

Comparison of Ward's and Comma-Shaped Incisions in Mandibular Third Molar Surgery: Impact Postoperative Mouth Opening: Randomized Controlled Trial

Misbah Razzaq¹, Zahoor Ahmed Rana², Shahnoor¹, Sahiba Batool¹, Hina Nasim³, Muhammad Shoaib⁴

1. Department of Oral & Maxillofacial Surgery, School of Dentistry, SZABMU, Islamabad, Pakistan

2. Department of Oral & Maxillofacial Surgery, PIMS, Islamabad, Pakistan

3. Department of Oral Biology, School of Dentistry, SZABMU, Islamabad, Pakistan

4. Department of Oral and Maxillofacial Surgery, Multan Medical and Dental College/Ibne Sina Hospital Multan, Pakistan

Abstract

Background: An impacted tooth is defined as one that fails to erupt within the expected time frame of normal dental development. Evidence synthesized from a recent systematic review and meta-analysis indicates that tooth impaction is highly prevalent globally, with overall rates nearing 90% in the general population, and nearly one-third of individuals exhibiting at least one impacted third molar.

Objectives: This study aimed to compare the effect of Ward's incision and the comma-shaped incision on postoperative limitation of mouth opening (trismus) following surgical removal of impacted mandibular third molars.

Materials and Methods: A comparative interventional study was conducted at the Department of Oral and Maxillofacial Surgery, PIMS, Islamabad, over one year. A total of 114 patients aged 17–45 years requiring mandibular third molar extraction were randomly allocated into two groups: Group A (Ward's incision, n=57) and Group B (comma-shaped incision, n=57). Standardized surgical protocols were followed, and patients were assessed for mouth opening (inter-incisal distance) on postoperative days 1, 3, and 7. Trismus was defined as <35 mm. Data were analyzed using SPSS version 25, and Chi-square tests determined statistical significance.

Result: The mean age of participants was 30.4 ± 6.8 years; females constituted 62.28% of the sample. On day 1, restricted mouth opening was more frequent in the Ward's group, with 22.81% measuring 25–29 mm compared to only 5.26% in the comma group ($p=0.001$). By day 3, 54.39% of comma group patients achieved 40–44 mm versus 43.86% in Ward's group ($p=0.047$). On day 7, significantly more patients in the comma group (29.82%) reached 55–50 mm compared to 7.02% in Ward's group ($p=0.00078$). Overall, trismus was consistently less severe in the comma-shaped incision group.

Conclusions: The comma-shaped incision demonstrated superior outcomes, with reduced postoperative trismus and faster recovery of mouth opening compared to Ward's incision. Careful flap selection, favoring the comma-shaped design, can significantly enhance patient recovery and minimize functional disability after third molar surgery.

Keywords: Impaction, Third Molar, Trismus, Postoperative Complications

Introduction

An impacted tooth is defined as one that fails to erupt within the expected time frame of normal dental development.¹ Evidence synthesized from a recent systematic review and meta-analysis indicates that tooth impaction is highly prevalent globally, with overall rates nearing 90% in the general population, and nearly one-third of individuals exhibiting at least one impacted third molar.² Although many affected third molars are asymptomatic and are frequent-

ly identified incidentally during routine radiographic evaluations; however, their prolonged existence may render individuals susceptible to various complications. These teeth can cause pericoronary infections, localized swelling, and a gradual narrowing of the mouth opening over time. This may eventually require surgery.³

Extraction of mandibular third molars is one of the most frequently performed minor oral surgical procedures worldwide.^{4,5} The widespread nature of this surgery highlights its clinical importance, but also underscores the need for careful surgical execution. Despite being considered a routine procedure, the removal of impacted third molars is often accompanied by postoperative sequelae that can significantly affect the patient's quality of life.² Among these complications, limitation in mouth opening, or trismus, is particularly significant.⁶

Trismus not only causes discomfort but also compromises mastication, speech, oral hygiene, and even professional or social functioning in the immediate postoperative period.⁷ For the surgeon, it may also

Corresponding Author

Hina Nasim

Department of Oral Biology, School of Dentistry, SZABMU, Islamabad, Pakistan

Email: drhinanasim@szabmu.edu.pk

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complicate follow-up care and management of potential secondary infections. Thus, reducing the risk and severity of this complication is central to improving patient outcomes.^{8,9} Surgical technique, especially the choice of incision, has a direct effect on how tissues are handled and how well they work after surgery.

This makes it important to think about how the design of the incision might make these problems better or worse.¹⁰ A well-planned incision provides adequate access and visibility while minimizing unnecessary trauma to surrounding soft tissues and adjacent anatomical structures. Conversely, an improperly designed incision may increase tissue tension, prolong healing, and aggravate postoperative complications, including restriction in mouth opening (trismus).¹⁰

The management of postoperative sequelae begins at the surgical planning stage, where the technique of tooth removal plays a decisive role. Several intraoperative factors such as the type of flap, duration of surgery, and extent of tissue manipulation have been shown to influence postoperative trismus. Of these, the design and execution of the surgical incision are among the most critical.^{10,11} Over the years, a variety of flap designs including envelope (Koener's), bayonet shaped, L-shaped, triangular (Ward's), and comma shaped incisions have been introduced to balance optimal exposure with minimal tissue damage.^{12,13}

An incision that causes excessive stretching of the mucoperiosteal flap, traction on the temporalis or masseter muscles, or increased inflammatory response around the surgical site can directly limit mandibular movement, thereby contributing to postoperative trismus.¹⁴ While Ward's and its modified variants are frequently employed owing to their mechanical and visual advantages, certain drawbacks such as proximity to the temporalis tendon insertion and suture placement over bone defects may predispose patients to postoperative difficulties, including limited mouth opening (trismus).¹⁵

Conversely, the disto-lingually oriented "comma-shaped incision" has been promoted as a more conservative option. This design limits superfluous extension into the buccal and anterior areas, therefore preventing excessive reflection towards the coronoid process and alleviating tension on the temporalis insertion during mouth opening. The comma-shaped incision minimizes soft-tissue stretching and decreases the necessity for forceful retraction, leading to less muscular effort and overall surgical damage, potentially alleviating postoperative limitations in mouth opening.¹⁶

Given the high frequency of third molar impactions and the significant clinical burden of postoperative trismus, it becomes essential to evaluate incision techniques not only in terms of surgical ease but also with respect to patient-centered outcomes. This study has therefore been designed to compare Ward's incision and comma-shaped incision in the surgical removal of impacted mandibular third molars. Particular emphasis has been placed on postoperative limitation of mouth opening, with the aim of determining which incision

design better facilitates patient recovery and minimizes functional disability.

Material and Methods

This comparative interventional study was conducted in the Department of Oral and Maxillofacial Surgery at the Pakistan Institute of Medical Sciences (PIMS), Islamabad, over one year following ethical approval (No. F. 1-1/2015/ERB/SZABMU/591).

A total of 114 patients, aged 17–45 years, who presented with unilateral or bilateral, partially or completely impacted mandibular third molars associated with a history of pain or swelling, were recruited after informed consent (inclusion criteria). Patients who were medically compromised, pregnant, on medications affecting wound healing, suffering from acute pericoronitis, localized or generalized periodontitis, existing trismus, or requiring general anesthesia were excluded (exclusion criteria).

Sample size was calculated using the WHO calculator (version 2.0), taking a significance level of 5% and a power of 90%. The anticipated population proportion for absence of trismus in the Ward's incision group (P1) was assumed as 34%, while for the comma-shaped incision group (P2) it was 64%.¹⁷ Based on these parameters, a total of 114 subjects were required, with 57 patients in each group.

Patients were randomized into two groups using a computer-generated sequence. Group A underwent extraction using Ward's incision, while Group B received the comma-shaped incision. All procedures were performed under local anesthesia with vasoconstrictor following standard aseptic protocols. For Ward's incision, a classical triangular flap was raised. A crevicular incision was made from the mesiobuccal line angle of the second molar to its distal aspect, followed by a single distal relieving incision extending into the retromolar area, consistent with the traditional Ward's flap design. A full-thickness mucoperiosteal flap was then reflected to provide access for bone removal and tooth elevation. In the comma-shaped technique, the incision began from the stretched vestibular reflection posterior to the second molar, extended anteriorly beneath the tooth, curved upward to join the distobuccal line angle, and continued as a sulcular incision to raise a distolingually based flap. In both groups, standard surgical steps for extraction were followed and closure was achieved using 3-0 Vicryl (Polyglactin 910) sutures.

Postoperatively, all patients received antibiotics (amoxicillin/clavulanic acid 675 mg PO TDS and metronidazole 400 mg PO TDS) and analgesics (ibuprofen 400 mg PO BD) for five days. Sutures were removed on the seventh day. Patients were evaluated on the 1st, 3rd, and 7th postoperative days. Mouth opening was measured as the maximal interincisal distance using a millimeter scale. All measurements were taken by the same examiner. Intra-examiner reliability was assessed through repeated measurements on a subset of patients prior to the study, demonstrating variation of less than 1 mm.

Mouth opening was measured as the maximal inter-incisal distance with a millimeter scale and categorized into ranges; trismus was defined as an opening less than 35 mm.

Data were analyzed using SPSS version 25. Mean and standard deviation were calculated for continuous variables, and frequencies with percentages were presented for categorical data. Comparisons of mouth opening and other categorical outcomes between the groups were performed using Chi-square tests. A p-value <0.05 was considered statistically significant.

Results

A total of 114 patients were included in the study, with 57 patients each allocated to the Ward's incision group (Group A) and the comma-shaped incision group (Group B). The age of participants ranged from 17 to 45 years, with a mean age of 30.4 ± 6.8 years. The majority (70.18%, n=80) were between 17–30 years, while 28.95% (n=34) were 31–45 years; no significant age difference was observed between groups (p=0.535). Regarding gender, 62.28% (n=71) of the study population were female and 37.72% (n=43) were male, with comparable distribution across the two groups (p=0.562).

Postoperative mouth opening was assessed on days 1, 3, and 7. On day 1, restricted mouth opening was more common in the Ward's group, where 22.81% (n=13) of patients had an inter-incisal distance of 29–25 mm and 47.37% (n=27) had 34–30 mm. In contrast, only 5.26% (n=3) of the comma group fell into the lowest category, while nearly half (47.37%, n=27) achieved 39–35 mm. This difference was statistically significant (p=0.001) (Table-1).

Table-1 Frequency & distribution of mouth opening at Day 1 in both groups

Mouth Opening DAY 1	Standad Ward's		Comma Shaped		p-value
	N	%	N	%	
29-25 mm	13	22.81	3	5.26	0.001
34-30 mm	27	47.37	17	29.82	
39-35 mm	11	19.30	27	47.37	
40-44 mm	6	10.53	10	17.54	
49-45 mm	0	0.00	0	0	
55-50 mm	0	0.00	0	0	

Comparison of inter-incisal mouth opening ranges on postoperative Day 1 between Ward's and comma-shaped incision groups

By day 3, both groups showed improvement, though the comma group demonstrated wider mouth openings. Nearly half of Ward's patients (49.12%, n=28) remained at 39–35 mm, whereas 54.39% (n=31) of comma cases achieved 40–44 mm. The difference between the two groups was statistically significant (p=0.047)(Table-2).

Comparison of inter-incisal mouth opening ranges on postoperative Day 3 between Ward's and comma-

shaped incision groups.

Table 2: Frequency & distribution of mouth opening at Day 3 in both groups

Mouth Opening DAY 3	Standard Ward's		Comma Shaped		p-value
	N	%	N	%	
29-25 mm	0	0.00	0	0.00	0.047
34-30 mm	0	0.00	0	0.00	
39-35 mm	28	49.12	15	26.32	
40-44 mm	25	43.86	31	54.39	
49-45 mm	4	7.02	9	15.79	
55-50 mm	0	0.00	2	3.51	

On day 7, substantial recovery was evident in both groups, though the comma group continued to perform better. In the Ward's group, most patients (43.86%, n=25) were at 49–45 mm, with only 7.02% (n=4) reaching 55–50 mm. In comparison, 54.39% (n=31) of the comma group reached 49–45 mm, and 29.82% (n=17) attained 55–50 mm. This difference was highly statistically significant (p=0.00078) (Table -3).

Table 3 Frequency & distribution of mouth opening at Day 7 in both groups

Mouth Opening DAY 1	Standard Ward's		Comma Shaped		p-value
	N	%	N	%	
29-25 mm	0	0.00	0	0.00	0.001
34-30 mm	0	0.00	0	0.00	
39-35 mm	6	10.53	0	0.00	
40-44 mm	22	38.60	9	15.79	
49-45 mm	25	43.86	31	54.39	
55-50 mm	4	7.02	17	29.82	

Comparison of inter-incisal mouth opening ranges on postoperative Day 3 between Ward's and comma-shaped incision groups.

Overall, the incidence of trismus (defined as mouth opening <35 mm) was consistently higher in the Ward's group in the early postoperative period. Patients in the comma-shaped incision group demonstrated earlier recovery and greater postoperative mouth opening across all follow-up intervals.

Discussion

The present study compared two flap designs, Ward's and comma-shaped, in mandibular third molar surgery, with particular emphasis on demographic distribution and postoperative limitation of mouth opening (trismus). The findings provide insights into the population most commonly affected by third molar impactions and the impact of flap design on functional recovery following surgery.

The age range of participants was 17 to 45 years, with a mean of 30.4 years. A majority of patients (70.18%) were between 17–30 years of age, while only 28.95% were older than 30. This reflects the well-established trend that mandibular third molar impactions are most prevalent in late adolescence and early adulthood, a

finding that has been consistently reported across multiple studies. Passi et al. similarly reported a mean age of 27.6 years among patients with impacted mandibular third molars¹⁸, while Zaman et al. documented a mean age of 26.86 years¹⁹, another local study reported mean age of patients as 29.8 years²⁰ these studies closely aligned with our results. International literature, including studies by Christian et al., Aleksandra Jaroń and Zahra et al., also supports this pattern, reporting mean ages in the mid-to-late twenties²¹⁻²³. The decreased frequency of older patients in our study likely reflects growing awareness of oral health and the increasing practice of early surgical removal of impacted teeth, preventing complications in later life.

Gender distribution in the present study demonstrated a clear female predominance, with 62.28% of the participants being female compared to 37.72% male. This observation is consistent with several regional and international studies that also noted higher frequencies of mandibular third molar impactions among females. Obuekwe had reported 53.6% female predominance²⁴, and Shital et al., documented 63.44% females in their study²⁵, both comparable to our findings. A study by Haria et al. further supported this trend with nearly 78.1% patients being female²⁶. The underlying biological explanation for this phenomenon has been attributed to differences in craniofacial growth patterns.

As Hellman proposed, females complete jaw growth earlier than males, often before eruption of the third molar begins, which may limit the space available for eruption and predispose to impaction. In males, continued jaw growth during the period of third molar eruption can create more space, potentially reducing the risk of impaction.^{27,28} However, contrasting findings have also been reported; Ahu Topkara, for example, observed a male predominance (61.3%), highlighting that gender distribution may vary based on population characteristics.²⁹ Despite these variations, the overall pattern of female predominance has been widely documented, and our results are consistent with the majority of available literature.

Postoperative limitation of mouth opening (trismus) is one of the most functionally significant sequelae of third molar surgery. In this study, trismus was evaluated by measuring inter-incisal distance at days 1, 3, and 7 postoperatively. The results clearly demonstrated better outcomes with the comma-shaped incision compared to the conventional Ward's incision across all follow-up intervals.

On the first postoperative day, patients in the Ward's group experienced marked restriction of mouth opening, with nearly a quarter (22.81%) falling into the severely restricted range of 29–25 mm and almost half (47.37%) restricted to 34–30 mm. In contrast, the comma group showed substantially better outcomes, with only 5.26% in the lowest category and nearly half (47.37%) achieving a relatively wider range of 39–35 mm. This difference was statistically significant ($p=0.001$). These findings reflect the early impact of

flap design, where Ward's incision, with its anterior and distal releasing components, may cause greater trauma to surrounding soft tissues and musculature, contributing to reduced early mobility.

By the third postoperative day, mouth opening had improved in both groups, but differences persisted. Nearly half of Ward's patients (49.12%) remained limited to 39–35 mm, whereas a greater proportion of patients in the comma group (54.39%) achieved 40–44 mm. Although the difference was less pronounced than on day 1, it remained statistically significant ($p=0.047$), indicating that recovery of function occurred earlier in the comma group.

On the seventh postoperative day, mouth opening improved considerably across both groups, yet the superiority of the comma flap remained evident. While 43.86% of Ward's patients achieved 49–45 mm and only 7.02% reached 55–50 mm, in the comma group, 54.39% attained 49–45 mm and nearly one-third (29.82%) reached the highest category of 55–50 mm. The difference was highly significant ($p=0.00078$), underscoring that functional recovery was faster and more complete with the comma-shaped incision.

The trend observed in this study aligns with existing literature, which consistently reports that trismus peaks within the first 24–48 hours after surgery, gradually improving over the following week.¹² It has been reported that maximal trismus typically occurs on the day of surgery or shortly thereafter and may persist for up to a week.^{30,31} Our results confirm this pattern, with marked restriction on day 1, partial improvement on day 3, and substantial recovery by day 7. Importantly, however, the extent of limitation and the speed of recovery differed significantly between the two incision groups, with the comma flap consistently demonstrating superior outcomes.

The reduced incidence of trismus in the comma group may be attributed to its design characteristics. Unlike Ward's incision, which often extends close to the temporalis tendon insertion and may involve greater tissue manipulation, the comma incision is less extensive and spares critical anatomical structures such as the buccal artery and temporalis tendon. This likely reduces postoperative inflammation and muscle spasm, both of which contribute to trismus. Studies by Lohana et al., Kumar et al., and Fareed et al., also reported similar findings, supporting the notion that more conservative flap designs result in improved postoperative function.³²⁻³⁴

Taken together, the demographic profile of our study highlights that mandibular third molar impactions are most common in young adults, with a female predominance, consistent with both regional and international literature. More importantly, the results on mouth opening demonstrate that flap design plays a crucial role in influencing postoperative function. The comma shaped incision was associated with sig-

nificantly reduced trismus and faster recovery of mouth opening compared to the Ward's incision across all time points. These findings emphasize the clinical relevance of careful flap selection in third molar surgery, not only for ease of access but also for optimizing patient comfort and functional recovery. However, we were unable to fully rule out transient medial pterygoid spasm following the inferior alveolar nerve block or lateral pterygoid spasm due to prolonged mouth opening during surgery. These factors may have contributed to postoperative restriction in mouth opening and could have influenced the trismus outcomes.

While the present study was limited by a relatively small sample size compared to other investigations, the findings suggest that the comma-shaped flap may serve as a promising alternative to the conventional flap design. To strengthen these results and enhance their generalizability, future research should be conducted as multicenter studies with larger and more diverse patient populations. Such studies would allow for more robust statistical analysis, minimize bias,

and provide stronger evidence for clinical practice.

Conclusion

Surgical removal of impacted third molars is the most frequently performed procedure in oral and maxillofacial surgery. Several flap designs are described in the literature for their extraction. Among the different considerations, the flap pattern plays a critical role in influencing postoperative sequelae such as swelling, wound healing, and mouth opening. In this study, we compared two flap designs in terms of postoperative complications, specifically limited mouth opening the conventional Ward's incision and the comma-shaped flap. Based on the assessment of results, we concluded that the new comma-shaped flap may be a better alternative, offering comparatively improved postoperative outcomes, particularly in relation to mouth opening, when compared to Ward's incision.

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Author Contributions

1. **Misbah Razzaq** : Conceptualization of the study, study design, and overall supervision.
2. **Zahoor Ahmed Rana** :Surgical procedures, clinical supervision, and methodology development.
3. **Shahnoor** :Data collection, patient follow-up, and maintenance of clinical records.
4. **Sahiba Batool** :Literature review, data entry, and assistance in manuscript drafting.
5. **Hina Nasim** :Statistical analysis and interpretation of results.
6. **Muhammad Shoaib** :Critical review of the manuscript and final approval of the version to be published.