ONLINE FIRST

ORIGINAL ARTICLE

Topographic Association of the Inferior Dental Canal with Different Patterns of Impacted Third Molar Using Cone Beam Computed Tomography: A Cross-Sectional Study

Syed Muhammad Awais[1], Umer Ullah[2]*, Asmatullah[3], Nida Murad[4], Zainab Shah[5], Muhammad Naeem[6]

[1]*Department of Science of Dental Materials, Bacha Khan College of Dentistry, Mardan, KPK, Pakistan*
[2]*Department of Oral and Maxillofacial Surgery, Sardar Begum Dental College, Peshawar, KPK, Pakistan*
[3]*Department of Oral Medicine, Khyber College of Dentistry, Peshawar, KPK, Pakistan*
[4]*Student MPhil Oral Biology, Sardar Begum Dental College, Peshawar, KPK, Pakistan*
[5]*Department of Oral Medicine, Sardar Begum Dental College, Peshawar, KPK, Pakistan*
[6]*Department of Community Dentistry, Bacha Khan College of Dentistry, Mardan, KPK, Pakistan*
Correspondence: *umer.ullah@rmi.edu.pk*
doi: 10.22442/jlumhs.2025.01238

ABSTRACT

OBJECTIVE: To determine the CBCT-based evaluation of the intimate relationships between impacted third molar teeth and the IDC before its surgical removal.

METHODOLOGY: This observational cross-sectional study was conducted on patients who visited the radiography department at Khyber College of Dentistry between January 2022 and January 2023. Before surgical extraction, the information was selected from a history gathered for the CBCT-based pre-operative assessment of IDC's intimacy with the third molar. The sample size calculated was 200 patients. The age range was 25-45 years. CBCT images were obtained using the Planmeca dental system at 90 kVp. The 3-D generated view was used to determine the Maglione (CBCT-based IDC intimacy 3rd molar), Winter's, and Gregory's classifications for the angulation, location, and space of impacted teeth. The data analyzed using SPSS 16 with level of significance P≤ 0.05.

RESULTS: The average age group was 29.6±5 years. Male-to-female ratio was 3:2. Winter classified most impacted teeth as vertically affected. Pell/Gregory classified most of the impaction at position B and Class II for both genders. The P-value was similarly highly significant (p = 0.001) for IDC morphometric measures recorded in both genders. According to the Maglione classification, the fourth pattern (4a = 22%) was the most prevalent presentation on CBCT. The most common radiographic symptom of IDC associated with an impacted Third molar tooth was a combination of deflected root and deviated canal.

CONCLUSION: The Maglione Class 4(a) was the most common presentation of impacted third molar with preserved diameter of IDC among both genders.

KEYWORDS: Inferior dental Canal, third molars, proximity

INTRODUCTION

The inferior alveolar nerve (IAN), sometimes the inferior dental nerve (IDN), is the third and greatest division of the fifth cranial nerve, the trigeminal nerve. It innervates the face, lips, chin, teeth, and gingivae, providing sensations like heat, cold, pressure, and pain to your lower jaw. It also regulates the movement of specific muscles in the lower jaw. [1]

The most often extracted teeth are mandibular third molars, which account for 16%-30% of all dental extractions. [2] They typically form between the ages of 8 and 15 and erupt between 17 and 22 years. As a result of the delayed eruption, mandibular third molars are frequently impacted, with 17 to 69% showing some degree of impaction. Extraction of third molars is complex and usually not recommended due to their physical proximity to the IAN. However, some surgeons remove their teeth to prevent future problems. [2] However, there is a higher chance of IAN damage, which can cause a transient or permanent change in feeling in its distribution region during the surgical removal of the third molar tooth. [3]

Complications can impact a dentist's professional reputation, potentially resulting in fewer patients, poor evaluations, and referrals. [4] In circumstances where complications cause significant harm (including IAN damage, extended recovery, or infection), patients may be entitled to compensation. This can involve charges of negligence or malpractice, as well as additional medical bills, therapies, and compensation for pain and suffering. Other possible consequences include fines, suspension, revocation of the dental license, or requiring extra training. Legal sanctions and licence revocation are serious consequences.[1,2]

The Rational Policy presented by the British National Institute for Clinical Excellence is unequivocal in its recommendation, adopted by the National Health Service: "The practice of prophylactic removal of pathology-free impacted third molars should be discontinued. There is no reliable evidence to support a health benefit to patients from the prophylactic removal of pathology-free impacted teeth." [4]

Thus, all the facts presented above demonstrate the importance of evaluating the position of IDC concerning third molar teeth pre-operatively. Accurately determining the positional relationship between the inferior alveolar nerve and the mandibular third molar using a two-dimensional panoramic radiograph is challenging[3]. Still, proper diagnosis with 3D Cone Beam Computed Tomography (CBCT) is highly effective. As IAC is a significant landmark and due to the scarcity of research in this field using CBCT in the population of KPK, we have undertaken this study.

We hypothesized that we would identify the potential risk of IDN damage in cases where the root apices of the third molars are very close to the IDN. Based on the results of this study, the clinicians will be able to apply Maglione CBCT-based classification objectively to describe the intimacy of the third molar tooth with IAN, as an objective tool. [5] We also represent an inference for the anatomical variants of the mandibular canal regarding its size, shape, and location in the third molar region of the Mandible concerning different levels of impaction among residents of Khyber Pakhtunkhwa.

The rationale of this study is that it will help surgeons extract teeth with minimal complications and trauma.

METHODOLOGY

This observational study was conducted on patients who visited the radiography department at Khyber College of Dentistry between January 2022 and January 2023. The retrospective data were collected after obtaining ethical approval from Khyber College of Dentistry (RRB-KCD-No-214/RRB/KCD). The sample size was 200 patients, with a proportion of 16% [9] and a confidence level of 95%. The age range chosen was 25 to 45 years. The mandibular third molars, whether impacted or erupted, were recommended by maxillofacial surgeons for pre-operative CBCT evaluation to determine the relationship between IDC and the third molar root apices. The cystic lesions or tumours associated with the third molar were excluded from the study. CBCT images were taken using the Planmecca dental system operated at 90kVp and 10-12.5MaN. To optimize visualization, images will be adjusted for brightness and contrast using the software's built-in adjustment tools. The contrast and brightness for males were adjusted to 2256 and 2304, respectively, due to the dense quality of the bone. The contrast and brightness for females were adjusted for 1569 and 1760. The sharpness for both genders was adjusted between 0 and 10. The pixel size of the images was 200 µm, 24-bit, with a width of 513 mA, and the image format was PNG (Portable Network Graphics). The 3D-rendered view was used to determine Winter's classification for angulation and Pell and Gregory classification for the position and space of the impacted teeth. The Maglione [8] CBCT-based classification was used objectively to describe the intimacy and relation of the third molar tooth with IDC. The axial CBCT view was used for horizontal impactions.

The coronal view was used for buccolingual, mesioangular, distoangular and vertical impactions. The area and volume of IDC were also calculated along with the height (superior to the inferior wall) and width (medial to the lateral wall) of the canal. All the data was collected in a well-structured Proforma. Two expert Maxillofacial surgeons were recruited from Rehman College of Dentistry and Bacha Khan Dental College as observers to enhance the validity of the research. The data were analyzed using SPSS version 16, employing descriptive statistics. The Quantitative variables were analyzed using an independent sample t-test, while qualitative variables were evaluated using a chi-square test. Statistical significance will be determined by considering P values less than 0.05.

RESULTS

The mean age group recorded was 29.6 years ± 5 years. The male-to-female ratio is 3:2.
According to Winter's classification, the majority of impacted teeth were vertically impacted, affecting both genders. Pell and Gregory's classification of the impacted tooth to the occlusal plane level was mostly Position B for both genders. Pell and Gregory's classification for the space between the ramus and a second molar tooth for the impacted tooth was class III, observed in both genders. The P-value was found to be highly significant, as shown in **Table I**.
As shown in **Table II**, the mean and standard deviation for the distance of IDC from root apices and the area of IDC, volume of IDC, width, and distance of IDC from the base of the Mandible were calculated for both genders. The P-value was also found to be highly significant (0.001).
The relationship of third molar root apices with IDC, according to Maglione classification, overall showed that the 4th pattern (4a = 22%) was the most common presentation, followed by the 2nd pattern (2a = 17%). **Figure I**
The morphometric parameters of IDC recorded in **Table III** have shown that the more intimate the relation of impacted third molar teeth with IDC like in class 2b (7.0%), 3b (6.0%), 4b(14%), 5b(7.5%) and 6b(1.8%), the dimensions of IDC were decreasing among both genders. This clearly states the careful handling of impacted third molars during surgical removal. A statistically significant relation (P-value=0.006/t=1.487, degree of freedom=45) was found for the relation of IDC and impacted third molars.
The most common radiographic sign of IDC associated with an impacted Third molar tooth was a combination of deflected root and deviated canal (26.00%), followed by deflection of roots (18.00%) only. **Figure II**

Table I: Gender based distribution of impacted third molars

Gender	Winter classification	Pell and Gregory's classification Position to OP/Space		P value
Male	Vertical (44, 22%)	Position A (0)	Class I(0)	0.001 15.235 x ^{2} DF-1
	MA (24, 12%)	Position B (108, 54%)	Class II (110, 55%)	
	BL (21, 10.5%)	Position C (12, 6%)	Class III (10, 5%)	
	Horizontal (16, 8%)			
	DA (15, 7.5%)			
Female	Vertical (20, 10%)	Position A (6, 3%)	Class I(0)	0.001 32.653 x ^{2} DF-1
	BL (22, 11%)	Position B (57, 28.5%)	Class II (46, 26%)	
	MA (16, 8%)	Position C (17, 8.5%)	Class III (34, 17%)	
	Horizontal (13, 6.5%)			
	DA (9, 4.5%)			
TOTAL	**200**	**100%**		

DF- Degree of freedom. x ^{2}- Chi-square value OP-occlusal plane

Table II: Gender based distribution of Mean and SD values of IDC

Gender of Patient	Distance of IDC from the root apices of the 3rd Molar	Height of IDC	Width of IDC	Area of IDC	Volume of IDC	Height of IDC from the base of the Mandible
Male						
Mean/SD	2.83/1.986	6.47/4.814	4.68/1.133	14.29/4.11	4.11/2.27	2.14/0.442
Female						
Mean/SD	2.73/2.123	5.74/1.439	4.29/0.697	12.76/2.166	3.55/1.311	2.14/0.442
Total						
Mean/SD	**2.79/1.037**	**6.17/3.80**	**4.52/0.992**	**13.65/4.213**	**3.88/1.948**	**2.02/0452**
x^2 **35.664, DF-5 P-Value 0.001**						

DF- Degree of freedom. x^2- Chi square value, P-value (level of significance) 0.05

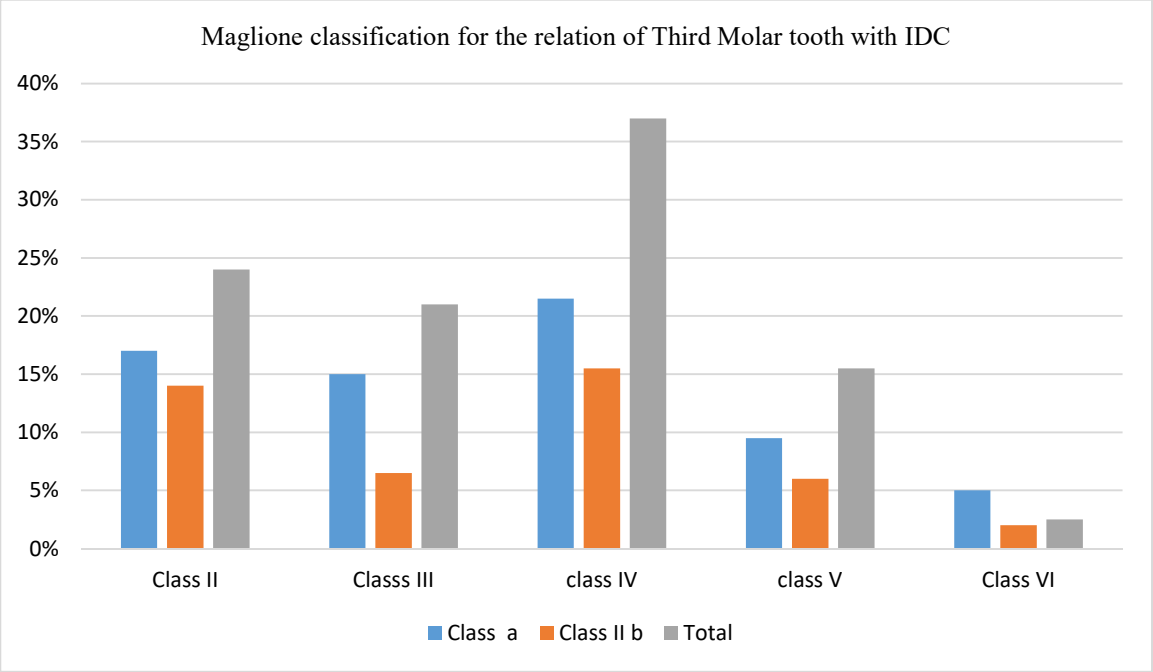

Figure I: Maglione classification for the relation of the Third Molar tooth with IDC

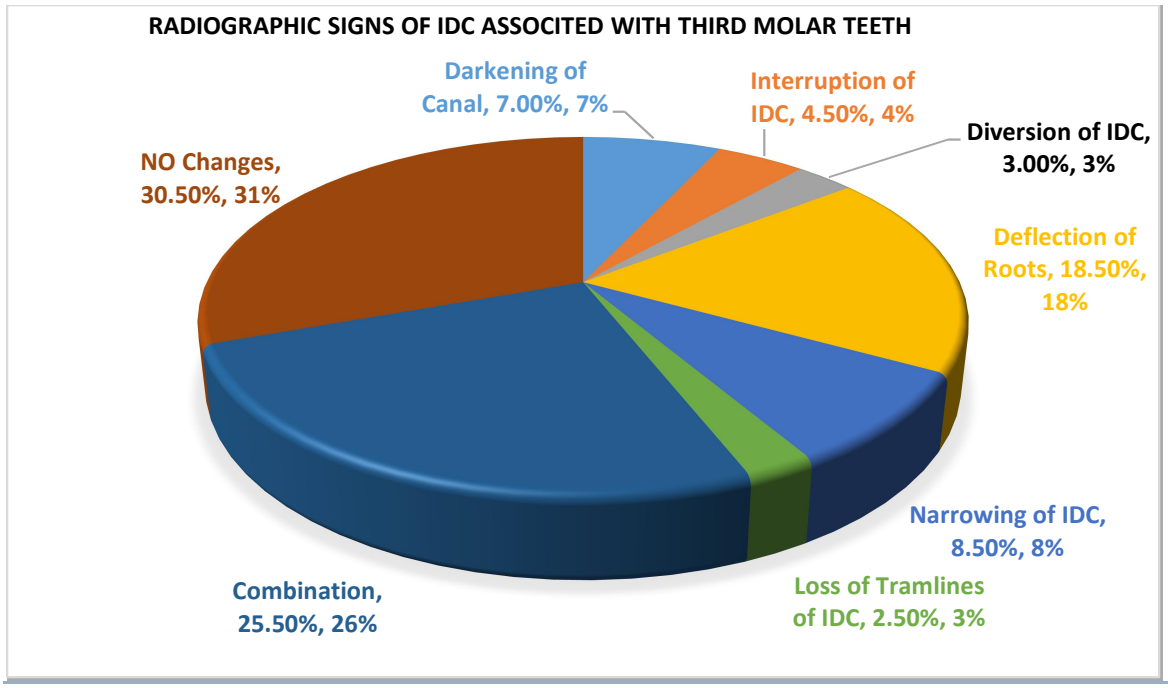

Figure II: The Radiographic Changes in IDC in the region of Third Molar Teeth

DISCUSSION

IDC involvement is a significant complication related to the surgical removal of impacted mandibular third molars, and it is the most common tooth to be extracted both surgically and non-surgically. [6, 7] This research report also determined the relationship between impacted third molar teeth and IDC, which required surgical removal. The average age of third molar teeth requiring surgical removal and CBCT-based assessment of intimacy with IDC was 26±5 years, and they were all males. This was following the findings of **Chi et al**, [8] where the `recorded mean age was 26.4±8.4 years, and 57.0% were male. However, the study of **Kautto et al,**[9] found dissimilar results with female predominance at the age of 30 years.

In the present study, Winter's vertical type impaction with Pell and Gregory Position B and Class II was the most common type of impaction that needed pre-operative CBCT evaluation due to depth and space deficiency. This corresponds well with the study of **Jarun**[10], which displayed vertical impactions followed by mesioangular impactions. In contrast, the study of **Balaji**[1] mesioangular impactions in the class II position require CBCT-based evaluation before surgical extraction.

The study by **Srivastava et al.**[11] found that 38% of cases of mandibular third molar in direct contact with IDC. This was dissimilar to our study, as our research has shown that 69% of cases of third molars in direct contact with IDC result in radiographic changes in canal morphology. However, **Srivastava** [11] didn't specify the position and level of impaction that was directly associated with IDC. Still, our study showed that the deeper the level of impaction in bone, the more the changes recorded with IDC. Thus, this study concluded that 3-dimensional analysis aided by CBCT provides exact images free of superimposition and distortions of anatomic structures. **Nasir et al.** [12] also showed a statistically significant difference in the topographic measurements of IDC among both genders, which was consistent with our findings.

Another study conducted by **Choo et al.**[13] reported the average distance of IDC from posterior teeth, 5.49mm at first premolar, 5.00mm at second premolar, 4.50mm at first molar, 2.58mm at second molar and 1.31mm at third molar. 64.6% of the third molars appeared to be 'in contact' with the IDC, which is consistent with the present study's findings.

Cameron [14] and Buser [15], while using their CBCT-based classification for the intimacy of IDC and 3rd molars, often found that 58% of impacted third molars represented Class III (a/b), in contrast to our findings, which frequently involved cases in IV, followed by Class IIa. The morphometric parameters recorded for IDC with different levels of impacted third molars showed noticeable dimensional changes among both genders, which correspond well with the results of **Harrison [16] and Jiang et al** [17]

The only limitation of the study was the ethical issues arising during the collection of Data. However, to increase the validity of the present study, it is recommended to conduct more studies in different populations and to measure the kappa value for all measurements. The better understanding

CONCLUSION

The Maglione Class 4(a) was the most common presentation of an impacted third molar with a preserved diameter of the IDC among both genders.

Ethical permission: MTI Khyber College of Dentistry, Peshawar KPK, Pakistan ERC letter No. 105/ADR/KCD.
Conflict of Interest: The author states no conflict of interest.
Financial Disclosure/Grant Approval: No funding agency was involved in this research.
Data Sharing Statement: The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Awais SM: Substantial contributions to the conception or design of the study or the acquisition, analysis, interpretation of data for the work, agreement to be accountable for all aspects of work.
Ullah U: Substantial contributions to the conception or design, agreement to be accountable for all aspects of work.
Asmatullah: Substantial contributions to the conception or design, agreement to be accountable for all aspects of work.
Murad N: Drafting and writing, critical review of study, agreement to be accountable for all aspects of work.
Shah Z: Substantial contributions to the conception or design, agreement to be accountable for all aspects of work.
Naeem M: Substantial contributions to the conception or design, agreement to be accountable for all aspects of work.

REFERENCES

1. Balaji K, Bhardwaj A. A review on extraction of impacted third molars: Indications and complications. J Dent Res Pract. 2020; 6(2): 35-41.
2. Nazir MA. Prevalence and indications for surgical extraction of lower third molars: A retrospective study in a dental hospital in Saudi Arabia. BMC Oral Health. 2020; 20: 1-7.
3. Weiss, R.; Read-Fuller, A.M. Cone Beam Computed Tomography in Oral and Maxillofacial Surgery: An Evidence-Based Review. Dent J. 2019; 7: 52.
4. Jacobs R. Cone beam computed tomography in implant dentistry: Recommendations for clinical use. BMC Oral Health. 2018; 18: 88-100.
5. Aljarbou FA. An analysis of the first and second mandibular molar roots' proximity to the inferior alveolar canal and cortical plates using cone beam computed tomography among the Saudi population. Saudi Med J. 2019; 40: 189–99.
6. Synan W, Stein K. Management of Impacted Third Molars. Oral Maxillofac Surg Clin North Am. 2020; 32(4): 519-59.
7. Chi H, Thomas B. Types, Frequencies, and Risk Factors for Complications After Third Molar Extraction. American Association of Oral and Maxillofacial Surgeons. J Oral Maxillofac Surg. 2023; 61: 1379-89.
8. Maglione M, Costantinides F, Bazzocchi G. Classification of impacted mandibular third molars on cone-beam CT images. J Clin Exp Dent. 2015; 7(2): 224-31.
9. Kautto A et al. Age of the patient at the extraction of the third molar. Int J Oral Maxfax Surg. 2018; 47(7): 947-95.
10. Jaroń A, Trybek G. The Pattern of Mandibular Third Molar Impaction and Assessment of Surgery Difficulty: A Retrospective Study of Radiographs in East Baltic Population. Int J Environ Res Public Health. 2021; 18(11): 23-31.
11. Srivastava S. Assessment of the Proximity of the Inferior Alveolar Canal with the Mandibular Root Apices and Cortical Plates - A Retrospective Cone Beam Computed Tomographic Analysis. J Person Med. 2022; 12: 3-9.
12. Nazir M. Postoperative Complications of Third Molar Surgery: A Systematic Review. Int J Oral Maxillofac Surg. 2020; 49(2): 156-172.
13. Choo. The Spatial Relationship and Distances of Posterior Root Apices to Various Anatomical Structures. Int Med J. 2018; 25(1): 45-50.
14. Cameron CE, Widmer C. Indications for Extraction of Third Molars: A Review of the Literature. Int J Oral Maxillofac Surg. 2020; 49(2): 139-145.
15. Buser D, Règine M. Complications Following Third Molar Surgery: An Overview. Eur J Oral Implantol. 2021; 13(1): 27-35.
16. Harrison JE. Edwards WD. Complications of Third Molars: Prevalence and Risk Factors. J Oral Facial Surg. 2020; 78(5): 735-742.
17. Jiang H**.** Risk Factors for Complications After Third Molar Extraction: A Meta-analysis. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 2020; 129(1): 48-56.