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Original Article

DISTAL CERVICAL CARIES IN MANDIBULAR SECOND MOLARS: A CONSEQUENCE OF IMPACTED THIRD MOLARS

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ABSTRACT

Objectives: *To determine the frequency, predisposing patterns of impaction, and subsequent treatment outcomes for distal cervical caries (DCC) in mandibular second molars (M2) associated with impacted mandibular third molars (M3).*

Materials and Methods: *This prospective observational study was conducted at Oral Surgery Department of Frontier Medical and Dental College, Abbottabad, during May-Oct. 2025. A convenience sample of 200 patients with impacted M3s was enrolled after applying inclusion and exclusion criteria; no refusals were reported. Clinical and radiographic assessments were performed to classify M3 angulation, depth, and ramus relationship (Pell & Gregory/Winter) and diagnose DCC. Data were analyzed using descriptive statistics, Chi-square tests, and binary logistic regression to identify independent predictors. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) are reported*

Results: *The overall prevalence of DCC was 46.5% (n=93). Univariate analysis revealed significant associations between DCC and mesioangular impaction, Depth A, Class I ramus relationship, and contact at the cervical line (all p<0.001). Binary logistic regression identified mesioangular impaction (Adjusted Odds Ratio, aOR=14.2, 95% CI: 7.1–28.4, p<0.001) and contact at the cervical line (aOR=9.1, 95% CI: 4.5–18.4, p<0.001) as the only independent predictors of DCC. Of the affected M2s, 57.0% required restoration, 26.9% required root canal treatment, and 16.1% required extraction.*

Conclusion: *Mesioangular impaction and contact at the cervical line are the strongest independent risk factors for DCC. In appropriately selected patients, shared decision-making regarding prophylactic removal of M3s exhibiting this high-risk pattern may be considered to preserve the second molar and prevent complex dental treatments.*

Key words: *Dental Caries; Mandible; Molar, Third; Risk Factors; Tooth Extraction; Tooth, Impacted*

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INTRODUCTION

Impacted mandibular third molars (M3s) are a prevalent clinical finding and a significant source of pathology for the adjacent second molar (M2). Among the various complications, the development of distal cervical caries (DCC) in the M2 is

particularly problematic. This lesion, located at the cement-enamel junction, is often subgingival, difficult to diagnose and restore, and can lead to the loss of an otherwise sound tooth[1].

The primary pathogenic mechanism involves the impacted M3 creating a plaque-retentive niche against the distal surface of the M2, an area notoriously difficult for patients to clean[2]. The degree of this risk is directly influenced by the spatial relationship between the teeth. Established classification systems, such as those by Pell & Gregory and Winter, provide a framework to quantify this relationship, with specific angulations (e.g., mesioangular) and positions (e.g., Depth A, Class I ramus relationship) recognized as predisposing to pathological contact and subsequent caries[3,4].

While systematic reviews have highlighted the burden of M2 pathology associated with M3s[1,5] and recent studies have explored these relationships using advanced imaging[6,7] there remains a need for prospective studies that not only report prevalence but also statistically isolate independent risk factors while accounting for confounding variables. This study addresses this gap by providing a contemporary analysis of DCC prevalence, identifying its independent predictors using multivariate analysis, and reporting on the consequential treatment outcomes for the affected second molars.

MATERIALS AND METHODS

This prospective observational study was conducted at the Oral and Maxillofacial Surgery Department, Frontier Medical and Dental College, Abbottabad, from May to October, 2025. The study protocol was approved by the institutional ethical review committee, and informed consent was obtained from all participants.

A sample of 200 patients presenting with at least one impacted mandibular third molar were enrolled via consecutive sampling. No formal sample size calculation was performed; the sample size was based on the feasibility of recruitment within the study period. All patients meeting the inclusion criteria during this period were approached, and none refused participation.

Patients aged 17-60 years with an impacted mandibular third molar were included. Medically compromised patients (ASA III or above) and those with pathological lesions associated with the M3 (e.g., cysts, tumors), and those with poor-quality orthopantomograms (OPGs) that precluded accurate assessment were excluded in the study. Data were collected through clinical examination and radiographic assessment using ortho-pantomograms (OPGs). All radiographic assessments were performed by a single calibrated examiner (the principal investigator) to ensure consistency. To assess intra-examiner reliability, a random subset of 30 OPGs was re-evaluated two weeks after the initial assessment, yielding a kappa statistic of 0.89 for impaction characteristics and 0.92 for DCC diagnosis, indicating excellent agreement.

M3 Impaction Pattern: Classified using:

oWinter's Classification: Mesioangular, Horizontal, Vertical, Distoangular.

oPell & Gregory Classification:

Depth: A (occlusal plane of M3 = M2), B (between occlusal plane and cervical line of M2), C (apical to cervical line of M2).

Ramus Relationship: Class I (sufficient space), Class II (ramus covers half of M3), Class III (ramus completely covers M3).

Point of Contact: The contact point of the M3's occlusal surface with the M2 was recorded as above, at, or below the M2's cervical line.

DCC Diagnosis & Outcome: DCC was diagnosed based on the presence of both radiographic and clinical evidence. Radiographically, DCC was defined as a radiolucency extending into the dentin at the distal cervical margin on the OPG. Clinically, DCC was confirmed by visual detection of a cavity or shadowing at the distal cervical aspect of the M2, often with probing confirmation. The required treatment for the carious M2 was recorded as: Restoration, Root Canal Treatment (RCT), or Extraction. Data on potential confounders such as patient-reported oral hygiene habits and history of previous caries were not collected.

Data were analyzed using IBM SPSS Statistics Version 20.0. Descriptive statistics were presented as frequencies, percentages, and mean ± standard deviation. The Chi-square test (or Fisher's Exact test where appropriate) was used to assess associations between categorical variables and DCC. An indepen-

dent samples t-test was used to compare the mean age between groups. To identify independent risk factors, variables with $p < 0.1$ in univariate analysis were included in a binary logistic regression model using a forward stepwise (likelihood ratio) entry method. Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test ($p = 0.72$), indicating adequate model calibration. The model's predictive accuracy was 84.5%. A p-value < 0.05 was considered statistically significant. A prior approved from the Ethics Committee of Dental College was obtained (EC # FMDC-85-R.A-25).

RESULT

A total of 200 patients (110 males, 90 females; mean age 26.5 ± 5.9 years) were included. The overall prevalence of DCC was 46.5% (n=93/200).

Univariate analysis (Table 1) revealed that DCC was significantly associated with gender (p=0.014), mesioangular impaction (p<0.001), Depth A (p<0.001), Class I ramus relationship (p<0.001), and contact at the cervical line (p<0.001). There was no significant difference in the mean age of patients with and without DCC (p=0.327).

The distribution of DCC cases according to the detailed impaction patterns is shown in Tables 3-5, providing context for the high-risk scenarios. Of the 93 M2s with DCC, the required treatments were: Restoration (Filling): 53 teeth (57.0%), Root Canal Treatment (RCT): 25 teeth (26.9%), and Extraction: 15 teeth (16.1%).

DISCUSSION

This prospective study confirms a high prevalence (46.5%) of distal cervical caries in second molars associated with impacted third molars. More

Table 1: Univariate Analysis of Factors Associated with DCC

Variable	Category	No DCC (n=107)	DCC Present (n=93)	p-value
Gender	Male	50 (46.7%)	60 (64.5%)	0.014
	Female	57 (53.3%)	33 (35.5%)	
Age (Years)	Mean ± SD	26.1 ± 5.8	26.9 ± 6.1	0.327
Angulation	Mesioangular	23 (21.5%)	71 (76.3%)	<0.001
	Non-Mesioangular*	84 (78.5%)	22 (23.7%)	
Depth	A	72 (67.3%)	80 (86.0%)	<0.001
	B/C	35 (32.7%)	13 (14.0%)	
Ramus Relationship	I	69 (64.5%)	83 (89.2%)	<0.001
	II/III	38 (35.5%)	10 (10.8%)	
Contact Point	At Cervical Line	32 (29.9%)	76 (81.7%)	<0.001
	Not at Cervical Line	75 (70.1%)	17 (18.3%)	

*Non-Mesioangular: Horizontal, Vertical, Distoangular combined

Table 2: Binary Logistic Regression Analysis for Independent Predictors of DCC

Variable	Category	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
Angulation	Mesioangular	14.2	7.1 - 28.4	<0.001
Contact Point	At Cervical Line	9.1	4.5 - 18.4	<0.001
Depth	A	1.9	0.8 - 4.3	0.124
Ramus Relationship	I	1.5	0.6 - 3.7	0.415

Variables with p<0.1 in univariate analysis were entered into the model. Model fit: Hosmer-Lemeshow p=0.72; Events per variable (EPV) = 93/5 = 18.6*

Table 3: Distribution of DCC by Angulation of M3 Impaction.

Angulation	Total Impactions (n=200)	Impactions with DCC (n=93)	% of Total Caries
Mesioangular	94	71	76.3%
Horizontal	57	20	21.5%
Vertical	40	2	2.2%
Distoangular	9	0	0%

Table 4: Association between Pell & Gregory Classification and DCC Prevalence

Classification	Category	Total Impactions	Impactions with DCC	% of Total Caries
Depth	A	152	80	86.0%
	B	44	13	14.0%
	C	4	0	0%
Ramus Relationship	Class I	152	83	89.2%
	Class II	46	10	10.8%
		2	0	0%

Table 5: Impact of M3-M2 Contact Point on DCC Development

Contact Point	Total Impactions	Impactions with DCC	% of Total Caries
At Cervical Line	108	76	81.7%
Above Cervical Line	22	10	10.8%
Below Cervical Line	24	7	7.5%

importantly, by employing multivariate analysis, we have identified the specific impaction characteristics that independently drive this risk.

Our findings robustly demonstrate that mesioangular impaction is the single strongest predictor of DCC (aOR=14.2). This aligns perfectly with the biomechanical model where this angulation creates a direct, broad contact area, forming an optimal plaque stagnation zone that is inaccessible to oral hygiene measures[2,6]. Similarly, contact at the cervical line emerged as a powerful independent risk factor (aOR=9.1). This position directly exposes the cement-enamel junction the tooth's most vulnerable anatomical site to the cariogenic challenge[7,8].

It is noteworthy that while Depth A and Class I ramus relationship were significant in univariate analysis, they were not retained as independent predictors in the multivariate model. This suggests that their apparent risk is largely mediated through their strong correlation with the primary mechanisms of mesioangular impaction and cervical contact. A tooth in a Depth A, Class I position is simply more likely to present with these high-risk contact characteristics.

The clinical consequences of DCC are severe, as evidenced by our treatment outcomes. A concerning 43% of affected M2s required either endodontic treatment or extraction, procedures that are costly, complex, and signify a major failure in preventive care. This finding strengthens the argument for a proactive approach in clearly defined high-risk cases, a stance that is increasingly supported by cost-effectiveness analyses[9,10].

LIMITATIONS

This study has several limitations that should be acknowledged. First, it was conducted at a single center over a relatively short enrollment period, which may limit the generalizability of the findings. Second, the reliance on panoramic radiography (OPG) for diagnosis, while practical, offers lower resolution than cone-beam computed tomography (CBCT) for assessing exact contact relationships and early caries detection [6]. Third, the lack of examiner calibration reported initially was addressed post-hoc, and future studies should incorporate this a priori. Fourth, and most importantly, we did not collect data on potential confounding factors such as patients' oral hygiene practices, dietary habits, fluoride exposure, socioeconomic status, or history of previous caries, which could influence DCC development independently of impaction characteristics.

We propose a refined, evidence-based strategy: High-Risk Indication: The consideration of prophylactic removal of asymptomatic M3s may be justified when a mesioangular impaction is in direct contact with the cervical line of the M2. This decision is best made in the patient's late teens or early twenties through a process of shared decision-making.

Shared Decision-Making: For other impaction patterns, the risk is lower. Patients should be informed of the quantified risks and engaged in a shared decision-making process regarding monitoring versus intervention, taking into account their individual oral hygiene capacity and overall risk profile.

CONCLUSION

Distal cervical caries of the mandibular second molar is a highly prevalent and destructive sequela of third molar impaction. Through multivariate analysis, this study identifies mesio-angular angulation and contact at the cervical line as the paramount independent risk factors. In the context of the study's limitations, these findings support that prophylactic removal of third molars exhibiting this specific high-risk configuration is a clinically justifiable consideration to preserve the long-term health, function, and longevity of the second molar. Further research, including multi-center studies with longer follow-up and control for patient-level confounders, is warranted to validate these findings and refine clinical guidelines.

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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	NA, MR. S, , ISQ, FS, MA
Acquisition, Analysis or Interpretation of Data:	NA, MR. S, , ISQ, FS, MA
Manuscript Writing & Approval:	NA, MR. S, , ISQ, FS, MA

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.