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Original Research

Assessment of Bone Healing Following Buccal Gutter vs. Lingual Split Technique in Impacted Mandibular Third Molar Removal: A Prospective Comparative Clinical and Radiographic Study

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ABSTRACT:
Background: Surgical extraction of impacted mandibular third molars can affect socket bone remodeling and distal periodontal health. Technique-related differences in ostectomy may influence bone healing. **Objective:** To compare bone healing following buccal gutter versus lingual split techniques using clinical and radiographic outcomes. **Methods:** A prospective comparative study included 60 patients (18–30 years) requiring impacted mandibular third molar removal (30 per group). Standardized surgery was performed by a single operator. Radiographic healing was assessed using standardized intraoral periapical radiographs with digital grayscale ROI measurements immediately postoperatively, at 3 months, and at 6 months. Periodontal probing depth (PD) and clinical attachment level (CAL) distal to the second molar were recorded preoperatively and at 6 months. Complications and operative time were documented. **Results:** Both groups showed progressive radiographic density increases. At 6 months, lingual split demonstrated significantly higher socket radiographic density (145.7 ± 15.0 vs 136.2 ± 14.4; p=0.01) and greater density gain from baseline (p=0.03). Periodontal parameters remained comparable, with a non-significant trend toward higher PD/CAL in the buccal gutter group. Early complications were low in both groups; one transient lingual paresthesia occurred in the lingual split group. **Conclusion:** Both techniques are clinically effective; lingual split may enhance radiographic bone density at 6 months, but should be selectively used with strict neurosensory precautions.
Keywords: impacted mandibular third molar; buccal gutter; lingual split; bone healing; radiographic bone density

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INTRODUCTION

Surgical removal of impacted mandibular third molars remains one of the most frequently performed procedures in oral and maxillofacial surgery. Although routinely undertaken, the operation is associated with clinically relevant morbidity—pain, swelling, trismus, periodontal deterioration distal to the second molar, and neurosensory complications involving the inferior alveolar and lingual nerves. These outcomes are influenced by patient-related variables (age, impaction depth, root morphology) and technique-related variables (flap design, ostectomy, tooth sectioning, and handling of lingual tissues). Large prospective series have demonstrated that surgical factors and degree of difficulty significantly affect the likelihood of temporary and permanent lingual nerve injury, reinforcing the need for careful technique selection and risk mitigation. [1]

The conventional buccal gutter (buccal ostectomy) technique uses rotary instruments to create a buccal and distal bony trough, facilitating tooth sectioning and delivery. This approach is widely taught and offers predictable access, but it may remove a greater volume of buccal cortical bone, potentially affecting

socket remodeling and bone fill, and may contribute to periodontal defects on the distal aspect of the mandibular second molar in selected patients. Evidence-based analyses have emphasized that while second-molar periodontal parameters often remain stable or improve after third molar removal, a subset of patients—particularly those with healthy distal periodontium preoperatively—may experience worsening probing depths or attachment loss, underlining the importance of atraumatic bone management. [2]

In contrast, the lingual split technique (and related chisel-based approaches such as distolingual alveolectomy) relies on controlled splitting of the lingual plate or removal of lingual/distal bone with chisels to mobilize the tooth, potentially preserving buccal bone. Classic clinical trials comparing lingual split and surgical bur methods reported broadly comparable efficiency and patient-reported morbidity, although the spectrum of postoperative outcomes varies across studies and operator experience. [3] Randomized and comparative clinical research has also suggested technique-specific morbidity patterns, with some reports noting greater pain with lingual split methods and greater swelling with surgical bur techniques. [4]

A central question for contemporary practice—particularly in settings where cost-effective, reproducible techniques are valued—is whether one approach offers superior hard-tissue healing (bone fill and socket density) without increasing complication rates. Radiographic studies using standardized digital analysis demonstrate that mandibular third molar extraction sockets progressively increase in radiographic density over months, and that quantitative or semi-quantitative radiographic approaches can track bone formation over a 6-month period. [5] Similarly, digital radiographic assessments have been applied to evaluate post-extraction mandibular bone quality changes following impacted third molar removal. [6] Periodontal healing studies comparing chisel-based and bur-based approaches have reported differences in bone and periodontal recovery distal to the second molar, particularly in deeper impactions. [7]

Given the clinical importance of socket bone regeneration and distal second-molar periodontal stability, this prospective study compared buccal gutter and lingual split techniques in impacted mandibular third molar removal, focusing primarily on bone healing outcomes measured radiographically and clinically. Consideration was also given to nerve-safety principles and known neurosensory risk factors in third molar surgery. [8–10]

MATERIALS AND METHODS

Study design and setting

A prospective comparative clinical study was conducted in a university-affiliated oral surgery unit. The protocol followed standard ethical principles for human research and written informed consent was obtained. Patients were enrolled over a defined recruitment period and allocated into two parallel groups according to the surgical technique used.

Participants

Inclusion criteria were: (1) age 18–30 years, (2) presence of a unilateral impacted mandibular third molar requiring surgical removal (Pell & Gregory Class I/II; Position A/B/C), and (3) good systemic health (ASA I–II). Exclusion criteria included: (1) acute infection at the surgical site, (2) systemic disease known to affect bone healing (e.g., uncontrolled diabetes), (3) pregnancy/lactation, (4) smoking >5 cigarettes/day, (5) history of radiotherapy/anti-resorptive therapy, and (6) inability to attend follow-up.

Sample size

A total of 60 participants were included (30 per group). This sample was planned to provide adequate power to detect clinically meaningful differences in radiographic bone density change at 6 months, assuming moderate effect size and 5% alpha error.

Surgical techniques

All procedures were performed by a single experienced surgeon to reduce operator variability. Local anesthesia was achieved using inferior alveolar, lingual, and long buccal nerve blocks with 2% lignocaine with 1:80,000 adrenaline. A standardized triangular mucoperiosteal flap was reflected.

Group A (Buccal gutter technique): Buccal and distal bone removal was performed using a sterile bur under copious saline irrigation to create a trough. Tooth sectioning was performed as required, followed by elevation and removal. Socket debridement and saline irrigation were done. Primary closure was achieved with 3-0 silk.

Group B (Lingual split technique): After flap reflection and controlled exposure, a chisel was used for controlled splitting/removal of lingual/distal bone to facilitate tooth mobilization. Tooth sectioning was performed when necessary to minimize excessive ostectomy. Socket toilet and closure were performed similarly to Group A. Special care was taken to avoid excessive lingual tissue manipulation.

Postoperative regimen and follow-up

Patients received standard postoperative instructions and medications (analgesic and, where indicated by institutional protocol, antibiotic coverage). Follow-up visits occurred at 1 week, 1 month, 3 months, and 6 months. Sutures were removed at 7 days.

Outcomes

Primary outcome: Radiographic bone healing assessed via standardized intraoral periapical

radiographs (IOPA) using a consistent technique and exposure settings. Digital images were analyzed using region-of-interest (ROI) grayscale measurement; mean grayscale values were recorded at the socket region and compared longitudinally (immediate postoperative, 3 months, 6 months).

Secondary outcomes: Clinical periodontal parameters distal to the mandibular second molar (probing depth [PD] and clinical attachment level [CAL]) recorded preoperatively and at 6 months; operative time; early complications (dry socket, infection); and neurosensory assessment (subjective and objective screening) at early follow-up.

Statistical analysis

Data were analyzed using standard statistical software. Continuous variables were presented as mean ± SD and compared using independent t-test (between groups) and repeated-measures comparisons (within group). Categorical variables were compared using chi-square or Fisher's exact test. Significance was set at $p<0.05$.

RESULTS

Baseline distribution of age, sex, and impaction pattern was comparable between the buccal gutter and lingual split groups (Table 1). Mean age was approximately 24 years in both groups, and the male-to-female ratio was similar. Pell & Gregory classes and positions were evenly represented, with Position B and mesioangular impactions being most frequent in both arms. The absence of statistically significant differences indicates appropriate baseline comparability for evaluating bone healing outcomes. Table 1

Table 1. Baseline demographic and impaction characteristics (n=60)

Variable	Buccal Gutter (n=30)	Lingual Split (n=30)	p-value
Age (years), mean ± SD	24.2 ± 3.1	24.0 ± 3.3	0.78
Sex (M/F)	14/16	13/17	0.79
Pell & Gregory Class I/II	18/12	17/13	0.79
Pell & Gregory Position A/B/C	10/16/4	9/17/4	0.96
Angulation (mesioangular/vertical/distoangular/horizontal)	14/9/3/4	13/10/3/4	0.99

Mean operative time was slightly lower in the lingual split group, though the difference was not statistically significant (Table 2). The frequency of tooth sectioning was high in both techniques, reflecting the impacted nature of the sample. Early complications were infrequent and comparable, with low rates of dry socket and infection. One transient lingual neurosensory disturbance occurred in the lingual split group at 1 week, resolving by subsequent review, while none were observed in the buccal gutter group. Table 2

Table 2. Intraoperative parameters and early postoperative complications

Variable	Buccal Gutter (n=30)	Lingual Split (n=30)	p-value
Operative time (minutes), mean ± SD	18.6 ± 4.5	16.9 ± 4.2	0.14
Tooth sectioning required, n (%)	21 (70.0)	18 (60.0)	0.41
Dry socket, n (%)	2 (6.7)	1 (3.3)	0.55
Postoperative infection, n (%)	1 (3.3)	1 (3.3)	1.00
Temporary paresthesia at 1 week (lingual), n (%)	0 (0.0)	1 (3.3)	0.31

Both groups demonstrated progressive radiographic socket mineralization over time (Table 3). Immediate postoperative grayscale values were similar, confirming comparable baseline socket radiodensity after surgery. At 3 months, the lingual split group showed a trend toward higher density. By 6 months, radiographic density and overall density gain were significantly greater in the lingual split group, suggesting a more favorable hard-tissue remodeling trajectory, potentially reflecting reduced buccal cortical removal and improved maintenance of socket bony walls. Table 3

Table 3. Radiographic bone density (grayscale value) progression at socket ROI

Time point	Buccal Gutter (n=30), mean ± SD	Lingual Split (n=30), mean ± SD	p-value (between groups)
Immediate postoperative	92.4 ± 10.8	93.9 ± 11.2	0.60
3 months	118.6 ± 12.5	124.9 ± 13.1	0.06
6 months	136.2 ± 14.4	145.7 ± 15.0	0.01*
Δ (6 months – immediate)	+43.8 ± 13.0	+51.8 ± 14.2	0.03*

*Statistically significant ($p<0.05$)

Periodontal parameters distal to the mandibular second molar remained clinically acceptable in both cohorts (Table 4). Baseline probing depths and attachment levels were similar. At 6 months, the buccal gutter group showed a modest mean increase in probing depth and attachment level compared with lingual split, although between-group differences did not reach statistical significance. A higher proportion of deeper pockets (≥5 mm) was observed in the buccal gutter group, indicating a possible tendency toward less favorable distal periodontal remodeling. Table 4

Table 4. Periodontal outcomes distal to mandibular second molar (baseline vs 6 months)

Parameter	Buccal Gutter (n=30)	Lingual Split (n=30)	p-value (between groups at 6 months)
PD baseline (mm), mean ± SD	3.2 ± 0.6	3.2 ± 0.7	0.88
PD at 6 months (mm), mean ± SD	3.6 ± 0.8	3.3 ± 0.7	0.12
CAL baseline (mm), mean ± SD	3.4 ± 0.7	3.5 ± 0.8	0.74
CAL at 6 months (mm), mean ± SD	3.9 ± 0.9	3.6 ± 0.8	0.18
PD ≥5 mm at 6 months, n (%)	5 (16.7)	2 (6.7)	0.23

DISCUSSION

This prospective comparative study evaluated whether the choice of ostectomy approach—buccal gutter versus lingual split—meaningfully influences hard-tissue healing following impacted mandibular third molar removal. The principal finding was that both techniques supported progressive socket mineralization over six months, but the lingual split group demonstrated significantly higher radiographic density at 6 months and a greater net density gain. These findings align with radiographic literature demonstrating that extraction sockets undergo measurable increases in radiodensity across months and that standardized digital analysis can track bone formation and density changes in mandibular third molar sites. [11] The magnitude of density improvement observed in the present dataset is clinically plausible for 6-month remodeling windows reported in longitudinal radiographic research. [12]

A likely mechanistic explanation is differential preservation of the buccal cortical plate and socket walls. Buccal guttering requires rotary removal of buccal/distal bone to create access; in deeper impactions this may increase the extent of ostectomy. In contrast, lingual split approaches may facilitate mobilization with potentially less buccal bone removal, thereby providing a more contained socket environment for clot stability and bone deposition. Periodontal and bone healing comparisons between chisel-based and bur-based approaches have suggested that distolingual alveolectomy (a chisel-based technique) can be associated with better periodontal and bone healing distal to the second molar, particularly for deeply impacted teeth. [13] Although the present study did not show a statistically significant difference in periodontal probing depth or attachment level at 6 months, the directionality—slightly higher probing depths and more frequent PD ≥5 mm in the buccal gutter group—coheres with evidence that technique and local surgical trauma may influence distal second-molar outcomes in certain clinical scenarios. [14]

The periodontal results also require interpretation in the context of broader evidence. Evidence-based decision analyses have concluded that, in many patients, second-molar periodontal status remains unchanged or improves after third molar removal, but a subset may experience deterioration depending on baseline health and case factors. [15] The modest changes observed here (mean differences of approximately 0.3 mm in probing depth and attachment level) may reflect typical variability in periodontal healing after third molar surgery and may be influenced by plaque control, depth of impaction, and surgical trauma. Additionally, because periodontal parameters were assessed at 6 months (rather than longer-term 12-month endpoints), complete maturation and stabilization of distal periodontal architecture may not be fully captured. Studies evaluating periodontal healing have reported ongoing recovery over extended follow-up, with some defects improving substantially over 12 months in impacted cases. [16]

With respect to operative time and early complications, both techniques performed comparably. Operative time was slightly lower in the lingual split group, but not significantly. Classic and subsequent comparative studies have reported mixed differences in efficiency and postoperative morbidity patterns across lingual split and bur-based approaches, with outcomes strongly moderated by surgeon experience and case selection. For example, randomized comparative work has identified technique-specific morbidity tendencies (more pain with lingual split, more swelling with bur-based approaches), while concluding that a simplified split bone technique may yield the least morbidity overall. [17] The present findings—low and similar rates of dry socket and infection—are consistent with the expectation that, under standardized irrigation, atraumatic handling, and good postoperative compliance, complication rates remain low irrespective of the chosen ostectomy method.

Neurosensory safety remains the key concern limiting routine use of lingual split approaches. While this study observed only one transient lingual sensory disturbance, the sample size was not powered to detect small differences in nerve injury incidence.

High-quality evidence indicates that lingual nerve morbidity is influenced by anatomical variability and surgical variables. A large prospective evaluation identified perforation of the lingual plate, nerve exposure, and increased difficulty as important predictors of lingual nerve injury. [18] Moreover, randomized trial evidence has shown that lingual flap retraction can substantially increase temporary lingual nerve disturbance compared with avoiding retraction. [19] A focused literature review has further suggested that lingual split technique may be associated with higher temporary lingual nerve injury risk than buccal approaches, and that minimizing ostectomy through tooth sectioning may be protective. [20,21] Therefore, even if lingual split techniques demonstrate favorable bone density outcomes, the technique should be applied selectively—preferably by experienced surgeons, in carefully chosen cases, and with strict adherence to nerve-protection principles and minimal lingual tissue manipulation.

Overall, the clinical implication is not that buccal guttering is inferior, but that the surgeon's approach to bone removal and socket wall preservation may be a modifiable determinant of radiographic bone healing. In settings where postoperative bone quality is a priority (e.g., future distal second-molar periodontal stability or planned implant considerations in adjacent regions), techniques that preserve bony architecture while maintaining nerve safety warrant consideration. Future studies with larger samples, standardized 3D imaging protocols, and longer periodontal follow-up could clarify the balance between hard-tissue benefits and neurosensory risk in specific impaction subtypes.

CONCLUSION

Both buccal gutter and lingual split techniques produced satisfactory clinical outcomes and progressive radiographic bone healing after impacted mandibular third molar removal. However, the lingual split technique demonstrated significantly greater radiographic socket density at 6 months and a higher overall density gain, suggesting potentially enhanced hard-tissue remodeling—likely related to differences in ostectomy pattern and socket wall preservation. Periodontal parameters distal to the mandibular second molar remained broadly comparable between techniques at 6 months, though a trend toward deeper probing depths was observed with buccal guttering. Early complications were infrequent in both groups. Given established evidence that neurosensory outcomes depend strongly on surgical variables and lingual tissue management, the lingual split approach should be reserved for carefully selected cases and performed with strict nerve-safety precautions. Larger, longer-term trials are recommended to confirm these findings and refine technique-specific indications.

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