

Review

Comparison of different flap designs in soft tissues periodontal healing after lower third molars extraction: a descriptive review

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ABSTRACT

The purpose of this descriptive review was to assess post-operative periodontal outcomes of adjacent molar sites after the extraction of lower third molars, comparing different surgical techniques. The electronic search strategy was conducted on different databases (PubMed, Scopus, and Web of Science) fitting the following selection criteria: clinical human studies (RCTs, retrospective and prospective); studies comparing different flap designs (e.g., envelope, triangular, and trapezoidal flaps) for surgical extraction of lower 3rd molars; studies assessing clinical outcomes of periodontal healing at adjacent molar sites. Studies included had to present a minimum follow-up of 1 month and at least variations of probing pocket depth (PPD) at 2nd molar site between baseline and follow-up. The search strategy considered a total of 148 records: based on the predetermined eligibility criteria, 24 articles were read, and 9 were finally identified. Regarding the primary outcome considered (PPD at 2nd molar site), no significant differences in its reduction between baseline and follow-up were found comparing different flaps designs. However, the greatest clinical attachment loss (CAL) was generally reported using a trapezoidal flap. Considering the heterogeneity of studies included, after 1 to 6 months of follow-up, no substantial evidence can be assumed for or against the use of a particular flap design for the extraction of lower third molars.

INTRODUCTION

Surgical removal of semi/fully impacted lower third molars usually require a surgical flap, ostectomy, and division of the tooth and suture of the soft tissue. Manipulation of the hard and soft tissues surrounding the impacted third molars can cause post-operative pain and swelling, together with periodontal pockets involving the adjacent molar sites (1), which may require further investigations to be solved (2). If signs of the post-operative course are transient, periodontal pocket often causes a chronic inflammatory process, which can turn into an established disease, which can severely compromise the stability of the tooth. In this proposal, care should be given to prevent and minimize tissue damage associated with the extraction of third molars by performing techniques highly respectful toward the periodontal complex (3).

Among flap incisions proposed (1, 4), which vary in terms of pattern and design, the envelope (marginal) flap provides an intrasulcular vestibular incision starting from the first molar and continuing distally to the second molar and a second release incision in the distal vestibular direction; the triangular flap is characterized by an additional releasing incision from the distobuccal side of the second molar; the trapezoidal flap provides a mesial-releasing incision starting from the first molar and a distal one to allow easier flap dissection; in the para-marginal flap incisions are made approximately 4-5 mm from the free gingival margin. Moreover, modifications of the commonly used flaps mentioned above were proposed as a more conservative approach with limited flap reflection: flap with papilla detachment and papilla decapitation (3, 4) are both modifications of envelope design. At the same time, the 3-cornered laterally rotated flap, and Szmyd flap are both modified standard triangular flaps (5).

Different authors in the literature evaluated the influence of a specific surgical flap design as a possible significant factor interfering with post-surgical periodontal healing (6, 7). No consensus and conflicting results were found regarding the ideal flap design for lower third molars extraction in terms of absolute worse or better clinical outcomes: despite some flap designs (e.g., triangular and marginal) registered irrelevant variations of PPD or CAL, others (e.g., trapezoidal flap) demonstrated worse outcomes in terms of CAL and gingival recession(1, 3, 4). In light of these considerations, the aim of this descriptive review was to investigate

potential differences in terms of periodontal healing at the second molar site after surgical extraction of the lower third molars.

MATERIALS AND METHODS

This study followed the PRISMA 2020 statement guidelines (8). The review was conducted according to the population, intervention, control, and outcome (PICO) format (9). We analyzed articles involving patients who underwent extraction of lower third molars, together with an assessment of periodontal conditions and postoperative healing.

Focused question

The current review attempts to answer the following question: “In patients undergoing surgical extraction of lower third molars, is there sufficient and adequate evidence in the scientific literature that a specific flap design can affect periodontal healing of the adjacent mandibular second molar during at least 1 month of follow-up?”

Search strategy

An electronic search was implemented to retrieve all relevant studies using the following databases: PubMed, Scopus, and Web of Science. The electronic search was conducted applying the following filters: publication date “10 years” up to the time of the search, 15/04/2024.

The research on PubMed was conducted using the mesh term: “third molar” (Title)” OR “third molars (Title)” AND “flaps (Title)” OR “flap “Title”); on Web of Science, the search terms were: third molar (Title) AND Flap (Title); on Scopus, the search terms were: third molar (Article Title) AND flap (Article Title).

Study selection

Two independent examiners reviewed titles from previously described research to minimize reviewer biases. In case of disagreement, the two reviewers analyzed the title jointly to arrive at a final decision concerning inclusion or exclusion. Articles identified as helpful in answering the research question were selected to read the abstract.

The following inclusion criteria were applied to carry out the study selection:

- human studies
- articles published exclusively in English
- randomized controlled trials (RCT), prospective studies and retrospective studies
- studies comparing different flap designs (e.g., envelope, triangular, and trapezoidal flaps) for surgical extraction of lower third molars
- studies assessing the postoperative course and clinical outcomes of periodontal healing at adjacent molar sites (1): (i) PPD at the second molar site as primary outcome; CAL, BOP (bleeding on probing), PI (plaque index) and REC (recession) as secondary outcomes.

In vitro studies, animal studies, case reports, case series and systematic reviews, and studies with less than one month of follow-up were all excluded. In examining the abstract, attention was paid to assessing the study's compliance with the inclusion criteria. The selected studies were saved as a digital or paper version and submitted to a full-text analysis. In this way, only articles that conformed to all the criteria were included.

Data extraction

The reviewer extracted the details on the characteristics of the studies using an Excel paper, filling in a table with the following data: PMID, Title, Authors, Type of Flap, N participants, Mean PPD preoperative, Mean PPD 1 week, Mean PPD 2 weeks, Mean PPD 1 month, Mean PPD 2 months, Mean PPD 3 months, Mean PPD 6 months, Δ PPD preop-1m, Δ PPD preop-2m, Δ PPD preop-6m, Mean GR preoperative, Mean GR 1 month, Mean GR 3 months, Mean GR 6 months, Δ GR preop-1m, Δ GR preop-6m, Mean CAL preoperative, Mean CAL 1 month, Mean CAL 2 months, Mean CAL 3 months, Mean CAL 6 months, Δ CAL preop-1m, Δ CAL preop-2m, Δ CAL preop-6m, Mean PI preoperative, Mean PI 1 week, Mean PI 1 month, Mean PI 2 months, Mean PI 3 months, Mean PI 6 months, Δ PI preop-1m, Δ PI preop-2m, Δ PI preop-6m, Mean BOP preoperative, Mean BOP 1 week, Mean BOP 1 month, Mean BOP 6 months, Δ BOP preop-1m, Δ BOP preop-6m, Pain Day 1, Pain Day 2, Pain Day 3, Pain Day 4, Pain Day 5, Pain Day 6, Pain Day 7, Pain 1st month, Dehiscence Day 2, Dehiscence day 7, Dehiscence 2 months, Mouth opening Day 1, Mouth opening Day 3, Mouth opening Day 7, Mouth opening 1st month, Wound healing Day 1, Wound healing Day 3, Wound healing Day 7, Wound healing 1st month, Swelling preoperative, Swelling Day 0, Swelling Day 1, Swelling Day 2, Swelling Day 3, Swelling Day 7, Swelling Day 30, Conclusion.

RESULTS

The electronic search through the PubMed, Scopus, and Web of Science databases identified 75 publications till the search date (15/04/2024). After reading all the abstracts, 24 studies were positive for eligibility and were read entirely. The analysis full text allowed for the exclusion of 15 articles with wrong outcomes, so the electronic search identified 9 articles (3-5, 10-15). A flow chart summarizing the study selection procedure was constructed in accordance with PRISMA guidelines 2020 (Fig. 1).

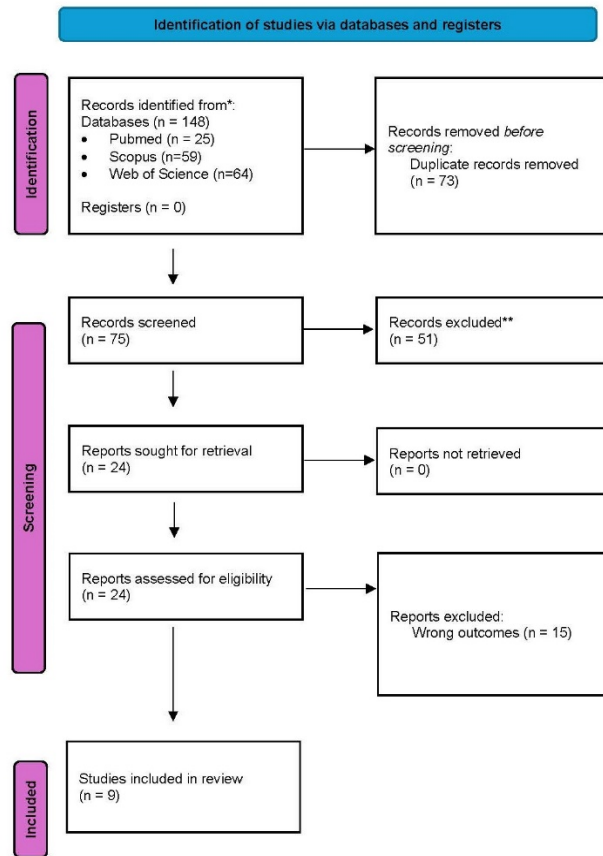


Fig. 1. PRISMA flow chart of the search strategy and selection of studies

Characteristics of the 9 included studies are summarized in Table I. The total number of participants reported was almost 30 (range 12-60), while the average number of sites registered was 66 (range 24-120). Furthermore, 7 studies were RCT, while 2 were retrospective. Post-operative conditions at 6 months were evaluated only by 3 studies, with the others shorter evaluations at 1, 2, or 3 months. The mean value for pre-operative PPD was 2,88 mm (range 2.35-3.31 mm), while the mean value after 6 months was reported equal to 3 mm. The other studies reported mean PPD values superior to 3 mm in the case of follow-ups less than 3 months (4.31 mm after 1 month; 3.18 mm after 2 months), equal to 3.16 mm in the case of follow-ups of at least 3 months.

Table I. Characteristics of the included studies: Pocket Probing Depth (PPD), CAL (clinical attachment level), BOP (bleeding on probing), plaque index (PI), recession (REC), keratinized tissue (KT).

Authors	Year	Study Design	Country	N Patients	N Sites	Surgery Groups (Test vs Control)	Follow-up	Periodontal outcomes	Postoperative course	Others evaluation
Korkmaz YT et al. (10)	2015	RCT (Split mouth)	Turkey	28	56	3-cornered Laterally Rotated Flap vs Envelope Flap	3 months	PPD, REC, PI, gingival index	Pain, swelling, infections	
Laurito D et al. (5)	2016	RCT (Parallel groups)	Italy	24	24	3-cornered Laterally Rotated Flap vs	2 months	PPD, PI, BOP, KT	/	

						Triangular Flap				
Alqahtani NA et al. (11)	2017	RCT (Split mouth)	Saudi Arabia	60	120	Modified Triangular Flap vs Envelope Flap	3 months	PPD	Pain, swelling, dehiscence	
Sridharan G et al. (12)	2020	RCT (Split mouth)	India	25	50	Triangular Flap with vertical anterior releasing incision vs Triangular Flap with oblique releasing incision	1 month	PPD	Pain, mouth opening, swelling	
Ahmad M et al. (13)	2021	RCT (Parallel groups)	Pakistan, Saudi Arabia	30	60	Modified Triangular (Smzyd) Flap vs Envelope Flap	6 months	PPD, CAL	/	Bone loss
Passarelli et al. (14)	2022	RCT (Parallel groups)	Italy	60	60	Triangular Flap vs Envelope Flap	6 months	PPD, REC, CAL	/	
Castagna et al. (2)	2022	Retrospective	Italy	80	80	Trapezoidal Flap, Envelope Flap, Marginal Flap with Papilla Detachment, Flap with Papilla Decapitation	2 months	PPD, CAL, PI,	/	
Zhao J et al. (15)	2023	RCT (Parallel groups)	China	100	100	Modified Triangular Flap vs Triangular Flap	2 months	PPD, PI, BOP	/	Bacterial characterization, inflammatory, and immunological indexes
Pardo et al. (4)	2023	Retrospective	Italy	40	40	Marginal Flap with Papilla Detachment vs Trapezoidal Flap	6 months	PPD, CAL, PI, BOP, REC	/	

DISCUSSION

The pattern of post-operative periodontal healing after extraction of lower third molars is widely reported (6, 7) to depend on the chosen surgical technique, as the design of the access flap directly affects the healing of both soft and hard tissues. Apart from the characteristics of the surgical site (e.g., periodontal conditions of the adjacent second molar, position of the third molar and inclination of its roots, relationship between the third molar and the inferior alveolar nerve, relationship between the third molar and the second molar), which are directly linked to the visibility during the surgical intervention, other factors related to patient's age and health status can influence post-operative wound healing (14, 16-19)

Considering post-operative periodontal conditions of the adjacent molar sites, no relevant differences in flap designs performed to extract impacted third molar are reported in the literature (20-23). The purpose of this descriptive review was to analyze this aspect, aiming to suggest possible strategies to minimize post-operative complications and discomfort for the patient.

Studies included in the final analysis were nine (3-5, 10-15): as homogeneous comparisons regarding follow-up, primary clinical outcome (PPD), and type of study were not possible, primary considerations regarding periodontal healing focused on follow-ups from 1 to 6 months, RCT prospective and retrospective studies, other clinical parameters (e.g., CAL, BOP, VPI). In this proposal, even if CAL, being less affected by gingival inflammation (1), represents a relevant clinical parameter, the most frequently one assessed by authors for the evaluation of soft tissue healing was PPD at the second molar site, chosen in the present review as the primary outcome. This site usually presents a greater risk for developing notable iatrogenic post-surgical periodontal pockets, which are easily measurable through direct probing (24).

The mean number of participants reported in the 9 included studies was almost 30 (range 12-60), while average number of sites registered was 66 (range 24-120). Furthermore, 7 studies were RCT (4, 9-14), while 2 were retrospective (3, 4). Post-operative conditions at 6 months were evaluated by 3 studies (3, 4, 13), with the others shorter evaluations at 1, 2 or 3 months (10-12, 14, 15). The mean value for pre-operative PPD was 2,88 mm (range 2,35-3,31 mm), while the mean value after 6 months was reported by Ahmad et al. (13) as 2,7 mm, by Passarelli et al. (14) as up to 3 mm, and by Pardo et al. (4) as 3,14 mm. The other studies (3, 10-12, 15) reported mean PPD values superior to 3 mm in case of follow-ups less than 3 months (4,31 mm after 1 month; 3,18 mm after 2 months); equal to 3,16 mm in case of follow-ups of at least 3 months. In this regard, the choice to set PPD (usually registered as an average value of vestibular and lingual sides) as a primary clinical outcome was influenced by the relatively short follow-ups of the included studies: an increasing pattern of PPD is compatible with an early post-surgery period (7), usually followed by its slight decrease or stabilization after 6 months, as demonstrated by other investigations with longer follow-ups, even with data at one-year after surgery (1, 22, 25).

Regarding the other clinical parameters collected, REC was evaluated only in 3 studies (4, 10, 14). Mean values of CAL at 6 months were reported by Passarelli et al. (14) as up to 3.6 mm and by Pardo et al. (4) as 2.55 mm, in accordance with a general trend found in the literature by other systemic reviews (1).

Concerning comparison between different surgical techniques, studies appear widely heterogeneous, including, in most cases, triangular flaps (also with modifications, according to the direction of releasing incision) (5, 11, 12, 14, 15) envelope flaps (3, 10, 11, 14), trapezoidal flaps (3, 4), marginal flaps (also with modifications, according to papilla detachment or decapitation) (3, 4).

As already reported by several authors (3, 4, 16, 26), the trapezoidal flap is reported to cause the greatest loss of periodontal attachment compared to other designs due to the mesial discharge incision, which leads to a greater laxity of the wound, particularly evident in terms of increasing PPD and REC not only at second but

also at first molar site (1, 3, 4), as a consequence of the reduced vascular supply at sutures points (27). On the other side, the repositioning of this flap can be easily obtained since the releasing incision at the level of the central-buccal part of the first molar preserves the papilla and facilitates the suture. Pointed out this issue, even using other flaps, more respective of papillae healing (e.g., marginal flaps, flaps with the detachment of the papilla), the second molar site appears to be anyway subjected to REC (4), as this element represents in both cases the site for the incision aimed to surgical access.

Regarding the use of triangular flap variants (12), it can be underlined that a closure of the surgical site with an anterior oblique release leads to buccal tissue displacement, which can interfere with the healing distal to second molar in terms of post-operative periodontal pocket formation: this can be effectively avoided by using a straight anterior release incision instead. Furthermore, the modified triangular flap design (13) showed better PPD, CAL, and bone loss outcomes for second molars compared to the envelope flap design regardless of the patient, tooth, and operative factor.

On the other hand, it was suggested (14) that a triangular or envelope flap design may not be preferred for surgical extraction of the lower third molars to improve periodontal outcomes of the adjacent second molar, as no statistically significant differences between the two techniques were found regarding PPD, CAL, and REC.

Considering the comparison between trapezoidal, marginal, and modified marginal flaps (3), no relevant differences between techniques were found in terms of PPD or CAL, even if some designs, e.g., flap with papilla decapitation, demonstrated a greater consideration for the interdental papilla (28) between first and second molar, leading to better post-operative healing.

Other investigations evidenced that using either type of flap during third molar extraction increased probing depth, changes in the relative abundance of subgingival microbiota, and the levels of inflammatory factors within 4 weeks (15). In this regard, indexes of gingival inflammation, especially BOP, seem to assume importance for longer follow-up evaluations (4, 22): BOP was demonstrated to increase more in the first molar site with a trapezoidal technique for the eventual excessive tissue manipulation due to the mesial-releasing incision (29).

Regarding post-operative evaluation of pain and swelling (11), the envelope flap design was better than the modified triangular flap. At the same time, this last one was more efficient in limiting the dehiscence following the wound healing.

Finally, analysis according to different pre-operative degrees of inclusion (30), almost all studies (3) declared that this variable does not represent a critical issue in periodontal healing after surgery apart from the technique used (19).

Cases subjected to radiotherapy or antiresorptive and antiangiogenic drugs would deserve a more in-depth discussion beyond this review, where complex extraction can transform into dramatic cases requiring extensive demolitions and complex reconstructions (31). The preparation of the mucosal flap must allow the best possible view to avoid complications such as tooth dislocation (32).

CONCLUSIONS

The review of different flap designs does not allow a univocal interpretation of clinical outcomes for heterogeneity of surgical techniques employed, follow-ups, and soft tissue variables collected related to periodontal healing. In light of these considerations, no strong evidence after 1 to 6 months of follow-up can be assumed for or against the use of a particular flap design for the extraction of lower third molars.

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