- All the second molars were mesio-angularly impacted and unerupted
- The angle of inclination between the impacted mandibular second molar and the mandibular first molar was not considered.

The twenty subjects were divided into groups I and II. Group I comprised ten subjects with the cementoenamel junction (CEJ) of the unerupted impacted second molar apical to the level of the alveolar ridge [Figure 3].

Group II comprised ten subjects with the CEJ of the unerupted impacted second molars at or coronal to the level of the alveolar ridge [Figure 4]. 1.8 mm diameter and 10 mm length self-drilling microscrews (3M Unitek TADs)

Figure 1: Impacted 17 and 47

Figure 2: Uprighted 47 seen along with the retromolar microscrew

were placed into the retromolar area distal to the impacted second molars [Figure 5]. In cases where third molars were extracted, the minimum wait period till the microscrew was placed was 3 months. In cases where the soft tissue thickness was more, an "O" cap over the microscrew head (3M Unitek) was placed, to prevent soft tissue coverage of the microscrew head during uprighting of the impacted second molar. Groups II and I underwent surgical exposure of the impacted second molars and placement of 10 mm length microscrew in the retromolar area. The incision was made on the distal aspect of the first molar. Full thickness mucoperiosteal flap was raised to expose the crown of the impacted mandibular second molar. In the 10 Group I subjects, bone was removed from the entire distal aspect of the impacted second molars.

Bone removal was in the form of a "furrow" (ditch) 2 mm wide upto the CEJ (average depth was 2 mm) [Figure 6a]. The 10 Group II subjects did not undergo any removal of the bone on the distal aspect of the impacted second molars [Figure 6b].

The procedure of creating a furrow involved removal of bone from the distal aspect of the impacted mandibular second molar upto the level of the CEJ without damage to the buccal and lingual cortical plates. Creation of the furrow was initiated using an HP 8 round bur (SS White) to determine the buccolingual extent of the furrow and subsequently, the SW 702 straight fissure (SS White) bur was used to complete the ostectomy [Figure 7].

Figure 3: Cementoenamel junction of impacted 47 apical to the level of the alveolar ridge

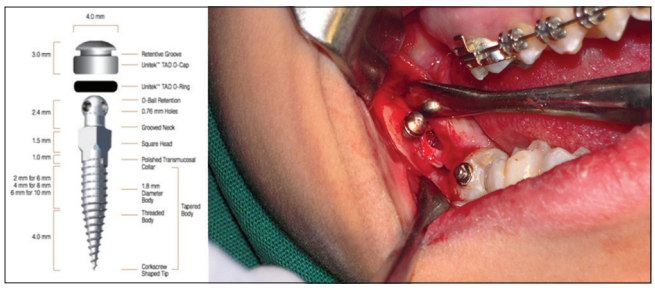


Figure 5: 3M Unitek microscrew placed in retromolar area

One button each was bonded on the buccal and lingual surfaces of the surgically exposed second molars. Elastomeric chains were attached from the microscrew head to the buccal and lingual buttons so as to bodily upright the molar [Figure 8]. Force level was maintained at 150 g on each side (buccal and lingual). Reactivation of the force was performed every 2 weeks. Uprighting of the second molar was observed clinically at intervals of 2, 4-12, 14 and 16 weeks. Gingival sulcus is "V" shaped and barely permits the entrance of periodontal probe [Figure 9]. Clinically, the sulcus is 1–2 mm deep (maximum 3 mm). Histologically, it is generally 1.8 mm deep. The factors considered while probing sulcus depth (SD) were shape and size of the probe tip, force with which introduced, direction of penetration, resistance of tissues, degree of tissue inflammation, and convexity of crown. The probing technique used was as follows: The probe was inserted along long axis of tooth and parallel to vertical axis of tooth. The probe was "walked" circumferentially around the tooth to detect areas of deepest penetration [Figure 10]. The SD was probed with a University of North Carolina probe. After complete uprighting, a single examiner (periodontist) who was blinded to the type of surgical technique used on the twenty subjects evaluated the periodontal status of the second molar by clinical probing of the SD. The probing was carried out for a minimum of three times on each uprighted second molar by the blinded examiner. This validated the relatively subjective SD measurement at the level of the individual patient. The blinded examiner recorded the SD at the distobuccal line angle, the distal surface and the distolingual line angle. The depth was also measured at the mesiobuccal line angle, the mesial surface and the mesiolingual line angle. The SD was recorded

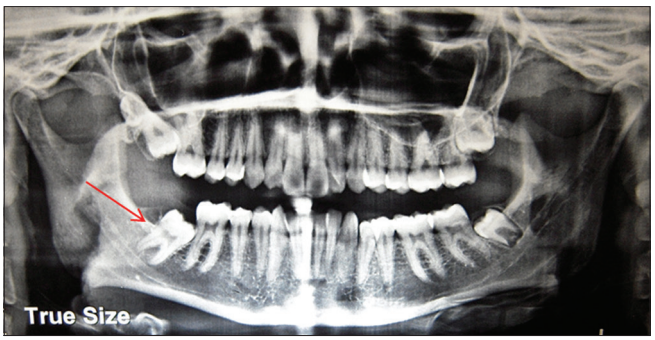


Figure 4: Cementoenamel junction of impacted 47 coronal to the level of the alveolar ridge

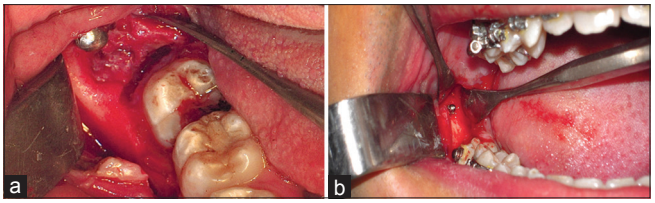


Figure 6: (a) Furrow (removal of bone). (b) No removal of bone

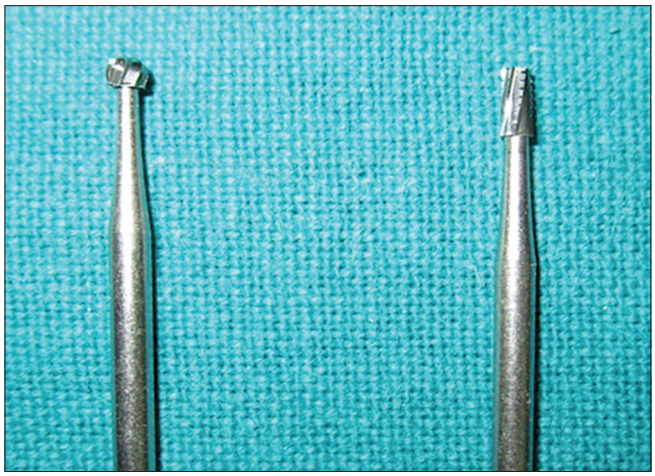


Figure 7: HP 8 round bur and SW 702 straight fissure (SS white)

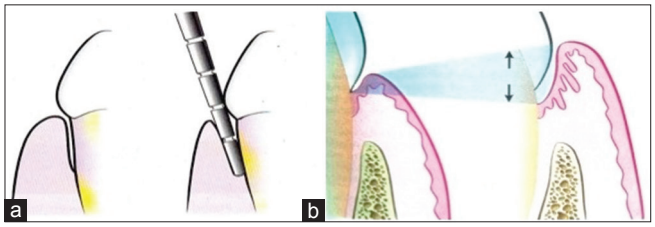


Figure 9: Gingival sulcus - Clinical and histologic. (a) Clinical pocket depth measurement. (b) Histologic pocket depth

8 weeks after uprighting of the molar. Data analysis was carried out by tabulating and comparing the time taken for uprighting the second molar in Group I (where furrowing of the bone was carried out) and Group II (where no furrowing of the bone was carried out). The SDs measured at six different sites on the uprighted second molars were tabulated and compared between Groups II and I. Comparison of SD between individual distal and mesial surface sites between the two groups was also carried out.

Values on the duration of uprighting and SD have been shown as mean ± standard deviation across the two study groups. The comparison of significance of the difference of average duration and average SD between the two study groups was tested using Mann–Whitney U-test (a nonparametric test). $P < 0.05$ is considered to be statistically significant. The entire statistical analysis was performed using Statistical Package for Social Sciences (version 11.5, IBM Corporation, Armonk, New York, USA) for MS Windows.

RESULTS

The mean average duration of uprighting of the impacted second molar in Group I was 4.8 ± 0.9 weeks and in Group II was 9.5 ± 2.1 weeks. The average duration of uprighting was significantly longer in Group II as compared to Group I ($P < 0.001$). The mean SD on an average on the

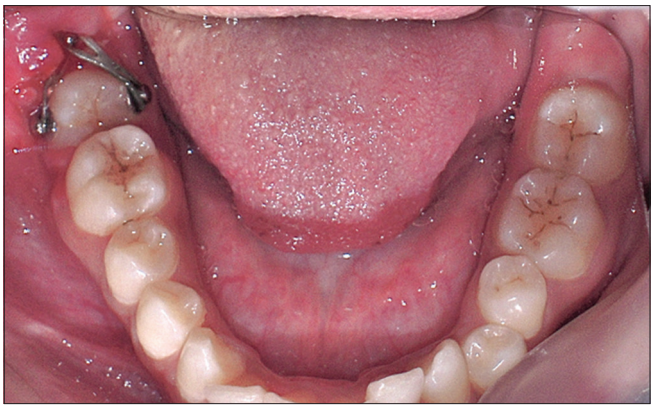


Figure 8: Elastomeric chains from the lingual buttons to the microscrew

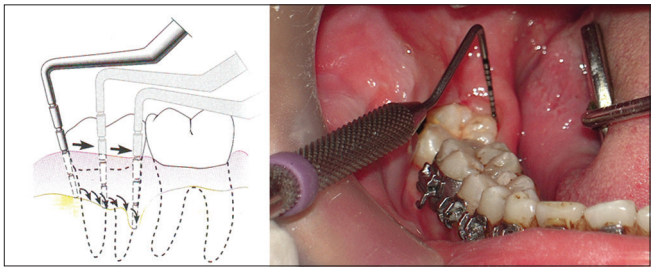


Figure 10: Walking of the probe

distal surface was 2.4 ± 0.1 mm in Group I and 1.3 ± 0.1 mm in Group II. On the mesial surface the SD was recorded as 1.3 ± 0.2 mm in Group I and 1.1 ± 0.2 mm in Group II. SD was significantly deeper in Group I (furrowing) as compared to Group II (no furrowing) at distal surfaces ($P < 0.001$ for all distal sites). Average SD did not differ significantly between Groups II and I at mesial surfaces ($P > 0.05$ for all mesial sites) [Table 1].

The graph below depicts the comparison of duration of uprighting between the two groups [Graph 1].

Table 2 depicts the comparison of SD between individual distal and mesial surface sites in Group I and II.

The graph below depicts the comparison of SD between the two groups on the distal and mesial surface sites [Graph 2].

Comparison of SD was also carried out between individual distal and mesial surface sites in Group I and II that is depicted in the graph below [Graph 3].

DISCUSSION

Uprighting of mandibular impacted second molars is a challenge for every orthodontist.[15] All conventional orthodontic mechanics are successful in uprighting these molars but the treatment takes time and also complicated biomechanics is involved.[3,16-18] With microscrews, the

Table 1: Comparison of duration of Uprighting and Depth of Sulcus between Group I and II

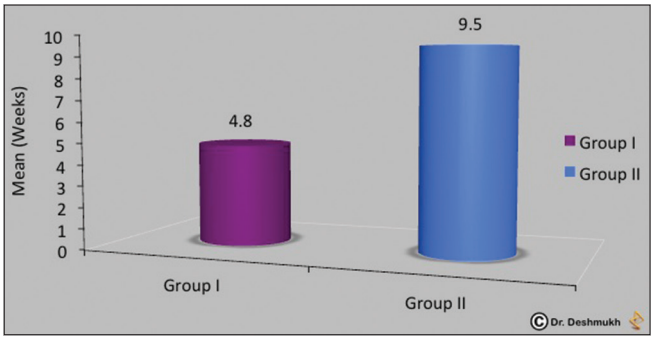
Parameters	Group I (*n*=10) furrowing	Group II (*n*=10) no furrowing	*P*
Duration of uprighting (weeks)	4.8±0.9	9.5±2.1	0.001 (Significant)
SD (mm)			
Distal surface	2.4±0.1	1.3±0.1	0.001 (Significant)
Mesial surface	1.3±0.2	1.1±0.2	0.247 (Non-Significant)

Values are mean±standard deviation. *P* values are obtained using Mann-Whitney U test. *P*<0.05 is considered to be statistically significant. SD at Distal surface includes SD at distobuccal, distal and distolingual sites. SD at Mesial surface includes SD at mesiobuccal, mesial and mesiolingual sites, SD – Sulcus depth

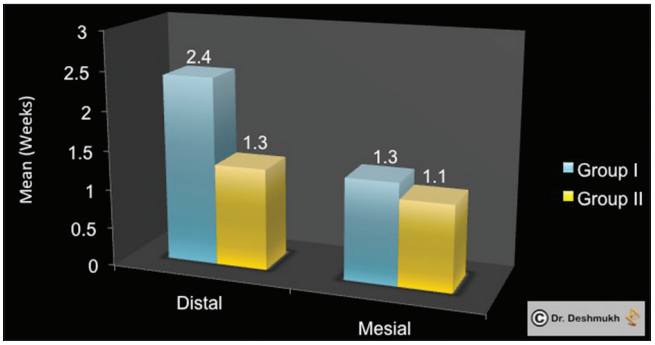
Table 2: Comparison of "SD" between individual distal and mesial surface sites in Group I and II

Parameters	Group I (*n*=10)	Group II (*n*=10)	*P*
SD (mm)			
Distobuccal site	2.4±0.2	1.3±0.3	0.001 (Significant)
Distal site	2.5±0.4	1.5±0.4	0.001 (Significant)
Distolingual site	2.4±0.3	1.2±0.4	0.001 (Significant)
Mesiobuccal site	1.2±0.3	1.1±0.2	0.481 (Non-Significant)
Mesial site	1.3±0.3	1.1±0.2	0.436 (Non-Significant)
Mesiolingual site	1.3±0.3	1.1±0.2	0.280 (Non-Significant)

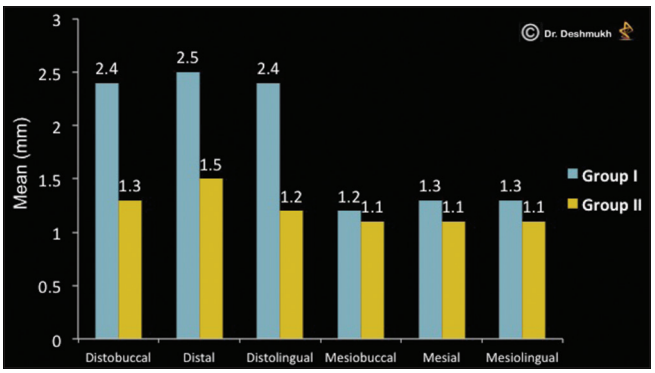
Values are mean±standard deviation. *P* values are obtained using Mann-Whitney U-test. *P*<0.05 is considered to be statistically significant. SD – Sulcus depth



Graph 1: Comparison of duration of uprighting



Graph 2: Comparison of sulcus depth



Graph 3: Comparison of SD between individual mesial & distal surface sites in Groups I & II

correction of the impacted molars has become more predictable.[8-14] However even with the use of microscrews, the uprighting of the impacted molars takes time and effort.[19] This region is relatively horizontal with good bone.[20] If a microscrew is placed in the external oblique ridge, however, the cheek usually folds over the head of the microscrew implant and becomes traumatized by the upper buccal cusps in maximum intercuspation or lateral excursive movements. Placing the microscrew in the retromolar area is preferred since the area is horizontal with relatively good bone and also the microscrew can be centered buccolingually and forces can be attached from the microscrew to both the buccal and lingual of the teeth so that the teeth feel a pure posterior force. If desired, the force can be attached only to the buccal or lingual of the teeth, which would provide great control if narrowing or expansion were desirable, respectively. Rotation control is also possible with this location.[21]

In this study, the authors used an innovative surgical technique to enhance and hasten the uprighting of the mandibular second molars. The chief resistance to uprighting the impacted second molar is the thick bone present distal to the impacted molar. The location of the second molar dictates the time taken for uprighting. Many a times, the CEJ of the unerupted impacted second molar is apical to the level of the alveolar ridge. In such cases, the uprighting of the molar is predicted to be difficult and time-consuming because of the thick mandibular bone. However in cases where the CEJ of the unerupted impacted second molars is at, or coronal to the level of the alveolar ridge, the uprighting is supposed to be comparatively easier and faster. This study was designed to compare two surgical techniques used to upright the impacted second molars with the help of microscrews. Twenty subjects were selected to take part in this study. Informed consent was procured from the subjects and the

procedure was explained to them in detail. The subjects were divided into groups I and II comprising 10 subjects each. In Group I the CEJ of the unerupted impacted second molar was apical to the level of the alveolar ridge whereas in Group II the CEJ was at or coronal to the level of the alveolar ridge. In cases where third molars were extracted, the minimum wait period till the microscrew was placed was 3 months. Both the groups underwent surgical exposure of the impacted second molars and placement of 1.8 mm diameter and 10 mm length microscrews in the retromolar area. The incision was made on the distal aspect of the first molar to raise a full thickness mucoperiosteal flap to expose the crown of the impacted mandibular second molar. In Group I bone was removed from the entire distal aspect of the impacted second molars in the form of a furrow (ditch) 2 mm wide upto the CEJ (average depth was 2 mm) without damage to the buccal and lingual cortical plates [Figure 6a]. The objective of creating a furrow on the distal aspect of the impacted tooth was to facilitate the early and rapid movement or prevent delayed movement due to osseous (bony) obstacle following application of orthodontic force. In Group II the subjects did not undergo any removal of the bone [Figure 6b].

One button each was bonded on the buccal and lingual surfaces of the surgically exposed second molars. Force was applied from the microscrew head to the buccal and lingual buttons so as to bodily upright the molar [Figure 8]. Force level was maintained at 150 g on each side (buccal and lingual). Reactivation of the force was done every 2 weeks. The authors felt that removing bone in such a manner may leave the distal surface of the uprighted molars vulnerable to the formation of a periodontal pocket. Hence, it was decided to study the SD on the distal surface of the uprighted molars. After complete uprighting, a single examiner (periodontist) who was blinded to the type of surgical technique used on the twenty subjects evaluated the periodontal status of the second molar by clinical probing of the SD. In both the groups, uprighting was carried out effectively and efficiently. Group I where furrowing of bone was carried out on the distal aspect of the impacted second molar showed predictably faster uprighting. Uprighting period of impacted lower second molars in Group I subjects was 4.8 ± 0.9 weeks and in Group II was 9.5 ± 2.1 weeks on an average [Figure 11]. Although the SD was found to be deeper on the distal aspect of these molars, this deepening cannot be termed as a periodontal pocket as it is well within normal limits of 2–3 mm [Figure 12]. We followed the uprighting and measured the SD upto 16 weeks. The findings of this study would have had more bearings if the SDs were measured over a longer period to evaluate for periodontal pocket formation. Bilateral impacted mandibular second molars also took about the same time to upright [Figure 13].

CONCLUSIONS

1. Use of microscrews in the mandibular retromolar area to upright the mesio-angularly impacted second molar is an effective and predictable method
2. Uprighting period of impacted lower second molars in Group I subjects was 4.8 ± 0.9 weeks and in Group II was 9.5 ± 2.1 weeks on an average
3. Although the CEJ of the impacted tooth in Group I subjects was apical to the alveolar bone, uprighting was hastened in comparison to Group II subjects where the CEJ was at or coronal to the alveolar bone
4. This was most likely due to the furrowing of the bone at the distal aspect in Group I subjects
5. The distal surface of the uprighted second molar in Group I patients on an average showed a significant increase in SD compared to subjects in

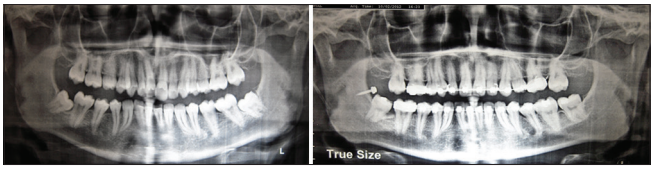


Figure 11: Uprighted 47

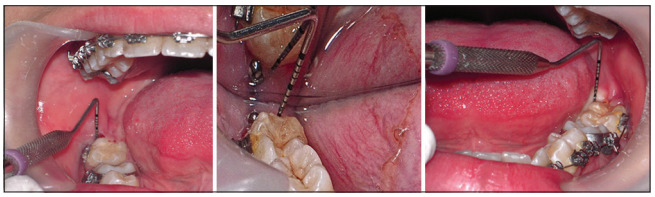


Figure 12: Measurement of sulcus depth

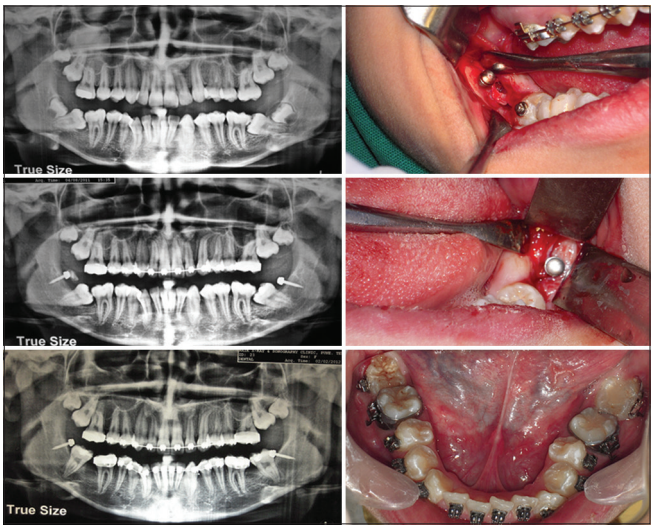


Figure 13: Uprighting of bilaterally impacted 37 and 47

Group II ($P < 0.001$ for all distal sites)

6. Furrowing of the bone did cause a deepening of the SD on the distal surface of the second molar, but this is not clinically significant as the SD in Group I subjects on an average was 2–3 mm which is within normal limits and hence cannot be termed as a periodontal pocket
7. Advantages of this technique were minimal anatomic limitations, minor surgical insertion, increased patient comfort, immediate loading, reduced treatment time and no immediate periodontal implications
8. It is recommended to follow Group I subjects in this study for any subsequent increase in distal SD of the uprighted second molars as the subjects grow older and the periodontium fully matures.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Ferrazzini G. Uprighting of a deeply impacted mandibular second molar. Am J Orthod Dentofacial Orthop 1989;96:168-71.
2. Pogrel MA. The surgical uprighting of mandibular second molars. Am J Orthod Dentofacial Orthop 1995;108:180-3.
3. Kogod M, Kogod HS. Molar uprighting with the piggyback buccal sectional arch wire technique. Am J Orthod Dentofacial Orthop 1991;99:276-80.
4. Davis WH, Patakas BM, Kaminishi RM, Parsch NE. Surgically uprighting and grafting mandibular second molars. Am J Orthod 1976;69:555-61.
5. Gazit E, Lieberman M. A mesially impacted mandibular second molar. Treatment considerations and outcome: A case report. Am J Orthod Dentofacial Orthop 1993;103:374-6.
6. Miyahira YI, Maltagliati LA, Siqueira DF, Romano R. Miniplates as skeletal anchorage for treating mandibular second molar impactions. Am J Orthod Dentofacial Orthop 2008;134:145-8.
7. Lau CK, Whang CZ, Bister D. Orthodontic uprighting of severely impacted mandibular second molars. Am J Orthod Dentofacial Orthop 2013;143:116-24.
8. Giancotti A, Arcuri C, Barlattani A. Treatment of ectopic mandibular second molar with titanium miniscrews. Am J Orthod Dentofacial Orthop 2004;126:113-7.
9. Melo AC, Duarte da Silva R, Shimizu RH, Campos D, Andrighetto AR. Lower molar uprighting with miniscrew anchorage: Direct and indirect anchorage. Int J Orthod Milwaukee 2013;24:9-14.
10. Nienkemper M, Pauls A, Ludwig B, Wilmes B, Drescher D. Preprosthetic molar uprighting using skeletal anchorage. J Clin Orthod 2013;47:433-7.
11. Mao LX, Fang B, Shen GF, Xia YH, Yuan LJ. Clinical study of ramus implant anchorage for mandibular arch distalization. Shanghai Kou Qiang Yi Xue 2011;20:500-5.
12. Roberts WE, Marshall KJ, Mozsary PG. Rigid endosseous implant utilized as anchorage to protract molars and close an atrophic extraction site. Angle Orthod 1990;60:135-52.
13. Roberts WE, Nelson CL, Goodacre CJ. Rigid implant anchorage to close a mandibular first molar extraction site. J Clin Orthod 1994;28:693-704.
14. Lee KJ, Park YC, Hwang WS, Seong EH. Uprighting mandibular second molars with direct miniscrew anchorage. J Clin Orthod 2007;41:627-35.
15. Papadopoulos MA, Papageorgiou SN, Zogakis IP. Clinical effectiveness of orthodontic miniscrew implants: A meta-analysis. J Dent Res 2011;90:969-76.
16. Park HS, Kyung HM, Sung JH. A simple method of molar uprighting with micro-implant anchorage. J Clin Orthod 2002;36:592-6.
17. Holberg C, Winterhalder P, Holberg N, Wichelhaus A, Rudzki-Janson I. Indirect miniscrew anchorage: Biomechanical loading of the dental anchorage during mandibular molar protraction-an FEM analysis. J Orofac Orthop 2014;75:16-24.
18. Mah SJ, Won PJ, Nam JH, Kim EC, Kang YG. Uprighting mesially impacted mandibular molars with 2 miniscrews. Am J Orthod Dentofacial Orthop 2015;148:849-61.
19. Roberts WE, Arbuckle GR, Analoui M. Rate of mesial translation of mandibular molars using implant-anchored mechanics. Angle Orthod 1996;66:331-8.
20. Roberts WE, Helm FR, Marshall KJ, Gongloff RK. Rigid endosseous implants for orthodontic and orthopedic anchorage. Angle Orthod 1989;59:247-56.
21. Cope J. An interview with Jason Cope. Dent Press J Orthod 2011;16:36-46.