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Effect of flap design on periodontal healing after impacted third molar extraction: a systematic review and meta-analysis

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Abstract. The extraction of an impacted third molar violates the surrounding soft and bony tissues. The surgeon's access to the tooth, for which there are various surgical approaches, has an important impact on the periodontium of the adjacent second molar. The aim of this review was to analyze the relationships between the different flap techniques and postoperative periodontal outcomes for the mandibular second molars (LM2) adjacent to the impacted mandibular third molars (LM3). An electronic search of MEDLINE and other databases was conducted to identify randomized controlled trials fulfilling the eligibility criteria. To assess the impact of flap design on the periodontal condition, the weighted mean difference of the probing depth reduction (WDPDR) and the weighted mean difference of the clinical attachment level gain (WDCAG) at the distal surface of LM2 were used as the primary outcomes. The results showed that, overall, the different flap techniques had no significant impact on the probing depth reduction (WDPDR −0.14 mm, 95% confidence interval −0.44 to 0.17), or on the clinical attachment level gain (WDCAG 0.05 mm, 95% confidence interval −0.84 to 0.94). However, a subgroup analysis revealed that the Szmyd and paramarginal flap designs may be the most effective in reducing the probing depth in impacted LM3 extraction, and the envelope flap may be the least effective.

Key words: complications; evidence-based dentistry; impacted tooth; periodontal pocket; periodontal attachment loss; third molar(s).

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Dentists and oral surgeons have long held the consensus that symptomatic or pathological impacted third molars should be extracted. However, in the case of asymptomatic impacted third molars there is still some debate about the need for removal. The American Association of Oral and Maxillofacial Surgeons (AAOMS) suggests a timely, prophylactic extraction to prevent possible future pathological changes around the impactions or adjacent second

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molars.[1] This argument was recently supported by Nunn et al., who reported a significantly increased risk of a second molar pathology of 4.88-fold with soft tissue impaction of the adjacent third molar and 2.16-fold with bony impaction of the adjacent third molar.[2] Their cohort study examined data collected over 25 years from 416 adult men and also noted that the incidence of a second molar pathology was lowest in subjects lacking an adjacent impacted third molar.[2] Since the impacted third molars might ultimately be extracted, any associated adverse effects would become a disconcerting, troublesome issue for both dentists and patients.

Impacted teeth are not fully erupted into the oral cavity. Therefore, removal procedures can require a surgical flap, ostectomy, and division of the tooth, as well as suture of the soft tissue. The manipulation of the hard and soft tissues surrounding the impacted third molars can cause postoperative pain and swelling, and possibly periodontal disease associated with the adjacent second molars.[3,4] Postoperative pain and swelling are transient outcomes, but periodontal disease can have a chronic course that severely compromises the stability of the teeth.[5] Periodontal defect formation often causes plaque accumulation and further local inflammatory disease. Therefore, consideration should be given to minimizing tissue damage around the surgical area. This can be accomplished through the intervention technique (flap design, suture, or additional periodontal regenerative therapy) and the perioperative management chosen by the surgeon during the operation. Over the past few decades, investigations into periodontal outcomes in regards to third molar extraction, as well as perioperative hard and soft tissue management techniques, have been reported extensively in the published literature in efforts to improve periodontal outcomes.[6–9]

The amount of bone loss and destruction of the periodontium perioperatively are primarily related to the surgeon's attempt to access, elevate, and luxate the tooth successfully. Since a mucoperiosteal flap is designed for adequate visual accessibility and manipulation of the surgical area by release of the soft tissue, it is intuitively thought to be related to soft tissue sequelae. Many studies have examined the effects of various mucoperiosteal flap designs, including the Szmyd flap, envelope flap, triangular (or three-cornered) flap, and modified versions of these flaps.[4,9–19]

For impacted mandibular third molars (LM3), envelope and triangular flaps are possibly two of the most commonly used flaps by oral surgeons. While both envelope and Szmyd flaps consist of a single horizontal incision and flap elevation by undermining the periosteum, triangular flaps utilize an additional vertical buccal releasing incision. The main advantages of the envelope and Szmyd flaps are the minimal disruption of the vascular supply to the elevated tissue and the ease of wound closure. On the other hand, the triangular flap allows extended reflection of the flap for better visibility and accessibility during ostectomy. Also, the relaxing vertical incision decreases flap tension, and thus the triangular flap is also believed to promote rapid wound healing.[20–22] Nevertheless, each study has proposed and investigated a flap design that the authors believe to provide better outcomes than other flap designs. With studies proposing various flap designs while detailing the failures of other designs, there has been no clear conclusion on the ideal flap design for LM3 extraction.

Although a descriptive review of this subject has been published, a comprehensive, systematic review and meta-analysis looking at the effects of the different flap designs on postoperative periodontal conditions is lacking.[23] The aim of this systematic review was to analyze the effects of various flap designs used for impacted LM3 extraction on the periodontal outcomes of the adjacent mandibular second molars (LM2). The comparison focused primarily on single horizontal flaps (envelope and Szmyd flaps) and flaps with a vertical releasing incision (triangular flaps).

Materials and methods

This systematic review and subsequent meta-analysis were conducted in accordance with the principles of the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses).[24]

PICO (population, intervention, comparator, outcomes) question

''Do different surgical flap techniques for impacted mandibular third molar extraction affect periodontal healing of the adjacent mandibular second molar during at least 3 months of follow-up?''

Study selection criteria

Only prospective randomized controlled trials (RCTs) that had recruited patients with a clinical diagnosis of impacted LM3, who underwent surgical extraction, were included. The studies had to primarily compare the clinical outcomes of impacted LM3 extractions using different surgical flap techniques (for example, envelope flaps, Szmyd flaps, and triangular flaps). Furthermore, the study had to report the clinical outcomes associated with periodontal healing, including changes in periodontal probing depth (PD) and clinical attachment level (CAL) at the distal surface of the adjacent second molars from baseline to the last measurement. Only original research studies that provided sufficient detail regarding the methods and results to enable the use and adjustment of the data and results were considered. A minimum mean follow-up time of 3 months (12 weeks) from baseline (tooth extraction) to the last clinical assessment was required. The studies were published in English.

Literature search

Electronic searches were conducted through the MEDLINE (PubMed), Embase, Cochrane CENTRAL, and Scopus databases to screen all relevant articles published from inception to April 2016. Appendix 1 lists the search strategies used in these databases.

A further search was performed in the following journals: *Journal of Oral and Maxillofacial Surgery*, *International Journal of Oral and Maxillofacial Surgery*, *British Journal of Oral and Maxillofacial Surgery*, *Journal of Cranio-Maxillofacial Surgery*, *International Journal of Oral Surgery*, and *Journal of Oral Surgery*. Moreover, the reference lists of selected articles were screened to identify additional articles that might fit the selection criteria.

Quality assessment of the included studies

The methodological quality assessment was undertaken using the Cochrane Collaboration risk-of-bias assessment tool for RCTs.[25] This tool addresses the following six domains: randomization, allocation concealment, blinding of patients and assessors, completeness of outcome data, and risk of selective outcome reporting. For each study, an assessment of low or high risk of bias was given. However, if insufficient information was given in the article for such a judgement to be made, the domain was assessed as having an 'unclear' risk of bias. The summarized overall risk of bias for each domain across all studies included was tabulated. Two

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