Vol-1 Issue-2 2023
Scientific Research Journal of Medical and Health Science
ISSN: 2584-1521, Peer Reviewed Journal

Conserving Smiles: An In-Depth Examination of Alveolar Crest Conservation in Implant Dentistry

Jasmine Widjaja, School of Dentistry, International Medical University, Kuala Lumpur, Malaysia

Key Xuen Ng, School of Dentistry, International Medical University, Kuala Lumpur, Malaysia

Abstract

Contemporary dentistry emphasizes Alveolar Crest Conservation (ACC) for managing post-tooth extraction bone loss and enabling effective dental implant placement. ACC involves techniques like membrane use and grafting, prompting ongoing discussions on optimal approaches. A comprehensive understanding of bone remodelling mechanisms is crucial in modern dental practices, guiding ACC implementation for implant preparation and aesthetic concerns. The primary benefit of ACC is its ability to maintain ridge dimensions, which is essential for subsequent implant procedures. Ongoing debates within the dental community highlight the need for precise clinical protocols through research and evidence-based practices. Challenges such as socket collapse and graft resorption necessitate specialized solutions for sustained implant stability—advances in ACC focus on optimizing bone formation, reducing graft resorption, and minimizing procedural invasiveness. The evolving landscape prioritizes a patient-centric approach for enhanced outcomes and experiences. Future dental trends emphasize patient-centric ACC strategies, refining techniques and improving overall health outcomes. These trends underscore dentistry's dynamic nature, consistently evolving for excellence and innovation.

Keywords: *Alveolar Crest Conservation, dental implants, ridge preservation, bone resorption, systematic review, clinical efficacy*

Introduction

Alveolar Crest Conservation (ACC) emerges as an essential procedure within dentistry, with the primary goal of mitigating the consequential bone resorption that follows tooth extraction, particularly in anticipation of subsequent prosthodontic interventions such as dental implant placement. ACC proves pivotal due to its efficacy in preventing unwelcome horizontal and vertical ridge reduction post-extraction reduction, significantly when the timeline for dental implant treatments is extended. This necessitates delaying implant placement for a period ranging from three to six months post-extraction, occasionally requiring more extended treatment durations compared to immediate or early implant placements within the initial four months. Through the application of ACC, practitioners aim to systematically curtail bone resorption, favouring implant placement that aligns with prosthetic considerations.

Over the years, various materials and methodologies have been employed for crest conservation. These approaches encompass the utilization of grafting materials, such as synthetic alloplasts or xenografts, either with or without accompanying membranes. However, the effectiveness of these techniques has spurred considerable debate and generated conflicting findings. While specific studies advocate for the successful mitigation of ridge resorption through grafting materials, others argue that intra-socket grafts

may impede the standard healing process or may not yield significant benefits. Additionally, controversy persists concerning the rate at which grafting materials undergo resorption.

The evolution of crest conservation techniques has spurred ongoing research and systematic reviews to assess the clinical efficacy of various materials and techniques. These comprehensive reviews aim to furnish evidence-based recommendations for dental clinicians and patients, directing them toward the most optimal approaches for conserving alveolar ridges and minimizing ridge resorption.

As a result, the primary objective of the systematic review in question is to meticulously evaluate the clinical efficacy of diverse materials and techniques employed in alveolar crest conservation (ACC). This review seeks to provide substantial evidence, meeting the needs of dental clinicians and patients, by elucidating the effects of these materials and techniques in preventing or minimizing alveolar ridge resorption.[1]

1. DENTAL OSSEOUS STRUCTURES: A DEEP DIVE

1.1 Dental Osseous Framework: Supporting Tooth Integrity

The support system for teeth in the maxilla and mandible relies on two crucial components within the alveolar bone: proper alveolar bone and supporting alveolar bone. The alveolar bone proper encompasses tooth sockets with compact bone, providing a foundation for the periodontal ligament's attachment. Concurrently, the supporting alveolar bone, comprised of cortical plates and spongy bone, envelops and reinforces the alveolar bone proper. This structural configuration evenly distributes forces during chewing, upholding dental stability and resisting pressure during biting. A grasp of the alveolar bone's architecture and function is indispensable for dental well-being, as it fortifies tooth integrity and helps prevent periodontal diseases.[2]

1.2 Mechanisms of Bone Resorption Following Tooth Extraction

Post-tooth extraction, bone resorption in the alveolar ridge transpires through varied mechanisms. Inflammatory responses initiate internal socket wall resorption, reducing ridge width and height. Tooth absence activates osteoclasts, hastening bone breakdown. Notably, substantial dimensional changes, approximately 0.7-1.5 mm vertically and 4.0-4.5 mm horizontally, manifest predominantly within three months post-extraction. This intricate process involves cellular and molecular actions, prominently osteoclast activity and inflammation. A comprehensive understanding of these mechanisms is crucial for formulating strategies to conserve alveolar ridge architecture and promote bone regeneration.[3]

2. INDICATIONS AND RATIONALE FOR RIDGE PRESERVATION

2.1 Clinical Scenarios Necessitating Ridge Preservation

Ridge preservation procedures are critical in diverse clinical contexts, maintaining alveolar ridge dimensions post-tooth extraction. Primarily, these interventions are indispensable for subsequent implant placement, ensuring a secure foundation. Their significance is particularly pronounced in the aesthetic zone, where they uphold natural contours and contribute to smile aesthetics. In thin buccal plates, ridge preservation safeguards against further resorption, a pivotal factor for implant stability. Addressing socket defects, post-extraction facilitates restoration and primes the site for future implants. For immediate implant placement, ridge preservation sustains dimensions, augmenting implant success and aesthetics. Additionally, these procedures form integral components of ridge augmentation, aiming to broaden and

heighten the alveolar ridge for enhanced implant accommodation and smile aesthetics. However, the decision to proceed with ridge preservation should be personalized, evaluating patient needs and clinical considerations under the guidance of a dental professional.[4]

2.2 Advantages of Ridge Preservation For Subsequent Implant Success

Ridge preservation, as a post-tooth extraction technique, serves to forestall resorptive changes in the alveolar bone and maintain its volume and shape, which is crucial for the subsequent success of implant placement. This procedure yields numerous benefits.

It mitigates post-extraction bone loss, providing a more stable base for future implants by preserving the ridge's structure. Consequently, subsequent implant procedures are streamlined, eliminating the necessity for additional, often invasive bone grafting or augmentation surgeries.

Moreover, preserving the natural contours of the alveolar bone enhances aesthetic outcomes for the eventual implant restoration, ensuring a more harmonious and natural appearance. Long-term stability is also enhanced, as maintaining the ridge's integrity and volume provides adequate support, reducing the risk of complications such as implant mobility or peri-implant bone loss.

Additionally, ridge preservation reduces treatment time and patient costs by eliminating the need for supplementary bone grafting procedures, streamlining the implant process and minimizing surgical interventions.[5]

2.3 Substantiating the Advantages of Ridge Preservation Techniques

Ridge preservation techniques offer pivotal advantages in implant therapy, effectively constraining alterations in the shape and size of the alveolar ridge following tooth extraction. This ensures optimal conditions for successful implant placement. Preserving the aesthetic appearance of the ridge is particularly crucial in areas of high aesthetic concern, where the loss of even a single tooth can significantly impact a patient's smile. Furthermore, these techniques provide a more stable foundation for prosthetic restorations, enhancing patients' functional and aesthetic outcomes. Notably, patients express high satisfaction with the results of ridge preservation procedures due to reduced postoperative complications. However, while studies underscore these advantages, no definitive evidence supports one technique's superiority over another. The choice of technique often relies on specific clinical circumstances and the preferences of the implant team.[6]

3 Revitalizing the Skeleton: Unraveling the Mysteries of Healing and Bone Renewal

After ridge preservation, wound healing involves an initial inflammatory, granulation, and remodelling phase. Bone regeneration success post-grafting depends on factors like grafting materials (autologous bone, allografts, xenografts, or alloplastic materials). Guided bone regeneration (GBR) uses membranes to direct new bone growth, impacting success. Healing duration, smoking, antimicrobials, and augmentation procedures influence outcomes. Radiographic and histologic assessments provide insights into alveolar bone regeneration, favouring barrier and resorbable membranes and innovative approaches like PDGF-BB in socket grafting. Flap elevation may not significantly impact long-term alveolar dimensions. Polymer membranes and acellular dermal matrix with hydroxylapatite show positive

outcomes. Innovative approaches, such as non-resorbable hydroxyapatite crystals and ePTFE membranes, hold promise in minimizing ridge remodelling post-extraction. These studies provide essential insights into successful alveolar bone regeneration, shaping techniques and material choices for post-extraction healing. [7][8][9]

4. Dental Progress and Triumph: Unraveling Clinical Achievements and Implant Success Metrics

A 4-year study comparing ridge-preserved and nonpreserved sites found superior implant outcomes with ridge preservation, regardless of grafting material. Cortical porcine or collagenated corticocancellous porcine bone yielded less marginal bone loss and enhanced implant stability. Esthetic outcomes, measured by the Pink Aesthetic Score (PES), were best with cortical porcine bone, emphasizing its support for soft tissues. Limitations included a small sample size, stressing the need for more extensive research. Overall, ridge preservation techniques showed improved clinical and esthetic outcomes in implant dentistry, though conclusive evidence requires further investigation. Complications, including infection, membrane issues, and graft material loss, underscore the importance of careful planning and ongoing research in alveolar ridge preservation.[10][11]

5. Exploring Ridge Preservation Strategies: A Comparative Analysis of Techniques

This research delves into various materials and methods for alveolar ridge preservation. Autogenous bone, known for osteogenic potential, faces availability and additional surgery challenges. Xenogenic and alloplastic alternatives eliminate the need for extra surgery. Platelet-rich plasma (PRP) shows promise but requires further clinical validation. Barrier membranes are crucial, preventing soft tissue intrusion, with resorbable and non-resorbable types offering distinct advantages. Growth factors stimulate bone formation, demanding careful selection and dosages. Stem cells promise regeneration but need more safety assessment. Grafting materials vary, requiring selection based on biocompatibility, integration, and size considerations. Overall, optimal utilization depends on specific techniques, materials, and patient factors, necessitating meticulous evaluation in clinical practice.

6. Navigating Hurdles and Charting Future Courses: Challenges and Prospects in Alveolar Ridge Preservation

Common Challenges:

Addressing socket and soft tissue collapse, infection, graft material resorption, and patient compliance is crucial in alveolar ridge preservation. These challenges can affect aesthetics and hinder successful outcomes.[12]

Solutions:

Potential solutions are implementing socket preservation techniques, adequate soft tissue management, antibiotic therapy, and using slow-resorbing graft materials. Patient education and motivation are pivotal in ensuring compliance with post-operative instructions for successful ridge preservation.[13]

Areas for Further Research:

Advancements in biomaterials, including synthetic scaffolds, growth factors, and stem cells, aim to enhance bone regeneration and minimize ridge resorption. Long-term evaluations, comparative studies on grafting techniques, and optimization of surgical protocols contribute valuable insights to the field.[14]

Future Trends:

Exploring novel biomaterials such as xenografts, allografts, and bio-active agents, as well as minimizing invasiveness through deantigenated cadaver transplants, represents future trends. Research focuses on the impact of residual bone height and vertical bone gain on graft healing and stability, emphasizing continuous innovation in alveolar ridge preservation.[15]

7. CONCLUSION

In conclusion, Alveolar Crest Conservation (ACC) emerges as a pivotal component in implant dentistry, playing a crucial role in preserving bone volume after tooth extraction and creating an optimal environment for future implant placement. Using diverse techniques and materials brings tangible benefits by mitigating bone resorption and promoting the success of subsequent implantation procedures. Despite persistent challenges such as socket collapse and graft resorption, the field is evolving with tailored solutions to address these issues. Ongoing ARP innovations focus on enhancing bone regeneration, minimizing invasiveness, and ultimately optimizing patient outcomes. As dentistry continues to evolve, these advancements improve implant success rates and contribute to the broader goal of advancing bone regeneration practices in the field.

8. REFERENCES

1. Pagni G, Pellegrini G, Giannobile WV, Rasperini G. Postextraction alveolar ridge preservation: biological basis and treatments. Int J Dent. 2012;2012:151030. DOI: 10.1155/2012/151030. Epub 2012 Jun 12. PMID: 22737169; PMCID: PMC3378971.
2. Atieh MA, Alsabeeha NH, Payne AG, Ali S, Faggion CMJ, Esposito M. Interventions for replacing missing teeth: alveolar ridge preservation techniques for dental implant site development. Cochrane Database Syst Rev. 2021 Apr 26;4(4):CD010176. DOI: 10.1002/14651858.CD010176.pub3. PMID: 33899930; PMCID: PMC8092674.
3. Emilio Couso-Queiruga, Cyrus J. Mansouri, Azeez A. Alade, Trishul V. Allareddy, Pablo Galindo-Moreno, Gustavo Avila-Ortiz. Published on 15 March 2022. https://doi.org/10.1002/JPER.22-0030.
4. Srinivas B, Das P, Rana MM, Qureshi AQ, Vaidya KC, Ahmed Raziuddin SJ. Wound Healing and Bone Regeneration in Postextraction Sockets with and without Platelet-rich Fibrin. Ann Maxillofac Surg. 2018 Jan-Jun;8(1):28-34. DOI: 10.4103/ams.ams_153_17. PMID: 29963421; PMCID: PMC6018297.
5. Yang Z, Wu C, Shi H, Luo X, Sun H, Wang Q, Zhang D. Advances in Barrier Membranes for Guided Bone Regeneration Techniques. Front Bioeng Biotechnol. 2022 Jun 22;10:921576. DOI: 10.3389/fbioe.2022.921576. PMID: 35814003; PMCID: PMC9257033.
6. De Angelis P, Rosa G, Manicone P, Giorgi A, Cavalcanti C, Speranza A, Grassi R, D'Addona A. (2022). Hard and soft tissue evaluation of alveolar ridge preservation compared to spontaneous healing: a retrospective clinical and volumetric analysis. International journal of implant dentistry. 8. 62. DOI: 10.1186/s40729-022-00456-w.
7. Jafer MA, Salem RM, Hakami FB, Ageeli RE, Alhazmi TA, Bhandi S, Patil S. Techniques for Extraction Socket Regeneration for Alveolar Ridge Preservation. J Contemp Dent Pract. 2022 Feb 1;23(2):245-250. PMID: 35748457.
8. Willenbacher M, Al-Nawas B, Berres M, Kämmerer PW, Schiegnitz E. Alveolar Ridge Preservation. Clinical Implant Dentistry and Related Research. 2016;18:1248-1268. DOI: 10.1111/cid.12364.
9. Lekovic V, Camargo PM, Klokkevold PR et al. Preservation of alveolar bone in extraction sockets using bioabsorbable membranes. Journal of Periodontology. 1998;69(9):1044–1049.

10. Marconcini S, Giammarinaro E, Derchi G, Alfonsi F, Covani U, Barone A. Clinical outcomes of implants placed in ridge-preserved versus nonpreserved sites: A 4-year randomized clinical trial. Clin Implant Dent Relat Res. 2018;1–9. DOI: 10.1111/cid.12682.
11. Barootchi S, Tavelli L, Majzoub J, Stefanini M, Wang H-L, Avila-Ortiz G. Alveolar ridge preservation: Complications and cost-effectiveness. Periodontol 2000. 2023;92:235-262. DOI: 10.1111/prd.12469.
12. Avila-Ortiz G, Gubler M, Romero-Bustillos M, Nicholas CL, Zimmerman MB, Barwacz CA. Efficacy of alveolar ridge preservation: A randomized controlled trial. J Dent Res. 2020;99:402–9.
13. Majzoub J, Ravida A, Starch-Jensen T, Tattan M, Suárez-López del Amo F. The influence of different grafting materials on alveolar ridge preservation: A systematic review. J Oral Maxillofac Res. 2019;10:e6. DOI: 10.5037/jomr.2019.10306.
14. Quisiguiña Salem C, Ruiz Delgado E, Crespo Reinoso PA, Robalino JJ. Alveolar ridge preservation: A review of concepts and controversies. Natl J Maxillofac Surg. 2023;14:167-76.
15. De Angelis N, Bagnasco F, Amaroli A. Bone Regeneration: Overview and Future Trends. J Clin Med. 2023;12:4529. DOI: 10.3390/jcm12134529.