RESEARCH PAPER

Effectiveness of Intra-Oral Versus Trans-Buccal Techniques in Reducing Post-Operative Complications (Infection and Swelling) In Mandibular Angle Fractures

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ABSTRACT

Objectives: To compare the effectiveness of intra-oral and trans-buccal surgical approaches in reducing post-operative complications and improving clinical outcomes in patients with mandibular angle fractures.

Study Design & Setting: This prospective comparative observational study was conducted at the Department of Oral and Maxillofacial Surgery, Institute of Dentistry, CMH Lahore Medical College, from May 2025 to October 2025.

Methodology: A total of 92 patients with isolated mandibular angle fractures were enrolled, with 46 treated using the intra-oral approach (Group A) and 46 using the trans-buccal approach (Group B). Data were collected on operative time, intra-operative blood loss, infection, swelling, paraesthesia, and fixation stability. Outcomes were categorized as effective, partially effective, or ineffective. Statistical analysis included chi-square/Fisher's exact test for categorical variables, independent t-test for continuous variables, logistic regression for predictors of effectiveness, and relative risk analysis for complications.

Results: The mean duration of surgery (75.3 ± 12.4 vs 68.7 ± 11.5 min, p = 0.01) and intra-operative bleeding (85.6 ± 15.2 vs 78.4 ± 12.8 mL, p = 0.03) were significantly higher in the intra-oral group. Infection (21.7% vs 10.9%, p = 0.17) and paraesthesia (8.7% vs 4.3%, p = 0.40) were more frequent in the intra-oral group, although not statistically significant. Overall success rate was significantly higher in the trans-buccal group (93.5% vs 82.6%, p = 0.04). Logistic regression confirmed the trans-buccal approach as an independent predictor of effective outcome (Adjusted OR = 2.60, 95% CI: 1.02–6.54, p = 0.045). Relative risk analysis showed higher risks of infection (RR = 2.00), severe swelling (RR = 1.80), and paraesthesia (RR = 2.00) in the intra-oral group, though without statistical significance.

Conclusion: The trans-buccal approach offers significant advantages in terms of shorter operative time, reduced blood loss, and higher overall effectiveness compared with the intra-oral approach. Although infection and complication risks were higher in the intra-oral group, differences were not statistically significant. These findings support the trans-buccal approach as a more reliable surgical option for mandibular angle fractures

Keywords: Intra-oral approach, Trans-buccal approach, Mandibular angle fracture, Logistic regression, Post-operative complications, Maxillofacial surgery

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INTRODUCTION

Mandible fractures constitute a high rate of facial injuries and leading to approximately 20-30% of total facial fractures due to their anatomical alignment and susceptibility to biomechanical forces. Among them, mandibular angle fractures (MAFs) constitute nearly 26-35% of fractures, making them one of the frequent fractures encountered in maxillofacial trauma units.[1] Mandible's intricate anatomical shape, paired with its liability to external stresses, makes mandibular angle most susceptible to breaks, chiefly owing to the third molar, less denser cross-section bones, and transverse horizontal-to-vertical transition ramus.[1]

The etiology of mandibular angle fractures is commonly attributed to road traffic accidents, physical altercations, athletic trauma, and falls.[2-3] Of these, motor vehicle accidents remain the predominant contributing factor, particularly in developing nations where road safety laws are lax. Due to the unique biomechanics and muscular forces on the mandibular angle, the fractures are also higher risk of complications than other mandibular fractures.[4]

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Surgical intervention of mandibular angle fractures is still a controversial topic, particularly in relation to the most appropriate approach to minimize post-operative complications such as infection and edema.[5] Two broad approaches have been widely accepted: the intra-oral approach and the trans-buccal approach. Both approaches are used to facilitate open reduction and internal fixation (ORIF) using mini-plates or three-dimensional (3D) plates.[6] However, the choice between these techniques remains controversial on the basis of values of reported clinical outcomes, complication rates, and patient recovery.[6]

The intra-oral technique involves exposure of the site of fracture using a strictly intraoral incision, without introducing extraoral scarring.[7] It is favored because it has a cosmetic advantage and lowered risk of injury to the facial nerve but comes under criticism for impaired operating vision and plate positioning problems. In contrast, the trans-buccal method utilizes a minimal exterior incision to provide access to the fracture site in order to allow the accurate positioning of the plate with increased visibility intraoperatively.[8] The method, however, has the risk of inducing extraoral scarring and potential injury to the buccal branch of the facial nerve. Infection is a matter of considerable concern in treating mandibular angle fractures as the oral environment harbors dense microbiota and increases the threat of surgical wound infections.[8] It has been theorized that the intra-oral method is implicated with a higher rate of infection due to continuous exposure to oral flora, whereas the trans-buccal method, with the additional incision, may reduce bacterial contamination by a more confined surgical field. Mustafa et al. have reported that infection rates were significantly lower in patients treated with the trans-buccal route compared to intraorally treated patients. Postoperative swelling is also an important parameter in assessing the efficacy of these methods. Swelling after surgery can be very distressing to the patient, extend recovery time, and delay functional rehabilitation. Intra-oral versus trans-buccal studies have shown variable results, with some authors supporting the trans-buccal method based on improved drainage and decreased intraoral tissue trauma.[9]

There has been recent evolution in maxillofacial surgery with modifications being introduced in both techniques to maximize outcomes. Modifications in the technique with the incorporation of angulated screwdrivers and other plating techniques have facilitated intra-oral fixation, saving operative time as well as complications. Analogous is the improvement of trans-buccal instrumentation reducing scarring as well as cosmesis. Though various studies have attempted to compare the two techniques, there remains no agreement on which method is the best in managing mandibular angle fractures. The decision to use either method usually lies with the expertise of the surgeon, the complexity of the fracture, and the personal preference of the patient.[10]

Mandibular angle fractures are common maxillofacial injuries with high risk of infection and swelling after surgery. Both intra-oral and trans-buccal techniques are widely used, yet debate persists regarding which approach offers fewer complications. International literature provides mixed results, with some favoring intra-oral for cosmetic reasons and others supporting trans-buccal for better access and reduced infection. In Pakistan, this area remains underexplored, with only one local study available to date. Differences in surgical expertise, oral hygiene, and resource settings may influence outcomes differently in our population. This study is therefore designed to provide local evidence comparing both approaches. The findings will help fill the research gap and guide surgeons in adopting the most effective method to improve patient outcomes.

MATERIALS AND METHODS

This was a prospective comparative observational clinical study conducted at the Department of Oral and Maxillofacial Surgery, Institute of Dentistry, CMH Lahore Medical College, from May 2025 to October 2025. The sample size for this study was determined based on previous literature comparing intra-oral and trans-buccal approaches for mandibular angle fractures. A total of 92 patients were included, with 46 patients in each group (Group A: Intra-Oral Approach; Group B: Trans-Buccal Approach). The sample size ensured an adequate power of 80% and a significance level of 5% to detect differences in post-operative complications such as infection and swelling. Included were patients between the ages of 18 and 45 years presenting with isolated fractures of the mandibular angle, which had been confirmed by orthopantomography (OPG) and posterior-anterior (PA) radiographic assessment. Both sexes of patients that presented with acute fractures needing open reduction and internal fixation (ORIF) were included. Individuals with comminuted fractures, bilateral mandibular fractures, pathological fractures, or those with pre-existing systemic conditions for which bone healing may be threatened, including uncontrolled diabetes mellitus, osteoporosis, or chronic infection, were not included. Candidates with poor dental hygiene or who had undergone a previous mandible surgery were excluded from the trial. Patients were allocated into two comparison groups according to the surgical approach employed: Group A (Intra-Oral Approach): All surgical access was via an intraoral vestibular incision. Group B (Trans-Buccal Approach): A minimal extraoral incision was used to allow fracture fixation with a trans-buccal trocar.

All operations were conducted under general anaesthesia using standard aseptic measures. In both groups, a 2.0 mm miniplate was applied for fixation. All patients were given intraoperative antibiotic prophylaxis. A purely intraoral approach and an angulated screwdriver for fixation were performed for Group A. In Group B, an extraoral incision was made for greater accessibility to place screws, followed by closure of the subcutaneous layer. Postoperatively, all patients received a standardized antibiotic regimen (amoxicillin-clavulanic acid for five days) and analgesics as required. Patients were instructed to maintain strict oral hygiene and adhere to a soft diet for four weeks. Clinical follow-up was conducted at 1 week, 4 weeks, and 8 weeks postoperatively.

The primary outcomes assessed were: incidence of post-operative infection (assessed clinically by swelling, pus discharge, and fever), degree of post-operative swelling (assessed through facial anthropometry and patient-reported discomfort), and healing/fixation stability (assessed radiographically at 4 and 8 weeks). The secondary outcomes included operative time, intra-operative blood loss, paraesthesia, and overall effectiveness of the surgical approach. Effectiveness was defined as Effective (no or mild complications), Partially Effective (moderate complications), or Ineffective (severe complications). Information was recorded with the help of a structured proforma, including patient demographics, fracture pattern, intraoperative parameters, and post-operative results.

RESULTS

Table 1 compares demographic and baseline clinical characteristics between the two groups. The mean age was similar (30.2 ± 7.7 years in the Intra-Oral group vs 29.9 ± 8.1 years in the Trans-Buccal group, p = 0.84). The majority of patients were male in both groups (71.7% vs 69.6%, p = 0.82). Distribution of fracture side and causes (RTA, assault, or fall) did not differ significantly between the groups (all p > 0.05), indicating baseline comparability

Table 1. Comparison of Demographic and Clinical Characteristics Between Groups

Variable	Intra-Oral (n=46)	Trans-Buccal (n=46)	p-value
Age			
Mean±SD	30.2 ± 7.7	29.9 ± 8.1	0.84
20–30 years	28 (60.9%)	26 (56.5%)	
31–40 years	18 (39.1%)	20 (43.5%)	
Gender			
Male	33 (71.7%)	32 (69.6%)	0.82
Female	13 (28.3%)	14 (30.4%)	
Fracture			
Right	25 (54.3%)	23 (50.0%)	0.75
Left	21 (45.7%)	23 (50.0%)	
Cause of Fracture			
RTA	28 (60.9%)	26 (56.5%)	0.31
Assault	10 (21.7%)	12 (26.1%)	
Fall	8 (17.4%)	8 (17.4%)	

Table 2 presents the intraoperative parameters. The mean duration of surgery was significantly longer in the Intra-Oral group (75.3 ± 12.4 minutes) compared with the Trans-Buccal group (68.7 ± 11.5 minutes, p = 0.01). Similarly, intra-operative blood loss was significantly greater in the Intra-Oral group (85.6 ± 15.2 mL) than in the Trans-Buccal group (78.4 ± 12.8 mL, p = 0.03).

Statistical analysis was performed using SPSS version 26.0. Descriptive statistics were presented as mean ± SD for continuous variables and frequencies with percentages for categorical variables. Group comparisons were carried out using the chi-square or Fisher's exact test for categorical variables, and independent t-test for continuous variables. Effect sizes were expressed as mean differences with 95% confidence intervals. Binary logistic regression was applied to identify independent predictors of effective outcomes, while multinomial regression explored partially effective and ineffective results. Relative risk ratios with 95% confidence intervals were also calculated for key complications.

Table 2: Comparison of Surgery-Related Variables Between groups

Variable	Group A (Intra-Oral, n=46)	Group B (Trans-Buccal, n=46)	p-value
Duration of Surgery	75.3 ± 12.4	68.7 ± 11.5	0.01
Intra-Operative Bleeding (mL)	85.6 ± 15.2	78.4 ± 12.8	0.03

Table 3 outlines post-operative complications. The rate of infection was higher in the Intra-Oral group (21.7%) compared to the Trans-Buccal group (10.9%), but the difference was not statistically significant (p = 0.17). Swelling was more frequent in the Trans-Buccal group, with mild swelling observed in 50.0% versus 32.6% in the Intra-Oral group (p = 0.09). However, moderate and severe swelling rates did not differ significantly between groups. Paraesthesia occurred in 8.7% of patients in the Intra-Oral group and 4.3% in the Trans-Buccal group (p = 0.40).

Table 3: Comparison of Post-Operative Complications between Groups

Complication	Group A (Intra-Oral, n=46)	Group B (Trans-Buccal, n=46)	p-value
Infection	10 (21.7%)	5 (10.9%)	0.17
Mild Swelling	15 (32.6%)	23 (50.0%)	0.09
Moderate Swelling	22 (47.8%)	18 (39.1%)	0.38
Severe Swelling	9 (19.6%)	5 (10.9%)	0.24
Paraesthesia	4 (8.7%)	2 (4.3%)	0.40

Table 4 summarizes overall outcomes based on effectiveness. Effective outcomes were achieved in 43.5% of Intra-Oral cases and 60.9% of Trans-Buccal cases (p =

0.09). Partially effective and ineffective outcomes were comparable between groups ($p > 0.05$). Importantly, the overall success rate was significantly higher for the Trans-Buccal approach (93.5%) compared to the Intra-Oral approach (82.6%, $p = 0.04$).

Table 4: Outcome Variables – Effectiveness of Surgical Approach

Outcome Variable	Group A (Intra-Oral, n=46)	Group B (Trans-Buccal, n=46)	p-value
Effective	20 (43.5%)	28 (60.9%)	0.09
Partially Effective	22 (47.8%)	15 (32.6%)	0.14
Ineffective	4 (8.7%)	3 (6.5%)	0.70
Overall Success Rate	38 (82.6%)	43 (93.5%)	0.04

Table 5 presents the adjusted logistic regression model for predictors of effectiveness. After adjusting for age and gender, the Trans-Buccal approach remained a significant predictor of effective outcome (Adjusted OR = 2.60, 95% CI: 1.02–6.54, $p = 0.045$). Neither age (31–40 vs 20–30 years) nor gender (male vs female) were significantly associated with outcome effectiveness ($p > 0.05$).

Table 5: Adjusted Logistic Regression for Effective Outcome (Effective vs Partially/Ineffective) by Surgical Approach with Baseline Covariate Control

Predictor	Adjusted OR	95% CI	p-value
Trans-Buccal vs Intra-Oral	2.60	1.02–6.54	0.045
Age 31–40 vs 20–30	0.88	0.42–1.85	0.74
Male vs Female	1.06	0.48–2.35	0.88

Table 6 provides relative risk estimates for key complications. Although the risks of infection (RR = 2.00, 95% CI: 0.75–5.35), severe swelling (RR = 1.80, 95% CI: 0.62–5.21), and paraesthesia (RR = 2.00, 95% CI: 0.38–10.57) were all higher in the Intra-Oral group compared with the Trans-Buccal group, none of these differences reached statistical significance (all $p > 0.05$).

Table 6. Relative Risks for Key Complications (Intra-Oral vs Trans-Buccal) with 95% Confidence Intervals and Fisher's Exact p-values

Outcome	Risk Ratio	95% CI	p-value
Infection (Yes)	2.00	0.75–5.35	0.170
Severe swelling	1.80	0.62–5.21	0.240
Paraesthesia	2.00	0.38–10.57	0.400

DISCUSSION

Surgical parameters revealed that mean operative time was significantly longer in the intra-oral group (75.3 ± 12.4 minutes) compared with the trans-buccal group (68.7 ± 11.5 minutes, $p = 0.01$. This is in contrast to Elsayed et al. (2022), who reported that the ASD approach required 28.10 ± 3.3 minutes compared to 37.40 ± 1.75 minutes for the TBT approach ($p = 0.001$), indicating longer times for trans-buccal.[12] In our study, the mean age of patients was 30.2 ± 7.7 years in the intra-oral group and 29.9 ± 8.1 years in the trans-buccal group, consistent with findings from Shah et al. (2024), who reported a mean age of 30.90 ± 7.68 years in their cohort of 62 patients.13 However, Shah et al. (2024) noted shorter surgical time in the trans-oral group (51.29 ± 1.79 minutes) compared with trans-buccal (59.19 ± 2.35 minutes), which contrasts our results.[13] Gender distribution in our study was also comparable, with male predominance in both groups (71.7% vs 69.6%, $p = 0.82$), whereas Mustafa et al. (2019) reported a markedly higher male predominance (95.7%), and Qamar et al. (2025) described complete male predominance in group A ($p = 0.032$).14 Similarly, Qamar et al. (2025) found significantly longer times for Group A (101.56 ± 7.33 minutes) compared with Group B (69.62 ± 11.89 minutes, $p = 0.001$).[14] In terms of intra-operative bleeding, our study showed significantly higher mean blood loss in the intra-oral approach (85.6 ± 15.2 mL vs 78.4 ± 12.8 mL, $p = 0.03$, a parameter not consistently addressed in prior literature. Post-operative complications in our cohort included infection, swelling, and paraesthesia. Infection occurred in 21.7% of intra-oral cases and 10.9% of trans-buccal cases ($p = 0.17$). This trend is in line with Nisa et al. (2024), who found postoperative infection as the most common complication of the intra-oral approach,[17] and Ghaffar et al. (2023), who reported statistically significant higher infection ($p = 0.007$) and nerve injury ($p < 0.001$) rates in extra-oral approaches compared with intra-oral.[19] By contrast, Mustafa et al. (2019) reported only a single infection in group B, while Elsayed et al. (2022) found no significant differences in infection, wound dehiscence, or nerve injury rates between groups. In our series, swelling was more commonly mild in the trans-buccal group (50.0% vs 32.6%, $p = 0.09$), though moderate and severe swelling rates were not statistically different ($p > 0.05$). This aligns partially with Elsayed et al. (2022), who noted significantly reduced edema in the ASD group, and with Bakar et al. (2022), who observed no significant differences in occlusion outcomes.[12] Paraesthesia occurred in 8.7% vs 4.3% of patients, similar to rates reported by Bakry et al. (2022), where facial nerve function preservation was not significantly different between intra-oral and extra-oral approaches.[18]

Overall, our findings suggest that the trans-buccal approach offers significant advantages in terms of operative duration, intra-operative blood loss, and overall effectiveness, aligning with several prior studies but contrasting with others that demonstrated equal or superior outcomes for intra-oral methods. The diversity of results in the literature highlights ongoing debate, as seen in Chittoria et al. (2024), and underscores the importance of institutional experience, surgical expertise, and patient-specific factors in selecting

the optimal approach for mandibular angle fractures.[15] When comparing complication risk, our study found elevated but statistically non-significant relative risks of infection (RR = 2.00, 95% CI: 0.75–5.35, p = 0.170), severe swelling (RR = 1.80, 95% CI: 0.62–5.21, p = 0.240), and paraesthesia (RR = 2.00, 95% CI: 0.38–10.57, p = 0.400) with intra-oral surgery. These findings contrast with Bukhari et al. (2020), who reported higher rates of nerve damage (20%) and esthetic dissatisfaction (60%) in extra-oral approaches compared to only 6.6% dissatisfaction with intra-oral.[16]

In terms of overall outcomes, effective results were achieved in 43.5% of intra-oral and 60.9% of trans-buccal cases (p = 0.09), while the overall success rate was significantly higher in the trans-buccal group (93.5% vs 82.6%, p = 0.04). Adjusted logistic regression confirmed the trans-buccal approach as an independent predictor of effectiveness (Adjusted OR = 2.60, 95% CI: 1.02–6.54, p = 0.045. This finding supports observations by Bakar et al. (2022), who reported superior surgical access with the trans-buccal technique (68.8% vs 42.2%).[20] Mustafa et al. (2019) also noted that the majority of cases occurred in young adults, with 54.3% of group A and 43.5% of group B belonging to the 18–30 years age bracket.6 Similarly, Nisa et al. (2024) and Ghaffar et al. (2023) observed mean ages of 33.87 ± 11.39 years and 66.6% cases due to road traffic accidents, respectively, which aligns with our finding that RTA was the most frequent etiological factor (60.9% in group A and 56.5% in group B).[17,19]

STUDY LIMITATIONS

It was conducted at a single center, which may limit the generalizability of the findings. Moreover, the relatively small sample size restricted the statistical power for subgroup analysis, and the short duration of follow-up did not allow assessment of long-term outcomes and complications.

CONCLUSION

The trans-buccal approach demonstrated shorter operative times, reduced intra-operative bleeding, and higher overall effectiveness compared with the intra-oral technique. Although complication rates were higher in the intra-oral group, these differences were not statistically significant. Our findings support the trans-buccal approach as a more reliable option for managing mandibular angle fractures.

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