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

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ABSTRACT

OBJECTIVE: To determine the Cone Beam Computed Tomography (CBCT) based evaluation of the intimate relationship between impacted third molar teeth and the Inferior Dental Canal (IDC) before its surgical removal.

METHODOLOGY: This retrospective cross-sectional study was conducted on patients visiting the radiography department at Khyber College of Dentistry between January 2022 and January 2023. 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 Inferior Dental Canal (IDC) intimacy 3rd molar), Winter's, and Gregory's classifications for the angulation, location, and space of impacted teeth. The data were analyzed using SPSS 16, with a level of significance of of P≤ 0.05.

RESULTS: The average age group was 29.6±5 years. The 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 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: Cone Beam Computed Tomography (CBCT), Inferior dental Canal, third molars.

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 delayed eruption, mandibular third molars are frequently impacted, with 17-69% 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].

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 IDC is a significant landmark and due to the scarcity of research in this field using CBCT in the population of

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Khyber Pakhtunkhwa (KPK), we have undertaken this study.

We hypothesized that we would identify a potential risk of IDN damage in cases where the root apices of third molars are very close to the IDN. Based on the results of this study, clinicians will be able to apply Maglione's CBCT-based classification objectively to describe the intimacy of the third molar tooth with IAN, serving as an objective tool. 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 KPK.

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

METHODOLOGY

This retrospective cross-sectional study was conducted among patients who visited the radiography department at Khyber College of Dentistry between January 2022 and January 2023. The 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. Cystic lesions or tumours associated with the third molar were excluded from the study. CBCT images were taken using the Planmeca 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 to 1569 and 1760, respectively. The sharpness for both genders was adjusted to a scale of 0 to 10. The pixel size of the images was 200 µm, 24-bit, with a width of 513 mA wide, and in PNG (Portable Network Graphics) format. The 3D-rendered view was used to determine Winter's classification of angulation and Pell and Gregory's classification of 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. Quantitative variables were analyzed using an independent-samples t-test, and qualitative variables were analyzed using a chi-square test. Statistical significance was determined by P values < 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, most 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 highly significant, as shown in **Table I**.

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**
	P-Value 0.001					

P-value (level of significance) 0.05

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 highly significant (0.001).

The relationship of third molar root apices with IDC, according to Maglione M 2015[8] classification, overall showed that the 4th pattern (4a = 22%) was the most common presentation, followed by the 2nd pattern (2a = 17%). **Figure 1**

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 2**

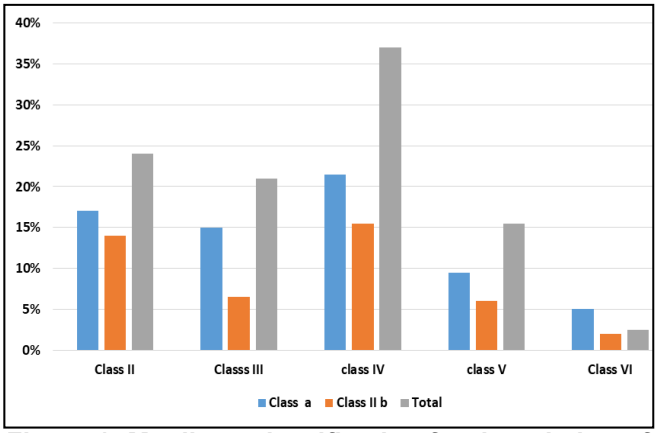

Figure 1: Maglione classification for the relation of the Third Molar tooth with IDC

DISCUSSION

IDC involvement is a significant complication of 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.

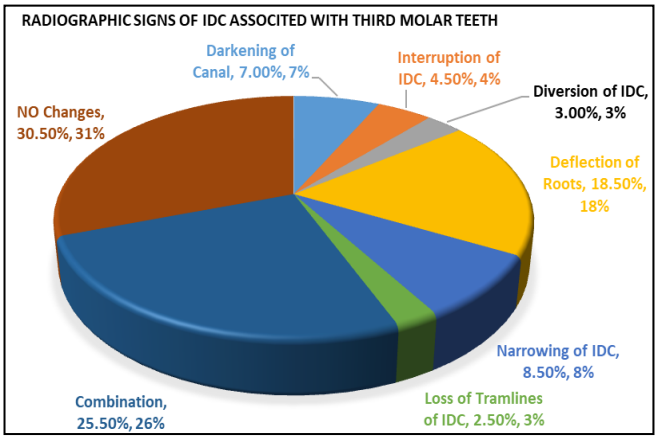

Figure 2: The Radiographic Changes in IDC in the region of Third Molar Teeth

This was following the findings of Bui CH 2023[7], where the `recorded mean age was 26.4±8.4 years, and 57.0% were male. However, the study of Kautto A 2018[9] found dissimilar results, with female predominance at 30 years of age.

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 A 2021[10], which showed vertical impactions followed by mesioangular impactions. In contrast, the study of Balaji K 2020[1] mesioangular impactions in the class II position requires CBCT-based evaluation before surgical extraction.

The study by Srivastava S et al.[11] found that 38% of cases of mandibular third molar were in direct contact with IDC. This was unlike our study, which showed that 69% of cases of third molars in direct contact with IDC exhibit radiographic changes in canal morphology. However, Srivastava S et al.[11] didn't specify the position or level of impaction directly associated with IDC. Still, our study showed that the deeper the level of bone impaction, the greater 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 M 2020[12] also reported a statistically significant difference in topographic measurements of IDC between the two genders, consistent with our findings.

Another study conducted by Choo S 2018[13] reported the average distance of IDC from the posterior teeth: 5.49mm at the first premolar, 5.00mm at the second premolar, 4.50mm at the first molar, 2.58mm at the second molar, and 1.31mm at the third molar. 64.6% of third molars appeared to be 'in contact' with the IDC, consistent with the present study's findings.

Cameron CE 2020[14] and Buser D 2021[15], using their CBCT-based classification of IDC and 3rd molars, often found that 58% of impacted third molars were 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 in both genders, which are consistent with the results of Harrison JE 2020[16] and Jiang H 2020[17].

This study has certain limitations. Being a retrospective cross-sectional study conducted at a single centre, the findings cannot establish causality and may not be generalizable to broader populations. Future prospective multicenter studies are recommended to validate these results.

CONCLUSION

Maglione Class (4a) was the most common pattern observed between impacted mandibular third molars and the inferior alveolar canal (IAC). A significant association was found between the closer proximity of third molar roots to the IAC and changes in canal dimensions on CBCT, highlighting the importance of pre-operative three-dimensional assessment to reduce the risk of nerve injury.

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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 the 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.

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