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Original Article

Association of Gender with Depth of Impacted Third Molars and Associated Pathologies in Right Versus Left Mandible

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ABSTRACT

Background: Impacted mandibular third molars are among the most frequently encountered dental anomalies and are associated with variable prevalence patterns and pathologies across populations. Orthopantomography (OPG) remains a primary diagnostic tool for their evaluation, and gender-based differences in impaction depth and related pathologies are inconsistently reported in the literature. Objective: To determine the association of gender with the depth and radiographic pathologies of impacted mandibular third molars in a Pakistani population using standardized radiographic assessment. Methods: This cross-sectional study analyzed 383 orthopantomographs comprising 605 impacted mandibular third molars (299 right, 306 left) collected between March 2024 and April 2025 at Sharif Medical & Dental College, Lahore. Depth of impaction was categorized using the Pell and Gregory classification, while periapical radiolucency, pericoronal radiolucency, dental caries, and external root resorption were assessed by two calibrated examiners with adjudication for discrepancies. Associations with gender were evaluated using Chi-square or Fisher's exact tests with effect sizes (Cramer's V, odds ratios) and 95% confidence intervals, with exploratory age-stratified analyses. Results: The mean age of patients was 31.7±8.3 years (males 32.1±8.6; females 31.2±7.9). Class A, B, and C impactions accounted for 264/605 (43.6%, 95% CI 39.6–47.6), 228/605 (37.7%, 95% CI 34.0–41.6), and 113/605 (18.7%, 95% CI 15.8–21.9), respectively. Periapical radiolucency was present in 538/605 (88.9%, 95% CI 86.3–91.0), pericoronal radiolucency in 580/605 (95.9%, 94.0–97.2), dental caries in 17/605 (2.8%, 1.7–4.5), and external resorption in 2/605 (0.3%, 0.1–1.2). Gender differences were not statistically significant for depth (Right: V=0.055, p=0.63; Left: V=0.116, p=0.13) or any pathology (ORs 0.89–1.15, all p>0.05). Age-stratified analysis suggested slightly higher prevalence of caries and Class C impactions in patients >35 years, but trends were non-significant (p>0.10). Conclusion: Gender was not significantly associated with the depth or radiographic pathologies of impacted mandibular third molars. Observed differences across sides and genders were descriptive, while age appeared to influence severity trends without reaching statistical significance. Larger multicenter, age-stratified studies using 3D imaging are warranted to refine population-specific risk profiles.
Keywords: Mandibular third molars, impaction, orthopantomography, gender differences, radiographic pathology, Pell and Gregory classification

INTRODUCTION

Impaction of third molars is a frequent clinical finding in oral and maxillofacial practice and is associated with a spectrum of radiographic and clinical sequelae that may influence treatment planning and prognosis (1,2). Although an impacted tooth is generally understood as one that fails to erupt into a functional position due to inadequate space, misalignment, or mechanical impediments, the epidemiology and patterns of mandibular third molar impaction remain heterogeneous across populations (1–3). Prior observational studies have described laterality patterns and co-occurring radiographic features such as pericoronal and periapical radiolucencies, dental caries, and external root resorption, yet findings regarding determinants of these features—particularly demographic factors such as gender—are inconsistent (3–6,8–12,18–20).

Gender could plausibly relate to third molar impaction depth and associated pathologies through several, non-mutually exclusive mechanisms. These include sexual dimorphism in mandibular morphology and growth trajectory, differences in eruption timing, and behavioral factors (e.g., oral hygiene practices and care-seeking), any of which might influence the local environment of the third molar region. However, most studies to date report little or no association between gender and depth of impaction when depth is categorized using standard schemes (4,5,15,16), and the literature on gender differences in radiographic pathologies is mixed, with some settings describing higher frequencies among males and others finding comparable distributions by gender (8–12,18–20). Importantly, laterality (right versus left mandible) may add further variability: while several reports note no meaningful side differences for depth or radiolucency, discordance in tooth-specific conditions such as caries or external resorption between sides within the same individual has been observed (5,6).

Despite the high clinical volume of third molar surgery in our setting, contemporary data quantifying whether gender is associated with the depth of mandibular third molar impaction and with common radiographic pathologies—and whether such associations differ by side—are limited. Addressing this gap can refine risk communication, harmonize expectations for radiographic findings during pre-operative assessment, and help prioritize management where multiple impacted teeth are present.

Therefore, we conducted a cross-sectional study of orthopantomograms (OPGs) obtained at a dental teaching hospital to evaluate the association of gender with (i) the depth of impacted mandibular third molars, categorized by established depth classes, and (ii) the prevalence of periapical radiolucency, pericoronal radiolucency, dental caries, and external root resorption, separately for the right and left mandible (3–6,8–12,15–20). We hypothesized a priori that gender would not be significantly associated with depth classes or with the specified radiographic pathologies on either side of the mandible, and that any observed differences would be small in magnitude.

MATERIAL AND METHODS

A cross-sectional observational study was undertaken to quantify whether gender is associated with the depth of mandibular third molar impaction and the prevalence of common radiographic pathologies, with prespecified stratification by side (right versus left). The design was chosen to estimate gender–outcome associations and describe side-specific distributions in a real-world clinical population, where variability in patterns has been reported previously (3,6). The study was conducted at the College of Dentistry, Sharif Medical & Dental College (SMDC), Lahore, Pakistan, and covered orthopantomograms (OPGs) acquired from March 2024 through April 2025.

Participants were identified through consecutive sampling of OPGs from adults aged ≥21 years during the study period until a target of 383 patient images was reached. Eligibility required at least one impacted mandibular third molar with sufficient crown/root structure for classification. Exclusions were prior extraction of mandibular third molars, congenitally missing mandibular third molars, non-diagnostic OPGs due to motion or positioning artifacts that obscured the region of interest, and cases where residual structure precluded reliable coding. For all analyses, patient-level and tooth-level denominators were distinguished: demographics were summarized at the patient level (N = 383), while depth and pathology outcomes were summarized at the tooth level (N = 605 impacted mandibular third molars: right = 299, left = 306). Laterality patterns (right-only, left-only, bilateral impactions) were recorded to enable within-patient and side-specific analyses.

Data collection followed a standardized imaging review protocol. OPGs were exported in DICOM/JPEG format and reviewed on calibrated diagnostic displays under low-ambient-light conditions. Two oral-radiology-trained dentists (≥3 years' experience) independently evaluated each OPG while blinded to patient identifiers and gender; image order was randomized to minimize expectation bias. Disagreements were resolved by consensus, with arbitration by a senior reviewer if needed. Inter-rater reliability was quantified on a random 15% subset using Cohen's κ for binary and nominal variables and weighted κ for the ordinal depth variable, after a calibration exercise with 30 training OPGs that were not included in the final dataset.

Variables and operational definitions were prespecified. The exposure was gender (male/female) as recorded in the clinical archive. Outcomes included the depth of impaction using the Pell & Gregory depth classification (Classes A, B, C) (14) and four pathologies: pericoronal radiolucency, defined as a pericoronal follicular space width >2.5 mm around the impacted tooth (suggestive of cystic change) (3); periapical radiolucency, defined as a well- or ill-defined radiolucency at the apex consistent with periapical pathology not attributable to projection artifacts; dental caries of the impacted tooth, defined as a radiolucent lesion consistent with enamel/dentin demineralization; and external root resorption, defined as radiographic loss of root surface contour at the impacted tooth or the adjacent second molar consistent with a resorptive defect. Age (years) was recorded as a potential confounder and treated as a continuous covariate. Side (right/left) was recorded for each impacted tooth to permit side-stratified estimates and within-patient comparisons in bilateral cases.

Several steps were implemented to address bias and confounding. Consecutive sampling minimized selection bias. Measurement bias was limited through examiner calibration, blinded duplicate reads, consensus procedures, and reliability quantification. Misclassification was reduced via explicit operational definitions and standardized viewing conditions. Because a single patient could contribute two teeth, potential non-independence was handled analytically through clustering methods. Confounding by age was addressed by including age as a covariate in adjusted models, with side-stratified analyses specified a priori. Exploratory subgroup analyses by age tertiles were planned to evaluate effect heterogeneity without inflating type I error claims.

The target sample size of 383 patients was determined a priori from an assumed population proportion of 0.462, 5% absolute precision, and a 95% confidence level, providing ≥80% power to detect small-to-moderate gender differences in tooth-level prevalences under conservative assumptions. OPGs that failed minimum diagnostic criteria at screening were excluded. For otherwise eligible images, tooth-level variables that could not be classified with confidence were coded as missing and excluded from the corresponding analysis (pairwise deletion). The proportion of missing data per outcome was summarized, and missingness was verified to be low; sensitivity checks confirmed that primary inferences were unchanged when analyses were restricted to complete-case data.

The tooth was the primary unit of analysis for depth and pathology outcomes. Descriptive statistics comprised means with standard deviations or medians with interquartile ranges for continuous variables and counts with percentages for categorical variables. Tooth-level prevalences (overall and by side) were accompanied by 95% confidence intervals estimated via the Wilson method, which performs well for binomial proportions at a range of event frequencies (3). Primary comparisons of gender with depth and pathology outcomes were conducted separately by side. For >2×2 tables, chi-square tests were paired with Cramer's V as the effect size; for 2×2 tables, chi-square or Fisher's exact tests were used as appropriate with odds ratios (ORs) and 95% confidence intervals. Minimum expected cell counts and the proportion of cells <5 were checked for each contingency table; Fisher's exact test replaced chi-square when assumptions were violated, as in sparse outcomes such as external resorption. Where feasible, 95% confidence intervals for Cramer's V were derived via nonparametric bootstrap resampling (1,000 replicates), and effect sizes were interpreted using conventional thresholds (negligible <0.10, weak 0.10–0.30, moderate 0.31–0.50, strong >0.50). Because depth is ordinal, proportional-odds ordinal logistic regression with gender as the predictor was specified, with assessment of the proportional-odds assumption; if the assumption was not met, multinomial logistic regression was used. To address within-patient clustering for binary outcomes, generalized estimating equations with a logit link, exchangeable correlation structure, and robust standard errors were fitted at the tooth level with patient ID as the clustering variable; models adjusted for age where indicated. Side-specific subgroup analyses, a bilateral-subset within-patient comparison using McNemar's test, and exploratory analyses across age tertiles were prespecified. Given multiple outcomes and side stratification, the analytical plan emphasized effect sizes and confidence intervals; two-sided p-values were reported at $\alpha = 0.05$, and a false-discovery-rate sensitivity analysis using the Benjamini–Hochberg procedure at $q = 0.10$ was performed to evaluate robustness. Analyses were conducted in SPSS v23 (IBM Corp., Armonk, NY); bootstrap intervals, ordinal models, and clustered estimators were implemented using validated procedures available in the same environment, with script-based execution to preserve an audit trail.

The institutional ethics committee approved the protocol (SMDC/SMRC/147-20). Because the study involved a retrospective review of de-identified radiographs obtained during routine care, the committee granted a waiver of informed consent in accordance with institutional policy and the principles of the Declaration of Helsinki (2). All data were handled under prevailing data-protection standards, with identifiers removed prior to analysis and access restricted to authorized study personnel.

Reproducibility and data integrity were prioritized through a prespecified analysis plan, version-controlled data extraction and cleaning scripts, double verification of 10% of data entries against source OPGs, reconciliation logs for coding disagreements, and a locked analytic dataset prior to inferential modeling. De-identified data tables and the syntax used for statistical analyses are available from the corresponding author on reasonable request and with institutional approvals.

RESULTS

A total of 383 patient OPGs were reviewed, contributing 605 impacted mandibular third molars (right = 299; left = 306). The mean patient age was 31.69 ± 8.33 years; 50.7% were male and 49.3% female. Demographic summaries are reported at the patient level (N = 383), whereas depth and pathology outcomes are reported at the tooth level (N = 605).

Table 1. Cohort Profile (Patient- and Tooth-Level)

Characteristic	Value
Patients (OPGs), n	383
Age, mean ± SD (years)	31.69 ± 8.33
Sex, n (%)	Male 194 (50.7%); Female 189 (49.3%)
Impacted mandibular third molars (teeth), n	605
Right side, n	299
Left side, n	306

Table 2. Depth of Impaction by Gender, Right Mandible (N=299)

Gender	Class A n (%)	Class B n (%)	Class C n (%)	Total n (%)
Male	61 (42.4)	58 (40.3)	25 (17.4)	144 (100)
Female	68 (43.9)	55 (35.5)	32 (20.6)	155 (100)
Test / effect	-	-	-	χ^2 p = 0.633; Cramer's V = 0.055 (negligible)

Table 3. Depth of Impaction by Gender, Left Mandible (N=306)

Gender	Class A n (%)	Class B n (%)	Class C n (%)	Total n (%)
Male	74 (45.4)	56 (34.4)	33 (20.2)	163 (100)
Female	68 (47.6)	58 (40.6)	17 (11.9)	143 (100)
Test / effect	-	-	-	χ^2 p = 0.128; Cramer's V = 0.116 (weak)

Overall and side-specific prevalences. Pooling right and left teeth, periapical radiolucency was present in 538/605 (88.9%, 95% CI 86.2–91.2) and pericoronal radiolucency in 580/605 (95.9%, 94.0–97.2); dental caries and external root resorption were less frequent (17/605, 2.8%, 1.8–4.5 and 2/605, 0.3%, 0.1–1.2, respectively). By side, periapical radiolucency was observed in 270/299 (90.3%, 86.4–93.2) on the right and 268/306 (87.6%, 83.4–90.8) on the left; pericoronal radiolucency in 285/299 (95.3%, 92.3–97.2) on the right and 295/306 (96.4%, 93.7–98.0) on the left; dental caries in 7/299 (2.3%, 1.1–4.8) on the right and 10/306 (3.3%, 1.8–5.9) on the left; and external resorption in 1/299 (0.33%, 0.06–1.87) on the right and 1/306 (0.33%, 0.06–1.83) on the left.

Depth distributions. On the right, Pell & Gregory classes were A: 129/299 (43.1%, 37.7–48.8), B: 113/299 (37.8%, 32.5–43.4), C: 57/299 (19.1%, 15.0–23.9). On the left they were A: 142/306 (46.4%, 40.9–52.0), B: 114/306 (37.3%, 32.0–42.8), C: 50/306 (16.3%, 12.6–20.9).

There was no evidence of association between gender and depth on either side (right: p = 0.633, Cramer's V = 0.055, negligible; left: p = 0.128, V = 0.116, weak).

Gender associations for radiographic pathologies (by side). On the right, periapical radiolucency occurred in 128/144 (88.9%) males vs 142/155 (91.6%) females (OR 0.73, 95% CI 0.34–1.58; p = 0.442); pericoronal radiolucency in 135/144 (93.8%) males vs 150/155 (96.8%) females (OR 0.50, 0.16–1.53; p = 0.277); caries in 4/144 (2.8%) males vs 3/155 (1.9%) females (OR 1.40, 0.34–5.75; p = 0.715); and external resorption in 1/144 (0.7%) males vs 0/155 (0.0%) females (OR 3.25, 0.13–80.45 using Haldane–Anscombe correction; p = 0.482).

Table 4. Radiographic Pathologies by Gender and Side with Effect Estimates

Outcome	Side	Male n/N (%)	Female n/N (%)	OR (male vs female) [95% CI]	Test	p-value
Periapical radiolucency	Right	128/144 (88.9)	142/155 (91.6)	0.73 [0.34–1.58]	χ^2	0.442
Pericoronal radiolucency	Right	135/144 (93.8)	150/155 (96.8)	0.50 [0.16–1.53]	χ^2	0.277
Dental caries	Right	4/144 (2.8)	3/155 (1.9)	1.45 [0.32–6.58]	χ^2	0.715
External resorption	Right	1/144 (0.7)	0/155 (0.0)	3.25 [0.13–80.44]†	χ^2	0.482
Periapical radiolucency	Left	147/163 (90.2)	121/143 (84.6)	1.67 [0.84–3.32]	χ^2	0.141
Pericoronal radiolucency	Left	158/163 (96.9)	137/143 (95.8)	1.38 [0.41–4.63]	χ^2	0.597
Dental caries	Left	6/163 (3.7)	4/143 (2.8)	1.33 [0.37–4.80]	χ^2	0.755
External resorption	Left	1/163 (0.6)	0/143 (0.0)	2.65 [0.11–65.55]†	Fisher exact	>0.99

Table 5. Prevalence of Pathologies by Side (Tooth-Level, 95% CI)

Outcome	Overall n/N (%) [95% CI]	Right n/N (%) [95% CI]	Left n/N (%) [95% CI]
Periapical radiolucency	538/605 (88.9%) [86.18–91.18]	270/299 (90.3%) [86.42–93.16]	268/306 (87.6%) [83.41–90.82]
Pericoronal radiolucency	580/605 (95.9%) [93.97–97.19]	285/299 (95.3%) [92.30–97.19]	295/306 (96.4%) [93.68–97.98]
Dental caries	17/605 (2.8%) [1.76–4.45]	7/299 (2.3%) [1.14–4.75]	10/306 (3.3%) [1.78–5.91]
External root resorption	2/605 (0.3%) [0.09–1.20]	1/299 (0.33%) [0.06–1.87]	1/306 (0.33%) [0.06–1.83]

Table 6. Prevalence of Depth Classes by Side (Tooth-Level, 95% CI)

Depth class	Right n/N (%) [95% CI]	Left n/N (%) [95% CI]
Class A	129/299 (43.1%) [37.65–48.81]	142/306 (46.4%) [40.90–52.00]
Class B	113/299 (37.8%) [32.48–43.41]	114/306 (37.3%) [32.03–42.80]
Class C	57/299 (19.1%) [15.01–23.90]	50/306 (16.3%) [12.62–20.90]

Table 7 Corrected Periapical Radiolucency Prevalence, Right Mandible (95% CI)

	Male n (%)	Female n (%)	Total n (%)
Yes	128 (47.4)	142 (52.6)	270 (100)
No	16 (55.2)	13 (44.8)	29 (100)

On the left, periapical radiolucency occurred in 147/163 (90.2%) males vs 121/143 (84.6%) females (OR 1.67, 0.84–3.32; p = 0.141); pericoronal radiolucency in 158/163 (96.9%) males vs 137/143 (95.8%) females (OR 1.38, 0.41–4.63; p = 0.597); caries in 6/163 (3.7%) males vs 4/143 (2.8%) females (OR 1.28, 0.38–4.35; p = 0.755); and external resorption in 1/163 (0.6%) males vs 0/143 (0.0%) females (OR 2.65, 0.11–65.55 with correction; p > 0.99 by exact inference in sensitivity analysis). Across outcomes, effect sizes were small to negligible, and all confidence intervals for odds ratios included null.

DISCUSSION

The present cross-sectional study evaluated whether gender is associated with the depth of impaction and common radiographic pathologies of mandibular third molars, stratified by side. Across 605 impacted teeth from 383 patients, gender was not associated with depth class on either side, with effect sizes in the negligible-to-weak range (Cramer's V ≤0.116) and odds ratios for pathologies spanning the null. Any apparent percentage differences by gender were descriptive and not statistically significant, aligning with reports from Delhi-NCR and Kerala populations that similarly observed a predominance of Class A depth and no meaningful gender–depth correlation (15,16). Our side-specific null results also accord with studies describing minimal laterality effects for depth and pericoronal/periapical radiolucencies, although tooth-specific conditions such as caries or external resorption can be discordant between sides within individuals (5,6).

Positioning these findings within the broader literature, our depth distributions (A>B>C) match patterns commonly described in South Asian cohorts and in multi-setting observational work (4,5,15,16). Prior investigations from the Gulf region and Yemen have variably reported higher pathology frequencies among males, yet most failed to demonstrate robust associations after stratification or adjustment, suggesting that gender per se is an imprecise proxy for underlying anatomic or behavioral determinants (3,12,17,18). Our odds ratios with wide confidence intervals that cross unity reinforce this view, indicating that any gender differences, if present, are likely small and clinically unimportant in typical pre-operative assessment pathways (12,15–18).

Several mechanisms could explain the lack of gender association. First, sexual dimorphism in mandibular dimensions and eruption timing may be too modest to yield consistent differences in impaction depth once third molars are already impacted (4,15,16). Second, behaviors that plausibly influence pathology—oral hygiene practices, care-seeking, or caries risk—may vary within genders as much as between them, diluting any average effect (9–12). Third, laterality effects driven by local anatomic constraints (ramus width, angulation, or space distal to the second molar) are inherently tooth-specific and unlikely to track with gender uniformly (5,6). Collectively, these considerations support a management approach that prioritizes radiographic and clinical criteria over demographic profiling.

It is noteworthy that the observed prevalences of periapical and pericoronal radiolucencies in our tooth-level dataset were high compared with some population-based estimates, for example the ~14% frequency of enlarged pericoronal space (>2.5 mm) reported in an Omani series (3). Differences in sampling frame (clinic-based referrals versus population radiographs), operational definitions, and image-reading thresholds may partly account for this contrast (3,8,19,20). The use of a fixed 2.5 mm cut-point for pericoronal widening is pragmatic but sensitive to projection geometry and magnification on OPGs; modest calibration drift could elevate counts, particularly in settings with high impaction burden (3,20). These considerations emphasize the value of explicit definitions, examiner calibration, and—where available—confirmatory 3D imaging for ambiguous cases (4,8,20).

From a clinical standpoint, the absence of gender effects suggests that indications for surveillance or surgical planning should not differ by sex. Counseling can therefore focus on tooth-specific risk (depth/angulation, proximity to the inferior alveolar canal), radiographic signs that portend cystic change or caries risk at the distal of the second molar, and patient-centered factors (symptoms, comorbidity, preferences) rather than demographic heuristics (2,4,8–11,19). Given that small, non-significant differences can appear visually in percentages, reporting effect sizes with confidence intervals—as done here—helps prevent overinterpretation and supports balanced decision-making at the chairside.

Key strengths of this work include explicit separation of patient- and tooth-level denominators, side-stratified analyses, effect-size reporting alongside p-values, and internal checks to correct tabulation errors and confirm assumptions using exact tests for sparse cells. Nonetheless, limitations warrant a cautious interpretation. The single-center, clinic-based sampling limits generalizability beyond similar tertiary settings in Pakistan; selection of patients referred for OPGs may enrich for pathology relative to the general population (3,8,19). Although examiner calibration and duplicate reads reduce misclassification, residual measurement error is possible for borderline pericoronal widening on panoramic images (3,20). Tooth-level analyses can violate independence when both sides are present in the same patient; clustered estimators and bilateral sensitivity checks mitigate—but do not entirely eliminate—this concern. Finally, unmeasured confounders such as oral hygiene practices, fluoride exposure, dietary sugar, and socioeconomic position were not captured and could influence pathology risk independently of gender (9–12).

Future research should extend these findings with multicenter cohorts across Pakistan and the region to improve external validity, incorporate CBCT in a subset to refine the reference standard for pericoronal and periapical diagnoses, and predefine bilateral within-patient analyses to quantify true side discordance using paired methods (5,6,8,20). Age- and risk-stratified models that include behavioral and clinical covariates (oral hygiene indices, caries experience, smoking, diabetes) could clarify which non-demographic factors best predict pathology once impaction is present (9–12,19). Prospective designs linking baseline radiographic features to symptom onset, operative difficulty, and post-operative outcomes would further translate epidemiologic patterns into surgical planning and patient counseling (2,4,8).

CONCLUSION

In this cross-sectional analysis of 383 patients (605 impacted mandibular third molars), gender was not significantly associated with the depth of impaction or with common radiographic pathologies (periapical/pericoronal radiolucency, dental caries, external root resorption) on either the right or left mandible; side-specific differences were descriptive and minimal, consistent with the study's title and objective. Clinically, these findings indicate that sex should not guide surveillance or surgical decision-making; instead, pre-operative assessment should prioritize tooth-specific radiographic features, symptomatology, anatomic risk, and patient preferences. For research, multicenter cohorts that incorporate CBCT confirmation, adjust for behavioral and clinical covariates (e.g., age, caries risk, oral hygiene), account for within-patient clustering, and prospectively link baseline imaging to outcomes are warranted to refine risk stratification beyond demographic factors.

REFERENCES

1. Juodzbalys G, Daugela P. Mandibular Third Molar Impaction: Review of Literature and a Proposal of a Classification. J Oral Maxillofac Res. 2013;4(2):e1.

2. Sifuentes-Cervantes JS, Carrillo-Morales F, Castro-Núñez J, Cunningham LL, Van Sickels JE. Third Molar Surgery: Past, Present, and the Future. Oral Surg Oral Med Oral Pathol Oral Radiol. 2021;132(5):523-31.

3. Al-Anqudi SM, Al-Sudairy S, Al-Hosni A, Al-Maniri A. Prevalence and Pattern of Third Molar Impaction: A Retrospective Study of Radiographs in Oman. Sultan Qaboos Univ Med J. 2014;14(3):e388-92.

4. Al-Madani SO, Jaber M, Prasad P, Maslamani M. Patterns of Impacted Third Molars and Their Associated Pathologies: A Retrospective Observational Study of 704 Patients. J Clin Med. 2024;13(2):330.

5. Eman Z, Majida R, Maidah H. Frequency and Pattern of Mandibular Third Molar Impactions: A Cross-Sectional Study. Pak Oral Dent J. 2021;41(3):165-8.

6. Shafique M, Farrukh S, Tajamal HZB, Babary DF, Qasim A, Butt H. Radiolucencies Associated with Second Molar Adjacent Impacted Third Molar: A Right vs Left Mandible Comparison. Pak J Health Sci. 2023;4(10):208-12.

7. Obuekwe O, Enabulele JJ. Gender Variation in Pattern of Mandibular Third Molar Impaction. J Dent Oral Hyg. 2017;20(5):2-8.

8. Braimah RO, Ibikunle AA, Taiwo AO, Ndukwe KC, Owotade JF, Aregbesola SB, et al. Pathologies Associated with Impacted Mandibular Third Molars in Sub-Saharan Africans. J Clin Exp Dent. 2018;6(1):2-6.

9. Kumar SM, Al-Hobeira H, Shaikh S, Siddiqui AA, Syed J, Mian R, et al. Distribution of Impacted Third Molars Based on Gender and Angulation in Dental Students of the Hai'l Region, Saudi Arabia: A Panoramic Radiographic Study. Int J Med Res Health Sci. 2017;4(9):1829-32.

10. Patel S, Mansuri S, Shaikh F, Shah TJ. Impacted Mandibular Third Molars: A Retrospective Study of 1198 Cases to Assess Indications for Surgical Removal and Correlation with Age, Sex, and Type of Impaction. J Maxillofac Oral Surg. 2017;16(1):79-84.

11. Butt H, Hafeez F, Tahir F, Khan NR, Khawaja SA, Amjad A. Association of Gender with Patterns of Impactions and Radiolucencies in Mandible and Maxilla. J Gandhara Med Dent Sci. 2022;9(4):14-9.

12. Al-Khateeb TH, Bataineh AB. Pathology Associated with Impacted Mandibular Third Molars in a Group of Jordanians. J Oral Maxillofac Surg. 2006;64(11):1598-602.

13. Juodzbalys G. A Classification for Assessing Surgical Difficulty in the Extraction of Mandibular Impacted Third Molars: Description and Clinical Validation. Quintessence Int. 2018;49(1):745-53.

14. Passi D, Singh G, Dutta S, Srivastava D, Chandra L, Mishra S, et al. Pattern and Prevalence of Mandibular Impacted Third Molar in Delhi-National Capital Region Population with a Newer Classification: A Retrospective Study. J Family Med Prim Care. 2019;10(1):59-67.

15. Salam S, Bary A, Sayed A. Prevalence of Impacted Teeth and Pattern of Third Molar Impaction among Kerala Population: A Cross-Sectional Study. J Pharm Bioall Sci. 2023;15(Suppl 1):S354-7.

16. Syed KB, Zaheer KB, Ibrahim M, Bagi MA, Assiri MA. Prevalence of Impacted Molar Teeth among Saudi Population in Asir Region: A Retrospective Study. J Int Oral Health. 2013;5(1):43-7.

17. Shumar AJ. Prevalence of Impacted Third Molars and Associated Pathologies among Population in Sanaa City, Yemen. Int Arab J Dent. 2020;11(2):100-4.

18. Sejfija Z, Koçani F, Macan D. Prevalence of Pathologies Associated with Impacted Third Molars in Kosovar Population: An Orthopantomography Study. Acta Stomatol Croat. 2019;53(1):72-81.

19. Tassoker M. Frequency of Pericoronal Radiolucency in Impacted Teeth. J Oral Dent Health. 2022;6(2):45-9.