

A comparison of envelope flap versus triangular flap (ward's incision) design in mandibular third molar disimpaction: A prospective comparative clinical study

ABSTRACT

Aim: The aim of study is to assess the influence of Envelope flap and Triangular flap (Ward's incision) on post operative healing after mandibular third molar surgery in relation to pain, swelling, trismus, dry socket and wound gaping.

Methods: 20 patients presenting with symmetrical bilateral impacted mandibular third molars comprising total of 40 surgical extraction sites of which 20 sites were used to study envelope flap and 20 sites were used to study triangular flap (ward's incision). In this procedure, one side of jaw receives an envelope flap, and the other side receives triangular flap randomly with a gap of one month, data was recorded on 24 hours, 3rd day and 7th day. The statistical analysis was performed using the Chi-square test, in which it was consider as statistically significant if P value will be < 0.05.

Results: Post surgery pain score and swelling were significantly higher in envelope flap compare to triangular flap, but there was no significant difference for trismus, wound gapping and dry socket in both the flap. Post surgery P-value is significant for pain and swelling, but P-value is insignificant for trismus, wound gapping and dry socket.

Conclusion: This study shows that triangular flap for removal of third molar is better choice if we consider pain and post-operative swelling as outcome but there is no significant difference in terms of post-operative wound gaping, trismus and dry socket.

Keywords: Envelope flap, flap design, mandibular third molar disimpaction, triangular flap.

1.INTRODUCTION

The most common operation in oral surgery is surgical removal of impacted third molars¹. Because third molar are the teeth that are most commonly impacted. Third molar are present in 90% of the population with 33% having at least one impacted third molar, these impactions are probably the result of both genetic and environmental factors².

Not every impacted tooth cause a problem of clinical significance, but it has potential to cause mild to serious problem if it remains in the unerupted state.

The surgical technique includes variables such as flap design, bone removal, and the tooth sectioning necessary to extract the tooth, and must be performed without damaging the surrounding anatomical structures¹. Flap design is important for optimal visibility, accessibility, healing of the surgically created defect and damage to the distal periodontal area of the adjacent second molar³. The presence of various important anatomical structures in the adjacent area around the surgical site has made many surgeons to design an incision, ranging from Koener's envelope incision, Ward's triangular incision, and its' modification, L shaped incision, bayonet shaped incision, comma incision, and "S" shaped incision⁴. Many studies found a different postoperative course in terms flap design, with the less extended flap generally being the one with fewer complaints⁵. Envelope flap with a distal releasing incision is the most common approach for lower third molar surgery.

The flap designs proposed by various authors can essentially be grouped into envelope and triangular flaps⁶⁻¹¹. Envelope flaps have no releasing incision, and the ease of access to the tooth to be extracted depends on the length of the mesial extension of the sulcular incision, which can, if necessary, extend to the second premolar. Triangular flaps involve a buccal releasing incision, which can be positioned mesially or distally to the second molar beside the papilla¹².

The incision type used in the surgery of impacted teeth seems to be crucial. Flap design is important not only to allow optimal visibility and accessibility to the impacted tooth but also healing of the surgically created defect and damage to the distal periodontal area of the adjacent second molar³.

The envelope flap with a distal releasing incision to the mandibular ramus and the triangular flap with a vestibular extension are the most common approaches for lower third molar extraction. They have been widely addressed in literature showing to be favourable for most surgeons¹¹. Both techniques depend on incisions over the mucosa covering the tooth to be removed, followed by osteotomy resulting in deep bone sulcus around it to expose the equator of the dental crown.

mesioangular impaction is the most prevalent type of impaction in the lower jaw¹³. After third molar surgery discomfort is often felt by patients arising from complications at the time of surgery or after surgery. Patients often experience pain, swelling, trismus, dehiscence, alveolar osteitis, infection, nerve injury and periodontal tissue damage¹⁴.

2.METHODOLOGY

This was a randomized single blinded, split-mouth study in which postoperative examination and surveys were done by oral and maxillofacial surgery resident who don't know the study design. Based on the inclusion criteria, 20 patients aged between 18 to 40 years were enrolled in the study. That is 20 patients presenting with symmetrical bilateral impacted mandibular third molars comprising total of 40 surgical extraction sites of which 20 sites were used to study Envelope flap and 20 were used to study Triangular flap (Ward's incision). The demographic data was recorded, a thorough history was taken, informed written consent was obtained from the patients and ethical committee approval was taken for the study. The patients were assessed clinically and radiographic analysis was performed for all the patients to determine the difficulty index using Pell and Gregory classification¹⁵. Patient with identical difficulty index bilaterally were selected which was determined by Pederson difficulty index¹⁶. In this procedure, one side of jaw receives an envelope flap, and the other side receives triangular flap randomly. All patients were given standard dose of prophylactic antibiotics and anti-inflammatory agents. Drugs started 1 day prior to surgery & continued for 3 days postoperatively. All patients were given capsule amoxicillin (500mg /8 hours), tablet ibuprofen (400 mg/6 hours) and mouthwash of chlorhexidine 0.2% for 7 days. Dose of drug was determined according to body weight of patient and from the similar study¹⁷.

The 40 sites of 20 patients were divided into two i.e. group A (Envelope Flap) & group B (Triangular Flap) by flipping the coin.

The Inclusion criteria

1. Patients with bilateral symmetrical mandibular impacted third molar.
2. Age group between 18-40
3. Healthy patients without any significant medical condition that may compromise healing.

The Exclusion criteria

1. Allergic to local anesthesia.
2. Medically unfit patient.
3. Mandibular impacted molar with associated pathology as cyst, tumour and carcinoma.
4. Below 18 and above 40 age group patient.

2.1 Operative procedure:

All patients underwent bilateral removal of mandibular third molar that were of the same degree of surgical difficulty which was determined by Pederson difficulty index in two appointments where one month gap was present between two appointments. Both the techniques were performed by the same surgeon in all the patients. After taking informed written consent from patient facial skin preparation was done using betadine scrub and standard draping procedure. Mandibular nerve block and buccal block of local anesthesia secured with 2% lignocaine hydrochloride and 1:80,000 epinephrine was given. After effective local anesthesia in patients presenting with bilaterally impacted mandibular third molars, the envelope flap was randomly allotted to one side of the arch and the triangular to the contralateral side.

Surgical flap techniques – Envelope flap - An incision was made beginning medial to the external oblique ridge and was extend up to the middle of the distal line angle of the second molar. Further, a

sulcular incision was made from the distofacial line angle of the second molar to the mesiofacial line angle of the first molar (figure 1).

Triangular flap (Ward's incision) Incision was made beginning at anterior border of ramus (external oblique ridge) and extends as far as the distal aspect of second molar, and vertical releasing incision was made obliquely downward and forward ending in the vestibular fold (figure 2). Following the incisions placement in both the techniques, the mucoperiosteal flap was reflected and the impacted molar was expose. ostectomy was performed following incision placement and in required cases, odontosection was done aiding in the removal of the impacted molar. After the surgical extraction and cavity treatment with saline solution, closure was done using 3-0 black braided silk suture. Following surgery all patients were on similar antibiotic and analgesic regime and patient were recalled after 24 hours ,3rd day and 7^{day} to evaluate post-operative healing.

Post-Operative Instructions:

- Keep the gauze pack for 1 hour at the surgical site.
- Rest as much as possible and avoid strenuous activity over the next 48 hours.
- Do not skip meals, drink plenty of fluids, and avoid hot liquids and foods. Eat soft bland foods for the next 48 hours, Avoid hard or chewy foods for one week.
- Avoid chewing around the surgical site until the sutures are removed.
- Ice the area 10 minutes on and off for the day of surgery.
- Do not try to examine the surgical area, the stitches may tear.
- Brush your teeth as normal, but avoid the surgical site for 2 days.
- Use a mouthwash, twice daily.



Figure.1-Envelope flap



Figure.2-Triangular flap

2.2 Assessment criteria

- 1.Pain assessment was done using Visual Analogue Scale (VAS) scale ranging from 0 to 10.
2. Assessment of swelling was done using a thread to measure the extent of swelling with following control points: a-b : Lateral canthus of eye to the angle of mandible, c-d: Tragus of ear to the corner of mouth which was later measured on scale.

Facial Swelling = $\frac{\text{Horizontal} + \text{Vertical measure}}{2}$

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3. Assessment of trismus was done by measuring the distance between the incisal edges of upper and lower central incisors using measuring scale.
4. Incidence of dry socket was noted based on the clinical presentation and symptomatic history by patient.
5. Incidence of wound gaping was noted based on the clinical presentation.

3.RESULT

Table 1 and graph 1 represent the results for comparison of study groups based on post-surgical pain at 24 hours. It was found that in group A there were 20%, 30%, 15%, 20% and 15% of the study participants who experienced pain of score 3, 4, 5, 6, and 7 respectively after 24 hours of the surgery. On the other hand, in group B 50% participants had pain score of 3 and other 50% had score 4 after 24 hours. On applying Chi-square test, the difference in pain score between groups A and B at 24 hours was statistically significant with P-value 0.009. Thus 24 hours after the surgery, the participants in Group A experienced significantly more pain as compared to those in group B.

Table 2 and graph 2 shows the comparison of study groups based on post-surgical pain after 3 days of the surgery. The results show that 25% and 35% of the participants in Group A experienced pain of score 1 and 2 respectively; whereas, 35% and 5% had score of 3 and 4 respectively. In case of Group B 70% participants had score 1 and 30% had score 2 for pain after 3 days of surgery. On comparison of these values with Chi square test, the difference in pain score in Group A and B after 3 days of surgery was statistically significant with P-value 0.006. This shows that Group B experienced significantly less pain as compared to Group A after 3 days of the surgery.

Table 3 and graph 3 shows the comparison of study groups based on post-surgical pain after 7 days. The result showed that score 0 was seen in 40% of group A and 75% of group B participants. Further in group A 45%, 10% and 5% had score 1, score 2 and score 3 respectively; however, in Group B 25% had score 1 and none of the participants had score 2 and 3. The difference in pain score between Group A and Group B after 7 days of surgery was statistically significant. Thus the participants in group A experienced more pain as compared to those of group B at 7 days after the surgery.

Table 4 and graph 4 show the comparison of study groups based on post-surgery swelling seen at different time intervals. The results show that mean swelling after 24 hours of surgery was 17.55 in Group A and 14.20 in Group B and this difference was statistically significant with p-value 0.01, analysed by Students T-test. Further the mean swelling recorded after 3 days of surgery was 14.10 and 11.45 in Group A and Group B respectively. When the difference in swelling between Groups A and B was analysed using Students-T test, it was found to be statistically significant with P-value 0.001. Finally, after 7 days of surgery the mean swelling in Group A was 11.70 and in Group B it was 10.05 units. On analysis with Students-T test the difference in swelling in the study Groups A and B 7 days post-surgery was statistically significant with P-value 0.027. Therefore, the results of this can be summarized by stating that Group B showed significantly less post-surgery swelling as compared to Group A at 24 hours, after 3 days as well as after 7 days.

Table 5 and graph 5 show the comparison of study groups based on post-surgery trismus seen at 24 hours, 3 days and 7 days. It was found that the mean trismus (mouth opening) in group A was 25.10 mm, 36.50 mm and 48.40 mm at 24 hours, 3 days and 7 days post-surgery respectively. Whereas, in Group B the post-surgery trismus (mouth opening) was 25 mm, 36.15 mm and 48.15 mm at 24 hours, 3 days and 7 days respectively. When the difference in trismus (mouth opening) was analyzed using Students-T test it was found statistically not significant at all 3-time intervals. Thus, the results showed that there was no significant difference in trismus (mouth opening) between Groups A and B at 24 hours, 3 days and 7 days after the surgery.

Table 6 and graph 6 shows the Comparison of study groups based on post-surgery wound gapping at different time intervals. The study showed that, at 24 hours post-surgery, wound gapping was absent in all study subjects in Group A as well as Group B. At 3 days post-surgery, wound gapping was absent in Group A; however, it was seen in 5% of the participants of Group B. But the difference was statistically not significant when analyzed by Chi-square test. Finally, after 7 days of surgery wound gapping was seen in 5% of the participant in both groups A as well as group B and there was no statistical significance.

Table 7 show the comparison of study groups based on dry socket seen at 24 hours, 3 days and 7 days post-surgery. It was found that there was no dry socket seen in group A or group B 24 hours, 3 days and 7 days after the surgery.

Table 1: Comparison of study groups based on post-surgical pain at 24 hours

Study group	Post-surgical pain at 24 hours (based on VAS Score)					P-value
	Score 3	Score 4	Score 5	Score 6	Score 7	
Group A	20.0%	30.0%	15.0%	20.0%	15.0%	0.009*
Group B	50.0%	50.0%	0.0%	0.0%	0.0%	

*Statistically significant value

Table 2: Comparison of study groups based on post-surgical pain at 3 days

Study group	Post-surgical pain at 3 days (based on VAS Score)				P-value
	Score 1	Score 2	Score 3	Score 4	
Group A	25.0%	35.0%	35.0%	5.0%	0.006*
Group B	70.0%	30.0%	0.0%	0.0%	

*Statistically significant value

Table 3: Comparison of study groups based on post-surgical pain at 7 days

Study group	Post-surgical pain at 7 days (based on VAS Score)				P-value
	Score 0	Score 1	Score 2	Score 3	
Group A	40.0%	45.0%	10.0%	5.0%	0.003*
Group B	75.0%	25.0%	0.0%	0.0%	

*Statistically significant value

Table 4: Comparison of study groups based on post-surgery swelling seen at different time intervals

Study Group	Swelling after 24 hours		Swelling seen after 3 days		Swelling seen after 7 days	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Group A	17.55	2.416	14.10	1.618	11.70	2.154
Group B	14.20	3.155	11.45	2.187	10.05	2.372
P-value (Students T-test)	0.01*		0.001*		0.027*	

*Statistically Significant value

Table 5: Comparison of study groups based on post-surgery trismus seen at different time intervals

Study Group	Trismus after 24 hours		Trismus seen after 3 days		Trismus seen after 7 days	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Group A	25.10	6.568	36.50	5.226	48.40	3.118
Group B	25.00	5.399	36.15	5.450	48.15	5.039
P-value (Students T-test)	0.958		0.849		0.831	

Table 6: Comparison of study groups based on post-surgery wound gapping at different time intervals

Study Group	Wound gapping after 24 hours		Wound gapping after 3 days		Wound gapping after 7 days	
	Present	Absent	Present	Absent	Present	Absent
Group A	0%	100%	0%	100%	5%	95%
Group B	0%	100%	5%	95%	5%	95%
P-value (Chi-square test)	-		0.547		-	

Table 7: Comparison of study groups based on dry socket seen at different time intervals

Study Group	Wound gapping after 24 hours		Wound gapping after 3 days		Wound gapping after 7 days	
	Present	Absent	Present	Absent	Present	Absent
Group A	0%	100%	0%	100%	0%	100%
Group B	0%	100%	0%	100%	0%	100%
P-value	-		-		-	

5.DISCUSSION

The removal of third molars is the most frequently performed surgical procedure in many oral and maxillofacial surgical practices¹⁸, because third molars are the teeth that are most commonly impacted. The epidemiological incidence of their impaction ranges from **9.8%-68% in different population¹⁹**.

After the third molar surgery discomfort is most commonly felt by patients arising from complications at the time of surgery or after surgery¹⁴. Patients commonly experience pain, swelling, trismus, dehiscence, alveolar osteitis, infection and nerve injury²⁰. These complications can be prevented through atraumatic procedure, aseptic conditions, drug administration, and physiotherapy, proper wound closure using fine suturing technique and also flap design¹⁴. Various flap designs are studies as it intended to achieve good access to the third molar impacted teeth, and facilitate easy suturing, so it is expected to have good post-surgical healing and least discomfort to the patient^{20,21}.

Surgical removal of the mandibular third molar requires that a flap be created and osteotomy be performed, Flap design is important not only to allow optimal visibility and access to the impacted tooth, but also for subsequent healing of the surgically created defect.

This study was conducted to compare effects of two flap design used for surgical removal of impacted third molars, that are envelope flap and triangular flap with gap of one month. Gap of one month was kept between two surgeries because complete healing of wound takes 4-6 weeks²², once one side is completely healed it was useful for chewing food on that side, as the surgical site was completely healed till 4th week there were less chances of error in measuring data of two sides, same gap was also given in other similar studies²³. We had compared postoperative effect of two flap design on pain, swelling, trismus, wound gaping and dry socket in 20 patients with 40 extraction site. Which were symmetrical bilateral impacted third molar in the age group of 18 to 40 years, of which twenty sites were used to study envelope flap which were mentioned as group-A and 20 sites were used to study triangular flap (ward's incision) which were mentioned as group-B, data of both the group were collected and compared after informed written consent was taken and ethical committee approval was taken on 24 hours, on 3rd day and on 7th day postoperatively.

Advantages of envelope flap were adequate blood supply to flap because of broad base, easy closure and reapproximation, no chances of injury to facial artery and vein. And complications were periodontal damage to teeth in surgical site, bone loss because of more osteoclastic activity. Advantages of triangular flap were its more conservative approach because of small site of reflection and mucoperiosteal flap, easy to retract flap margins away from surgical area. And complications were difficult closure, chances of injury to facial artery and vein. Triangular flap was indicated in deep seated and difficult disimpaction, whereas envelope flap was indicated in superficially seated and less difficult disimpaction.

Pain:

In this study we found that the participants in envelope flap group experienced more pain as compared to those of triangular flap group after the surgery which was because of large size of flap anteriorly, less accessible operating site, difficult retraction of flap because of absence of realising incision which leads to longer time for completion of procedure and more tissue injury. But triangular flap was more conservative, leads to less tissue reflection, as soft tissue on buccal aspect of second molar is intact, it was simple to close and allow tension free closure.

Koyuncu et al²⁴ study also says that pain was less in modified triangular flap compared to envelope flap. In contrast Erdogan et al²⁵ and Fareheen U et al³. study found that less inflammation and pain after surgery in envelope flap than the triangular flap. But Kirk et al.²⁶ found that pain was not directly influenced by the flap design when they investigated influence of buccal envelope flap and modified triangular flap.

Swelling

In this study we found triangular flap was better compared to envelope flap in terms of post-operative swelling, as envelope flap procedure was taking more operating time, and more tissue injury than triangular flap. Realising incision in triangular flap helps to easy retraction of flap and it also allows drainage of collection from operating site which reduces the postoperative swelling significantly.

Nicola M. et al⁵. study says that duration of surgery affects the post operative pain and swelling than the flap design which is more in envelope flap. Our study results were comparable to study by Koyuncu et al²⁴ which reported greater inflammation and swelling in envelope flap than modified triangular flap. However study by Dolanmaz et al.²⁷ says there is no significant difference between the envelope and modified triangular flap regarding postoperative pain and swelling

Trismus:

Assessment of trismus in this study was done by measuring the distance between the incisal edges of upper and lower central incisors using measuring scale postoperatively. This study showed that there was no significant difference in trismus between envelope and triangular flap after the surgery.

Kirk et al²⁶ study says that flap design does not influence the trismus and use of different flap design is a matter of surgical preference. da Silva BL et al.²⁸ study also says that flap design does not influence the trismus. Sandhu et al.²⁹ study also gives insignificant difference between envelope flap and bayonet flap for trismus.

Wound gaping:

Wound gaping in this study was assessed using clinical presence or absent of the gap at the surgical site. In this study we found no significant difference in both envelope and triangular flap. But study by [Desai et al⁴](#) says there exists a significant difference between Ward's triangular incision and Koener's envelope incision in respect to wound gaping, which was significant in Ward's triangular incision compare to Koener's envelope incision.

Clinical significance of wound gaping during post-surgical phase is important as it affects the wound healing and wound dehiscence. Postoperative presence of wound gaping allows food lodgement which further may lead to infection and delayed wound healing.

Dry socket:

Dry socket in this study was assessed using its presence or absence clinically and from complain of pain from three to five days post extraction by patients. In this study there were no incidence of dry socket in any patients of both the groups.

In [Hassan M. et al.³⁰](#) study found that application of modified triangular flap may lead to reduction in dry socket. [Desai, et al⁴](#) study says that there is no significant difference in Ward's triangular incision and Koener's envelope incision

From this study we found that in regards to pain and post-operative swelling triangular flap can be preferred over envelop flap as this group patients experience less pain and swelling because of conservative flap, easy reflection, better accessibility and visibility which further reduces the tissue injury and operating time. Both flaps are equal in regards to wound gapping, trismus and dry socket.

Limitation of the study: This study was carried out in the department of Oral & Maxillofacial surgery of CSMSS Dental college and hospital between the year January 2021 to October 2022, limitation of this study which affected to generalize findings were single centre study, small sample size, short duration of study. Circumferential facial measurements are not representative of total swelling because oedema has three planes of measurements.

6.CONCLUSION.

As most common operation in oral surgery is surgical removal of impacted third molars. Because third molar are the teeth that are most commonly impacted.

There are many ways to do it and generally decided by operating surgeon on the basis of his prior experience and literature available regarding same, this particular area has lot of scope for research.

This study compared the two different designs of flap used for surgical removal of third molars like Envelop flap and Triangular flap methods. As both methods were done in same patients who were having symmetrical bilateral impacted third molars, so result can be compared nicely as it has eliminated patient bias. This study has shown us that Triangular flap for removal of third molar is better choice if we consider pain and post-operative swelling as outcome but same time it has emphasised that both methods are equal in terms of post-operative wound gaping, trismus and dry socket and it will surgeon's prerogative to choose either of them.

To make this observation as general rule we need larger sample size and multicentric study but this study has shown us that further research will be helpful for both patient community and doctors before choosing right approach.

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8.COMPETING INTERESTS

Authors have declared that no competing interests exist.

9.AUTHORS' CONTRIBUTIONS:

Author A' designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. 'Author B' and 'Author C' managed the analyses of the study. 'Author C' managed the literature searches. All authors read and approved the final manuscript."

10.CONSENT:

All authors declare that 'written informed consent was obtained from the patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

11.ETHICAL APPROVAL:

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

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