Journal of Surgery and Trauma. 2026; 14(3):163-9. https://jsurgery.bums.ac.ir

Original Article

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Effects of Semi-impacted Mandibular Third Molar Surgery on Alveolar Bone Level around the Second Molar Teeth: A Pilot Study

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Received: 31 October 2025
Revised: 14 April 2026
Accepted: 6 June 2026

Citation: Ataei A, Azizi M, Shirzadeh A, Azizi M, Mirmehrabi F, Sharifzadeh Gh. Effects of Semi-impacted Mandibular Third Molar Surgery on Al-veolar Bone Level around the Second Molar Teeth: A Pilot Study. J Surg Trauma. 2026;14(3):163-9. DOI:10.61882/jsurgtrauma.14.3.163

Abstract

Introduction: In most cases, dental injuries caused by surgical extraction of an impacted third molar are underestimated. The present study aimed to investigate changes in the periodontal pocket depth and the cementum-enamel junction to the alveolar bone crest (CEJ-ABC) in the adjacent mesial and distal second molars before, three, and six months after semi-impacted third molar surgery without the use of Fresage.

Methods: This pilot study was conducted on patients with semi-impacted third molar, who were referred to the Dental Clinic of Birjand Faculty of Dentistry, Birjand, Iran. The periapical photographs of each patient were used to measure the periodontal pocket depth and CEJ-ABC before, three, and six months after the surgery (pushing aside the soft tissue flap from the mesial of the second molar to the distal of the third molar by the sulcular method and removing the semi-impacted molar tooth without a handpiece bone removal). All data were analyzed using SPSS software (version 19, Chicago, IL, USA) and Friedman test.

Results: A total of 12 patients were included in this study. In terms of gender, 3(25%) and 9(75%) cases were male and female, respectively. The Mean±SD age of the patients was 28.6±11.16 years. Based on the statistical analysis, no statistically significant difference was observed between the mean CEJ-ABC of the mesial second molar tooth (P>0.05) and the distal second molar tooth (P>0.05) before and after the surgery. Nonetheless, a statistically significant difference was observed in the mean distal periodontal pocket depth index of the second molar tooth before and after the surgery (P<0.05).

Conclusion: As evidenced by the obtained results, it can be concluded that surgery on the semi-impacted mandibular molar tooth may improve the periodontal health (pocket depth) of the adjacent second molar tooth. Comparative studies with larger sample sizes, broader age ranges, and longer follow-up periods are essential to confirm the results of the present study.

Key words: Alveolar Bone Loss, Impacted Tooth, Mandible, Third Molar, Tooth Extraction

Introduction

Impacted tooth surgery is among the most common outpatient surgeries performed in dental treatment centers (1). The presence of the third molar reduces the amount of bone distal to the adjacent second molar and, sometimes, in addition

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[DOI: 10.61882/jsurgtrauma.14.3.163]

to causing periodontal problems, exerts pressure on the root of the adjacent molar, leading to root erosion. In addition, impacted third molars may lead to pericoronitis, dental caries, orofacial infections, orthodontic problems, cystic and neoplastic changes, tooth resorption, periodontitis, and even problems with the temporomandibular joint, particularly when adjacent teeth are similarly affected (2). According to previous studies, completely erupted second molars adjacent to the impacted third molars are more likely to develop periodontitis (3-5). According to another study, gingival plaque increases in the posterior areas of the arch due to the presence of an impacted third molar in the hemi arch (6). When plaque accumulates in the distal root of the second molar, it can cause periodontal disease and apical migration of the periodontal ligament (7). It is also important to note that some symptoms associated with these diseases can adversely affect the patient's quality of life. Numerous complications can arise from impacted teeth; therefore, surgical removal is recommended (8).

As illustrated by previous studies, third molar surgery can prevent chronic and new periodontal defects (9-11). Some physicians also believe that the removal of the third molar causes periodontal problems. For this purpose, some researchers have investigated the risk factors related to postoperative complications in latent third molar teeth. According to these studies, the site of third molar tooth surgery heals more slowly in older adults (6). The complexity of surgery is another factor that leads to delayed healing of the surgical site and affects the periodontal health of adjacent molar teeth (12). Due to the increased amount of plaque accumulation in the area of the partially impacted third molar and the presence of the operculum on these teeth, it is more difficult to clean this area; therefore, the possibility of losing the connections of periodontal fibers in the distal areas of the second molar raises, increasing the infrabony lesions in these teeth (13). The periodontal status following impacted third molar surgery presents considerable challenges. The third molar surgery can be performed to create or remove the periodontal pockets. As third molar surgery is the most common procedure in dentistry, this potential effect should be taken into account when removing third molars (14). In light of the aforementioned issues, the present study aimed to investigate the changes in the periodontal pocket depth and the cementum-enamel junction to the alveolar bone crest (CEJ-ABC) in the adjacent mesial and distal second molars before, three months, and six months after semi-impacted third molar surgery without the use of Fresage.

Methods

Study design

This before-and-after pilot study was conducted on 12 patients with semi-impacted third molar, who were referred to the Dental Clinic of Birjand Faculty of Dentistry, Birjand, Iran, from March to May 2019.

Participants

The patients included in the present study were those with semi-impacted third molars, who had been referred to the Dental Clinic of Birjand Faculty of Dentistry, Birjand, Iran. The inclusion criteria entailed no history of systemic diseases, no active periodontitis in the surgery area, no flap surgery (periodontal pocket removal) in the surgery area, semi-impacted wisdom teeth that did not require Fresage for extraction, second molar teeth near the semi-impacted third molar teeth. On the other hand, those who were < 25 years old and > 35 years and had already removed their second molars were excluded from the study. A simple and non-probability sampling method was used to select the patients for the study.

Sample size

The sample size was determined using G*Power software based on the study by Blakey et al. (15) for comparing two means. The effect size was calculated using the mean difference between groups ($\bar{X}1=4.063$, $\bar{X}2=3.399$) and standard deviations (S1=0.42, S2=0.32). With a significance level (α) of 0.05 and a statistical power ($1-\beta$) of 0.80, the required sample size was estimated at five participants per group. To account for potential attrition and enhance statistical robustness, the final sample size was increased to 12 participants in total (6 per group). Participants were selected using a simple non-probability sampling method.

Study implementation

As this study was conducted during the COVID-19 pandemic, all clinical procedures were performed under strict infection control measures. Standardized protocols, including the rigorous use of personal protective equipment and enhanced sterilization of surgical instruments were strictly followed in the dental clinic. These safety measures were

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implemented without altering the established surgical protocols for mandibular third molar extraction, ensuring that the clinical outcomes were not affected by the pandemic-related precautions. Therefore, the selected patients were scheduled in order. Upon arrival, informed consent was obtained from all participants after explaining the study objectives and assuring them that COVID-19 protocols would be followed. Then, the periapical photographs of each patient were taken in a parallel manner in a film holder using an XCP film, before the surgery. In addition, the periodontal pocket depth was measured in the mesial and distal second molar incisors using the Dental Probe Periodontal (Michigan-O Probe). For each patient, dental radiographs were taken with the Nikon D600 camera. Then, patient's teeth photographs were taken from dental radiographs with a Nikon D600 camera. This data was investigated using Adobe Photoshop CC 2017 to determine the size of CEJ-BC (Figure 1A). All measures were performed by a last-year general dentist and under supervision of periodontologist.

The soft tissue flap from the mesial of the second molar to the distal of the third molar was pushed aside by the sulcular method. The semi-impacted molar tooth was removed without a handpiece bone removal and sutured with catgut and a #19 needle. After the surgery, a prescription, including a pain reliever (ibuprofen), mouthwash (chlorhexidine), and necessary health recommendations was provided. Thereafter, peripheral radiographs were taken again using a parallel technique at three (Figure 1B) and six (Figure 1C) months after the surgery. Patients' periodontal pocket depth was measured again in these time periods. In all cases, surgery and index measurements were performed by the same person. Moreover, the distance of CEJ-ABC in the mesial and distal regions of the second molar tooth was measured.

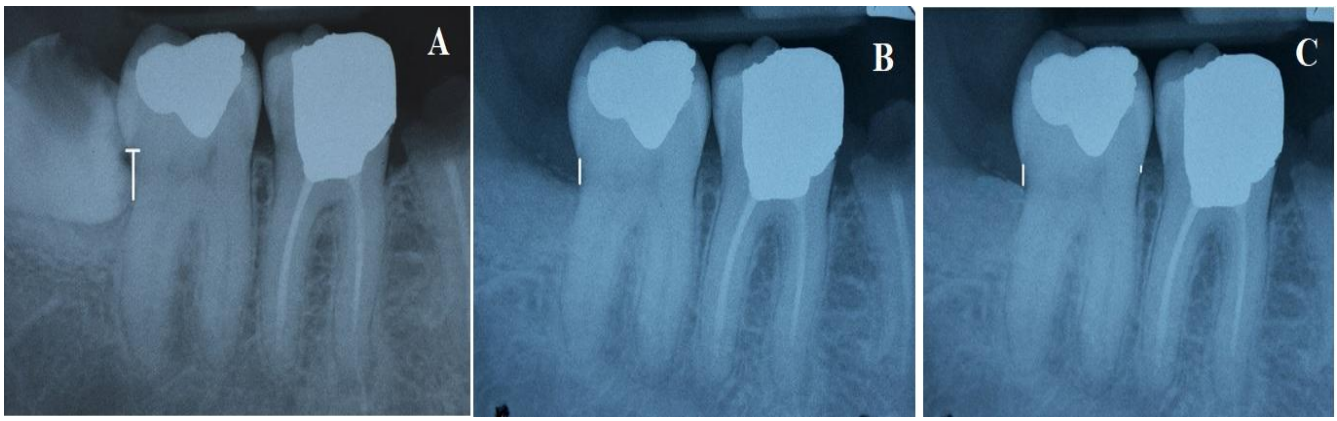


Figure 1. Evaluation of the periodontal pocket depth, A: before the surgery; B: three months after the surgery; C: six months after the surgery

Statistical analysis

The descriptive data were presented as Mean±SD and percentage. The normal distribution of the data was checked by the Kolmogorov-Smirnov test. The Friedman test was used due to the non-normality of the data. All the collected data was analyzed in SPSS software (version 19, Chicago, IL, USA), and a *P*-value<0.05 was considered as statistically significant.

Results

A total of 12 individuals were included in this study, of whom 3(25%) and 9(75%) were male and female, respectively. The Mean± SD age of the patients was 28.6±11.16 years (ranging from 25-30 years). The results of the periodontal pocket depth and CEJ-ABC of the mesial second molar tooth and distal second molar tooth before, three, and six months after semi-impacted molar tooth surgery are demonstrated in tables 1 and 2, respectively. Based on the statistical analysis, no statistically significant difference was observed between the mean CEJ-ABC of the mesial second molar tooth (P>0.05) and the distal second molar tooth (*P*>0.05) before and after the surgery. Based on statistical analysis, no statistically significant difference was found in the mean periodontal pocket depth index of the mesial second molar before and after the surgery (*P*>0.05). Nevertheless, a statistically significant difference was seen in the mean distal periodontal pocket depth index of the second molar tooth before and after the surgery (*P*<0.05). Based on this, the mean distal

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periodontal pocket index decreased three and six months after the surgery.

Table 1. Results of CEJ-ABC after the surgery (n=12)

Variable	Time	Mean±SD	F	*P*-value
Mesial second molar	Before surgery	0.61±0.41	0.81	0.46*
	3 months after surgery	0.60±0.36		
	6 months after surgery	0.58±0.36		
Distal second molar	Before surgery	1.45±1.27	0.87	0.43*
	3 months after surgery	1.32±0.57		
	6 months after surgery	1.08±0.38		

* Friedman test

Table 2. Results of periodontal pocket depth after the surgery (n=12)

Variable	Time	Mean±SD	X2	*P*-value
Mesial second molar	Before surgery	2.00±0.20	2	0.37*
	3 months after surgery	1.96±0.39		
	6 months after surgery	1.87±0.31		
Distal second molar	Before surgery	3.25±0.87	9.30	0.009*
	3 months after surgery	2.83±0.33		
	6 months after surgery	2.75±0.34		

* Friedman test

Discussion

This study on patients aged 20-35 undergoing surgery for semi-impacted mandibular third molars found no significant changes in the second molar's CEJ-ABC index or mesial pocket depth at three- and six-months post-surgery compared to pre-operative levels. However, the distal pocket depth of the second molar showed a significant reduction during the same follow-up period.

Similar to the findings of this study, another study by Monaco et al. demonstrated that no significant changes were observed in CEJ-ABC three months after surgery (16). However, contrary to our results, a study by Kim et al. found a significant increase in CEJ-ABC at 3 and 12 months post-operatively (17). A longer follow-up period might explain the discrepancy between these two studies. Additionally, in the study by Passarelli et al., CEJ-ABC significantly increased by the end of the follow-up period. However, in that study, surgery was performed on symptomatic impacted teeth, such as those with pain and inflammation, and the bone height before surgery was lower than that in the current study (5). The present findings reinforce the hypothesis that the surgical technique employed here, designed to minimize damage to the surrounding healthy tissues of the second molar (i.e., removal of soft tissue and tooth without bone removal using a handpiece), appears to be incapable of causing significant bone loss in the short term. This can be reassuring, as alveolar bone loss is a primary concern in wisdom tooth extraction surgeries, especially in proximity to the roots of the second molar (18). Nevertheless, it should be noted that CEJ-ABC measurements may be less sensitive to changes in periodontal pocket depth in the short term, and bone remodeling or resorption processes may require a longer time to manifest observable changes.

Regarding the distal periodontal pocket depth of the second molar compared to the pre-operative pocket depth, similar to the results of the present study, Petsos et al. showed a reduction in the pocket depth of an impacted third molar after a six-month follow-up (19). Furthermore, in the study by Xie et al., after six months of follow-up, plaque index, gingival index, and periodontal pocket depth were significantly lower in the intervention group compared to the control group (20). Passarelli et al. observed a significant reduction in pocket depth in the distal second molar during follow-up periods similar to the current study (6). Moreover, in a study by Gupta et al., the pocket depth in the distal second molar differed significantly from the pre-operative state (21). Contrary to the current research, another study on 30 patients revealed that pocket depth increased after six months of surgery (22). It should be noted that the upper jaw was examined.

In general, the improvement in distal periodontal

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pocket depth can be attributed to several factors. The surgery for semi-impacted wisdom teeth, especially when accompanied by complete removal, can lead to the elimination of chronic inflammation and infection, thereby improving oral hygiene access in the distal region of the second molar. In many cases, a semi-impacted wisdom tooth can cause gingivitis or periodontitis in the adjacent tooth; removing the offending tooth facilitates hygiene in that area and helps reduce the periodontal pocket depth. Furthermore, the elimination of constant pressure exerted by the impacted tooth on the periodontal structures of the adjacent tooth can also contribute to the improvement of gingival health. In addition, the researchers suggested reducing this index by maintaining good oral hygiene before the surgery and getting a periodic check-up after the surgery (22). On the other hand, it is notable that, the surgical management of semi-impacted third molars is inherently associated with various clinical risks. Beyond the changes in alveolar bone levels observed in this study, established complications in the literature include post-operative edema, trismus, and alveolar osteitis (18). More severe complications, such as neurosensory disturbances resulting from nerve injury, must also be considered during surgical planning (18, 23). Our findings regarding bone level stability/loss should be interpreted alongside these potential risks, emphasizing the need for surgical precision to prevent both periodontal damage and more systemic post-operative complication.

A significant point in the present study is the performance of surgery without the use of a bur for bone preparation. This technique, which often involves bone grinding, can increase the risk of damage to the surrounding bone and soft tissues. Our findings of no significant bone loss and improved pocket depth (in the distal region) may indicate the effectiveness, or at least the non-detrimental nature, of minimally invasive surgeries in this context. In addition, these findings offer important clinical reassurance regarding the surgical management of semi-impacted mandibular third molars. The relatively stable alveolar bone levels observed around the second molar suggest that, when performed with standard surgical protocols, the risk of significant collateral bone loss is minimal. This indicates that clinicians can proceed with the extraction of semi-impacted third molars with a lower concern for compromising the periodontal support of the adjacent second molar. However, these results should encourage surgeons to maintain precise control over surgical instrumentation to ensure that the observed stability is maintained post-operatively.

Despite these promising initial results, the limitations of this study necessitate careful interpretation. The small sample size (12 patients), the pilot nature of the study design, and the single-group approach lacking a control group comparison are significant constraints that require caution in interpreting the findings. The current three- and six-month follow-up periods may be insufficient for a comprehensive evaluation of the long-term effects of the surgery on periodontal health, as extended follow-up durations would provide more robust insights into healing processes and periodontal stability. The narrow age range of patients (mean age 28.6 years) also limits generalizability. Furthermore, the statistical power to detect small changes in CEJ-ABC may be limited due to the small sample size. Additionally, the use of a single type of probe (Michigan-O Probe) without a discussion of calibration or standardization of measurement techniques may introduce variability. Therefore, it is suggested that further studies be performed on larger sample sizes with longer follow-up periods, broader age groups, a control group, and sensitivity analysis with different standard probes to provide more comprehensive and reliable insights.

Conclusion

As evidenced by the obtained results, it can be concluded that surgery on the semi-impacted mandibular molar tooth may improves the periodontal health (pocket depth) of the adjacent second molar tooth. Comparative studies with larger sample sizes, broader age ranges, and longer follow-up periods are essential to confirm the results of the present study.

Ethics Approval and Consent to Participate

The study protocol was reviewed and approved by the Ethics Committee of Birjand University of Medical Sciences, Birjand, Iran (No: IR.BUMS.REC.1398.050). The radiographs were prepared for patient follow-ups. Moreover, written consents were obtained from the patients for the surgery, the preparation of the radiographs, and their use in the study. In addition, participants were assured of the confidentiality of their information and the lack of information dissemination with name and individually.

Consent for Publication

Not applicable.

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[DOI: 10.61882/jsurgtrauma.14.3.163]

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request

Funding Statement

Not applicable.

Acknowledgements

Not applicable.

Author's Contribution

A.A. Conceptualization, methodology, software, validation, formal analysis, data curation, writing—original draft preparation, and project administration; M.A. Investigation, supervision, writing—review and editing, and funding acquisition; A.S. Methodology, investigation, and resources; M.Az. Software, formal analysis, and data curation; F.M. Validation, visualization, and investigation; G.Sh. Supervision, project administration, and writing—review and editing. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Declaration of Generative Artificial Intelligence in Scientific Writing

No generative artificial intelligence tools were used in the preparation, analysis, or writing of this manuscript.

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