

## Review of Mucoperiosteal Flap Designs for Mandibular Third Molar Surgery

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Transalveolar extraction or third molar (M3) surgery is one of the routine procedures performed by Oral and Maxillofacial Surgeons in their clinical practice. The surgery involves various steps which determines the success of the procedure. One such step is the reflection of mucoperiosteal flap, which is vital in M3 extractions. The Surgeon should handle the soft tissue with all caution when reflecting a local flap as it is an important component for wound closure after the surgical procedure. In this article we have reviewed various flap design used in M3 surgery and the fundamental principles of flaps are highlighted.

**Keywords:** Surgical Flaps; Third Molar; Impacted Tooth; Tooth Extraction**Introduction**

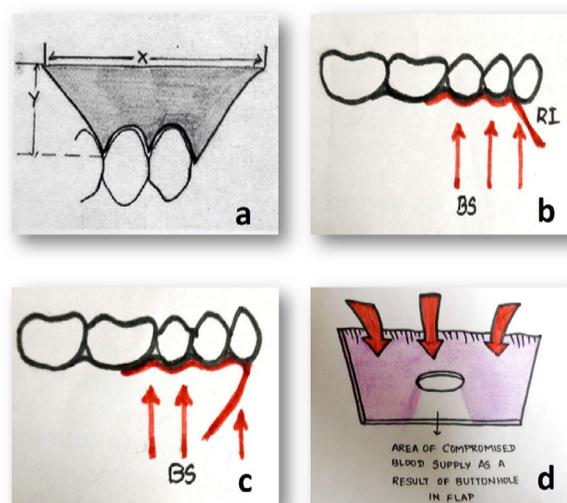
Flaps are designed and reflected to provide adequate access to the surgical site apart from mechanical access for an atraumatic surgical procedure. The type of flap determines the feasibility of primary closure, duration of wound healing and has an influence on other post-operative complications such as pain, trismus, alveolar osteitis and wound dehiscence. The reflected flap should have dimension that is adequate enough to allow placement of retractors and instruments for bone and tooth removal [1,2].

The extraction of impacted M3 can become simpler by obtaining adequate access which reduces the degree of difficulty of extraction. Other factors that can enhance the ease of the procedure is the capability to create a pathway for tooth delivery and gain purchase for tooth elevation. This article discusses principles of flap design, classifications of flaps for M3 surgery and reviews various flap designs used in M3 surgical extraction.

**Classification and Principles of flap design**

Mucoperiosteal flap for 3<sup>rd</sup> molar surgery is broadly classified as envelope and triangular flaps and few other variants (Table 1). The flap should follow certain basic principles for its viability. The base of the flap should be broader than the free end to ensure adequate blood supply (Figure 1a-1d). Flap must be made according to the requirement of soft tissue reflection for proper visualization. Full thickness flaps should be preferred as periosteum is required for bone healing. Accurate anatomic apposition of soft tissue should be achieved at the end of the procedure. The incision should lie upon healthy bone whenever possible. A long straight incision is

preferred as they heal faster. The incision should be placed firmly through mucosa and periosteum to the bone through a smooth stroke. Pen grasp should be used while placing the incision. The soft tissue has to be cut perpendicular to the underlying bone. The mucoperiosteal flap should be reflected from the bone using gentle pressure [2].



**Figure 1:** (a) Flap base dimension (x) should be greater than the height dimension (y), preferably  $x = 2y$ ; (b) Releasing incision should be designed to maximize blood supply by leaving wide base. BS - Blood supply, RI - Releasing incision; (c) Incorrect flap design. BS - Blood supply; (d) If buttonhole deformity occurs near free edge of flap, blood supply to flap tissue on side of hole away from flap base is compromised.

Based on Thickness	Based on side of reflection	Based on placing releasing incision
Full thickness	Labial/Buccal flap	Envelope flap
Partial thickness	Palatal/Lingual flap	Two sided triangular flap
		Three sided rhomboid flap
		Semilunar flap

**Table 1:** Classification of Flaps.

### Various flap designs and techniques

Howe GL described the basic flap design where, an anterior incision that curves forward from distobuccal aspect of second molar (M2) up to mesiobuccal aspect of the same tooth. The incision is extended distally towards external oblique ridge in the buccal side. Posteriorly the incision should slope outwards and backwards. The resulting mucoperiosteal flap provides excellent access and wound closure that is achieved by approximating buccal and lingual soft tissues together [1].

Envelope flap described is raised by placing a sulcular incision from first molar (M1) to M2 continuing distally along the mandibular ramus. Posteriorly the incision should extend laterally due to anatomic divergence of the mandible. The advantages of this flap include good vascularity up to margin [4] (Figure 2a) In 1959, Kruger described an envelope flap which is made by placing incision medial to external oblique ridge extending to distal lower angle of M2 following which a sulcular incision is made from distobuccal angle of M2 to mesiobuccal angle of M1 [5].

A triangular or vertical flap is a versatile option which incorporates the incision distal to ramus of mandible to distobuccal aspect and a sulcular incision in mesiobuccal aspect with a releasing incision in distal aspect of M2 towards the mandibular vestibule. It is a preferred type of flap when access to apical areas of tooth is required over an envelope flap. It provides a tension free wound closure. Loose adaptation in the apical portion allows easy relief of hematoma [4] (Figure 2b and 2c).

Berwick described a variant in which a tongue shaped vestibular flap is made from buccal shelf of the mandible where the incision line does not fall over defective bone and the base is at the distolingual aspect of M2. The incision line does not lie over the bony defect created by extraction [5] (Figure 2d).

In 1969, lateral trepanation technique was described by Henry for extraction of developing mandibular M3 claiming less post-operative complications. Enclosed by the findings of Kal and Klamfeldt. This technique is less popular and is not routinely in practice. An S-shaped incision is placed from retromolar fossa through external oblique ridge with downward curvature extending up to the anterior border of M1 [1,5] (Figure 2e).

Killy and Kay in 1979, described a flap design which starts along the crevice of M2 but it remains rarely used as the healing in gingival crevice is unsatisfactory when such modifications is used [5] (Figure 2f).

Pedicle flap proposed by Goldsmith S., *et al.* (2012) is elevated by incorporating a distal incision which enables soft tissue advancement and rotation for complete closure of the surgical wound. Design includes a pedicle flap i.e. the buccal envelope flap. The buccal gingival sulcus incision is placed from the mesio-buccal line angle of M1 to the distal most visible part of M3. The lingual flap is elevated in subperiosteal plane with lingual nerve protection. The releasing incision is extending to the external oblique ridge. The buccal soft tissue can be incorporated over the defective region which enables complete wound closure. This design claims to prevent loss of blood coagulum and minimizes bone loss [6].

In 2002, Nageshwar proposed a distolingual flap, designed a buccal comma shaped flap for removal of mandibular impacted M3. The incision for this flap is placed at a point below M2 and it is curved upwards to meet the gingival crest of M2 at the distobuccal line angle, from there it continues as a crevicular incision around the distal aspect of M2. The advantage of this flap is that it is designed to overcome the drawbacks of routinely used conventional incisions where there will be dissection of temporalis muscle tendon and flap which lies over the bony defect [7] (Figure 2g).

The incision for a bayonet flap is described to be placed on ascending ramus, following the mid-portion of M3 shelf and then extended as a sulcular incision up to midpoint of buccal sulcus of M2, followed by an oblique vestibular releasing incision [8] (Figure 2h).

The Szmyd flap is described in literature as vertical incision which leaves the collar of gingiva intact on the disto-buccal aspect of M2 [8]. This is said to minimize bone resorption. It is a type of marginal flap and results in better primary healing.

Koener's incision is a modification of envelope flap that is placed as a distal extension beginning near the external oblique ridge in the lateral mandible. The incision should be extended forward and medially towards the mid-portion of the distal surface of M2 terminating at the mesiobuccal line angle of M2 [9].

### Discussion

The difference between an average and an excellent surgical outcome depends on how good the surgeon handles the tissues. Tissue handling is an essential aspect, with the use of proper incision and flap design techniques.

Kumar BS., *et al.* conducted a split mouth study on influence of post-operative complications after impaction surgery comparing standard incision and Nageshwar's comma shaped incision. They have inferred that pain score and other post-operative complica-

tions were less in comma shaped incision when compared to the side where standard incision was used [7,12].

Stephens, *et al.* concluded that there is no significant difference in the periodontal status when different access flaps were compared. But sometimes when the periodontal defects are severe, a secondary procedure may be utilized to close them such as a lingual gingival finger flap [7].

A study conducted by Sandhu A., *et al.* comparing the envelope and bayonet flap in a split mouth study concludes that the pain and wound dehiscence is greater in envelop flap as compared to bayonet flap group. But there was no significant difference in post-operative swelling and trismus. They concluded that bayonet flap is superior to envelop flap in terms of evaluated post-operative pain and wound dehiscence [8].

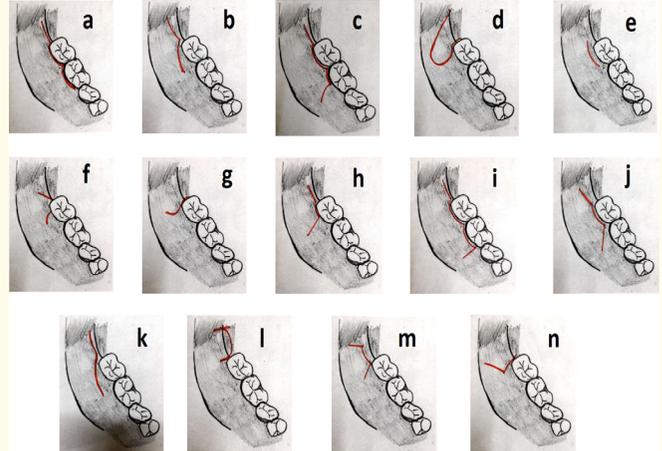
Desai A., *et al.* compared the Koener's triangular incision and Ward's envelop incision evaluating access, healing of wound, alveolar osteitis and found that there was significant difference between both the groups with hematoma formation, wound gaping and distal pocket being more prominent in Koener's triangular incision [9].

Karaca I., *et al.* concluded that the preference of flap design is based on Surgeon's choice and flap design selection does not have a lasting effect in periodontal health of M2 [10]. In a study by Suarez-Conqueiro., *et al.* comparing marginal and paramarginal flap it is concluded that marginal flap results in better wound healing. It provides adequate exposure and bony support for soft tissue flap [11]. Van Gool AV, *et al.* deduced that the oblique vertical incision is more beneficial for better access and it is not easily torn when compared to horizontal incisions [13].

Baquain HZ., *et al.* conducted a split mouth randomized study and investigated the effects of envelop and triangular flap on post-operative morbidity after removal of M3. The study showed that there was no difference in pain, plaque accumulation and bleeding on probing between both the study groups. But probing depth was found to be greater in patients where envelop flap was used. Trismus was evident in patients who received triangular flap [14]. This is in contrast to the study done by Rabi A., *et al.* who concluded that patient on whom triangular flap was performed had better mouth opening than the group where envelop flap was used. The study concluded that the flap design in M3 surgery influences post-operative recovery [15].

Alqahtani, *et al.* in their study evaluated two different types of flap in periodontal health of M2 after M3 removal by comparing envelop and modified triangular flap designs. They found that the probing depth was less in modified triangular flap design but pain was greater than the envelop flap, although without any statistical significance [16]. In a study conducted to compare routine triangular flaps and an alternate lingual sided triangular flap in M3 extractions. The alternate flap showed greater pain 12 hours post-surgery and exhibited less wound dehiscence. It was concluded that alternate flap is superior to conventional triangular flap [17].

There are various other designs proposed by Mead (1930) (Figure 2i), Cogswell (1933) (Figure 2j), Avellanal (1946) (Figure 2k), Maurel (1959), Ries Centeno (1960), Lotter (1964), Saad Berzaghi (1989) (Figure 2l), Neto (2000), Suarez (2003) (Figure 2m), Heitz (2003) (Figure 2n) [18].



**Figure 2:** (a) An envelope flap; (b) Ward's incision; (c) Modified ward's incision; (d) Berwick's tongue flap proposed in 1971; (e) Henry's incision (1969); (f) Killey and Kay incision (1979); (g) Nageshwar's Comma shaped incision; (h) Bayonet flap; (i) Flap design by Mead, 1930; (j) Flap design by Cogswell, 1933; (k) Flap design by Avellanal, 1946; (l) Flap design by Berzaghi, 1989; (m) Flap design by Suarez, 2003; (n) Flap design by Heitz, 2003.

## Conclusion

A variety of techniques have been described about various flaps for impacted mandibular third molar extraction but envelop flap and triangular flap remains to be the commonly performed in the routine clinical practice. There is no significant statistical difference among the literature with respect to post-operative pain, primary wound healing, swelling, and trismus and periodontal status. The clinical difference that the authors have noted is the difference in the extent of surgical site exposure and the incidence of damage to the flap. The operating surgeon should have a thorough knowledge of the different type of flaps and should be skillful enough to advocate proper technique in day to day practice to execute the procedure uneventfully as each flap design has its own advantages and disadvantages.

## Compliance with Ethical Standards

- Funding: Self-funded.
- Conflict of Interest: None.
- Ethical approval: Not Applicable.
- Informed consent: Not Applicable.

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