Bi-Quarterly

Volume 3 , Issue 2, Autumn and Winter 2026

GHALIB MEDICAL JOURNAL
(MJ)

Journal Homepage: https://www.mj.ghalib.edu.af

ISSN
P: 3105-0786
E: 3006-094X

OPEN ACCESS

Publisher: Ghalib University-Herat | https://doi.org/10.58342/MJ.V.3.I.2.2

Prevalence of Impacted Teeth on Panoramic Radiographs in Radiology Centers of Herat, Afghanistan

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Article Info

Article type:
Research Article

pp: 37-53

Received:
10/02/2026
Accepted:
04/06/2026
Published:
23/09/2026

ABSTRACT

Background: Impacted teeth are a common developmental anomaly that may lead to functional, esthetic, and pathological complications if left untreated. Epidemiological data regarding impacted teeth in Afghanistan remain limited. This study aimed to determine the prevalence and radiographic characteristics of impacted teeth using panoramic radiographs obtained from radiology centers in Herat, Afghanistan.

Methods: A retrospective cross-sectional study was conducted using digital panoramic radiographs collected from three major radiology centers (Hekmat, Razi and Jawad X-ray centers) in Herat. From 2,000 archived radiographs, 323 eligible images of patients aged 15–40 years were selected through systematic random sampling. Demographic data and radiographic characteristics of impacted teeth were recorded. Angulation and depth of impaction were assessed according to Winter's and Pell and Gregory classifications, respectively. Data were analyzed using SPSS version 26 with descriptive statistics.

Results: Among the 323 radiographs, 165 impacted teeth were identified, corresponding to a prevalence of 51.1%. Complete impaction accounted for 46.4% of cases, while 4.6% were partially impacted. The mean age of the participants was 24.58 ± 6.04 years. No statistically significant association was observed between gender and the prevalence of impacted teeth ($p>0.05$). Mesioangular impaction was the most frequent angulation (53.3%),

followed by vertical (25.45%) and horizontal (13.9%) impactions. Level B was the predominant depth of impaction. Completely impacted teeth were more commonly observed in the mandible.
Conclusion: Impacted teeth were frequently observed in the studied population, with similar prevalence between males and females. Mesioangular angulation and Level B depth were the predominant radiographic patterns. These findings provide baseline epidemiological evidence for Afghanistan and emphasize the importance of early radiographic assessment to facilitate timely diagnosis and appropriate management of impacted teeth.
Keywords: Prevalence, Impacted teeth, OPG, Radiology centers

Cite this article Sadiqi Z, Erfan O, Danish A. N, Naqib F, A. Prevalence of Impacted Teeth on Panoramic Radiographs in Radiology Centers of Herat, Afghanistan. *Ghalib Medical Journal*. [Internet]. Publication date. 23.09.2026; 3 (2): 37-53: https://doi.org/10.58342/MJ.V.3.I.2.2

دوفصل‌نامه

دوره ۳، شماره ۲، خزان و زمستان ۱۴۰۵

مجلهٔ علوم طبی غالب

(MJ)

صفحهٔ اصلی مجله: https://www.mj.ghalib.edu.af

ISSN
P: 3105-0786
E: 3006-094X

OPEN ACCESS

ناشر: پوهنتون/ دانش‌گاه غالب – هرات

https://doi.org/10.58342/MJ.V.3.I.2.2

بررسی شیوع دندان‌های نهفته بر اساس رادیوگرافی‌های پانورامیک در مراکز رادیولوژی هرات، افغانستان

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اطلاعات مقاله

نوع مقاله:
پژوهشی

صفحات: ۵۳-۳۷

تاریخ دریافت:
۱۴۰۴/۱۱/۱۹

تاریخ پذیرش:
۱۴۰۵/۰۳/۱۳

تاریخ نشر:
۱۴۰۵/۰۷/۰۱

چکیده

زمینه و هدف: دندان‌های نهفته یک ناهنجاری رشدی شایع هستند که در صورت عدم درمان ممکن است منجر به عوارض عملکردی، زیبایی و پاتولوژیک شوند. داده‌های اپیدمیولوژیک در مورد دندان‌های نهفته در افغانستان محدود است. این مطالعه با هدف تعیین شیوع و ویژگی‌های رادیوگرافیک دندان‌های نهفته با استفاده از رادیوگرافی‌های پانورامیک به‌دست‌آمده از مراکز رادیولوژی در هرات، افغانستان انجام شد.

روش: یک مطالعه مقطعی گذشته‌نگر با استفاده از رادیوگرافی‌های پانورامیک دیجیتال جمع‌آوری‌شده از سه مرکز رادیولوژی اصلی (مراکز رادیولوژی حکمت، رازی و جواد) در هرات انجام شد. از بین ۲۰۰۰ رادیوگرافی بایگانی‌شده، ۳۲۳ تصویر واجد شرایط از بیماران ۱۵ تا ۴۰ ساله از طریق نمونه‌گیری تصادفی سیستماتیک انتخاب شدند. اطلاعات دموگرافیک و ویژگی‌های رادیوگرافی دندان‌های نهفته ثبت شد. زاویه و عمق نهفتگی به ترتیب بر اساس طبقه‌بندی‌های وینتر و پل و گرگوری ارزیابی شد. داده‌ها با استفاده از نرم‌افزار SPSS نسخه ۲۶ با آمار توصیفی تجزیه و تحلیل شدند.

یافته‌ها: در میان ۳۲۳ رادیوگرافی، ۱۶۵ دندان نهفته شناسایی شد که مربوط به شیوع ۵۱,۱٪ است. ۴.۴۶٪ موارد نهفتگی کامل و ۴,۶٪ موارد نهفتگی نسبی بودند. میانگین سنی شرکت‌کنندگان ۲۴,۵۸±۰۴.۶ سال بود. هیچ ارتباط آماری معنی‌داری بین جنسیت و شیوع دندان‌های نهفته مشاهده نشد (p>۰,۰۵). نهفتگی مزیوانگولار شایع‌ترین زاویه (۵۳,۳٪) و پس از آن نهفتگی عمودی (۲۵,۴۵٪) و افقی (۱۳,۹٪) قرار داشتند. سطح B

عمق غالب نهفتگی بود. دندان‌های کاملاً نهفته بیشتر در فک پایین مشاهده شدند.

نتیجه‌گیری: دندان‌های نهفته اغلب در جمعیت مورد مطالعه مشاهده شدند و شیوع مشابهی بین مردان و زنان داشتند. زاویه مزیوانگولار و عمق سطح B الگوهای رادیوگرافی غالب بودند. این یافته‌ها شواهد اپیدمیولوژیک پایه را برای افغانستان فراهم می‌کنند و بر اهمیت ارزیابی رادیوگرافی اولیه برای تسهیل تشخیص به موقع و مدیریت مناسب دندان‌های نهفته تأکید دارند.

کلیدواژه‌ها: شیوع، دندان نهفته، OPG، مراکز رادیولوژی

ارجاع به این مقاله: صدیقی ز، عرفان ع، دانش ا. ن، نقیب ف. ا. بررسی شیوع دندان‌های نهفته بر اساس رادیوگرافی‌های پانورامیک در مراکز رادیولوژی هرات، افغانستان. مجلهٔ علوم طبی غالب. [اینترنت]. ۱۴۰۵/۰۷/۰۱. [تاریخ برداشت]؛ ۳(۱): ۵۳-۳۷: https://doi.org/10.58342/MJ.V.3.I.2.2

Introduction

Impacted teeth are a common dental finding and may lead to several clinical complications, including malocclusion, periodontal problems, root resorption of adjacent teeth, and cyst formation. Knowledge of their prevalence and distribution is important for diagnosis, treatment planning, and public oral health management. However, epidemiological data on impacted teeth in Afghanistan, particularly in Herat, remain limited. Therefore, this study aimed to determine the prevalence and characteristics of impacted teeth using panoramic radiographs obtained from radiology centers in Herat. A retained tooth is defined as a tooth that fails to erupt completely into the oral cavity despite complete root formation and requires external intervention for eruption [1-3]. Several hereditary and environmental factors contribute to tooth impaction, including ectopic positioning of tooth buds, prolonged retention of primary teeth, localized pathologies, and inadequate dental arch length. Although any tooth may become impacted, the most commonly affected teeth, in descending order, are mandibular third molars, maxillary canines, maxillary third molars, mandibular second premolars, maxillary premolars, and maxillary central incisors [4]. Impacted teeth may lead to various complications, such as dental caries, pulpal and periodontal diseases, root resorption of adjacent teeth, cyst formation, tumors, and jaw fractures. If left untreated, impacted teeth can complicate diagnosis and treatment planning, negatively affecting oral function and aesthetics [5]. Studies have shown that impacted mandibular third molars may weaken the mandibular angle and increase the risk of fractures [6].

Impacted maxillary canines frequently cause clinical challenges and require early diagnosis and intervention. In most adolescents and young adults, clinical examination methods such as palpation are sufficient; however, in approximately 7–10% of cases, radiographic evaluation is necessary to detect eruption disturbances and associated root resorption of adjacent teeth. Failure to treat impacted canines at an early age may result in ankylosis and damage to neighboring incisors, complicating orthodontic and surgical management The surgical removal of impacted teeth can be challenging. Therefore, preoperative assessment of impaction difficulty is essential and is primarily based on radiographic evaluation, particularly panoramic radiographs [7]. If there is no evidence of primary canine root resorption the displaced or impacted maxillary canine should be suspected. Every dentist should palpate the maxillary permanent canines by 9 to 10 years of age or earlier and take radiographs as needed [8].

Dental impacted can be defined as a condition in which a tooth is prevented from erupting completely or partially in the oral cavity, being positioned adjacent to another tooth, below bone or soft tissue. Numerous factors may be related to the process of dental impacted, such as reduced development of the maxillary and mandibular arches. Contemporary ultra-processed food requires

less stimulus from the stomatognathic system and, as a consequence, generates less stimulus in the development of the maxillary arches. Dental anomalies are congenital malformations of the dental tissues that are presented by alterations in development, which may include the shape, number, size, position, eruption, space and structure [9, 10]. Impacted teeth (IT) are those which, after having reached the normal period of eruption, are trapped inside the maxillaries maintaining the integrity of their physiological peri-coronary sac. The prevalence of these teeth is high in young and adult populations. The most common local causes include the density of the bone that covers the tooth, lack of space in underdeveloped maxillaries, prolonged retention of temporary teeth or their premature loss, irregularity in the pressure and position of an adjacent tooth [11, 12]. However, the most common cause is gingival fibrosis [13]. An impacted tooth is completely or partially covered by mucosa and bone for more than 2 years after the time of physiological eruption. Teeth impaction is a commonly observed dental anomaly, although the prevalence varies from place to place and from tooth to tooth. Third molars are the teeth most frequently impacted followed by the maxillary canines.

The etiology of tooth impaction is multifactorial. In the literature, the most commonly reported etiological factors related to tooth impaction can be divided into three different groups: systemic, local and genetic [14].

I. Systemic factors:

1) endocrine deficiencies (e.g. hypothyroidism),
2) radiation therapy,
3) cleidocranial dysostosis,
4) amelogenesis imperfecta.

II. Local factors:

1) failure of deciduous tooth resorption,
2) premature loss of a deciduous tooth,
3) prolonged retention of a deciduous tooth,
4) abnormal eruptive path,
5) presence of a supernumerary tooth/teeth, dental crowding and space loss,
7) early extraction of a deciduous tooth,
8) enlarged dental follicle/dentigerous cyst or other forms of soft tissue pathology (neoplasm),
9) thickened post-extraction or post-trauma repair of the mucosa.
10) dental trauma,
11) odontoma.
12) anomaly in the position of a tooth (e.g. tilting, displacement, transmigration),
13) ankylosis of deciduous molars,
14) root dilacerations,

15) alveolar cleft.

III. Genetic factors:

1) hereditary factors such as a malposed tooth
germ and presence of an alveolar cleft
Classification System for Impacted Third Molars
Pell and Gregory Classification (Depth of Impaction)
Class A: Occlusal plane of the impacted tooth is at the same level as the adjacent tooth.
Class B: Occlusal plane lies between the occlusal plane and the cementoenamel junction (CEJ) of the adjacent tooth.
Class C: Occlusal plane lies apical to the CEJ of the adjacent tooth.
Winter's Classification (Angulation)
Vertical: 0–10°
Mesioangular: 11–79°
Distoangular: 11–79° in a posterior direction
Horizontal: 80–100°

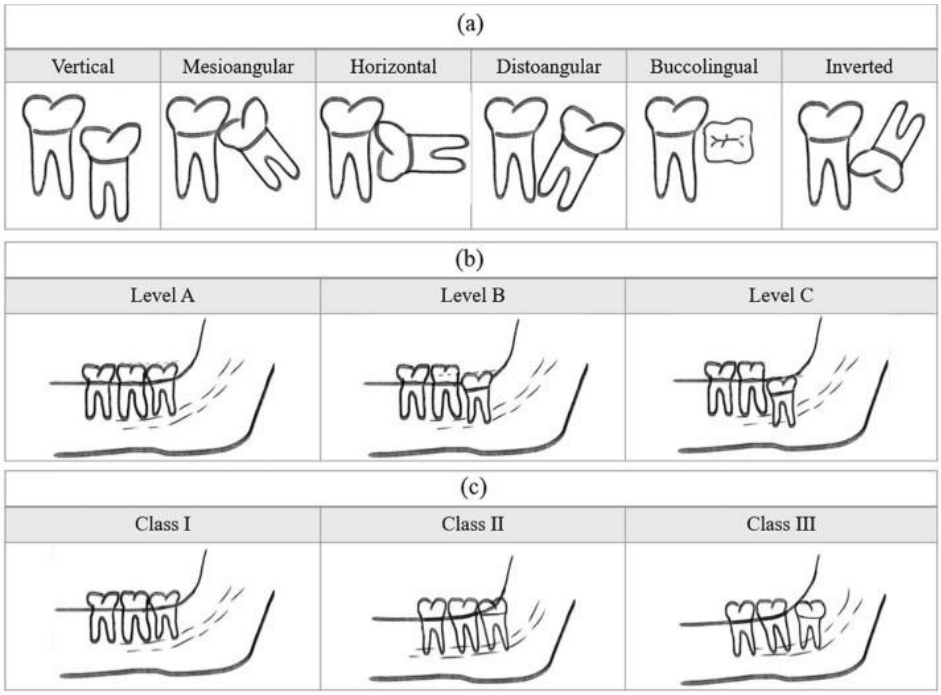

figure 1. Winter's Classification (Angulation)

To the best of our knowledge, this study is among the first analytical investigations assessing Prevalence of Impacted Teeth on Panoramic Radiographs in Radiology Centers of Herat, Afghanistan . Given the limited availability of population-based impacted teeth research in Afghanistan, the

present study provides important baseline evidence that may support future impacted disorders, preventive strategies, and community-based interventions in the country.

Methods

This retrospective descriptive cross-sectional study was conducted to evaluate the prevalence and radiographic characteristics of impacted teeth using digital panoramic radiographs (orthopantomograms; OPGs) obtained from three major digital radiology centers in Herat City, Afghanistan, namely Hikmat, Razi, and Jawad Radiology Centers. These centers were selected because they are among the largest providers of dental radiographic services in the region and receive patients from diverse demographic and socioeconomic backgrounds. The study utilized panoramic radiographs acquired between May 1, 2023, and December 30, 2023. The study population consisted of 2,000 archived digital panoramic radiographs available in the selected centers during the study period. The required sample size was calculated using the RaoSoft sample size calculator based on a finite population of 2,000 radiographs, a 95% confidence level, a 5% margin of error, and an assumed population proportion of 50%. The assumption of a 50% population proportion was adopted because no previous local epidemiological studies were available to estimate the prevalence of impacted teeth, and this conservative approach provides the maximum required sample size while ensuring adequate statistical precision. Accordingly, the minimum sample size was estimated to be 323 radiographs. Eligible radiographs were selected through simple random sampling, ensuring that each radiograph had an equal probability of inclusion. The inclusion criteria comprised patients aged between 15 and 40 years, availability of diagnostically acceptable panoramic radiographs, complete visualization of both dental arches, and radiographs obtained from one of the selected radiology centers. Radiographs belonging to patients younger than 15 years or older than 40 years, images with poor quality, distortion, motion artifacts, incomplete visualization of the maxillary or mandibular arches, duplicate records, or radiographs obtained from centers other than the selected facilities were excluded from the study. Data were collected using a structured radiographic data extraction checklist developed based on established oral and maxillofacial radiology criteria and relevant scientific literature. The checklist included demographic variables such as age, sex, and radiograph identification code, as well as radiographic variables including the presence or absence of impacted teeth, number of impacted teeth, type of impacted tooth, arch distribution (maxillary or mandibular), level of impaction, angulation of impaction, and radiology center of origin. To establish content validity, the checklist was reviewed by five academic experts from the Faculty of Stomatology, Herat University, and their recommendations were incorporated to improve the clarity, relevance, comprehensiveness, and

appropriateness of the recorded variables. All panoramic radiographs were examined systematically under standardized viewing conditions to identify impacted teeth and evaluate their radiographic characteristics. An impacted tooth was defined as a tooth that failed to erupt into its normal functional position within the expected eruption period due to insufficient space, physical obstruction, abnormal eruption pathway, or other developmental factors. The angulation of impacted mandibular third molars was assessed according to Winter's classification and categorized as mesioangular, distoangular, vertical, horizontal, or other angulations where applicable. Furthermore, the depth and ramus relationship of impacted mandibular third molars were evaluated using the Pell and Gregory classification system, which categorizes impactions according to their position relative to the occlusal plane (Levels A, B, and C) and their relationship to the anterior border of the mandibular ramus (Classes I, II, and III). All radiographic findings were recorded directly on the data extraction checklist and subsequently entered into a computerized database for analysis. Data were coded, entered, cleaned, and analyzed using the Statistical Package for the Social Sciences (SPSS), version 26. Descriptive statistical analyses, including frequencies, percentages, means, and standard deviations, were performed as appropriate to summarize the demographic and radiographic characteristics of the study population. The findings were presented in tables and figures to facilitate interpretation and provide a comprehensive overview of the prevalence and distribution patterns of impacted teeth. This study involved the retrospective analysis of existing radiographic records and did not require direct patient contact, clinical examination, or therapeutic intervention. Patient confidentiality and privacy were strictly maintained throughout the study, and all identifying information was removed prior to data extraction and analysis. Permission to access archived radiographic records was obtained from the respective radiology centers. The study protocol was approved by the Ethics Committee of the Faculty of Stomatology, Herat University (Ethics Committee approval code: 0303062026). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and internationally accepted standards governing research involving human participants and their health-related data.

Results

This study aimed to investigate the occurrence of impacted teeth in OPG radiographs from radiology centers in Herat city. Out of 2000 radiographs examined a sample size of 323 radiographs was analyzed, among the 323 radiographs which included, 136 (42.11%) belonged to male patients and 187 (57.87%) to female patients (fig 1).

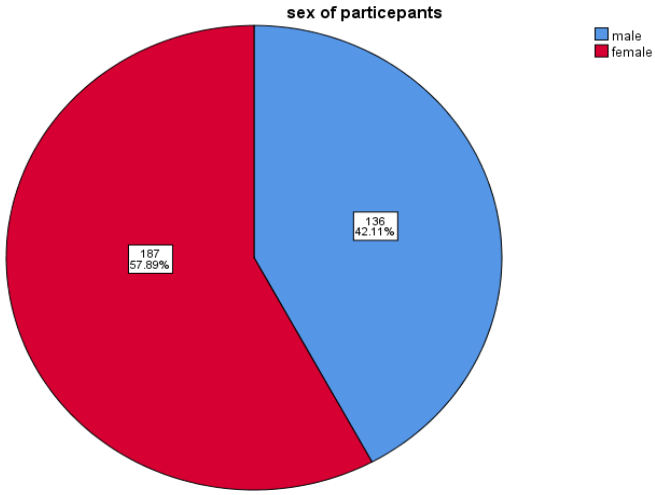

Figure1. illustrates the distribution of patients by gender

Among 323 radiographs examined, 165 impacted teeth were identified, representing 51.1% of the total sample. Of the 165 impacted teeth, 150 (46.4%) were completely impacted, while 15 (4.6%) were partially impacted. Among the affected patients, 71 had one impacted tooth, 53 had two impacted teeth, 11 had three impacted teeth, and 30 had four impacted teeth.A total of 165 impacted teeth (51.08%) were identified. Seventy-one patients had one impacted tooth, 53 had two, 11 had three, and 30 had four impacted teeth (Table 1, 2).

Table 1. explains the number of complete limpacted teeth and partially impacted.

	Frequency	Percent	Valid Percent	Cumulative Percent
yes	150	46.4	46.4	46.4
No	158	48.9	48.9	95.4
Semi Impact	15	4.6	4.6	100.0
Total	323	100.0	100.0	

Table 2. explains the number of impacted teeth.

	Frequency	Percent	Valid Percent	Cumulative Percent
1	71	22.0	43.0	43.0
2	53	16.4	32.1	75.2
3	11	3.4	6.7	81.8
4	30	9.3	18.2	100.0
Total of impacted	165	51.1	100.0	
Total of patiant	323	100.0		

The age of patients ranged from 15 to 40 years, with a mean age of 24.58 years (Table 3).

Table 3. shows the age distribution of the patients.

	N	Minimum	Maximum	Mean	
	Statistic	Statistic	Statistic	Statistic	Std, Error
Ages of particepants	323	15	40	24,58	,336
Valid N (listwise)	323				

Statistical analysis revealed no significant difference in the prevalence of impacted teeth between males and females ($p > 0.05$).

Regarding the angulation of impacted teeth, mesioangular impaction was the most common pattern, accounting for 53.3% of all cases. After that vertical impaction, which constituted 25.45% of the impacted teeth the third most common angulation, was horezontal 13.9% of cases. Excluding cases categorized as undetermined due to the limitations of panoramic radiographs (OPG) in accurately assessing tooth angulation, distoangular impaction was the least frequently observed pattern, comprising only 1.8% of the impacted teeth. (Fig 2).

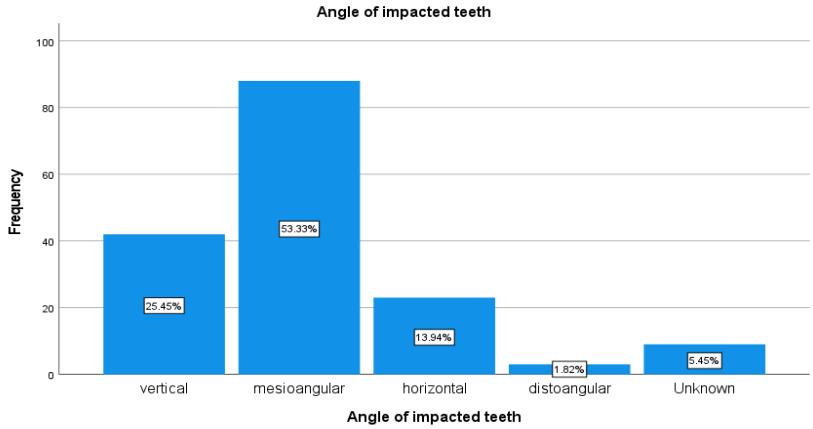

Figure 2. illustrates the angles of tooth impaction.

With respect to dental arch distribution, completely impacted teeth were observed most frequently in the mandible alone, followed in the maxilla alone. In contrast, partially impacted teeth were more commonly identified in the maxilla than mandible distributions (Table 4).

Table 4. Impacted teeth arch of teeth crosstabulation.

	Maxilla	Mandibular	Both arch	Total
Yes	47	62	41	150
Semi Impact	8	6	1	15
Total	55	68	42	165

The most common impaction depth was Level B. In males, Level C was most prevalent, whereas in females, Level B predominated (Table 5).

Table 5. Description of Tooth Impaction Types in Patients.

	A	B	C	Total
Male	20	24	25	69
Female	14	47	35	96
Total	34	71	60	165

Discussion

Surgical extraction of impacted lower wisdom teeth is one of the outpatient surgeries performed more frequently in mandibular cases than in maxillary ones. The tissue of impaction is significant and has been discussed across various branches of dentistry such as surgery, pediatrics, orthodontics, and prosthodontics. This is to address complications arising from impacted teeth, including periodontal tissues, decay of adjacent teeth, root resorption of neighboring teeth, crowding, cyst formation, tumors, and unexplained pains, to develop a correct and timely treatment plan and make appropriate therapeutic decisions to prevent subsequent complications [15].The dentist must determine whether an impacted wisdom tooth will remain impacted or has a chance of erupting.

Determining factors include:

1. Patient's age
2. Available space in the area concerned

The average age for wisdom tooth eruption is around 20 years; however, in some individuals, especially men, eruption may occur up to 25 years of age. It is evident that after age 25, wisdom teeth will not erupt. During growth, the angle of the mandible causes the lower third molar to initially be horizontal, then mesioangular, and finally vertical. One reason for the impaction of lower third molars is the failure of the tooth to rotate from a mesioangular position to a vertical position [16] . Eruption of impacted canines in the maxilla often leads to complications; therefore, it requires thorough examination and timely diagnosis. In most young adults and adolescents, diagnosis can be made using clinical methods such as palpation; however, in 7 to 10 percent of patients, this method must be complemented with radiographic studies to identify developmental disorders and related problems such as root resorption of adjacent teeth. The primary diagnostic tool for assessing canine eruption disorders includes periapical and panoramic radiographs. Due to their inability to display bone status and root shape of adjacent teeth, especially in the apical region, a newer method called computed tomography is now used [17].

Given that non-eruption of upper canines poses positioning and treatment challenges for orthodontists and surgeons, it has been established that without orthodontic treatment at a young age, there is a risk of canine ankylosis and its detrimental effects on the roots of incisors. Therefore, finding a method for early diagnosis and preventing palatally impacted canines eliminates the need for complex treatments and enhances treatment prognosis. The positional determination of buccal or palatal placement of canines in the jawbone can influence treatment plans. It is evident that a tooth positioned appropriately for eruption with orthodontic treatment will not require surgical extraction [18-20].

A study conducted in Northern Greece by Fardi et al. indicated that out of 1239 patients, 593 were men (47.9%) and 646 were women (52.1%), with at least one impacted tooth found in 170 patients (13.7%). Among these cases, 45.9% of impactions were observed in men and 54.1% in women [5].
In another study conducted by Abdulrazaghi et al. in Qom, differences were shown compared to this research [18].

Conclusion

This study provides one of the first epidemiological assessments of impacted teeth in Herat, Afghanistan, using panoramic radiographs obtained from major radiology centers. Impacted teeth were frequently identified in the studied population, with no statistically significant difference between males and females. Mesioangular impaction represented the predominant angulation pattern, while Level B was the most common depth of impaction according to the Pell and Gregory classification. Mandibular teeth were affected more frequently than maxillary teeth, particularly in cases of complete impaction.
These findings highlight the importance of routine radiographic screening, particularly among adolescents and young adults, to facilitate early diagnosis and timely management of impacted teeth before the development of associated complications such as root resorption, periodontal destruction, cystic lesions, and malocclusion. The results also provide baseline epidemiological data for Afghanistan, where evidence on impacted teeth remains scarce, and may assist clinicians, orthodontists, oral surgeons, and public health authorities in planning preventive and therapeutic strategies.
Future multicenter studies with larger and more representative populations, together with three-dimensional imaging modalities such as CBCT, are recommended to better characterize impaction patterns, evaluate anatomical relationships, and identify risk factors influencing tooth impaction in the Afghan population.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the retrospective cross-sectional design precludes the assessment of causal relationships or longitudinal changes in tooth eruption patterns. Second, the study was based solely on panoramic radiographs (OPGs), which have inherent limitations in accurately assessing the three-dimensional position of impacted teeth and their relationship to adjacent anatomical structures. Third, the radiographs were obtained from three radiology centers within Herat City; therefore, the findings may not be fully generalizable to the entire Afghan population. In addition, clinical examination and CBCT imaging were not available to validate radiographic findings or evaluate associated pathological conditions. Finally, potentially influential factors such as

socioeconomic status, genetic predisposition, systemic diseases, and previous orthodontic treatment history were not assessed, which may have affected the observed prevalence and distribution of impacted teeth.

Recommendations

Based on the findings of this study, routine panoramic radiographic evaluation is recommended for adolescents and young adults with delayed tooth eruption or suspected impaction to facilitate early diagnosis and appropriate treatment. Dental practitioners should incorporate comprehensive radiographic assessment into treatment planning to minimize complications associated with impacted teeth. In addition, public oral health initiatives should emphasize awareness of the importance of early dental examinations and timely management of impacted teeth. Future research should include larger, multicenter studies involving more representative populations from different regions of Afghanistan to improve the generalizability of the findings. Furthermore, the use of three-dimensional imaging modalities, particularly cone-beam computed tomography (CBCT), is recommended to provide more accurate assessment of impacted teeth and their anatomical relationships. Investigating potential demographic, genetic, environmental, and craniofacial risk factors associated with tooth impaction would also contribute to a better understanding of its etiology and support the development of effective preventive and clinical management strategies.

Acknowledgments

The authors would like to express their sincere gratitude to the staff of Hikmat, Razi, and Jawad Radiology Centers in Herat, Afghanistan, for granting access to the archived panoramic radiographs and for their valuable cooperation throughout this study. The authors also gratefully acknowledge the Faculty of Stomatology, Herat University, for its academic support and guidance. In addition, the authors sincerely thank the Research Center of Ghalib University for its scientific support, valuable guidance, and encouragement during the preparation and completion of this research. Finally, the authors extend their appreciation to all individuals who contributed directly or indirectly to the successful completion of this study.

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