Khalij Libya Journal of Dental and Medical Research. 2026;10(2):213-219
https://doi.org/10.47705/kjdmr.26304
eISSN:2708-888X

Original article

Panoramic Radiographic Analysis of Distal Caries Prevalence in Mandibular Second Molars Associated with Adjacent Third Molar Position: A Retrospective Study in Benghazi, Libya

Samia Alawjali, Iman El Kumati, Lubnah Shamsah

Department of Conservative Dentistry and Endodontics, Faculty of Dentistry, University of Benghazi, Libya
Corresponding Email. iman.elkumati@uob.edu.ly

ABSTRACT
The present study aimed to investigate, using panoramic radiographs, the association between mandibular third molars and the occurrence of distal caries in adjacent second molars. This retrospective cross-sectional study was conducted at Elaml Dental Centre, Benghazi, Libya, using digital panoramic radiographs (orthopantomograms, OPGs) obtained between January 2022 and November 2023. A total of 557 radiographs from Libyan adults aged over 21 years were examined to evaluate the eruption status and angulation of impacted mandibular third molars, as well as the presence of distal caries in adjacent mandibular second molars. Impaction patterns were classified according to Winters' and Pell & Gregory's systems. Statistical analysis was performed using the Chi-square test. Results showed that 339 second molars (34.8%) exhibited caries on the distal surface. The majority of second molars affected by distal carious lesions were linked to Level A third molar status, comprising 194 affected mandibular second molars (57.2%), followed by Level B, which accounted for 133 cases (39.2%). Mesially inclined third molars were most commonly associated with distal caries in the second molars (n=144, 42.5%), followed by vertically oriented third molars (n=94, 27.7%). The study concluded that mandibular third molars are associated with an increased risk of distal caries in second molars, especially when they are classified as level A or mesioangular-tilted third molars. It is advisable to conduct regular radiographic examinations for early detection. Additionally, if impacted third molars are in contact with the oral cavity, their removal may be necessary as a preventive measure.
Keywords. *Orthopantomograms, Radiographic Study, Third Mandibular Molar, Second Mandibular Molar, Distal Surface Caries.*

Received: *01/05/26*
Accepted: *30/06/26*
Published: *08/07/26*

Introduction

The mandibular third molars, as the final teeth to emerge in the oral cavity, are frequently predisposed to impaction [1]. Their persistent unerupted state has been linked to a diverse array of pathological conditions, including pericoronitis, dental caries, periodontal compromise, cystic formations, benign and malignant tumors, and pathological resorption of adjacent roots. Additionally, impacted third molars may adversely affect neighbouring teeth, posing a broader risk to oral health integrity [1,2].

Among the various complications associated with impacted third molars, dental caries is the most prevalent hard-tissue pathology, with reported incidence rates ranging from 13.4% to 30.1%. The second molar's predisposition to pathological changes is frequently linked to the anatomical position and spatial proximity of the third molar, which create favourable conditions for microbial biofilm accumulation and undermine the integrity of the distal enamel surface [3,4]. Mesioangular and horizontally impacted third molars positioned adjacent to the cemento-enamel junction of second molars markedly heighten the likelihood of distal caries. This increased risk arises from the facilitation of food entrapment and the consequent difficulty in maintaining adequate interproximal hygiene. Clinical inspection alone often fails to detect these lesions, making radiographic evaluation an essential adjunct for reliable diagnosis in this region [2,3,4]. Early detection and consistent monitoring are crucial, and prophylactic removal of the third molar may be considered in specific instances [2].

Various diagnostic methods have been employed to assess the clinical association between distal caries in lower second molars and neighbouring third molars. Among the various techniques used to detect caries are clinical assessments, periapical imaging, bitewing radiographs, and panoramic radiography. All of which have their own advantages that directly impact the level of accuracy and comprehensiveness [5]. Panoramic radiography is a commonly employed imaging technique for evaluating mandibular third molars, particularly their impaction status and anatomical relationships with adjacent structures. Its lower radiation exposure and efficiency make panoramic radiography exceptionally suitable for routine dental assessments. Compared with CT imaging, panoramic radiography demonstrates greater cost-efficiency while maintaining diagnostic reliability, reinforcing its importance in clinical decision-making [6].

Accurate radiographic assessment enhances clinical judgment by revealing the angulation, depth of impaction, and proximity of third molars to adjacent structures. When interpreted through established frameworks such as Winter's and Pell & Gregory's classification systems, imaging supports early diagnosis and surgical planning, particularly in cases at

Khalij Libya Journal of Dental and Medical Research. 2026;10(2):213-219
https://doi.org/10.47705/kjdmr.26304
eISSN:2708-888X

risk for distal caries in second molars [7]. Building on this foundation, the present study aimed to investigate, using panoramic radiographs, the association between mandibular third molars and distal caries in adjacent second molars.

Methods

This is a retrospective cross-sectional study conducted in Benghazi, aimed to evaluate the relationship between mandibular third molars and distal caries in second molars using panoramic radiographs. The study adhered to the guidelines outlined in the Declaration of Helsinki and received approval from the Ethics Committee of the University of Benghazi, Libya (protocol no 0454). Digital panoramic radiographs were randomly selected from the records of dental patients who attended Elaml Dental Centre at Benghazi, Libya, for routine dental treatment.

The dataset comprised high-quality panoramic radiographs of patients referred by dentists from both public and private sectors. All images were captured using the Owandy digital X-ray system (Italy). Data for this study were collected between January 2022 and November 2023. The study initially evaluated 620 orthopantomographic images. However, after applying the predefined inclusion and exclusion criteria, only 557 radiographs met the eligibility requirements and were included in the final dataset.

The study population included Libyan adults aged 21 years and older seeking dental care, presenting with normally and fully erupted mandibular second permanent molars in direct adjacency to third molars on one or both sides. Patients were excluded from the study if they had missing mandibular second molars, previously extracted third molars, or associated pathological conditions such as cysts or tumors. Additional exclusion criteria included second or third molars with partially destroyed or absent crowns, missing roots, replacement by dental implants, or a coverage crown on the second molar, as these conditions compromised accurate radiographic assessment. Furthermore, individuals with developmental anomalies, including microdontia, impacted second molars, supernumerary teeth, or odontomas, or those with implant-supported dentition, were not considered eligible for inclusion.

To minimise examiner bias, all panoramic radiographs were evaluated by a single experienced examiner. To check consistency, a second examiner randomly reviewed 20 radiographs. The results showed full agreement between the two examiners, confirming a reliable diagnostic interpretation. The evaluation of mandibular third molars was conducted using a multifactorial approach. Eruption status was assessed in accordance with the Pell and Gregory classification [8,9], while angulation was determined based on Winter's classification system [3,10]. Additionally, radiographic analysis was performed to identify the presence of any radiographic evidence of caries or restorations affecting the distal surface of the adjacent mandibular second molar. The Pell and Gregory classification system evaluates the vertical position of impacted mandibular third molars relative to the occlusal plane of the adjacent second molar. This system defines three distinct levels: Level A: The highest point of the third molar lies above the occlusal plane of the second molar. Level B: The most coronal aspect of the third molar is situated between the occlusal plane and the cementoenamel junction (CEJ) of the second molar. Level C: The coronal portion of the third molar is positioned below the CEJ of the adjacent second molar. Winter's classification provides a systematic approach to evaluating the angulation of impacted mandibular third molars relative to the longitudinal axis of the adjacent second molar. This method categorises impactions into the following types: Mesioangular: The third molar is inclined mesially, with its crown directed toward the second molar. Distoangular: The third molar is tilted distally, away from the second molar. Vertical: The long axis of the third molar is aligned vertically, parallel to that of the second molar. Horizontal: The third molar lies horizontally, with its long axis perpendicular to the second molar.

Statistical analysis was performed using SPSS® software, version 21.0, and $P \leq 0.05$ was considered statistically significant with a 95% confidence interval. The chi-square test was utilized to find the association between caries and the third molar.

Results

A total of 557 Orthopantomograms (OPGs) were retrospectively collected from a private dental clinic and analyzed. The patients were 259 males (46.5%) and 298 females (53.5%) (Figure 1).

Khalij Libya Journal of Dental and Medical Research. 2026;10(2):213-219
https://doi.org/10.47705/kjdmr.26304
eISSN:2708-888X

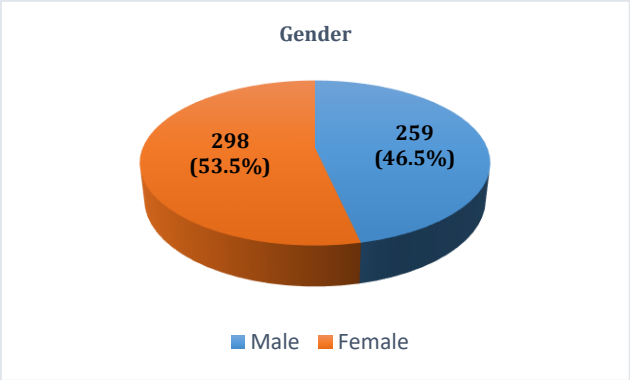

***Figure 1**. Gender Distribution of the Studied (OPGs)*

Prevalence of Caries on the Distal Surface of Mandibular Second Molar

In the present study, 974 right and left second molars were assessed using 557 panoramic radiographs. The result showed that 339 teeth (34.8%) exhibited caries on the distal surface, whereas distal caries was absent in 635 teeth (65.2%) (Table 1).

Table 1. Prevalence of Caries on the Distal Surface of Mandibular Second Molar.

Caries on the Distal Surface of Mandibular Second Molar	Number	Percentage
Caries Absent	635	65.2%
Caries Present	339	34.8%
Total	974	100%

Distribution of Mandibular Third Molar Status

A total number of third molars were evaluated in the current study was 974. According to third molar status, the teeth included in the study were classified as: Level A, which represented the majority of the evaluated teeth (n=728, 74.7%), followed by Level B (n=226, 23.2%), and Level C (n=20, 2.1%) (Table 2).

Table 2. Distribution of Mandibular Third Molar Status.

Mandibular Third Molar Status	Number	Percentage
Level A	728	74.7%
Level B	226	23.2%
Level C	20	2.1%
Total	974	100%

Distribution of Mandibular Third Molar Angulation

In the present study, among the 974 examined mandibular third molars, the majority showed vertical angulation (n=528, 54.3%), followed by mesial angulation (n=199, 20.4%), distal angulation (n=163, 16.7%), and horizontal angulation represent (n=84, 8.6%) (Table 3).

Table 3. Distribution of Third Molar Angulation.

Mandibular Third Molar Angulation	Number	Percentage
Mesial	199	20.4%
Distal	163	16.7%
Vertical	528	54.3%
Horizontal	84	8.6%
Total	974	100%

Prevalence of Caries on the Distal Surface of Mandibular Second Molar in Relation to Mandibular Third Molar Status

Within the group of mandibular second molars presenting with distal caries (n=339), a statistically significant association was observed with the status of the adjacent mandibular third molar ($p< 0.001$). The majority of second molars affected by distal carious lesions were associated with Level A third molar status, accounting for 194 affected mandibular second

Khalij Libya Journal of Dental and Medical Research. 2026;10(2):213-219
https://doi.org/10.47705/kjdmr.26304
eISSN:2708-888X

molars (57.2%), followed by Level B (n=133, 39.2%). Level C third molar status demonstrated the lowest prevalence, with only 12 affected mandibular second molars (3.5%). The results revealed that distal caries of the mandibular second molar is considerably more common when the adjacent third molar is aligned at Level A or Level B compared to Level C (Table 4).

Table 4. Prevalence of Distal Caries in the Second Molar in Relation to Third Molar Status.

Third molar status	Caries on the Distal Surface of Mandibular Second Molar		Total	p-value
	Caries Absent n(%)	Caries Present n(%)		
Level A	534 (84.1%)	194 (57.2%)	728 (74.7%)	0.000
Level B	93 (14.6%)	133 (39.2%)	226 (23.2%)	
Level C	8 (1.3%)	12 (3.5%)	20 (2.1%)	
Total	635 (100%)	339 (100%)	974 (100%)	

Prevalence of Caries on the Distal Surface of Mandibular Second Molar in Relation to Third Molar Angulation

Within the group of mandibular second molars affected by distal caries (n=339), a statistically significant difference was observed with the angulation of the adjacent mandibular third molars (p <0.001). Mesially inclined third molars were most commonly related to distal caries in the second molars (n=144, 42.5%). Followed by vertically oriented third molars (n=94, 27.7). Third molars with horizontal angulation accounted for 64 affected second molars (18.9%). Furthermore, distally angulated third molars revealed the lowest association with distal caries of second molars (n=37, 10.9%). The result of the current study indicates that mesial and vertical angulations of mandibular third molars are strongly associated with the occurrence of carious lesions on the distal surface of adjacent second molars. (Table 5).

Table 5. Prevalence of Distal Caries in the Second Molar in Relation to Third Molar Angulation.

Mandibular Third molar angulation	Caries on the Distal Surface of Mandibular Second Molar		Total	p-value
	Caries Absent n(%)	Caries Present n(%)		
Mesial	55 (8.7%)	144 (42.5%)	199 (20.4%)	0.000
Distal	126 (19.8%)	37 (10.9%)	163 (16.7%)	
Vertical	434 (68.3%)	94 (27.7%)	528 (54.3%)	
Horizontal	20 (3.1%)	64 (18.9%)	84 (8.6%)	
Total	635 (100%)	339 (100%)	974 (100%)	

Discussion

A review of the literature revealed limited evidence on the role of mandibular third molar position in distal caries of adjacent second molars, particularly in the Libyan population. Byahatti et al. conducted a study examining the eruption status of third molars among the Libyan student population. The findings showed that fully erupted third molars accounted for approximately one-third of the total sample; the remaining majority existed in different stages of incomplete eruption [11].

In a separate study conducted at Benghazi Dental School in Libya, Krishnan et al. reported that dental caries and pulpitis of the third molar were the second most common reasons for the extraction of impacted third molars, representing 22% of the cases studied, while caries affecting the adjacent second molars accounted for 9% of reported indications [12]. Claudia et al. revealed that the presence of third molars increases the pathological changes in second molars, particularly caries and periodontitis. Conversely, their absence is associated with the lowest incidence of such conditions [3]. Nunn et al. consistently found that second molars next to missing third molars have a low risk of developing pathological changes. In contrast, second molars adjacent to soft-tissue impacted third molars show a significantly higher susceptibility to pathology. This illustrates a correlation between the type of impaction and the risk of pathology in adjacent teeth [13].

This study investigated the association between mandibular third molars and the incidence of distal caries in adjacent second molars with panoramic radiographs as a diagnostic tool. A notable aspect of this research is its dataset, obtained from a private dental center that provides multidisciplinary care. Unlike surgical clinics that typically rely on direct referrals for third molar extractions, this center received requests for panoramic imaging from a wide range of dental specialties. This diversity in referral sources may explain the variations observed in the current findings compared to published literature.

Khalij Libya Journal of Dental and Medical Research. 2026;10(2):213-219
https://doi.org/10.47705/kjdmr.26304
eISSN:*2708-888X*

In the current study, we conducted a retrospective analysis of 557 orthopantomograms (OPGs), which included 259 male patients (46.5%) and 298 female patients (53.5%). This data aligns with the results reported in previous research by Shams et al. and Mokhtar et al. [14,15]. One possible explanation for the gender differences is that females tend to use dental services more regularly than males. In addition, females usually pay more attention to their oral health and practice better dental hygiene, which may account for variations noted [8].

An analysis of second molars revealed that among the 974 teeth examined, 339 exhibited distal caries, with an estimated rate of 34.8%. Ashar et al. illustrated that earlier research indicates a significant variation in the occurrence of dental caries in teeth adjacent to impacted third molars, with prevalence rates ranging from 1% to 4.7% and 15% to 51%. [16]. These variations may be influenced by cultural and demographic factors within the patient population, including differences in oral hygiene habits, socioeconomic status, and the diagnostic methods chosen [8,17]. Among 974 lower third molar teeth assessed, most were classified as Level A (74.7%), with fewer cases in Level B (23.2%) and only a small proportion in Level C (2.1%). This result aligns with the findings of Falci et al. and Srivastava et al.[8,18]. Hassan's investigation demonstrated that Level B impaction was the most prevalent in the mandible, accounting for 67.5% of cases. This observation is consistent with the findings reported by Quek et al.[19].

In the present study, vertical angulation was the most common orientation, accounting for 54.3% of cases. Byahatti et al. reported similar findings in Libya, noting that 38.25% of mandibular third molars were positioned vertically [11]. In line with our findings, Hugoson and Kugelberg identified vertical angulation as the main orientation [20]. This result is further supported by AlHobail et al., who documented vertical impaction as the most frequent type, followed by other angulation patterns [21]. In contrast, Hassan's study, consistent with the findings of Quek et al., Kramer and Williams, and Moris and Jerman, pointed out mesioangular positioning as the most prevalent mandibular angulation [19,22-24]. The divergence observed across these studies may be attributed to methodological variation, particularly the use of alternative classification systems for angulation assessment [19].

One of the main goals of the current study was to evaluate distal caries in mandibular second molars in relation to the angulation and eruption status of adjacent third molars. A statistically significant association was observed between distal caries in mandibular second molars and the eruption status of adjacent mandibular third molars ($p<0.001$). The data revealed that distal caries was most frequently associated with Level A impaction (57.2%, n=194), followed by Level B (39.2%, n=133), whereas Level C showed the lowest prevalence (3.5%, n=12). These findings are consistent with those of Srivastava and Rashid, who reported a significant association between Levels A and B and distal caries in mandibular second molars, a relationship explained by their exposure to the oral cavity and subsequent bacterial colonization [4,18]. In contrast, Falci et al. described level C third molars as completely enclosed, with crowns positioned below the cervical line of the second molar. This specification supports the observations of Chang et al., who documented 27 level C molars free of caries, thereby reinforcing the concept that partial eruption of third molars is a key predisposing factor for distal caries [8].

Within the group of mandibular second molars affected by distal caries, a statistically significant difference was observed in the angulation of the adjacent mandibular third molars ($p <0.001$). Mesially angulated third molars showed the strongest correlation with distal caries in mandibular second molars, accounting for 42.5% of cases (n=144). Vertically positioned third molars were associated with 27.7% (n=94) of cases, while horizontally angulated third molars contributed to 18.9% (n=64). Distally angulated third molars had the lowest association, representing only 10.9% (n=37) of cases. These results are in agreement with prior studies showing that distal caries in mandibular second molars is most common when mesioangular third molars are either partially or fully erupted [2,7,14,21,25]. Claudia et al. found that distal caries related to mesioangular third molars varies across populations. For example, Polat et al. documented a prevalence of 12.6% in Turkish individuals, Knutsson et al. observed 26% in Americans, Jung and Cho reported a prevalence of 27.4% among Koreans, and Ali et al. found a rate of 38.53% in Pakistani individuals based on an analysis of 250 radiographic images [3]. Collectively, these differences highlight the influence of demographic and cultural backgrounds on the occurrence of distal caries and reinforce mesioangular impaction as a significant predisposing factor.

These findings could be explained by the fact that, in situations where mesioangular or horizontal mandibular third molars are partially exposed, the occlusal surface tends to create plaque-retentive crevices against the distal surface of the second molar, leading to the gradual development of distal caries. Additionally, with gingival recession, the cementoenamel junction becomes exposed, providing another site for microbial and food accumulation, thereby increasing the risk of root surface caries [25,26]. Toeddling et al illustrated that the duration for which a mesioangular or horizontal third molar remains partially erupted is a critical determinant of caries risk. Prolonged partial eruption increases susceptibility to demineralization and cavitation, and these changes may create space that facilitates further eruption of the third molar, while leaving the second molar compromised [26]. In contrast, distoangular impaction of the mandibular third molar demonstrated the lowest prevalence of distal caries in adjacent second molars, with an incidence of 10.9%. This finding may indicate a potential protective effect of distoangular impaction against the initiation of distal

surface caries. Such an interpretation is consistent with the observations of AlHobail et al. and Knutsson et al., both of whom reported a diminished risk of distal caries associated with distoangular impactions [21,27].

Early prophylactic removal of impacted third molars is an effective strategy for maintaining the health of adjacent second molars. Specifically, when the third molar is positioned with a mesioangular inclination, immediate removal is highly recommended [2,8,13,15,16,18]. The justification for that rests on several factors. These teeth contribute little to mastication, occlusal load distribution, or maintenance of occlusion. Moreover, significant crown loss in second molars due to cervical caries, the financial costs of restorative treatment, and the eventual extraction of second molars in advanced cases collectively highlight the preventive value of third molar removal [2,13]. Recent evidence suggests that pathological conditions associated with retained third molars are relatively rare. Therefore, for young adults with asymptomatic impacted third molars, careful observation may be a more appropriate management approach than routine extraction [14]. Kumran et al. highlight the importance of multidisciplinary cooperation among operative dentistry, endodontics, oral diagnosis, and oral surgery when managing third molars. Advising patients during the diagnostic or restorative phase about the benefits of prophylactic extraction of third molars may help prevent the progression of caries in adjacent second molars. However, patients often hesitate to proceed due to concerns about postoperative pain, swelling, and potential complications [13].

Conclusion

Within the limitations of this study, the results indicate that the presence of mandibular third molars increases the risk of distal caries in mandibular second molars. The risk is significant when the third molars are Pell and Gregory class A, or impacted in a mesioangular position. Careful monitoring with regular radiographic examinations is recommended to detect caries early. However, when impacted third molars communicate with the oral cavity, preventing second molar caries might not be possible, and prophylactic removal of lower third molars should be considered as a conservative approach.

Limitations

The study was limited by the small number of patients, which reduces the strength and generalizability of the findings. Larger studies, ideally conducted across multiple centres and involving more dentists, are needed to provide stronger evidence and wider representation. The use of panoramic radiography (OPG) alone restricted diagnostic accuracy. OPG has low sensitivity for detecting early proximal caries and is less reliable than bitewing or periapical radiographs. Although OPG was practical for this study, cone-beam computed tomography (CBCT) offers clearer three-dimensional images and is more accurate for presurgical evaluation. The cross-sectional design did not allow follow-up over time, which limits the ability to draw causal conclusions. Longitudinal studies with clinical and radiographic monitoring are needed to reduce influencing factors and explain the causes of distal caries in mandibular second molars, which could not be fully clarified here.

Conflict of interest

There are no financial, personal, or professional conflicts of interest to declare.

References

1. Shahzad MA, Marath MA, Chatha MR, Sohail A. Evaluation of patterns of mandibular third molar impactions and associated pathologies. Pak Oral Dent J. 2016;36(2):192-196.
2. Marques J, Montserrat-Bosch M, Figueiredo R, Vilchez-Perez M, Valmaseda-Castellon E, Gay-Escoda C. Impacted lower third molars and distal caries in the mandibular second molar. Is prophylactic removal of lower third molars justified? J Clin Exp Dent. 2017;9(2):e194-e200. doi: 10.4317/jced.53919.
3. Claudia A, Barbu HM, Adi L, Gultekin A, Reiser V, Gultekin P, Mijiritsky E. Relationship between third mandibular molar angulation and distal cervical caries in the second molar. J Craniofac Surg. 2018;29(8):2267-2271. doi: 10.1097/SCS.0000000000004505.
4. Rashid MO, Baban MT, Gul SS, Salih RO, Abdulkareem BN, Abdulalttef DS. Prevalence of impacted mandibular third molars and its association with distal caries in mandibular second molars using cone beam computed tomography. J Oral Res. 2019;8(4):66-73. doi: 10.17126/joralres.2019.009.
5. Pentapati KC, Gadicherla S, Smriti K, Vineetha R. Association of impacted mandibular third molar with caries on distal surface of second molar. Pesqui Bras Odontopediatria Clin Integr. 2019;19(1):e4682. doi: 10.4034/PBOCI.2019.191.22.
6. Goyal S, Verma P, Sunder Raj S. Radiographic evaluation of the status of third molars in Sriganganagar population - a digital panoramic study. Malays J Med Sci. 2016;23(6):103-112. doi: 10.21315/mjms2016.23.6.11.
7. Silva HO, Pinto ASB, Pinto MESC, Rego MRDS, Gois JF, De Araujo TLC, Mendes JDP. Dental caries on distal surface of mandibular second molars. Braz Dent Sci. 2015;18(1):51-59. doi: 10.14295/bds.2015.v18i1.1063.

8. Falci SGM, De Castro CR, Santos RC, De Souza Lima LD, Ramos-Jorge ML, Botelho AM, Dos Santos CRR. Association between the presence of a partially erupted mandibular third molar and the existence of caries in the distal of the second molars. Int J Oral Maxillofac Surg. 2012;41(10):1270-1274. doi: 10.1016/j.ijom.2012.03.003.
9. Pell GJ, Gregory GT. Impacted mandibular third molars: classification and modified technique for removal. Dent Dig. 1933;39:330-338.
10. Winter G. Principles of exodontia as applied to the impacted mandibular third molar: a complete treatise on the operative technique with clinical diagnoses and radiographic interpretations. St Louis: American Medical Book Co; 1926.
11. Byahatti S, Ingafou MSH. Prevalence of eruption status of third molars in Libyan students. Dent Res J (Isfahan). 2012;9(2):152-157. doi: 10.4103/1735-3327.95228.
12. Krishnan B, El-Gehani R, Orafi H. Indications for removal of impacted mandibular third molars: a single institutional experience in Libya. J Maxillofac Oral Surg. 2009;8(4):246-248. doi: 10.1007/s12663-009-0060-3.
13. Syed KB. Prevalence of distal caries in mandibular second molar due to impacted third molar. J Clin Diagn Res. 2017;11(2):ZC46-ZC49. doi: 10.7860/JCDR/2017/18582.9509.
14. Mokhtar A, Bronoosh P, Haghnegahdar A. Pathologic conditions associated with impacted mandibular third molar angulation in an Iranian population. J Dentomaxillofac Radiol Pathol Surg. 2015;4(3):23-27. doi: 10.18869/acadpub.3dj.4.3.23.
15. Shams S, Hassan SG, Punjabi SK, Abdullah S. Molar caries: distal surface mandibular second molar caries, existence and association with partially erupted mandibular third molar. Prof Med J. 2017;24(7):1088-1092. doi: 10.17957/TPMJ/17.3857.
16. Ashar T, Shakoor A, Ghazal S, Parveen N, Saleem MN, Raja HZ. Prevalence of distal carious lesions in mandibular second molars due to mesio-angular impacted third molars. J Pak Dent Assoc. 2021;30(1):50-55. doi: 10.25301/JPDA.301.50.
17. Modi JD, Gala SA, Dave HA, Gupte SH, Singh S. The assessment of the prevalence of impacted third molars, its relation to space available for eruption, and its effect on the adjacent second molar in adults from 18 to 65 years of age using orthopantomograms: a retrospective cross-sectional study. Cureus. 2025;17(2):e78608. doi: 10.7759/cureus.78608.
18. Srivastava N, Shetty A, Goswami R, Apparaju V, Bagga V, Kale S. Incidence of distal caries in mandibular second molars due to impacted third molars: nonintervention strategy of asymptomatic third molars causes harm? A retrospective study. Int J Appl Basic Med Res. 2017;7(1):15-19. doi: 10.4103/2229-516X.198505.
19. Hassan A. Pattern of third molar impaction in a Saudi population. Clin Cosmet Investig Dent. 2010;2:109-113. doi: 10.2147/CCIDEN.S12394.
20. Hugoson A, Kugelberg CF. The prevalence of third molars in a Swedish population: an epidemiological study. Community Dent Health. 1988;5(2):121-138.
21. AlHobail S, Baseer M, Ingle N, Assery M, AlSanea J, AlMugeiren O. Evaluation of distal caries of the second molars in the presence of third molars among Saudi patients. J Int Soc Prev Community Dent. 2019;9(5):505-511. doi: 10.4103/jispcd.JISPCD_19_19.
22. Kramer R, Williams A. The incidence of impacted teeth. Am J Orthod. 1970;29(2):237-241.
23. Morris C, Jerman A. Panoramic radiographic survey: a study of embedded third molars. Am J Orthod. 1971;29(2).
24. Quek SL, Tay CK, Tay KH, Toh SL. Pattern of third molar impaction in a Singapore Chinese population: a retrospective radiographic survey. Int J Oral Maxillofac Surg. 2003;32(6):548-552. doi: 10.1016/S0901-5027(03)90412-1.
25. Khanji A. Prevalence of distal caries in mandibular second molars related to impacted third molars in RAKCODS. Open Access J Dent Sci. 2018;3(4):000211. doi: 10.23880/oajds-16000211.
26. Toedtling V, Coulthard P, Thackray G. Distal caries of the second molar in the presence of a mandibular third molar: a prevention protocol. Br Dent J. 2016;221(6):297-302. doi: 10.1038/sj.bdj.2016.677.
27. Knutsson K, Brehmer B, Lysell L, Rohlin M. Pathoses associated with mandibular third molars subjected to removal. Swed Dent J. 1996;20(1-2):7-10.