ORIGINAL RESEARCH

Clinical Comparative Evaluation of Envelope Flap and Triangular Flap in Lower Third Molar Surgery: A Prospective Study

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ABSTRACT

Objective: The main objective of the study is to compare the efficacy of envelop flap and triangular flap in lower third molar surgery and to evaluate the effect of flap design on operating time, accessibility and ease of suturing in lower third molar surgery, post-operative complications after lower third molar removal, and periodontal health of the second molar.

Study Design: Twenty individuals with age group 18–35 years, with bilateral impacted lower third molars were the study subjects and divided into two groups - Group (A) - those in which envelop flap was used and Group (B) - those in which triangular flap was used.

Result: The results of our study suggested that flap design has an influence in post-operative complications of third molar surgery. Envelop flaps had a better short-term outcome on post-operative swelling and trismus, while triangular flaps allowed for an early return to pre-operative probing depth around the second molar. Intraoperatively it was also found that envelop flap is easier to perform and suture than the triangular flap.

Conclusion: The decision about which flap to use for third molar surgery in young patients should be according to surgeon's preference, taking into consideration the patient's needs and oral hygiene.

Keywords: Triangular flap, Envelope flap, Trismus

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INTRODUCTION

The term impaction is of Latin origin from impetus; it means organ/structures have been prevented from assuming its normal position due to an abnormal mechanical condition.[1] Third molars are present in 90% of the population with 33% having at least one impacted third molar. In most of situations, it results in recurrent pericoronitis, caries to an adjacent tooth, cyst, etc. Due to these, surgical removal of the third molar is one of the most frequently performed procedures in the oral and maxillofacial surgery.[2-4] Surgical removal of impacted third molar may be associated with a variety of complications such as pain, swelling, trismus, and wound infection. There are different variables in the surgery which influences the post-operative complications, flap designing being one of such variables.[2,3] Flap designs are not only important to allow optimal visibility and access to the impacted third molar but also for subsequent healing of the surgically created defects. Hence, to minimize the post-operative discomfort, various flaps have been designed, among them are envelope, triangular, marginal, paramarginal, standard Ward's, modified Ward's, and comma incision.[4-8]

Envelope flaps have no release incisions and the ease of access to tooth to be extracted depends on the length of mesial extension of the sulcular incision, which can if necessary extend up to the second premolar.[7] Triangular flaps involve a buccal releasing incision, which can be positioned mesially or distally to the second molar beside the papilla.[7] Each flap has its own merits and demerits. Although the choice of flap has remained predominantly a surgeon's preference, there are various studies comparing the flaps with conflicting results. Hence, we found a need for a study to compare two commonly used flaps in third molar surgeries. Our study aims at comparing the envelope flap with triangular flap related to the post-operative pain, swelling, trismus, and periodontal health of the second molar.

METHODOLOGY

Twenty individuals with age group of 18–35 years, with bilateral impacted lower third molars were the

study subjects**.** This was a split-mouth study where the impacted lower third molars on either side were divided into two groups:

- Group (A) - those in which envelope flap was used.
- Group (B) - those in which triangular flap was used.

In every patient, one side was Group A and the other was Group B. Impacted third molars were selected randomly for the flap design.

A standard pro forma was used to collect necessary information regarding each case after inclusion. The patients were informed about the study, and necessary consent was taken from them. All necessary pre-operative, intraoperative, and post-operative photographic records were maintained for these patients, and all treatments were performed on an outpatient basis.

Inclusion Criteria

The following criteria were included in this study:

- Age group between 18 and 35 years.
- Bilateral impacted lower third molars and to have a similar degree of surgical difficulty (as per Warfe's difficulty assessment index) requiring similar surgical techniques.
- The patient should be healthy and without any significant medical diseases that may compromises healing.

Exclusion Criteria

The following criteria were excluded from this study:

- Immuno-suppressed patients like patient with uncontrolled diabetes mellitus.
- Impacted molars with pathology and periapical infection.

Following Standard Parameters were used in Both the Types of Surgery

- All the patients were treated using 2% lignocaine HCL with adrenaline in 1:100000 concentrations (Lignox 2% - Warren).
- Both right and left impacted molars were treated by the same surgeon.
- Incision was given with B.P. blade no. 15.
- Sutures were given with round body needle 3–0 black silk (Lifeline) after surgery.
- Removal of the third molar of other side was done after 1 month.
- Same medications were given postoperatively after removal of both third molars.
- Cap Amoxicillin 500 mg thrice daily for 5 days. (If allergic, tab Cefixime 200 mg BD for 5 days) - Tab aceclofenac 100 mg twice daily for 5 days (if allergic, tab paracetamol 500 mg TID) postoperatively patients were given chlorhexidine mouthwash 0.2% for mouth rinsing 3 times a day for 7days.

Clinical Parameters

Various pre-operative, intraoperative, and post-operative parameters were used to evaluate the study subjects. They were:

Pre-operative assessment

- Opening of mouth with Vernier Caliper (interincisal distance) to compare it with post-operative mouth opening.
- Facial measurement with thread to compare with post-operative swelling. It was measured from corner of mouth to attachment of earlobe following the bulge of cheek and the distance from outer canthus of the eye to angle of the mandible.
- Periodontal health by measuring pocket depth using William's periodontal probe to compare it with post-operative periodontal health.
- Difficulty level of impacted third molar using Wharf's difficulty index.

Intraoperative assessment

Operating time

- Time taken from the time of incision till the completion of the final suture.
- Accessibility and ease of suturing in lower third molar surgery.

Post-operative assessment

Postoperatively patient was evaluated for:

Pain

It was evaluated using visual analog scale (VAS) of 10 cm size, in which endpoints are indicated with "no pain" to "unbearable pain."

Swelling

The facial swelling was determined by measuring the distance from corner of mouth to attachment of earlobe following the bulge of cheek and the distance from outer canthus of the eye to angle of the mandible.[7]

Trismus

Opening of mouth after removal of impacted third molar will be evaluated by measuring the distance between incisal edges of upper and lower central incisors using Vernier's Caliper.[6,7] The patients were evaluated for pain, trismus, and swelling after- 24 h, 3 days, 1 week, and 15 days.

Periodontal health

- It was checked with William's periodontal probe, with millimeter marking by measuring pocket depth.
- It was checked from free gingival margin to bottom of pocket on mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, distolingual, and distal aspect of second molar.[7]
- It was compared with pre-operative pocket depth. Postoperatively it will evaluated after 24 h, 1 week, 1 month, and 3 months.

Procedure for Surgical Removal of Impacted Lower Third Molars

Anesthesia

Classical inferior alveolar nerve block technique by Halstead, long buccal nerve block.

Incision

1. Group A: For envelope flap, the incision started on the ascending ramus, following the center of the third molar shelf to the distobuccal surface of the second molar and then extended as a sulcular incision to the mesiobuccal corner of the first molar.[7,9]
2. Group B: For triangular flap, the incision started on the ascending ramus, following the center of the third molar shelf to the distobuccal surface of the second molar and then extended as a sulcular incision up to the midpoint of the buccal sulcus of the second molar, followed by an oblique vestibular extension.[7,9]

Bone removal

Bone removal was done by buccal guttering technique and was performed using rotary instruments with proper cooling. Maximum care was taken to preserve the alveolar bone on the buccal side.[7,9,10]

RESULTS

An unpaired *t*-test was used to compare the mean operating time between two incisions. The mean operating time for envelope flap (49.6 min) was less than the mean operating time required for the triangular flap (51.3 min), but this difference was not statistically significant ($P = 0.368$) [Table 1].

The pain was evaluated with the help of VAS, with 0 = no pain and 10 = worst pain. An unpaired *t*-test was used to compare the mean pain scores between two incisions. The post-operative pain values in all the four post-operative visits were almost same in both envelope flap and triangular flap. There was no statistically significant difference present between pain scores of both flaps at different post-operative days. The pain score was gradually decreasing from 1st post-operative day to 15th post-operative day [Table 2].

An unpaired *t*-test was used to compare the mean trismus scores between two incisions. It was observed that there was no significant difference present between two incisions on 1st, 1 week, and 15th post-operative day. However, there was statistically significant difference present on the third post-operative day. The mean interincisal opening on the third post-operative day for envelope flap group was 36.53 mm while for triangular flap group was 36.2 mm. The difference was 3.33 mm which indicates that triangular flap group has more trismus on the 3rd post-operative day [Table 3].

An unpaired *t*-test was used to compare the mean swelling scores between two incisions. It was observed that there was no significant difference present between two incisions on 1st, 7th, and 15th post-operative day. However, there was statistically significant difference present on the third post-operative day. The mean swelling measurement on the third post-operative day for envelope flap group was 21.57 mm while for triangular flap group was 22.13 mm. The difference was 0.563 mm, which indicates that triangular flap group has more swelling on the 3rd post-operative day [Table 4].

An unpaired *t*-test was used to compare the mean pocket depth scores between two incisions. It was observed that there was no significant difference present between two incisions on 1st, 1 month, and 3 months post-operative period. However, there was statistically significant difference present on the 7th post-operative day. The mean pocket depth on the 7th post-operative day for envelope flap group was 4.54 mm while for triangular flap group was 4.242 mm. The difference was 0.3 mm, which indicates that envelope flap group has more pocket dept on the 7th post-operative day [Table 5].

DISCUSSION

There are different variables in the third molar surgery which influences the post-operative complications, flap designing being one of such variables. Flap designs are not only important to allow optimal visibility and access to the impacted third molar but also for subsequent healing of the surgically created defects.[11-15] Among different flaps used for third molar surgery, envelope and triangular flaps are most commonly used.[14,16]

Envelope flaps have no release incisions and the ease of access to the tooth to be extracted depends on the length of mesial extension of the sulcular incision, which can if necessary extend up to the second premolar.[7] In our study, it was extended up to the first molar.

Triangular flaps involve a buccal releasing incision, which can be positioned mesially or distally to

Table 1: Comparison of mean operating time (in min) in triangular flap and envelop flap

Groups	*n*	Mean±SD	Mean difference	*t*-value	*P*
Envelope	20	49.6667±5.49892	−1.66	−0.915	0.368 NS
Triangular	20	51.3333±4.41858			

SD: Standard deviation

Table 2: Comparison of mean pain scores in the triangular flap and envelop flap at different post-operative days

Groups	*n*	Mean±SD	Mean difference	*t*-value	*P*
24 h					
Envelope	20	6.6000±0.73679		−0.775	0.445NS
Triangular	20	6.8000±0.67612	−0.20		
3rd day					
Envelope	20	3.9333±0.88372		−0.774	0.442NS
Triangular	20	4.1333±0.63994	−0.20		
1 week					
Envelope	20	1.2667±0.70373		1.402	0.172NS
Triangular	20	0.9333±0.59362	0.33		
15 days					
Envelope	20	0.0667±0.25820		1.00	0.326NS
Triangular	20	0.0000±0.00000	0.066667		

SD: Standard deviation

Table 3: Comparison of mean trismus scores (in mm) in triangular flap and envelope flap at different post-operative days

Groups	*n*	Mean±SD	Mean difference	*t*-value	*P*
Pre-operative					
Envelope	20	40.2000±1.85934		0.00	1.000NS
Triangular	20	40.2000±1.85934	0.0000		
24 h					
Envelope	20	38.6667±1.63299		0.498	0.622NS
Triangular	20	38.5333±1.64172	0.333		
3rd day					
Envelope	20	36.5333±2.16685		−0.281	0.781SS
Triangular	20	36.2000±1.42428	−0.2000		
1 week					
Envelope	20	38.9333±2.01660		0.104	0.918NS
Triangular	20	39.1333±1.88478	0.066		
15 days					
Envelope	20	40.1333±1.76743		0.223	0.825NS
Triangular	20	40.0667±1.75119	0.133		

SD: Standard deviation

the second molar beside the papilla.[7] In our study, it was positioned mesially to the second molar beside the papilla.

Intraoperatively both flaps were checked for accessibility of tooth and ease of suturing. It was found that envelope flap is easier to perform and suture than the triangular flap. This is probably because of more suturing involved due to releasing incision and difficulty in the repositioning of triangular flap. It has been reported that flap designing influences the post-operative complications in third molar surgery.[16-30] In our study, we have compared the envelope flap with triangular flap related to the post-operative pain, swelling, trismus, and periodontal health of the second molar.

In our study, visual analog scale was used for the assessment of pain. There was no statistically significant difference present between pain scores of envelop flap and triangular flap at different post-operative days.

In our study, the mean operating time for envelope flap (49.6 min) was less than the mean operating time required for triangular flap (51.3 min), but this difference was not statistically significant (P = 0.368). When mean trismus scores were compared between two incisions, it was observed that there was no significant difference present between two incisions on 1st, 1 week, and 15th post-operative day. However, there was statistically significant difference present on the third post-operative day. The mean interincisal opening on the third post-operative day for envelope flap group was 36.53 mm while

Table 4: Comparison of mean swelling scores (in mm) in the triangular flap and envelope flap at different post-operative days

Groups	*n*	Mean±SD	Mean difference	*t*-value	*P*
Pre-operative					
Envelope	20	20.3567±0.399	−0.013	−0.096	0.924NS
Triangular	20	20.3700±0.358			
24 h					
Envelope	20	20.6833±0.324	−0.260	−0.274	0.786NS
Triangular	20	20.9433±0.371			
3rd day					
Envelope	20	21.5733±0.327	−0.563	−3.041	0.05 SS
Triangular	20	22.1367±3.711			
1 week					
Envelope	20	20.4633±0.385	0.053	0.401	0.692NS
Triangular	20	20.4100±0.342			
15 days					
Envelope	20	20.3833±0.359	0.070	0.538	0.595 NS
Triangular	20	20.3133±0.353			

SD: Standard deviation

Table 5: Comparison of mean pocket depth scores (in mm) in the triangular flap and envelope flap at different post-operative days

Groups	Mean±SD	Mean difference	*t*-value	*P*
Pre-operative				
Envelope	1.0286±0.11127	−0.028	−1.682	0.118NS
Triangular	1.0571±0.09759			
24 h				
Envelope	5.9714±0.17995	−0.143	−0.476	0.643NS
Triangular	6.1143±0.13452			
1 week				
Envelope	4.5429±0.26921	−0.300	−2.234	0.045S
Triangular	4.2423±0.29095			
1 month				
Envelope	2.4143±0.25448	−0.100	−0.679	0.510NS
Triangular	2.5143±0.24785			
3 months				
Envelope	1.0000±0.20000	−0.057	−0.511	0.619NS
Triangular	1.0571±0.09759			

SD: Standard deviation

for triangular flap group was 36.2 mm. The difference was 3.33 mm, which indicates that triangular flap group has more trismus on the 3rd post-operative day.

It has been suggested that triangular mucoperiosteal flaps induce inflammation in the muscles of mastication and it is possible that muscle irritation induced by hematoma forming when the periosteum is incised for the anterior releasing incision, is more likely with this design.[31-42] In contrary to our results Kirk *et al*. and Nageshwar found no significant difference in mouth opening between the two flap designs; explaining their findings on the grounds that the distal incision, which follows the same course in both flap designs, is similar.[42]

The third parameter compared to our study was swelling. It was observed that there was no significant difference present between two incisions on 1st, 7th, and 15th post-operative day. However, there was statistically significant difference present on the third post-operative day. The mean swelling measurement on the third post-operative day for envelope flap group was 21.57 mm while for triangular flap group was 22.13 mm. The difference was 0.563 mm which indicates that triangular flap group has more swelling on the 3rd post-operative day.

Triangular flaps were associated with significantly greater measures of facial swelling after surgery on the 3rd post-operative day, but the difference lost statistical difference when measured on the 7th post-operative day. This finding is in accordance with the outcome of Kirk *et al*. and Z.H. Baqain *et al*., but contrary to those of Sandhu *et al*. who reported that post-operative swelling is related to operating time and not because of flap design.[25] However, in our study, there was no significant correlation between duration of surgery and post-operative swelling ($P > 0.05$). It is likely that

anterior releasing incision of triangular flap induced a greater inflammatory response and subsequent edema in the buccal tissues.

In our study, all operations were performed by a single surgeon, under similar operating conditions, using same instruments. Therefore, patient's compliance bias was eliminated, and all other possible factors and surgical procedures were kept as constant as possible, presenting flap design as the sole independent factor to determine the severity of outcome variables. The results of our study suggested that flap design has an influence on accessibility and ease of suturing during lower third molar removal and it also influences post-operative complications of third molar surgery. Envelop flaps had a better outcome in terms of ease of suturing and on post-operative swelling and trismus, while triangular flaps allowed for an early return to pre-operative probing depth around the second molar. However, there were no differences in the long term (1 month and more) in both the flaps with respect to periodontal health.

SUMMARY AND CONCLUSION

The aim of this prospective clinical study was to compare the efficacy of envelope flap and triangular flap in lower third molar surgery and effect of flap design in post-operative complications of third molar surgery.

There was statistically significant difference present in post-operative trismus and swelling on the 3rd post-operative day. Triangular flap group had more swelling and trismus on the 3rd post-operative day than envelope flap group. While periodontal health was better in triangular flap group on the 7th post-operative day than envelope flap group ($P > 0.05$), but there were no significant differences found in intraoperative time and pain scores of both the groups.

The results of our study suggested that flap design has an influence in post-operative complications of third molar surgery. Envelope flaps had a better short-term outcome on post-operative swelling and trismus, while triangular flaps allowed for an early return to a pre-operative probing depth around the second molar. Intraoperatively it was also found that envelope flap is easier to perform and suture than the triangular flap.

Therefore, the decision about which flap to use for third molar surgery in young patients should be according to surgeon's preference, taking into consideration the patient's needs and oral hygiene.

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