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Comparison of Envelope and Modified Triangular Flaps on Incidence of Dry Socket after Surgical Removal of Impacted Mandibular Third Molars

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ABSTRACT

Objectives: To compare the incidence of dry socket between envelope and modified triangular flaps in patients undergoing surgical removal of impacted mandibular third molars. **Study Design:** Quasi-experimental study. **Place and Duration of Study:** Department of Oral and Maxillofacial Surgery, 30 Military Dental Centre, Combined Military Hospital Peshawar, and Pakistan Institute of Medical Sciences, Islamabad, from December 2022 to November 2024. **Methods:** A total of 94 patients aged 18-50 years undergoing surgical extraction of impacted mandibular third molars were included and allocated to two equal groups. Patients in Group EF received an envelope flap created by an intersulcular incision from the first to second molar, extending onto the ramus and laterally diverging distal to the third molar in order to protect the lingual nerve. In Group MTF; a modified triangular flap was created with an incision from the ramus ridge to 2 mm distal to the second molar, then extended into the buccal vestibule while preserving a thin gingival collar around the second molar. Patients were evaluated on postoperative day 3 for the development of dry socket, diagnosed by the presence of exposed alveolar bone and pain score> 7 on visual analogue scale. Chi-square test applied to compare the primary outcomes between the two groups. **Results:** The mean age of participants was 30.6±6.5 years, with a higher male population (66%). No statistically significant difference was reported between the Group EF and Group MTF regarding the incidence of dry socket (19.2% Vs 17%, p-value= 0.79). **Conclusion:** Both envelope and modified triangular flap methods demonstrate a comparable efficacy in preventing dry socket after mandibular third molar surgery.

INTRODUCTION

The mandibular third molars (M3M) are the most impacted teeth, with an approximate prevalence up to 23% in Pakistan.[1] The affected M3M can cause a series of issues such as food retention, resulting in inflammation, pain, swelling and the resorption of the roots of the adjacent second molars, making them the most commonly extracted teeth.[2]

Despite being regularly performed, post-operative (post-op) morbidities are not uncommon after this extraction procedure.[3] These morbidities entail the presence of inflammatory complications such as pain, edema, restricted mouth opening, and dry socket during the immediate post-op period.[3,4] Among these, dry socket or alveolar osteitis is one of the most common local complications after surgical extraction of M3M, adversely affecting patient comfort and healing.[5] The incidence of dry socket after M3M surgery is estimated to be 20%, which is much higher than that experienced after routine extraction of other teeth. The complication is in fact the disintegration or premature loss of the clot within the alveolar socket, often due to flap dehiscence, infection, or trauma. The pain due to dry socket is severe, appearing 48-72 hours after the surgery, and may in some cases, not be relieved by over-the-counter analgesics.[6]

Various surgical procedures have been utilized to prevent dry socket following M3M surgery. Firstly, the formation of a dry socket can be prevented by performing the surgery in a sterile environment with as minimum possible trauma to the surgical site. The prophylactic use of antimicrobial, antiseptic, antifibrinolytics, anti-inflammatory agents, and clot supporting agents before and after surgery may also help to reduce the incidence of dry socket. Flap design is another critical issue that influences the number and severity of postoperative complications including dry socket.[7,8]

The routinely used design for M3M surgery is called the envelope flap (EF) which involves a sulcular incision along

the gingival margin of mandbilbular 1st to 2nd molar without any anterior vertical releasing incision. This design provides broad access, maintains good vascularity, and allows a straightforward closure. EF design is able to minimize tissue trauma and is generally considered easy to elevate.[9] The modified triangular flap (MTF) is another design that begins with an incision from the top of the alveolar ridge to mandibular second molar, leaving a 2 mm thick gingival collar around its buccal side and ending with a final vertical or oblique releasing incision, offering improved visibility and access in difficult impactions. This design reduces flap tension, supports wound closure, and may enhance postoperative healing by promoting more stable clot retention.[10] Both of these flaps have a widespread use, however, current evidence remains inconsistent regarding efficacy of these designs in minimizing postoperative complications, particularly the dry socket.[11]

This study was therefore designed to determine which flap technique, envelope or modified triangular, is associated with a lower incidence of dry socket. The findings of this study will be helpful for dentists working in our health care setups to select a flap design that optimizes healing, reduces patient's postoperative discomfort, and thereby improves overall outcomes of M3M surgery.

METHODOLOGY

This quasi-experimental study was conducted at the Department of Oral and Maxillofacial Surgery, 30 Military Dental Centre, CMH Peshawar, and the Pakistan Institute of Medical Sciences (PIMS), Islamabad, from Dec-2022 to Nov-2024 over a period of 2 years. Ethical approval of conducting the study was obtained from the Training Branch of Military Dental Centre, CMH Peshawar (ERC Ref: 3199/MDC/Trg/OMFS/04-2022). The same protocol was then implemented at PIMS under the supervision of the co-investigator.

The sample size was calculated using the WHO sample size calculator with anticipated proportions of dry socket 39.28% in the envelope flap group and 10.71% in the MTF group. Using a 5% significance level and 90% power, a total sample size of 94 patients (47 per group) was obtained.[6]

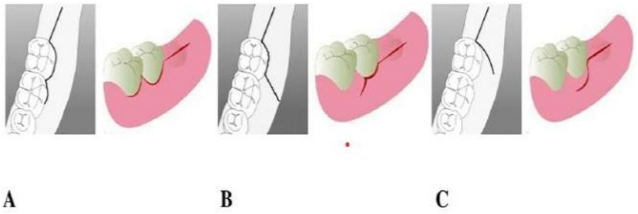
A total of 94 patients aged 18–50 years, presenting for surgical removal of M3M and fulfilling the inclusion criteria were recruited through non-probability consecutive sampling. Exclusion criteria consisted on patients with uncontrolled diabetes mellitus, pregnancy, and any systemic immunocompromised condition. Written informed consent was obtained from all participants.

Demographic and clinical details were noted for each patient. Local anesthesia was administered using 2% lignocaine 1.6 mL with 1:100,000 adrenaline, for the inferior alveolar nerve block, 0.2 mL for the lingual nerve, and 0.2 mL for the long buccal nerve. Standardized surgical protocol was followed for all patients, including flap elevation, bone guttering, tooth sectioning when required, copious socket irrigation, and closure with 3-0 silk sutures. Patients were allocated to two equal groups, Group EF and Group MTF by the resident surgeon on the basis of alternate allocation. Patients in Group EF underwent an envelope flap which was created with a sulcular incision from the first to the second molar and a relief incision distal to the mandibular ramus. The flap was closed with two or three simple interrupted sutures distal to the second molar. In addition to that the flap was adapted with interdental sutures between the first and second molars. In Group MTF, patients underwent a modified triangular flap where incision was made from the mandibular ramus to the distobuccal edge of the second molar crown. This was followed by a vertical /oblique incision in the mandibular vestibule, approximately 10 mm long which was extended beyond the mucogingival junction and the periodontium of the second molar, and touched only at the dentofacial junction. The same suturing technique was then used distally as of the EF, while the vertical incision was only repositioned with a coronally placed single suture.

Both flap designs provided adequate access and were performed in accordance with the standard surgical protocols.

Figure 1

Schematic diagram Envelope flap (A), Triangular Flap (B), Modified Triangular flap (C).[12]



All surgeries were performed by a single maxillofacial surgery resident to reduce operator-related variability. Patients received postoperative antibiotics and analgesics according to departmental guidelines and were evaluated on postoperative days 3 for the presence of dry socket. The primary outcome was set as the development of dry socket (alveolar osteitis), diagnosed clinically by the presence of exposed alveolar bone and a pain score greater than 7 on visual analogue scale (VAS). The presence of severe halitosis was also recorded as a secondary outcome of the study.

Data were entered and analyzed using SPSS 26. Quantitative variables were presented as mean ± standard deviation, while qualitative variables were shared as frequencies and percentages. The Chi-square test was applied to compare the incidence of dry socket between the two groups, with a p-value <0.05 considered statistically significant.

Figure-2

Modified Triangular Flap (two cases): Top (left) Incision Outline,Top (right) Flap Reflection, Bottom (right) Closure

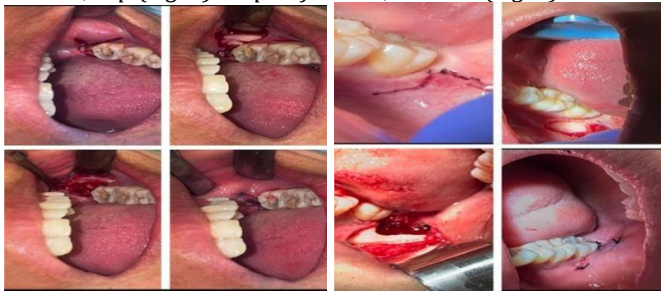
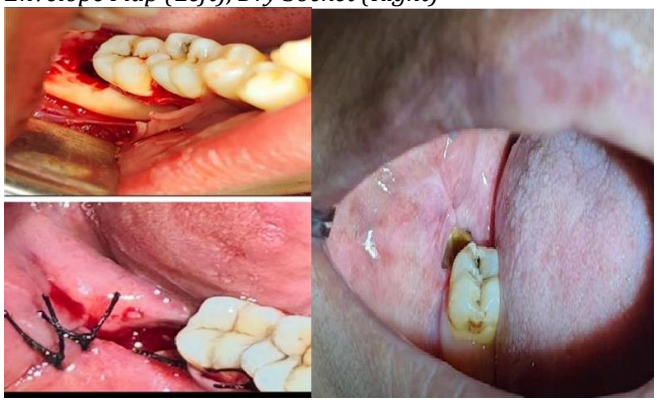


Figure 3

Envelope Flap (Left), Dry Socket (Right)



RESULTS

Mean age of patients in this study was 30.6±6.5 years, ranging from 21 to 47 years, with higher male population (66%) than the females (34%). The group wise demographics and clinical features are shared in table 1.

Table 1

Group Wise Demographics and Clinical Features. n=94

Group wise demographics and clinical features		Group EF (n=47)	Group MTF (n=47)
Age (Mean± SD) years		30.07±5.4	31.22±7.4
Gender	Male n (%)	32 (68.1)	30 (63.8)
	Female n (%)	15 (31.9)	17 (36.2)
Type of impaction	Mesioangular n (%)	17 (36.2)	16 (34)
	Vertical n (%)	15 (31.9)	14 (29.8)
	Horizontal n (%)	8 (17)	9 (19.2)
	Distoangular n (%)	7 (14.9)	8 (17)

The results of primary outcomes of the study showed no statistically significant difference between the two study group in the incidence of dry socket (p= 0.79), as assessed by the presence of exposed alveolar bone and a pain score> 7 on VAS as shown in Table 2.

Table 2

Incidence of Dry Socket by Flap Design. n=94

Incidence of dry socket	Group EF (n=47)	Group MTF (n=47)	p-value
Yes n (%)	9 (19.2)	8 (17)	0.79
No n (%)	38 (80.8)	39 (83)	

Moreover, there was no difference in the incidence of severe halitosis between the groups as shown in Table 3.

Table 3

Presence of Severe Halitosis. n=94

Presence of severe halitosis	Group EF (n=47)	Group MTF (n=47)	p-value
Yes n (%)	9 (19.2)	7 (17)	0.58
No n (%)	38 (80.8)	39 (83)	

DISCUSSION

The results of primary outcomes of the study showed no statistically significant difference between the two study group in the incidence of dry socket (p= 0.79), as assessed by the presence of exposed alveolar bone and a pain score> 7 on VAS. Moreover, there was no difference in the presence of severe halitosis between the groups (p=0.58). The findings of our study align with the results of various studies conducted over the topic and principles in oral surgery which state that the flap selection should be individualized based on anatomical considerations, impaction characteristics and the required surgical access. Bailey E et al. reviewed the available evidence regarding the effect of various surgical technique on the risk of dry socket and mentioned that the evidence is largely insufficient and of low certainty. However, most comparisons including flap designs, irrigation method, and closure technique have shown no reliable differences in the incidence of dry socket.[13]

Systematic reviews have consistently reported comparable outcomes between varying flap designs. Lopes da Silva BC et al. in their systematic review compared triangular and envelope flap designs in cases of M3M surgery in terms of outcomes after surgery. The review concluded that flap design had no significant influence on outcomes such as post-op pain, edema, trismus, dehiscence, or dry socket.[14]

This finding is further supported by evidence coming from our local population. In a randomized controlled trial conducted in Pakistani population, wound healing and post-op recovery after impacted M3M surgery was compared between triangular and envelope flap techniques. The results showed wound healing in 93.8% of EF cases versus 83.3% in MTF cases, with no statistically significant difference (p=0.1953). Post-op pain was also similar between the groups (p=0.3271). The study therefore concluded that both flap designs yield comparable outcomes including dry socket with no superiority identified.[15]

Providing support to our findings, Sridharan G et al. also mentioned that flap designs has no significant impact on pain, swelling, mouth opening, wound healing, periodontal status and overall complications including dry socket.[16]

Despite this body of evidence suggesting equivalence, the literature remains contradictory and these comparable outcomes are not supported by all the investigators. Some investigators have found MTF to be more effective while others have supported EF.

Results of the study by Jakse et al. revealed a significantly higher wound dehiscence rate with the EF (57%) versus the MTF (10%; RR=5.67, 95% CI 1.852–12.336). The study concluded that the MTF design is superior and significantly reduces the risk of wound dehiscence.[17]

Similarly, Mohajerani et al. reported a higher incidence of dry socket (exposed bone) with envelope flaps (41%) compared to modified triangular flaps (12%).[6]

A meta-analysis by Zhu J et al. concluded that EF required less operation time (P < 0.00001) and showed reduced pain and trismus but demonstrated a higher incidence of dry socket (P = .001). Overall, MTF were found to reduce the dry socket risk.[18]

In contrast to the above mentioned results, some studies have reported advantages with EFs over other designs. Xie Q et al. reported that while no difference was present for surgery time and early outcomes (p > 0.05), EF produced significantly less swelling and trismus on days 3 and 7 (p <

0.05) and offered reduced complications like dry socket and offered faster recovery.[19]

The above discussion concludes that the results are inconsistent and the outcomes of M3M surgery depend not just on flap design, but also on patient factors and surgical skill.

Limitations of this study include the short-term follow-up, which may not capture delayed complications as well as learning curve of resident surgeon. Future studies with larger sample sizes and longer follow-up periods may be beneficial to provide further evidence to improve the postoperative outcomes including pain, swelling, wound healing and overall patient satisfaction.

CONCLUSION

Both EF and MTF techniques are similar in efficacy regarding the prevention of dry socket. The choice of technique therefore may be made as per the accessibility, operator preference and individualized complexity of the case rather than the anticipated dry socket risk. Larger, multicenter trials with standardized outcome assessment are required.

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REFERENCES

1. Waseem N, Asim MA, Maqsood A, Ghafoor MW, Khalid MO. Evaluation of patterns of impacted third molars and their association with vital structures by radiographic examination. Pak Armed Forces Med J. 2021;71(1):255-60. https://doi.org/10.51253/pafmj.v71i1.3315.
2. Tassoker M. What are the risk factors for external root resorption of second molars associated with impacted third molars? A cone-beam computed tomography study. J Oral Maxillofac Surg. 2019;77(1):11-17. https://doi.org/10.1016/j.joms.2018.08.023
3. De Marco G, Lanza A, Cristache CM, Capcha EB, Espinoza KI, Rullo R, et al. The influence of flap design on patients' experiencing pain, swelling, and trismus after mandibular third molar surgery: a scoping systematic review. J Appl Oral Sci. 2021;29. https://doi.org/10.1590/1678-7757-2020-0932
4. Şimşek Kaya G, Yapıcı Yavuz G, Saruhan N. The influence of flap design on sequelae and quality of life following surgical removal of impacted mandibular third molars: A split-mouth randomised clinical trial. J Oral rehabil. 2019;46(9):828-35. https://doi.org/10.1111/joor.12814
5. Mamoun J. Dry socket etiology, diagnosis, and clinical treatment techniques. J Korean Assoc of Oral Maxillofac Surg. 2018;44(2):52-8. https://doi.org/10.5125/jkaoms.2018.44.2.52
6. Mohajerani H, Esmaeelinejad M, Jafari M, Amini E, Sharabiany SP. Comparison of Envelope and Modified Triangular Flaps on Incidence of Dry Socket after Surgical Removal of Impacted Mandibular Third Molars: A Double-blind, Split-mouth Study. J Contemp Dent Pract. 2018;19(7):836-41. https://doi.org/10.5005/jp-journals-10024-2344
7. Shah R, Davies R. Oral Flap Design. [Updated 2024 Dec 27]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan https://www.ncbi.nlm.nih.gov/books/NBK610687/
8. Tarakji B, Saleh LA, Umair A, Azzeghaiby SN, Hanouneh S. Systemic review of dry socket: aetiology, treatment, and prevention. J Clin Diagn Res. 2015;9(4):ZE10-3. https://doi.org/10.7860/JCDR/2015/12422.5840.
9. Ahmad M, Khan ZA, Khan TU, Alqutub MN, Mokeem SA, AlMubarak AM, et al. Influence of Surgical Flap Design (Envelope and Szmyd) for Removal of Impacted Mandibular Third Molars on Clinical Periodontal Parameters: A Clinical Trial. Int J Environ Res Public Health. 2021;18(9):4465. https://doi.org/10.3390/ijerph18094465.
10. Mudjono H, Rahajoe PS, Astuti ER. The effect of triangular and reversed triangular flap designs to post third molar odontectomy complications (a pilot study). J Clin Exp Dent. 2020;12(4):e327-e334. https://doi.org/10.4317/jced.55864.
11. Chen Y-W, Lee C-T, Hum L, Chuang S-K. Effect of flap design on periodontal healing after impacted third molar extraction: a systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2017;46(3):363-72. https://doi.org/10.1016/j.ijom.2016.08.005
12. DE Marco G, Lanza A, Cristache CM, Capcha EB, Espinoza KI, Rullo R, et al. The influence of flap design on patients' experiencing pain, swelling, and trismus after mandibular third molar surgery: a scoping systematic review. J Appl Oral Sci Rev FOB. 2021;29:e20200932. https://doi.org/10.1590/1678-7757-2020-0932.
13. Bailey E, Kashbour W, Shah N, Worthington HV, Renton TF, Coulthard P. Surgical techniques for the removal of mandibular wisdom teeth. Cochrane Database Syst Rev. 2020;7(7):CD004345. https://doi.org/10.1002/14651858.CD004345.pub3.
14. Lopes da Silva BC, Machado GF, Primo Miranda EF, Galvão EL, Falci SGM. Envelope or triangular flap for surgical removal of third molars? A systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2020;49(8):1073-86. https://doi.org/10.1016/j.ijom.2020.01.001.
15. Rahman AU, Hashmi MJ, Sadiq MS, Ahmad F, Alam MA, Qadeer M. Comparison of wound healing using envelope and triangular flap for impacted mandibular third molar surgery. Pak J Med Health Sci. 2021;15(10):2811-13. https://doi.org/10.53350/pjmhs2115102811.
16. Sridharan G, Nakkeeran KP, Andavan G, Raja V B KK. "Effects of flap modification on third molar extraction outcomes"-A randomised split mouth study. J Oral Biol Craniofac Res. 2020;10(4):619-24. https://doi.org/10.1016/j.jobcr.2020.08.010.
17. Jakse N, Bankaoglu V, Wimmer G, Eskici A, Pertl C. Primary wound healing after lower third molar surgery: evaluation of 2 different flap designs. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2002;93(1):7-12. https://doi.org/10.1067/moe.2002.119519.
18. Zhu J, Yuan X, Yan L, Li T, Guang M, Zhang Y. Comparison of Postoperative Outcomes Between Envelope and Triangular Flaps After Mandibular Third Molar Surgery: A Systematic Review and Meta-Analysis. J Oral Maxillofac Surg. 2020;78(4):515-27. https://doi.org/10.1016/j.joms.2019.11.026.
19. Xie Q, Wei S, Zhou N, Huang X. Modified envelope flap, a novel incision design, can relieve complications after extraction of fully horizontal impacted mandibular third molar. J Dent Sci. 2021;16(2):718-722. https://doi.org/10.1016/j.jds.2020.06.022.