Quest Journals
Journal of Medical and Dental Science Research
Volume 12~ Issue 6 (June 2025) pp: 119-128
ISSN(Online): 2394-076X ISSN (Print):2394-0751
www.questjournals.org

Research Paper

CBCT-Based Assessment of Anatomical Risk Factors for Mandibular Fracture During Third Molar Surgery

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Abstract
Background:
Intraoperative mandibular fracture is an uncommon but clinically significant complication of mandibular third molar surgery. Preoperative identification of anatomical risk factors using cone-beam computed tomography (CBCT) may help improve surgical planning and reduce complications. This study evaluated the association between CBCT-derived anatomical parameters and intraoperative mandibular fracture during mandibular third molar surgery.
Materials and Methods:
A cross-sectional observational study was conducted among 100 patients undergoing mandibular third molar surgery. Preoperative CBCT examinations were assessed for root–inferior alveolar canal (IAC) distance, buccolingual bone width, lingual cortical plate thickness, root volume, IAC cortical integrity, impaction depth, impaction class, and root morphology. Patients were categorized according to the occurrence of intraoperative mandibular fracture. Categorical variables were analyzed using the chi-square test, while continuous CBCT measurements were compared between groups using independent-samples t-tests. Statistical significance was set at $p < 0.05$.
Results:
Intraoperative mandibular fracture occurred in 8 of 100 cases (8.0%). Significant associations were observed between fracture and reduced root–IAC distance ($p = 0.022$*), IAC cortical interruption (*$p = 0.045$*), lingual cortical plate thinning/perforation (*$p = 0.027$*), and Pell and Gregory Class III impaction (*$p = 0.027$*). Compared with non-fracture cases, fracture cases demonstrated significantly smaller mean root–IAC distance (0.72 ± 0.31 vs. 1.58 ± 0.62 mm;* $p < 0.001$*), reduced buccolingual bone width (2.41 ± 0.58 vs. 3.18 ± 0.71 mm;* $p = 0.005$*), thinner lingual cortical plate (0.86 ± 0.24 vs. 1.31 ± 0.39 mm;* $p = 0.002$*), and greater root volume (315.4 ± 62.8 vs. 268.7 ± 58.4 mm³;* $p = 0.035$*).*
Conclusion:
CBCT assessment identified several anatomical features significantly associated with intraoperative mandibular fracture during mandibular third molar surgery. Reduced root–IAC distance, IAC cortical interruption, lingual cortical plate thinning or perforation, greater impaction depth, reduced buccolingual bone width, and increased root volume may indicate increased surgical risk. Incorporating these CBCT findings into preoperative assessment may facilitate individualized surgical planning and risk stratification. However, the findings should be interpreted cautiously because of the relatively small number of fracture events.

Received 16 June., 2025; Revised 23 June., 2025; Accepted 30 June., 2025

I. Introduction

Surgical extraction of impacted mandibular third molars is a routine procedure in oral and maxillofacial surgery. Despite its widespread use and generally favorable safety profile, the procedure may be associated with several postoperative complications, including pain, swelling, infection, alveolar osteitis, nerve injury, and, rarely, mandibular fracture. Although fracture is an uncommon complication, its occurrence can result in considerable morbidity, prolonged recovery, and the need for additional surgical intervention [1].

The development of mandibular fracture following third molar surgery is multifactorial and may be related to patient characteristics, tooth position, surgical technique, and local anatomical conditions. Deeply positioned or severely angulated third molars may require extensive bone removal, thereby reducing the structural integrity of the posterior mandible. Factors such as the depth of impaction, relationship with the ascending ramus, root configuration, and quantity of residual bone may influence the amount of mechanical resistance available during tooth removal [2]. In addition, increasing patient age and pathological alterations associated with impacted teeth may affect bone quality and further modify the susceptibility of the mandible to fracture [3].

Panoramic radiography remains a commonly employed imaging modality for the preoperative evaluation of impacted mandibular third molars. However, its two-dimensional (2D) representation can limit assessment of complex three-dimensional (3D) anatomical relationships. Structures such as the buccal and lingual cortical plates, precise root morphology, inferior alveolar canal (IAC) position, and the amount of residual bone surrounding an impacted tooth may not be adequately demonstrated on panoramic images [4]. These limitations may be particularly relevant when the third molar is deeply impacted or located in close proximity to important mandibular structures.

Cone- beam computed tomography (CBCT) has expanded the ability to evaluate impacted mandibular third molars by providing multiplanar and 3D visualization of the tooth and surrounding osseous structures. It permits more detailed assessment of tooth orientation, root anatomy, IAC relationships, cortical bone characteristics, and available bone dimensions. Such information can be particularly useful in cases where conventional radiographs indicate a complex anatomical relationship or when additional information is required for surgical planning [5].

Several anatomical parameters visible on CBCT may provide useful information regarding the potential vulnerability of the mandible during third molar removal. These include the thickness of the cortical plates, dimensions of the mandibular body and ramus, depth and angulation of impaction, relationship between the tooth roots and IAC, and the quantity of bone remaining around the impacted tooth. Evaluation of these characteristics may assist in identifying cases with increased surgical difficulty and potentially greater susceptibility to structural compromise [6]. 3D assessment may also provide information that is difficult to obtain reliably from conventional radiographs, thereby supporting more individualized surgical planning [7].

Previous investigations have emphasized the importance of preoperative radiographic assessment in predicting surgical difficulty and identifying anatomical relationships that may influence complications associated with mandibular third molar removal [8]. A detailed understanding of the 3D anatomy may help clinicians modify the surgical approach, minimize unnecessary bone removal, and reduce excessive forces during elevation of the impacted tooth. Appropriate preoperative assessment may therefore contribute to improved surgical safety and more predictable clinical outcomes [9].

Despite the increasing application of CBCT in third molar assessment, the specific anatomical characteristics that may contribute to mandibular fracture during third molar surgery require further systematic evaluation. Therefore, the present study was undertaken to assess CBCT-based anatomical risk factors associated with mandibular fracture during surgical removal of impacted mandibular third molars. The findings are intended to improve preoperative identification of potentially high-risk anatomical features and support safer, individualized surgical planning.

II. Materials & Methods

Study Design and Setting

A cross-sectional observational study was conducted at a single tertiary care centre between January and May 2025 to investigate CBCT-based anatomical factors associated with intraoperative mandibular fracture during surgical removal of mandibular third molars. The study included 100 patients who required surgical extraction of a mandibular third molar. Preoperative CBCT examinations were performed for all participants to assess the anatomical relationship of the impacted third molar with the IAC and adjacent cortical bone structures. The study population comprised 58 males (58.0%) and 42 females (42.0%), with a mean age of 27.8 ± 5.6 years.

Inclusion Criteria

- Patients aged 18 years or older
- Patients who underwent the planned mandibular third molar surgical procedure at the study centre
- Patients with a mandibular third molar adequately visualized on preoperative CBCT
- Patients with sufficient CBCT image quality for assessment of the tooth, IAC, buccolingual bone, and lingual cortical plate

- Patients for whom complete clinical and radiographic records were available
- Patients who provided appropriate consent for surgical treatment and use of their clinical and radiographic data for research purposes

Exclusion Criteria

- Patients with previous mandibular fracture or major mandibular surgery in the region of the third molar
- Patients with pathological lesions or extensive bone pathology involving the mandibular third molar region
- Patients with developmental anomalies affecting mandibular morphology
- Patients with inadequate, distorted, or otherwise non-diagnostic CBCT images
- Patients with incomplete clinical or radiographic records
- Patients who had undergone previous surgical intervention involving the same mandibular third molar
- Patients with systemic or local conditions that could substantially alter mandibular bone quality or healing

CBCT Image Acquisition

Preoperative CBCT examinations were performed for all patients using a Planmeca ProMax 3D Classic CBCT unit (Planmeca Oy, Helsinki, Finland). Images were acquired using a medium field of view (FOV) of 8 × 8 cm, with a voxel size of 0.2 mm, 90 kVp, and **10 mA**, using an exposure time of approximately 15 seconds, according to the manufacturer's recommended protocol for dentomaxillofacial imaging. Patients were positioned in an upright position with the head stabilized to minimize movement and maintain consistent image quality during acquisition. The CBCT datasets were reconstructed in axial, coronal, and sagittal planes and evaluated using multiplanar reconstruction. Images were analyzed using the manufacturer's dedicated viewing software. All measurements were obtained using the software's calibrated measurement tools and recorded in millimetres or cubic millimetres, as appropriate.

CBCT Assessment

- Preoperative CBCT images were evaluated to characterize the anatomical features relevant to the risk of intraoperative mandibular fracture. The assessed parameters included:
- Root–IAC distance, measured as the shortest distance between the mandibular third molar root and the IAC
- Buccolingual bone width at the relevant third molar region
- Lingual cortical plate thickness
- Root volume
- Presence or absence of IAC cortical interruption
- Presence or absence of lingual cortical plate thinning or perforation
- Impaction depth, including Position C
- Pell and Gregory classification, with particular attention to Class III impaction
- Root morphology, including large or divergent roots

The radiographic findings were recorded systematically for each case and subsequently compared according to the occurrence of intraoperative mandibular fracture.

Assessment of Intraoperative Mandibular Fracture

The primary outcome was the occurrence of mandibular fracture during surgical removal of the mandibular third molar. Patients were categorized into two groups: fracture group and non-fracture group. An intraoperative fracture was recorded when an unintended mandibular fracture occurred during the surgical procedure and was clinically recognized and documented by the operating surgeon.

Statistical Analysis

All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS), IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive and inferential statistical techniques were selected based on the nature and distribution of the variables. Continuous variables, including age, were summarized using mean and standard deviation, whereas categorical variables were presented as frequencies and percentages. The chi-square test was used to evaluate associations between categorical CBCT risk factors and the occurrence of intraoperative mandibular fracture. Independent-samples t-tests were used to compare the CBCT-derived anatomical measurements between patients with mandibular fractures and those without fractures. A two-sided p-value < 0.05 was considered statistically significant

III. Results

Table 1 & Figure 1 present the demographic characteristics of the study population. A total of 100 patients who underwent mandibular third molar surgery were included in the study. The participants had a mean age of 27.8 ± 5.6 years. Males constituted the larger proportion of the study population, accounting for 58 participants (58.0%), while females comprised 42 participants (42.0%).

Table 1: Study population and demographic characteristics

Parameter	**n**	**Percentage / Mean ± SD**
Total patients / third molars	100	100.0%
Age (years)	—	27.8 ± 5.6
Male	58	58.0%
Female	42	42.0%

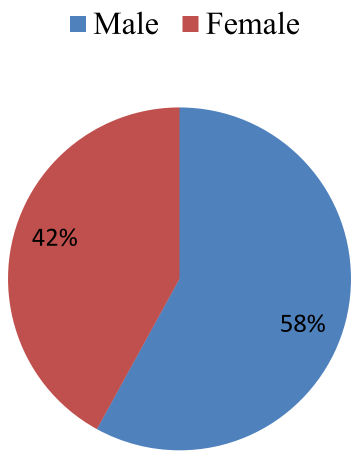

Figure 1: Demographic characteristics of the study population

Table 2 & Figure 2 illustrate the distribution of mandibular third molar cases according to the side involved. Among the 100 cases assessed, the right mandibular third molar was involved in 48 cases, whereas the left side accounted for 52 cases. The distribution between the two sides was nearly balanced, with a marginally greater proportion of cases involving the left mandibular third molar.

Table 2: Distribution according to mandibular third molar position

Parameter	**n**	**%**
Right mandibular third molar	48	48.0%
Left mandibular third molar	52	52.0%
Total	100	100.0%

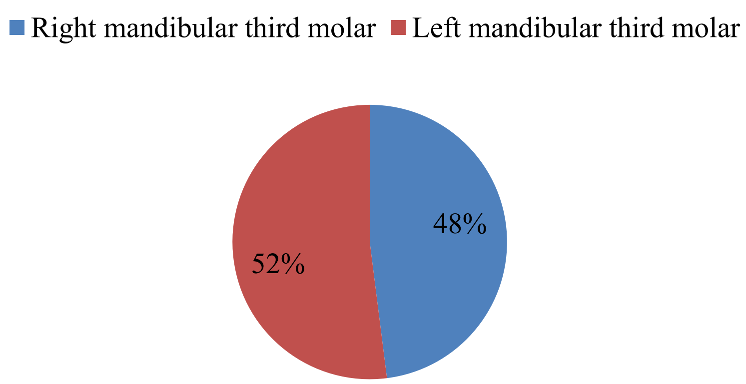

Figure 2: Distribution of mandibular third molar cases according to side involved

Table 3 & Figure 3 show the distribution of mandibular third molars according to their radiographic angulation. Mesioangular impaction was the most commonly identified pattern, observed in 42 cases (42.0%). Vertical impaction was recorded in 28 cases (28.0%), followed by horizontal impaction in 18 cases (18.0%) and distoangular impaction in 12 cases (12.0%). Overall, mesioangular impaction was the predominant angulation pattern among the mandibular third molars assessed.

Table 3: Radiographic classification of third molars

Radiographic characteristic	n	%
Mesioangular impaction	42	42.0%
Vertical impaction	28	28.0%
Horizontal impaction	18	18.0%
Distoangular impaction	12	12.0%
Total	100	100.0%

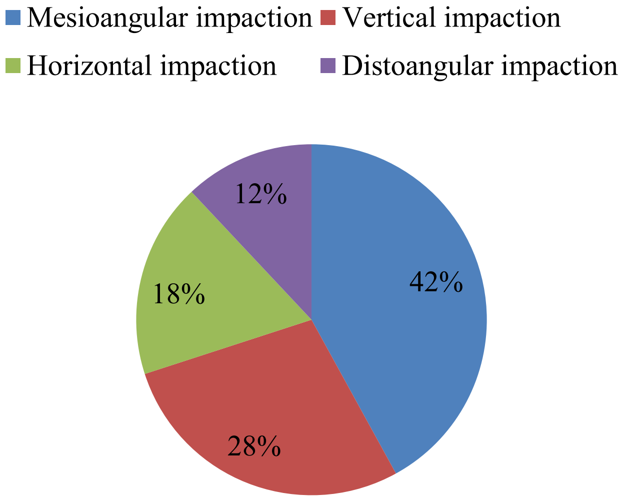

Figure 3: Distribution of mandibular third molars according to radiographic angulation

Table 4 & Figure 4 summarize the CBCT-determined anatomical risk factors associated with mandibular third molar surgery. The most commonly identified finding was a close relationship between the third molar roots and the IAC, observed in 38 cases (38.0%). Changes involving the lingual cortical plate, including thinning or perforation, were noted in 31 cases (31.0%). Position C impaction was identified in 29 cases (29.0%), while reduced buccolingual bone width was present in 27 cases (27.0%). Cortical interruption of the IAC was observed in 24 cases (24.0%). Pell and Gregory Class III impaction was recorded in 22 cases (22.0%), whereas increased root volume or root divergence was noted in 19 cases (19.0%). Overall, root–canal proximity and lingual cortical plate alterations were the most prevalent anatomical findings identified on CBCT.

Table 4: CBCT-based anatomical risk factors

Risk factor	Present n (%)	Absent n (%)
Reduced distance between roots and IAC	38 (38.0%)	62 (62.0%)
Lingual cortical plate thinning/perforation	31 (31.0%)	69 (69.0%)
High impaction depth (Position C)	29 (29.0%)	71 (71.0%)
Reduced buccolingual bone width	27 (27.0%)	73 (73.0%)
Deep impaction (Pell & Gregory Class III)	22 (22.0%)	78 (78.0%)
IAC cortical interruption	24 (24.0%)	76 (76.0%)
Large root volume / divergent roots	19 (19.0%)	81 (81.0%)

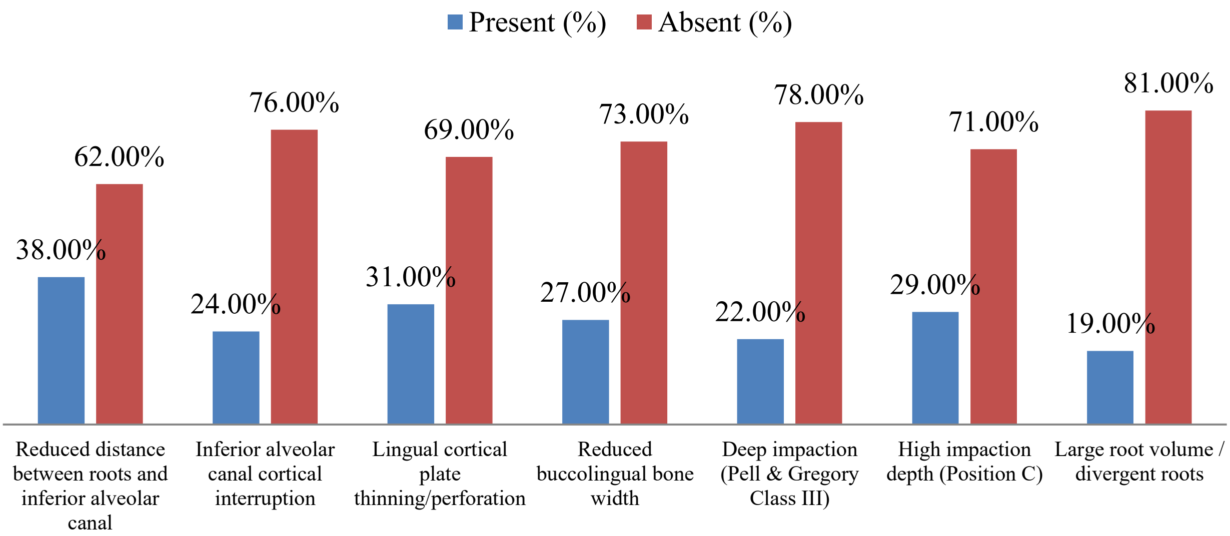

Figure 4: Distribution of CBCT-determined anatomical risk factors associated with mandibular third molar surgery

Table 5 & Figure 5 depict the occurrence of intraoperative mandibular fractures among the evaluated cases. A mandibular fracture was recorded intraoperatively in 8 of the 100 cases, whereas no fracture occurred in the remaining 92 cases. Therefore, intraoperative mandibular fracture was relatively infrequent in the study population, although it represented an important surgical complication.

Table 5: Incidence of intraoperative mandibular fracture

Outcome	n	%
Mandibular fracture occurred	8	8.0%
No mandibular fracture	92	92.0%
Total	100	100.0%

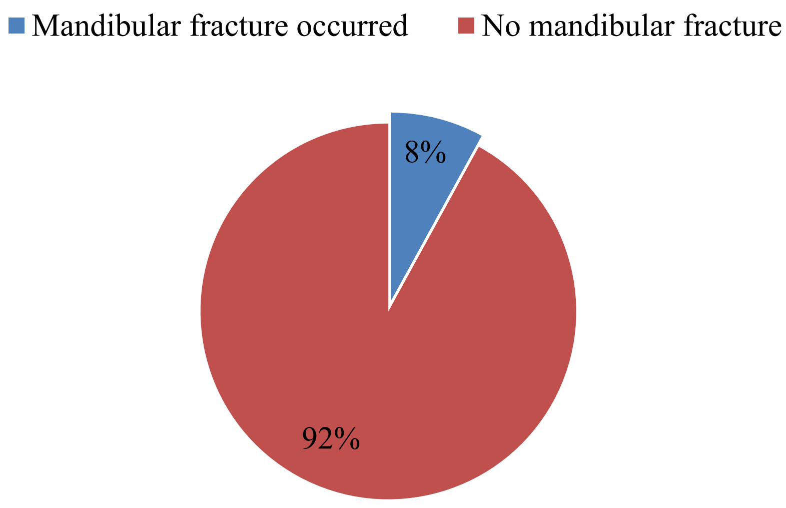

Figure 5: Distribution of intraoperative mandibular fractures among the study cases

Table 6 & Figure 6 summarize the association between CBCT-derived anatomical factors and intraoperative mandibular fracture. A reduced IAC–root distance was significantly associated with fracture, occurring in 6 (15.8%) fracture cases compared with 32 (84.2%) non-fracture cases ($\chi^2 = 5.27$, $p = 0.022$). IAC cortical interruption also showed a significant association, being identified in 4 (16.7%) fracture cases and 20 (83.3%) non-fracture cases ($\chi^2 = 4.03$, $p = 0.045$). Lingual cortical plate thinning/perforation was significantly associated with fracture and was observed in 5 (23.8%) fracture cases and 16 (76.2%) non-fracture cases (χ^2 = 4.92, p = 0.027). Similarly, Class III impaction demonstrated a significant association, occurring in 4 (20.0%) fracture cases compared with 16 (80.0%) non-fracture cases (χ^2 = 4.87, p = 0.027).

No statistically significant association was observed for reduced buccolingual bone width (χ^2 = 2.76, p = 0.097), Position C impaction (χ^2 = 1.98, p = 0.159), or large/divergent roots (χ^2 = 1.71, p = 0.191). Overall, reduced IAC–root distance, IAC cortical interruption, lingual cortical plate thinning/perforation, and Class III impaction were significantly associated with an increased occurrence of intraoperative mandibular fracture.

Table 6: Association of CBCT risk factors with mandibular fracture

CBCT risk factor		Fracture n/N (%)	No fracture n/N (%)	χ^2	p-value
Reduced IAC–root distance	Present	06 (15.8%)	32 (84.2%)	5.27	0.022
	Absent	02 (3.2%)	60 (96.8%)		
IAC cortical interruption	Present	04 (16.7%)	20 (83.3%)	4.03	0.045
	Absent	04 (5.3%)	72 (94.7%)		
Lingual cortical plate thinning/perforation	Present	05 (23.8%)	16 (76.2%)	4.92	0.027
	Absent	03 (4.3%)	66 (95.7%)		
Reduced buccolingual bone width	Present	04 (14.8%)	23 (85.2%)	2.76	0.097
	Absent	04 (5.5%)	69 (94.5%)		
Class III impaction	Present	04 (20.0%)	16 (80.0%)	4.87	0.027
	Absent	04 (5.1%)	74 (94.9%)		
Position C impaction	Present	04 (13.8%)	25 (86.2%)	1.98	0.159
	Absent	04 (5.6%)	67 (94.4%)		
Large/divergent roots	Present	03 (15.8%)	16 (84.2%)	1.71	0.191
	Absent	05 (6.2%)	76 (93.8%)		

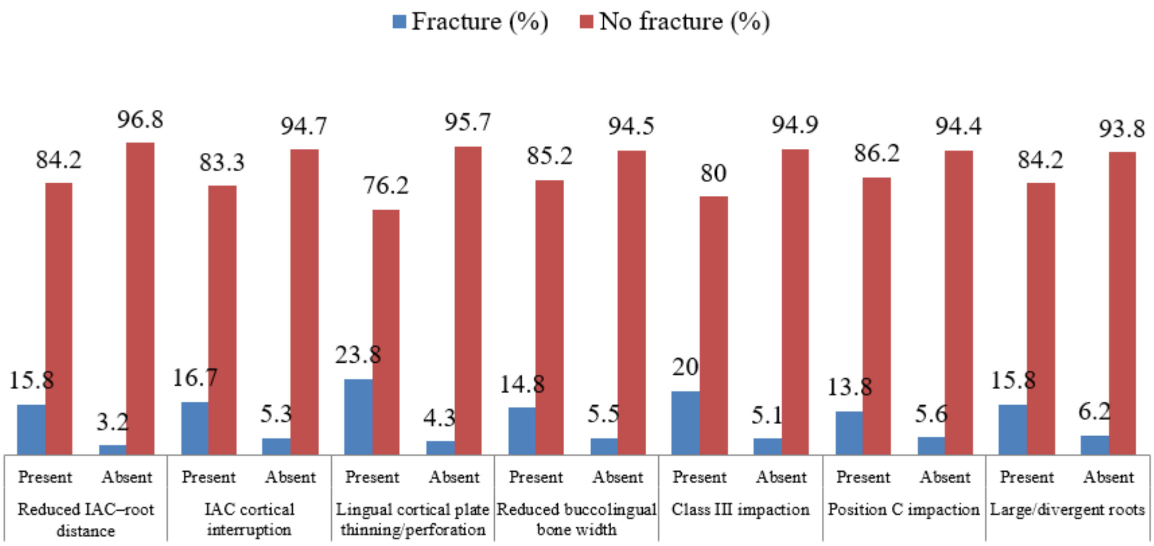

Figure 6: Association between CBCT-based risk factors and intraoperative mandibular fracture

Table 7 & Figure 7 compare the continuous CBCT measurements between the fracture and non-fracture groups. The mean root–IAC distance was significantly smaller in the fracture group (0.72 ± 0.31 mm) than in the non-fracture group (1.58 ± 0.62 mm), with a mean difference of 0.86 mm ($t = -3.79$, $p < 0.001$). Similarly, the mean buccolingual bone width was significantly reduced in fracture cases (2.41 ± 0.58 mm) compared with non-fracture cases (3.18 ± 0.71 mm), showing a mean difference of 0.77 mm ($t = -2.91$, $p = 0.005$). The mean lingual cortical plate thickness was also significantly lower in the fracture group (0.86 ± 0.24 mm) than in the non-fracture group (1.31 ± 0.39 mm), with a mean difference of 0.45 mm ($t = -3.17$, $p = 0.002$). In contrast, mean root volume was significantly higher among fracture cases (315.4 ± 62.8 mm^3) than among non-fracture cases (268.7 ± 58.4 mm^3), with a mean difference of 46.7 mm^3 ($t = 2.14$, $p = 0.035$). Overall, fracture cases were characterized by a shorter root–IAC distance, reduced buccolingual bone width, thinner lingual cortical plates, and greater root volume compared with non-fracture cases.

Table 7: Comparison of anatomical measurements between fracture and non-fracture groups

CBCT measurement	Fracture (n=8)	No fracture (n=92)	Mean difference	t-value	p-value
Root–IAC distance (mm)	0.72 ± 0.31	1.58 ± 0.62	0.86	−3.79	<0.001
Buccolingual bone width (mm)	2.41 ± 0.58	3.18 ± 0.71	0.77	−2.91	0.005
Lingual cortical plate thickness (mm)	0.86 ± 0.24	1.31 ± 0.39	0.45	−3.17	0.002
Root volume (mm^3)	315.4 ± 62.8	268.7 ± 58.4	46.7	2.14	0.035

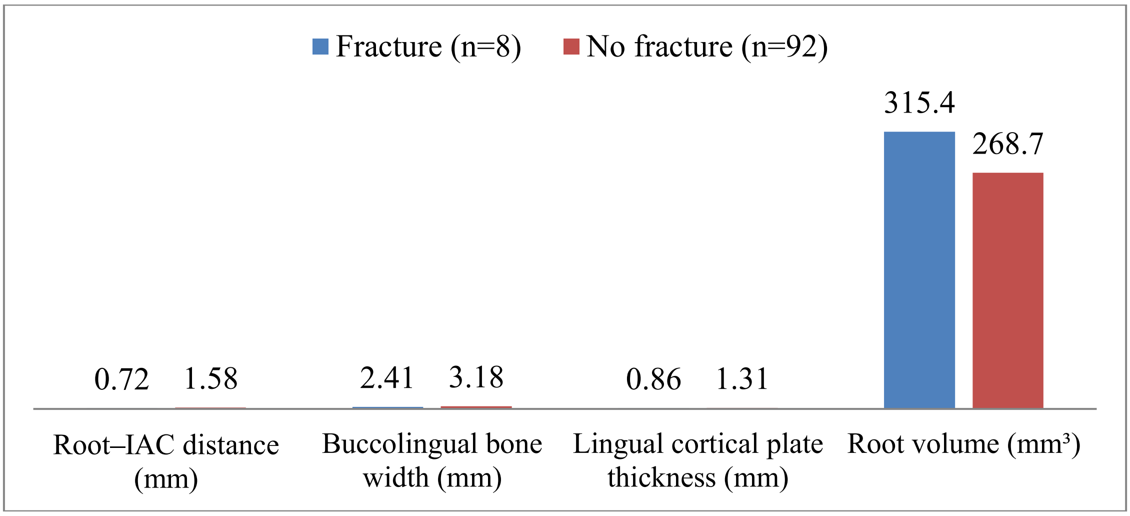

Figure 7: Comparison of continuous CBCT measurements between fracture and non-fracture groups

IV. Discussion

The present investigation focused on the CBCT-based evaluation of anatomical features that may influence the susceptibility of the mandible to fracture during surgical removal of impacted mandibular third molars. The findings indicate that surgical risk is determined by a combination of tooth-related and surrounding osseous characteristics rather than by impaction status alone. CBCT provides multiplanar visualization of the impacted tooth, cortical boundaries, IAC, and available supporting bone, allowing these structures to be assessed more comprehensively before surgery.

Gbotolorun et al. (2007) [10] evaluated factors contributing to the difficulty encountered during extraction of impacted mandibular third molars and demonstrated that surgical complexity is influenced by both clinical and radiographic characteristics. Their observations suggest that assessment of third molars should incorporate several anatomical variables rather than depending on a single indicator of difficulty. In the present context, an unfavorable tooth position combined with reduced surrounding bone may necessitate greater osteotomy and application of increased extraction forces. Such circumstances could potentially compromise the mechanical integrity of the posterior mandible and increase the possibility of fracture.

Wihokrut et al. (2022) [11] investigated the proximity of mandibular third molar roots to the surrounding cortical bone using CBCT and panoramic radiography. Their findings underline the importance of evaluating the spatial relationship between the roots and cortical boundaries before surgical removal. This relationship has particular relevance when considering mandibular fracture because the cortical plates contribute substantially to the structural stability of the jaw. Minimal bone between the roots and cortical surface may indicate a restricted osseous envelope, which can influence both the surgical technique and the amount of bone that can be removed without unnecessarily weakening the mandible.

Chen et al. (2009) [12] assessed the relationship between impacted mandibular third molars and the IAC using panoramic radiography and CBCT. Their findings demonstrated the ability of CBCT to provide more comprehensive information concerning the 3D position of the IAC in relation to the impacted tooth. Although proximity to the canal is traditionally emphasized because of its association with inferior alveolar nerve injury, this anatomical relationship can also provide useful information about the amount of bone separating the tooth roots from adjacent structures. Consequently, IAC position should be incorporated into the overall anatomical evaluation of surgically challenging third molars.

Ghaeminia et al. (2009) [13] compared CBCT with panoramic radiography for determining the position of impacted mandibular third molars relative to the IAC. Their work demonstrated the diagnostic value of CBCT in situations where the relationship between the tooth and canal could not be adequately established from panoramic imaging. These findings are consistent with the rationale of the present study, in which 3D imaging is used to characterize potentially unfavorable anatomical configurations. The ability of CBCT to reveal buccolingual relationships, cortical boundaries, and the exact spatial orientation of the tooth can provide additional information for selecting an appropriate surgical approach.

Leung and Cheung (2011) [14] investigated the association between radiographic findings, exposure of the inferior dental nerve, and sensory deficit following mandibular third molar surgery. Their findings emphasized that specific radiographic characteristics may have clinically relevant implications for surgical outcomes. Although their investigation primarily addressed neurological complications rather than mandibular fracture, it supports the broader importance of identifying unfavorable anatomical relationships before third molar surgery. In the present study, parameters such as IAC position, cortical thickness, root configuration, and residual bone should consequently be considered together when evaluating the anatomical complexity of an impacted third molar.

Matzen et al. (2016) [15] examined the radiographic techniques used before mandibular third molar removal and reported that panoramic imaging was commonly used as the primary investigation, whereas CBCT was generally reserved for selected cases. This supports a selective rather than routine approach to CBCT examination. In patients with complex impaction patterns, uncertain anatomical relationships, unusual root morphology, or limited surrounding bone, however, CBCT may provide clinically valuable information that cannot be obtained reliably from conventional 2D imaging. For the assessment of mandibular fracture risk, this additional information may help identify cases in which preservation of the remaining osseous support should receive particular attention.

CBCT assessment can extend preoperative evaluation beyond conventional third molar classification by demonstrating the 3D structural anatomy of the posterior mandible. Assessment of residual bone support, cortical plate configuration, root morphology, impaction depth, and the relationship of the tooth to the IAC may help identify cases in which surgical manipulation is likely to be more demanding. Because mandibular fracture results from the interaction of multiple anatomical and surgical factors, individual CBCT characteristics should be interpreted collectively rather than as isolated predictors.

The integration of these radiographic findings into surgical planning may allow clinicians to anticipate difficult access, minimize unnecessary osseous removal, and select appropriate tooth-sectioning and mobilization strategies. This anatomy-based approach may be particularly beneficial for deeply impacted and structurally complex third molars, where preservation of the remaining mandibular bone is critical. Thus, CBCT may serve as a useful adjunct for individualized surgical planning and risk stratification, with the potential to improve procedural safety and reduce the likelihood of major complications such as mandibular fracture.

V. Limitations

The present study has several limitations. First, the sample size was relatively small, comprising 100 patients, with only 8 cases of intraoperative mandibular fracture. The limited number of fracture events reduces the statistical power of the study and warrants cautious interpretation of the observed associations. Second, the study was conducted at a single clinical centre, which may limit the generalizability of the findings to other populations and clinical settings. Third, the observational study design precludes establishing a causal relationship between the CBCT findings and the occurrence of intraoperative mandibular fracture. Although several CBCT-derived anatomical parameters were assessed, other potentially relevant clinical and surgical factors, including surgeon experience, surgical technique, duration of surgery, extent of bone removal, tooth sectioning, extraction forces, bone quality, and bone density, were not comprehensively evaluated. In addition, postoperative complications and long-term outcomes following intraoperative fracture were not assessed. The accuracy of CBCT-based measurements may also be influenced by image quality, voxel size, patient positioning, and measurement technique. Finally, multiple anatomical variables were evaluated in a relatively small sample, and the possibility of chance associations cannot be excluded. Therefore, larger multicentre prospective studies using standardized CBCT measurement and surgical protocols are required to validate these findings and determine which anatomical characteristics may be clinically useful for identifying patients at increased risk of intraoperative mandibular fracture.

VI. Conclusion

CBCT identified several anatomical characteristics associated with intraoperative mandibular fracture during third molar surgery, particularly reduced root–IAC distance, IAC cortical interruption, lingual cortical plate thinning or perforation, and Class III impaction. Fracture cases also demonstrated smaller buccolingual bone width, thinner lingual cortical plates, and greater root volume. These findings highlight the value of 3DCBCT assessment for preoperative evaluation of anatomically high-risk mandibular third molars. However, the findings should be interpreted cautiously because of the small number of fracture events and require validation in larger prospective studies.

Conflicts of Interest: Nil
Financial Support: None

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