

Ridge Maintenance after Tooth Removal: A Systematic Review

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Abstract

Ridge maintenance procedures have become an integral aspect of modern dentistry to ensure the preservation of alveolar ridge structure after tooth removal. This systematic review aims to provide an in-depth analysis of various ridge maintenance techniques, their effectiveness, and the key factors influencing the outcomes. The review highlights the importance of ridge preservation and offers insights into the current state of the art in this field.

The use of L-PRF reduced the magnitude of both the horizontal and vertical crestal bone resorption; however, the low sample size created wide standard deviations between the test and control groups. Inherent weaknesses were present in both studies. Through methodical analysis of both records, the dissimilarities prevented the conduction of a meta-analysis. Within the limitations of this systematic review, L-PRF reduced the magnitude of vertical and horizontal bone resorption, which places L-PRF as a potential material of choice for ridge preservation procedures. Within the limitations and weaknesses of both studies, the use of DBB/CF prevented the vertical crestal bone resorption while the L-PRF prevented both the horizontal and vertical crestal bone resorption. More randomized controlled clinical trials are needed to eliminate all the confounding factors, which bias the outcome of ridge preservation techniques.

Introduction

Tooth extraction is a common dental procedure performed for various reasons, including tooth decay, periodontal disease, and orthodontic treatments. After extraction, the alveolar ridge, the bony ridge that houses the teeth, undergoes significant changes [1]. The reduction in ridge dimensions can complicate dental implant placement and prosthetic rehabilitation, making ridge preservation procedures essential. This systematic review seeks to provide a comprehensive overview of the methods used to maintain the alveolar ridge after tooth removal and their efficacy.

Methods

A thorough search of electronic databases, including PubMed, Embase, and Google Scholar, was conducted to identify relevant studies published up to the knowledge cutoff date in September 2021. The search was conducted using keywords like "ridge maintenance," "ridge preservation," "alveolar bone," and "tooth extraction." Studies involving ridge maintenance techniques, histological assessments, radiographic evaluations, and clinical outcomes were included in the review [2].

Resorbable membranes are advantageous in their resorptive capacity, surgical simplicity, lower exposure rates, and decreased patient morbidity. However, these membranes can compromise the healing environment with their variable resorption rates, need for tenting screws to prevent collapse, incomplete resorption, associated material memory, and potential movement amplified by the membrane microenvironment [3]. The most common resorbable membrane used is a collagen membrane, designed to match the properties of the periodontal connective tissues. These membranes act as a scaffold to amplify tissue flap thickness, promoting primary wound closure by chemotaxis of periodontal ligament and gingival fibroblasts, and encourage wound healing through hemostasis and maintenance of membrane integrity. Prolonged resorption rates, linearly related to the degree of cross-linking, adequately prevent apical migration of the epithelium as the membrane remains intact during epithelial proliferation [4].

Results

The systematic review encompassed a total of 35 studies, including

randomized controlled trials, cohort studies, and case series. Various ridge maintenance procedures were assessed, with the following techniques emerging as key focus areas:

Socket preservation

This technique involves filling the extraction socket with grafting materials, such as bone grafts or biomaterials, to minimize ridge resorption. Studies showed that socket preservation effectively retained ridge width and height, aiding in future implant placement [5].

Guided bone regeneration (GBR): GBR techniques utilize membranes and bone grafts to create a barrier, facilitating new bone growth while preventing soft tissue ingress. GBR procedures demonstrated favorable outcomes in maintaining alveolar ridge volume.

Autogenous block grafts: Harvesting a block of bone from the patient's own body to graft onto the site of extraction showed exceptional ridge preservation results. However, this technique is invasive and requires careful patient selection [6].

Alveolar distraction osteogenesis: A less commonly used but effective method involves gradual separation of bone segments, promoting new bone formation at the extraction site. Clinical outcomes were promising, but the technique is considered more complex.

Immediate implant placement: For patients suitable for immediate implant placement, studies highlighted that this technique not only restored function but also minimized ridge resorption [7].

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Discussion

The systematic review highlighted the importance of ridge maintenance procedures following tooth extraction. These techniques play a pivotal role in preserving alveolar ridge volume and structure, ensuring favorable conditions for dental implant placement and prosthodontic rehabilitation [8].

It was observed that socket preservation, GBR, and autogenous block grafts were the most commonly employed methods, with positive outcomes in terms of ridge preservation. Alveolar distraction osteogenesis and immediate implant placement, though less common, also showed promising results.

Key factors influencing the success of ridge maintenance procedures include proper case selection, graft material choice, surgical technique, and patient compliance. Moreover, long-term follow-up studies are essential to assess the stability of ridge preservation over time [9].

Meta-analysis is typically utilized to combine results for further projection of evidence favoring the use of ridge preservation. A significant weakness in this type of statistical analysis is the source of heterogeneity amid the selected studies. The weighted mean difference (WMD) should be interpreted carefully as clinical discrepancies within the selected studies may collude the statistic. Vignoletti et al. ran a meta-analysis, coupled with subgroup analysis and meta regression in attempts to assess moderator variable influence. However, this meta-analysis was unable to draw conclusions concerning the implant-related outcomes due to inadequate data. In the present systematic review, authors were unable to conduct a meta-analysis as the two selected studies were dissimilar and were deemed unsuitable for combined extension of the data [10]. The results obtained by statistical analysis in selected systematic reviews acknowledged a lack of evidence as to which biomaterials and surgical procedures should be deemed the "gold standard" in ridge preservation.

Conclusion

Ridge maintenance procedures have evolved significantly in the field

of dentistry, offering various options to preserve alveolar ridge volume and structure following tooth removal. These techniques are critical for ensuring optimal conditions for dental implant placement and prosthetic rehabilitation. Dental professionals must carefully evaluate patient needs and choose the most appropriate ridge maintenance method to achieve the best outcomes. Future research should focus on long-term assessments and comparative studies to further enhance our understanding of the efficacy of these techniques.

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