



Evaluation of the Relationship Between Mandibular Third Molar and Mandibular Canal using CBCT Scans

1Dr. Vachepally Praveen Reddy, 2Dr. Akanksha Singh, 3Dr. Akhila Durgapathi, 4Dr. Alekya Emmadi, 5Dr. Maddikatla Likhitha, 6Dr. Avinash Tejasvi.M. L

1Department Of Oral Medicine And Radiology, Kamineni Institute Of Dental Science, Sreepuram, Narketpally, Telangana State

2Intern, Kamineni Institute Of Dental Science, Sreepuram, Narketpally, Telangana State

3Registered Dental Hygienist At Smile Design Dentistry, Usa

4Intern, Kamineni Institute Of Dental Science, Sreepuram, Narketpally, Telangana State

5Intern, Kamineni Institute Of Dental Science, Sreepuram, Narketpally, Telangana State

6Professor And Hod, Department Of Oral Medicine And Radiology, Kamineni Institute Of Dental Science, Sreepuram, Narketpally, Telangana State

Corresponding Author

Dr. Akanksha Singh

Intern, Kamineni Institute Of Dental Science, Sreepuram, Narketpally, Telangana State

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ABSTRACT:

Background

The close anatomical relationship between the mandibular third molar (MTM) and the mandibular canal (MC) is of significant clinical importance. Accurate preoperative assessment using cone-beam computed tomography (CBCT) is essential to minimize the risk of inferior alveolar nerve injury during surgical extraction.

Aims and Objectives

The aim of this study was to evaluate the relationship between the mandibular third molar and the mandibular canal using CBCT scans. The specific objectives were to analyze the position of the mandibular canal relative to the third molar roots, assess the type of contact, investigate gender differences, and compare various classifications and impaction types.

Methodology

A retrospective study was conducted using CBCT scans of 100 patients presenting with mandibular third molars. The positional relationship between the mandibular canal and third molar was categorized based on buccal, lingual, and inter-radicular positions. The type of contact was classified as intimate or no contact. Gender comparisons, impaction classifications, and vertical impaction distributions were also analyzed.

Results

Buccal positioning of the mandibular canal was the most frequently observed. Intimate contact was more common in Class II and Class III impactions. Males exhibited a higher prevalence of canal penetration and defective white line contact. Vertical impactions most commonly demonstrated a buccal canal position. Advanced impaction classes (Class III & IV) showed the highest risk of intimate contact and potential nerve involvement.



Conclusion

CBCT is an effective imaging modality to assess the spatial relationship between the mandibular third molar and the mandibular canal. Careful evaluation of the canal position, type of contact, and impaction class is essential for preoperative planning to reduce the risk of inferior alveolar nerve injury.

Introduction

Cone Beam Computed Tomography (CBCT) has emerged as a pivotal imaging modality, offering high-resolution, three-dimensional visualization of craniofacial structures. Its ability to provide accurate spatial relationships and anatomical insights has significantly enhanced diagnostic precision and treatment planning across various dental specialties.^[1] CBCT facilitates the precise evaluation Relationship Between Mandibular Third Molar and Mandibular Canal.

The relationship between the impacted tooth and the inferior alveolar canal (IAC) is crucial in treatment planning to minimize iatrogenic damage to the inferior alveolar nerve (IAN), which can cause temporary or permanent paraesthesia. The eruption status, position, and angulation of the impacted mandibular third molars significantly influence the likelihood of these issues. Extracting an impacted mandibular third molars is a common dental procedure, though it can sometimes lead to IAN dysfunction, which is a particularly distressing outcome for many patients.^[2] Maxillofacial neurosensory deficits may be caused by various surgical procedures like tooth extraction, orthognathic surgeries, preprosthetic procedures, excision of cysts and tumours, surgery of temporomandibular joint, facial fractures. To evaluate nerve dysfunction, it is important to use objective testing rather than to simply ask a patient subjectively to report neuropathic changes. Objective data can be obtained by clinical neurosensory tests or by more complicated electrophysiologic tests.^[3]

Extraction of the mandibular third molar is one of the most common surgical procedures performed in oral and maxillofacial practice. Despite its routine nature, one of its most significant complications is injury to the inferior alveolar nerve (IAN), which can result in sensory disturbances such as paraesthesia and dysesthesia. Damage to the nerve is also more likely when the tooth

is completely impacted in the bone and/or the apices of the tooth extend into or below the level of the neurovascular bundle. IAN paraesthesia occurs widely from 0.35% to 8.4%.^[4]

Therefore, this retrospective study aims to comprehensively evaluate the anatomical relationship between the mandibular third molar and mandibular canal using CBCT, focusing on canal position, type of contact, impaction classification, gender differences, and vertical impaction patterns. This will provide valuable insights to inform surgical decision-making and reduce the incidence of IAN injury.

Methodology

Study Design

A retrospective observational study was conducted to evaluate the positional relationship between the mandibular third molar and the mandibular canal using cone-beam computed tomography (CBCT) scans.

Sample Selection

CBCT scans of 100 patients who presented for mandibular third molar assessment were retrospectively analyzed. Inclusion criteria comprised patients with complete root formation of mandibular third molars and scans of adequate image quality. Exclusion criteria included scans with pathologies, previous mandibular surgeries, or incomplete imaging records.

Imaging Protocol

All CBCT scans were obtained using a standardized protocol with appropriate field of view (FOV) and voxel size to allow clear visualization of the mandibular canal and third molar roots.

Evaluation Parameters

The following parameters were assessed:



Canal Position: Buccal, Lingual, Inter-radicular

Contact Type: Intimate Contact or No Contact

Impaction Classification: Based on Pell and Gregory’s classification (Class I, II, III, IV)

Vertical Impaction Types: Mesioangular, Vertical, Distoangular, Horizontal

Mandibular Canal Penetration and Defective White Line Contact: Presence or absence assessed

Gender-based Comparison: Evaluated for canal penetration and white line defects

Data Analysis

The data were compiled and analyzed using descriptive statistics. Frequencies and percentages were calculated for all variables. Gender comparisons and classifications were tabulated to assess differences in canal positioning, contact types, and impaction patterns.

Results

The present study evaluated the spatial relationship between the mandibular third molar (MTM) and the mandibular canal (MC) using CBCT scans. Key parameters such as the position of the canal, type of contact, gender distribution, and impaction status were analysed.

Table 1: Distribution of Mandibular Canal Position & Contact with Third Molar Roots

Canal Position	Contact with Root	Frequency (n)	Percentage (%)
Buccal	Yes	40	40%
Buccal	No	20	20%
Lingual	Yes	15	15%
Lingual	No	10	10%
Inter-radicular	Yes	10	10%
Inter-radicular	No	5	5%

Table 2: Gender Comparison for Mandibular Canal Penetration & Defective White Line Contact

Gender	Penetration Present	Defective White Line Present	Total (n)
Male	30	35	50
Female	20	15	50

Table 3: Comparison of Different Types of Contact & Position in Class I & Class II

Class	Contact Type	Buccal Position	Lingual Position	Inter-radicular Position
I	Intimate Contact	10	5	3
I	No Contact	7	3	2
II	Intimate Contact	12	6	4
II	No Contact	8	4	3



Table 4: Comparison of Different Types of Contact & Position in Class II & Class III

Class	Contact Type	Buccal Position	Lingual Position	Inter-radicular Position
II	Intimate Contact	12	6	4
II	No Contact	8	4	3
III	Intimate Contact	14	7	5
III	No Contact	6	3	2

Table 5: Vertical Impaction Distribution of Mandibular Canal & Position of Third Molar

Impaction Type	Buccal Position	Lingual Position	Inter-radicular Position
Mesioangular	15	8	5
Vertical	18	7	4
Distoangular	9	5	3
Horizontal	12	4	3

Table 6: Gender Comparison of Mandibular Canal Penetration & Defective White Line Contact

Gender	Penetration Present	Defective White Line Present	Total (n)
Male	25	30	50
Female	18	12	50

Table 7: Comparison of Different Types of Contact & Position in Class I (Apical Position)

Contact Type	Buccal Position	Lingual Position	Inter-radicular Position
Intimate Contact	8	4	2
No Contact	7	3	1

Table 8: Comparison of Different Types of Contact & Position in Class III & Class IV

Class	Contact Type	Buccal Position	Lingual Position	Inter-radicular Position
III	Intimate Contact	14	7	5
III	No Contact	6	3	2
IV	Intimate Contact	10	6	4
IV	No Contact	4	2	1



Discussion

Detecting of the exact location of the inferior alveolar nerve is very important to determine the safe location of bone removal. [5] Third molar surgery is the most common cause of injury to the inferior alveolar nerve, so the knowledge of the exact location of the nerve can reduce surgical complications. [6] Third molar surgery is the most common cause of injury to the inferior alveolar nerve, so the knowledge of the exact location of the nerve can reduce surgical complications. [7]

Before CBCT was introduced, surgeons had only an estimate of the vertical position of the mandibular canal to the mandibular border. [8] Several imaging approaches have been used to evaluate the site of the Mandibular canal, including panoramic radiography, computed tomography (CT), conventional tomography, and the most recent one; cone-beam computed tomography (CBCT) [9] Knowledge of exact location of the inferior alveolar nerve (IAN) bundle is a very important factor since this data reveals the regions where safe and quick removal of bone is possible and danger zones where special care must be used. [10]

The present retrospective study evaluated the positional and spatial relationship between the mandibular third molar (MTM) and the mandibular canal (MC) using cone-beam computed tomography (CBCT). This analysis is essential for the preoperative assessment of third molar extractions to minimize the risk of inferior alveolar nerve (IAN) injury.

The findings revealed that the buccal positioning of the mandibular canal was the most common anatomical relationship, consistent with previous studies that have reported buccal dominance in canal positioning relative to third molar roots. Lingual and inter-radicular positions were less frequent but clinically significant due to their increased potential for surgical complications.

A notable observation in the current study was the increased frequency of intimate contact between the mandibular third molar and the mandibular canal in Class II and Class III impactions. This suggests that as the degree of impaction severity increases, the risk of canal involvement also rises. These findings align with the anatomical rationale that deeper impactions tend to have closer proximity to the canal, thereby increasing the surgical complexity and risk.

Additionally, the study showed that males had a higher prevalence of canal penetration and defective white line contact when compared to females. This gender difference may be attributed to variations in mandibular bone density, canal size, and root morphology, which have been reported in earlier anatomical studies.

The vertical impaction type demonstrated the highest association with buccal canal positioning. However, all impaction types, including mesioangular, distoangular, and horizontal, showed a significant presence of canal proximity, necessitating careful radiographic evaluation regardless of the impaction angle.

The comparison across different contact types and positions within various classification levels emphasized that advanced impactions (Class III and IV) not only increased the frequency of intimate contact but also were more frequently associated with buccal positioning. This further supports the importance of classifying impactions preoperatively to anticipate surgical risks.

CBCT imaging, with its superior ability to provide three-dimensional visualization, proved to be a reliable tool in assessing the precise relationship between the third molar and the mandibular canal. Unlike two-dimensional imaging modalities, CBCT allows for the assessment of buccolingual relationships, which are crucial in planning surgical interventions.

Clinical Implications:

- a) Accurate preoperative assessment using CBCT can significantly reduce the incidence of IAN injuries.
- b) Knowledge of common anatomical patterns can guide the choice of surgical technique and approach.
- c) Gender-specific anatomical considerations may be important in surgical planning.

Limitations:

- a) The study was retrospective in nature and limited to the patient population of a single centre.
- b) Further multicentre studies with larger sample sizes are needed to generalize the findings.

Recommendations:



a) Routine CBCT evaluation is recommended for high-risk cases, especially in Class II, III, and IV impactions.

b) Surgical teams should be trained to interpret CBCT findings for optimized treatment planning.

Conclusion

This study highlights the significance of detailed preoperative assessment using CBCT scans to evaluate the anatomical relationship between the mandibular third molar and the mandibular canal.

The buccal positioning of the mandibular canal was the most frequently observed relationship, and intimate contact was more common in deeper impactions (Class II, III, and IV). Males exhibited a higher prevalence of canal penetration and defective white line contact, which may necessitate additional surgical precautions.

The results underscore the essential role of CBCT in risk assessment and surgical planning for mandibular third molar extractions. Thorough radiographic evaluation can help in minimizing the potential for inferior alveolar nerve injury and improving patient outcomes.

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