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Evaluating The Role Of Buccolingual Tooth Angulation In Predicting Lingual Plate Fracture In Horizontally Impacted Mandibular Third Molars " A Prospective Observational CBCT Analysis

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Abstract

Background: *Extraction of horizontally impacted mandibular third molars is a common oral surgical procedure, yet it carries potential complications. Lingual plate fracture, although rare, can lead to nerve injury, postoperative hemorrhage, and delayed recovery. Tooth orientation, specifically buccolingual angulation, may influence the risk of cortical thinning and fracture.*

Aim: *To evaluate the role of buccolingual angulation in predicting lingual plate thinning and fracture, and to examine its relationship with odontectomy patterns using CBCT imaging.*

Methods: *Preoperative CBCT assessment was performed on 58 patients (mean age 28.3 years; 32 females, 26 males) with horizontally impacted mandibular third molars in this prospective observational study. Buccolingual angulation was measured relative to the pulp axis of adjacent molars. Odontectomy patterns were recorded intraoperatively, and lingual plate integrity was assessed. Postoperative outcomes, including pain, mouth opening, and nerve function, were evaluated.*

Results: *Mean buccolingual angulation was 3.28°. A significant inverse correlation was found between angulation and lingual plate thickness at both mid-root and apical levels. Only one lingual plate fracture occurred (longitudinal odontectomy group), highlighting the multifactorial nature of fracture risk. Angulation values varied across odontectomy patterns (longitudinal: 1.32°, transverse: 6.53°, full: 13.66°, p = 0.001), but the pattern was randomly assigned. Postoperative recovery was favorable, with improved mouth opening and complete pain resolution by day 30.*

Conclusion: *Buccolingual angulation is a significant predictor of lingual plate thinning and potential fracture. Preoperative CBCT assessment is critical for surgical planning, while careful flap handling and periosteum preservation contribute to optimal postoperative outcomes.*

Keywords: *Buccolingual angulation, Mandibular third molar, Horizontally impacted tooth, CBCT, Lingual plate fracture, Odontectomy.*

INTRODUCTION

Extracting horizontally impacted mandibular third molars is a routine yet potentially challenging procedure in oral surgery. A significant concern during this surgery is the risk of lingual plate fracture. Such fractures not only increase the risk of injury to the lingual nerve but can also lead to postoperative complications, including hemorrhage, infection, and prolonged recovery.[1]

A key factor influencing the risk of lingual plate fracture is the buccolingual angulation of the impacted tooth. This angulation plays a crucial role in determines the vector of force applied during surgical elevation and can contribute to excessive pressure on the lingual cortical plate, particularly in cases where the bone is thin or the tooth is oriented unfavourably. Research using CBCT imaging has demonstrated that as buccolingual angulation increases, lingual plate thickness correspondingly decreases, heightening the risk of perforation or fracture.[2] Particularly, horizontally impacted third molars often show the thinnest lingual bone at the mid-root and apex—regions most vulnerable during extraction.[3]

This study aimed to determine the contribution of surgical parameters, such as the odontectomy pattern, that may contribute to lingual plate fractures, as well as the impact of buccolingual tooth angulation in predicting lingual plate fracture in horizontally impacted mandibular third molars using CBCT.

MATERIALS AND METHODS –

Study Design and Population:

A prospective observational study was conducted at SRM Dental College, Chennai, with ethical approval (IRB No. SRMDC/IRB/2022/MDS/NO.405) and CTRI registration (CTRI/2024/01/062105). Fifty-eight patients (18–55 years) with horizontally impacted mandibular third molars were included. Exclusion criteria: systemic diseases, incomplete root formation, severe crown destruction (>40%,), abnormal root morphology, and unwillingness for follow-up.

Imaging

Patients had to sit upright during CBCT scans to make sure that the Frankfort horizontal plane aligned parallel to the ground and the mid-facial plane aligned at right angles to the floor. A CS 9600 system with a 12 x 10 cm field of view has been utilized for imaging. The scans had a slice thickness of 0.3 mm were acquired at 120 kV and 5 mA. Images were examined in the axial, sagittal, and coronal sections.

Measurement procedure

For analysis, only scans that fully depicted the mandibular third molar and adjacent alveolar bone and with the best resolution were taken into account. Measurements of buccal and lingual bone thickness were taken from coronal, sagittal, and axial sections to ensure accurate evaluation of bone morphology in relation to the impacted tooth. The buccolingual angulation determined from axial CBCT sections by drawing a reference axis that bisected the pulp chambers of the first and second molars (M1 and M2). For horizontally impacted third molars (M3), the crown inclination was measured relative to this axis. **(Fig 1)** If the crown was tilted buccally, the angulation was assigned a positive value, whereas a lingual tilt was given a negative value. To standardize the measurement, a reference line parallel to the bisection of M2 was drawn, and the angular difference of the impacted M3 was calculated. Based on the degree of inclination, angulation less than −5° was categorized as lingual**,** greater than +5° as buccal**,** and values between −5° and +5° as central**.**

Figure 1: Measurement of buccolingual angulation on axial CBCT slice using the pulp chamber axis of first and second molars as reference.

Surgical procedure

To ensure consistency in technique and reduce bias linked to surgical variability, a single consultant surgeon conducted all extractions and the subsequent assessment of lingual plate integrity while under local anesthetic. The operative field was prepared with 5% povidone–iodine. Through an inferior alveolar nerve block, 2% lignocaine hydrochloride with 1:80,000 adrenaline was administered to deliver a local anesthesia. A full-thickness mucoperiosteal flap was raised following a Ward's incision.Bone removal was carried out with a No. 702 surgical bur under continuous saline irrigation to prevent thermal damage. The impacted tooth was sectioned either transversely or longitudinally **(Fig. 2a, b)** and delivered accordingly. Using direct visual inspection, the integrity of the lingual plate was meticulously evaluated intraoperatively. A 3-0 silk suture was used to close the wound.

A 5-day course of amoxicillin (250 mg TID), metronidazole (400 mg TID), and aceclofenac (50 mg BID) was part of the postoperative care to control infection and relieve pain. Following surgery, patients were evaluated on the first, third, seventh, and thirty days.

The following parameters were systematically evaluated:

- **Pain:** Graded using the Visual Analog Scale (VAS).
- **Mouth opening:** Recorded in millimeters with a ruler or Vernier caliper.
- **Difficulty in swallowing:** Assessed with the Mellow–Pinkas scoring system.
- **Hematoma:** Documented clinically with respect to its presence, size, and associated discomfort.
- **Lingual nerve paresthesia:** Evaluated using standardized patient-reported questions:
  - Do you experience any change in taste?
  - Do you have difficulty in speaking?
  - Do you feel numbness on your tongue?

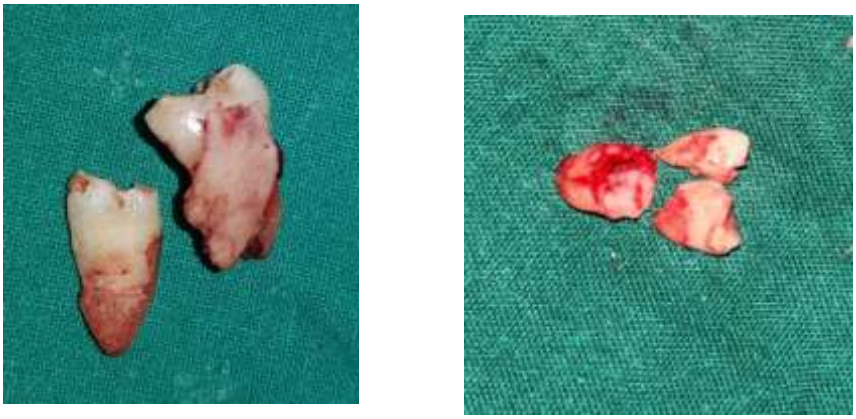

Figure 2: Tooth Sectioning (a) Longitudinal sectioning with Lingual Plate Fracture (b) Transverse Sectioning

STATISTICAL ANALYSIS

Continuous variables were represented by descriptive statistics as mean ± standard deviation, whereas categorical variables were shown as percentages and frequencies. Inferential analysis was performed using a one-way ANOVA and post hoc pairwise comparisons to assess group differences in mouth opening and pain. Category variables such as gender and buccolingual angulation, odontectomy pattern and buccolingual angulation, buccolingual angulation and lingual plate thickness, and odontectomy pattern and plate fracture were evaluated using Pearson's correlation coefficient.IBM SPSS Statistics for Windows, Version 26.0 (Armonk, NY: IBM Corp., 2019), was used for all statistical analyses. Statistical significance was determined by adopting a significance level of $\alpha = 0.05$ and considering p-values less than 0.05.

RESULTS

A total of 58 patients with horizontally impacted mandibular third molars were enrolled, including 26 males and 32 females with a mean age of 28.3 years (range: 18–55 years). The majority of participants (66%) were younger than 30 years, while only 3% were above 44 years.

Analysis of buccolingual angulation revealed an overall mean angulation of 3.28°. When stratified by gender, females exhibited significantly higher mean angulation compared to males. This difference was statistically significant ($P < 0.05$)., highlighting a possible gender-related variation in the buccolingual orientation of horizontally impacted mandibular third molars.

The correlation analysis of buccolingual angulation with lingual plate thickness revealed a clear inverse relationship. As angulation increased, both mid-root and apical lingual plate thicknesses decreased

significantly. This trend was consistent and statistically significant, underscoring the role of angulation as a predictive factor for thinning of the lingual cortical plate.

Evaluation of odontectomy patterns revealed a clear association with angulation severity: mean values increased progressively from 1.32° in longitudinal, to 6.53° in transverse, and 13.66° in full odontectomy cases ($p = 0.001$).

A single lingual plate fracture was recorded and it occurred in a case treated with a longitudinal odontectomy despite the longitudinal group's lower mean buccolingual angulation (1.32°). In both the transverse and complete odontectomy groups, there were no fractures.

This event highlights the multifactorial nature of lingual plate fracture. Localized thinning of the lingual cortex, root anatomy, undercuts, bone density, and the vector of surgical forces may all contribute, underscoring that fracture risk cannot be explained by angulation alone. With only one recorded fracture, no meaningful comparison of fracture rates between
odontectomy patterns and angulations can be made. The lingual periosteum had been preserved in every patient, and no cases necessitated lingual flap elevation during surgery.

Postoperative recovery showed a consistent improvement in functional outcomes. With a statistically significant improvement ($p = 0.005$), the mouth opening, which started out at just over 31 mm on average, increased gradually over the course of the follow-up period and reached over 40 mm by the end of one month. The highest rise was observed in the first postoperative week. Similar trends were seen in pain scores, which began at a mean score above 4.2 right after surgery, dropped precipitously throughout the first week, and then completely resolved by day 30 ($p < 0.01$). None of the patients complained lingual nerve paresthesia or difficulties with swallowing during their recovery period. **(Table 1)**

Table 1: Correlation of Buccolingual Angulation, Odontoectomy Pattern, Mouth Opening, and Pain

Variables	Group / Category	Mean ± SD	P-value	Remarks
Buccolingual Angulation	Overall	3.25 ± 0.37	-	Baseline mean angulation
Comparison by Gender	Males	3.08 ± 0.32	0.043*	Significant difference
	Females	3.41 ± 0.54		
Correlation with Lingual Plate Thickness	Root Apex vs Buccolingual Angulation	-10.34 ± 7.43	0.001*	Significant
	Mid-Root vs Buccolingual Angulation	-9.36 ± 8.69	0.001*	Significant
Odontectomy Pattern & Angulation	Longitudinal	1.32 ± 0.06	-	
	Transverse	6.53 ± 0.97	0.001*	Significant
	Full	13.66 ± 2.75		
Mouth Opening Over Time	Day 1	31.55 ± 3.57	<0.01*	Progressive improvement
	Day 3	35.33 ± 2.68		
	Day 7	38.55 ± 3.25		
	Day 30	40.55 ± 3.15		
Pain Over Time	Day 1	4.26 ± 1.52	<0.01*	Pain decreased significantly
	Day 3	1.79 ± 1.28		
	Day 7	0.47 ± 0.68		
	Day 30	0.00 ± 0.00		

DISCUSSION

One of the most common minor oral surgery procedures is the extraction of impacted mandibular third molars. Despite being widely regarded as safe, there are certain difficulties. Problems have been documented both during and after surgery, including hemorrhage, trismus, dysphagia, lingual nerve injury, inferior alveolar nerve damage, and lingual plate fracture [1-3] Despite being comparatively rare, lingual plate fractures can cause serious concerns because of the possibility of lingual nerve involvement and the resulting morbidity. For this reason, surgeons should consider this aspect when making surgical decisions.

Unlike traditional radiographs, CBCT delivers accurate and distortion-free three-dimensional imaging with excellent spatial resolution. This enables reliable assessment of lingual plate thickness and morphology, evaluation of tooth angulation and position, and detailed visualization of the inferior alveolar canal and its relation with tooth apices. [4-9]

In the present study, 58 patients with horizontally impacted mandibular third molars were assessed using CBCT to evaluate the role of buccolingual angulation in predicting lingual plate fracture. The mean age was 28.3 years, with the majority of patients younger than 30 years, which is consistent with earlier studies reporting that third molar extractions are more commonly performed in younger age groups due to the frequency of impaction in this population [10,11] Interestingly, our analysis demonstrated significantly greater buccolingual angulation in females compared to males, suggesting potential gender-based anatomical differences in mandibular morphology. While the existing literature does not focus heavily on sex-related variations, this novel finding may warrant further investigation in larger multicentric cohorts.

The mean buccolingual angulation in this study was 3.28°, and a significant correlation was found between increasing angulation and thinning of the lingual plate at both the mid-root and apical regions. Similar associations have been highlighted in earlier investigations. Mallick et al. [11], in a CBCT-based retrospective study of 251 patients, reported that 4.4% of mandibular third molars roots were in direct contact with the lingual cortex, and tooth angulation was significantly associated with cortical perforation. Likewise, Tolstunov et al. [12] observed that buccolingual angulation, assessed in both coronal and axial planes, was significantly related to lingual bone perforation, with greater angulation values noted in perforated compared to non-perforated cases. Menziletoglu et al. [1] also reported that buccolingual angulation had a strong predictive value for lingual bone perforation, reinforcing our results. A prospective study by Gumber et al [2] reported that third molars with lingual plate perforation had a mean buccolingual angulation of 5.07° compared with only 0.49° in non-perforated cases ($p = 0.0258$). Together, these findings confirm that increased buccolingual angulation is an important predictor of cortical thinning and potential intraoperative complications.

In our study, mean buccolingual angulation values differed significantly across odontectomy patterns, with values ranging from 1.32° in the longitudinal group to 6.53° in the transverse group and 13.66° in the full odontectomy group ($p = 0.001$). This trend suggests that angulation may influence the surgical pathway adopted, with higher angulations appearing more frequently in cases managed with more extensive odontectomy. While full odontectomy in our protocol involved removal of the tooth in toto without sectioning and is often considered less complex, the observed statistical association highlights the multifactorial nature of surgical decision-making, where tooth angulation, root morphology, and cortical bone thickness may all play contributory roles. Importantly, while only one lingual plate fracture was recorded (in the longitudinal odontectomy group), this highlights the multifactorial nature of lingual plate fractures. As suggested in the literature, localized cortical thinning, unfavorable root morphology, undercuts, bone density variations, and the vector of applied surgical forces may all contribute [2,11,12] Therefore, while angulation is an important factor, but it alone cannot predict fracture risk.

Postoperative outcomes in this cohort were favorable, with steady improvements in mouth opening and pain scores throughout the follow-up period. By one month, mouth opening had increased from 31 mm to 40 mm ($p = 0.005$), and pain had completely resolved ($p < 0.01$). No cases of lingual nerve paresthesia or swallowing difficulty were reported, likely due to preservation of the lingual periosteum and the absence of lingual flap elevation. These results reinforce the importance of careful flap design and soft tissue handling in minimizing postoperative complications.

Taken together, the present findings add further evidence that buccolingual angulation plays a key role in surgical difficulty, odontectomy planning, and the risk of lingual cortical perforation. Our results, in

agreement with Mallick et al. [11] Tolstunov et al. [12], and Menziletoglu et al. [2], confirm that higher angulation is significantly associated with cortical thinning and potential perforation. This highlights the need for preoperative CBCT assessment not only to evaluate root–canal relationships but also to anticipate variations in lingual plate thickness, thereby improving surgical safety and outcomes.

This study, while providing valuable insights into buccolingual angulation and lingual plate thinning, had a relatively small sample size and only one recorded lingual plate fracture, limiting statistical analysis of fracture risk. Gender-related differences were observed, but the study was not powered to draw definitive conclusions on sex-specific anatomical variations. Intraoperative factors such as bone density and surgical force vectors were not quantitatively assessed, although procedures were performed by a single experienced surgeon to ensure consistency. Despite these limitations, the findings offer meaningful guidance for preoperative planning and safe surgical practice.

CONCLUSION

This prospective CBCT-based study demonstrates that buccolingual angulation of horizontally impacted mandibular third molars is significantly associated with thinning of the lingual cortical plate, particularly at the mid-root and apical regions. While angulation may influence the choice of surgical approach, the occurrence of lingual plate fracture is multifactorial and cannot be predicted by angulation alone. Preoperative CBCT assessment remains essential for identifying high-risk cases, planning safe odontectomy strategies, and minimizing intraoperative complications. Preservation of the lingual periosteum and careful flap handling contribute to favorable postoperative outcomes, including adequate mouth opening and pain resolution.

REFERENCES

1. Menziletoglu D, Tassoker M, Kubilay-Isik B, Esen A. The assesment of relationship between the angulation of impacted mandibular third molar teeth and the thickness of lingual bone: A prospective clinical study. Med Oral Patol Oral Cir Bucal. 2019 Jan 1;24(1):e130-e135. doi: 10.4317/medoral.22596. PMID: 30573722; PMCID: PMC6344005.
2. Gumber TK, Kandiara P, Bhullar RS, Dhawan A, Kapila S, Singh B. Assessment and Correlation of Variation in Lingual Cortical Plate Thickness with Different Angulations of Impacted Mandibular Third Molar Using Cone Beam Computed Tomography in North Indian Population. J Maxillofac Oral Surg. 2023 Sep;22(3):590-602. doi: 10.1007/s12663-022-01835-x. Epub 2022 Dec 28. PMID: 37534344; PMCID: PMC10390454.
3. Wang D, He X, Wang Y, Zhou G, Sun C, Yang L, Bai J, Gao J, Wu Y, Cheng J. Topographic relationship between root apex of mesially and horizontally impacted mandibular third molar and lingual plate: cross-sectional analysis using CBCT. Sci Rep. 2016 Dec 19;6:39268. doi: 10.1038/srep39268. PMID: 27991572; PMCID: PMC5171861.
4. Garcıa-Sanz V, Bellot-Arcıs C, Hernandez V, Serrano-Sanchez P, Guarinos J, Paredes-Gallardo V. Accuracy and reliability of cone-beam computed tomography for linear and volumetric mandibular condyle measurements. A human cadaver study. Sci Rep 2017;7:11993.
5. Periago DR, Scarfe WC, Moshiri M, Scheetz JP, Silveira AM, Farman AG. Linear accuracy and reliability of cone beam CT derived 3-dimensional images constructed using an orthodonticvolumetric rendering program. Angle Orthodont 2008;78:387– 95.
6. Araki K, Maki K, Seki K, Sakamaki K, Harata Y, Sakaino R, Okano T, Seo K (2004) Characteristics of a newly developed dentomaxillofacial X-ray cone beam CT scanner (CB MercuRay): system configuration and physical properties. Dentomaxillofac Radiol 33(1):51–99. https://doi.org/10.1259/ dmfr/54013049
7. Hashimoto K, Kawashima S, Kameoka S, Akiyama Y, Honjoya T, Ejima K, Sawada K (2007) Comparison of image validity between cone beam computed tomography for dental use and multidetector row helical computed tomography. Dentomaxillofac Radiol 36(8): 465–471. https://doi.org/10.1259/dmfr/22818643
8. Loubele M, Guerrero ME, Jacobs R, Suetens P, van Steenberghe D (2007) A comparison of jaw dimensional and quality assessments of bone characteristics with cone -beam CT, spiral tomography, and multi-slice spiral CT. Int J Oral Maxillofac Implants 22(3):446–454
9. Pauwels R, Araki K, Siewerdsen JH, Thongvi gitmanee SS (2015) Technical aspects of dental CBCT: state of the art. Dentomaxillofac Radiol 44(1):20140224. https://doi.org/10.1259/dmfr.20140224
10. Kose I, Koparal M, Günes N, Atalay Y, Yaman F, Atilgan S, Kaya G (2014) Displaced lower third molar tooth into the submandibular space: two case reports. J Nat Sci Biol Med 5(2):482–484. https:// doi.org/10.4103/0976-9668.136274
11. Mallick A, Vidya KC, Waran A, Rout SK. Measurement of Lingual Cortical Plate Thickness and Lingual Position of Lower Third Molar Roots Using Cone Beam Computed Tomography. J Int Soc Prev Community Dent. 2017;7:8-12.
12. Tolstunov L, Brickeen M, Kamanin V, Susarla SM, Selvi F. Is the angulation of mandibular third molars associa ted with the thickness of lingual bone? Br J Oral Maxillofac Surg. 2016;54:914-9