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Prosthodontic Rehabilitation of Patients with Severe Alveolar Ridge Resorption

Abdullayeva Malikabonu Umedjonovna
Samarkand State Medical University, Department of Orthopedic Dentistry, 1st year clinical supervisor

Islamova Nilufar Bustanovna
Associate Professor of Orthopedic Dentistry Department of Samarkand State Medical University

Abstract: Severe alveolar ridge resorption represents a major challenge in prosthodontic rehabilitation because it compromises denture stability, retention, function, esthetics, and patient comfort. Progressive bone loss following tooth extraction alters jaw morphology, reduces denture-bearing area, and complicates prosthetic planning and execution. The aim of this article is to provide a comprehensive review of clinical strategies, materials, and rehabilitation approaches for patients with severe alveolar ridge resorption. Various prosthetic modalities, including conventional complete dentures, implant-supported overdentures, fixed implant-supported prostheses, and adjunctive surgical and non-surgical techniques, are evaluated with emphasis on anatomical adaptation, functional outcomes, and long-term maintenance. Additionally, the article addresses material selection, handling, and storage to optimize prosthesis performance and biological compatibility. Clinical evidence indicates that individualized treatment planning, precise impression techniques, proper material utilization, and strategic prosthetic design significantly improve functional and esthetic outcomes, minimize soft tissue trauma, and enhance patient satisfaction. Early identification of residual ridge morphology and tailored rehabilitation strategies are critical to achieving long-term prosthetic success.

Keywords: Alveolar ridge resorption, Prosthodontic rehabilitation, Complete dentures, Overdentures, Implant-supported prostheses, Residual ridge morphology, Denture stability, Material selection, Functional efficiency, Patient satisfaction.

Introduction: Alveolar ridge resorption is a progressive, irreversible physiological and pathological process that occurs after tooth loss and is influenced by patient age, systemic health, duration of edentulism, occlusal loading, and local anatomical factors. In severe cases, both vertical and horizontal resorption result in unfavorable ridge morphology characterized by diminished height, reduced width, and shallow vestibular depth. These anatomical changes compromise the foundation for conventional denture support, reduce prosthesis stability and retention, alter occlusal relationships, and increase susceptibility to mucosal trauma. Clinically, severely resorbed ridges often present with thin mucosal coverage, high muscle attachments, and increased ridge mobility, complicating impression making, denture fabrication, and functional adaptation. Conventional prosthetic rehabilitation may fail to provide adequate retention and patient comfort in these cases, necessitating the use of advanced prosthetic approaches, including implant-supported overdentures and fixed implant prostheses. Multidisciplinary evaluation, careful assessment of residual ridge morphology, and selection of appropriate materials are crucial for developing a treatment plan that restores function, esthetics, and long-term oral health. Understanding the biological and mechanical consequences of ridge resorption enables clinicians to anticipate challenges, optimize prosthesis design, and reduce complications.

Materials and Methods: The study is based on a comprehensive narrative review of contemporary prosthodontic literature, including clinical trials, systematic reviews, and standard prosthodontic textbooks. Data were extracted regarding prosthetic strategies, material selection, impression techniques, prosthesis design, retention methods, and clinical outcomes in patients with severe alveolar ridge resorption. Conventional complete dentures, overdentures, and implant-supported prostheses were compared in terms of stability, retention, patient comfort, masticatory efficiency, tissue health,

and long-term durability. Clinical parameters, including residual ridge height, mucosal thickness, occlusal force distribution, and soft tissue response, were analyzed to guide rehabilitation strategies. Material performance, biocompatibility, and storage requirements were also evaluated to ensure optimal prosthetic outcomes.

Materials: 1. Heat-cured acrylic resin is the primary material for complete denture bases due to its rigidity, adaptability, ease of repair, and cost-effectiveness. Proper storage in cool, dry conditions prevents monomer evaporation and dimensional changes. 2. Flexible denture base resins provide enhanced patient comfort, especially for undercut or irregular ridges, although long-term stability is limited; these materials should be kept away from heat and direct sunlight. 3. Soft lining materials, including silicone-based and resilient acrylic liners, cushion mucosa over thin ridges, reduce trauma, and distribute occlusal loads; storage in airtight containers prevents dehydration and loss of elasticity. 4. Titanium implants are the gold standard for implant-supported rehabilitation due to high biocompatibility, osseointegration, and corrosion resistance; components should be stored in sterile, moisture-free conditions. 5. Locator attachment systems provide overdenture retention and stability, ensuring effective load distribution; components must be stored in sealed containers to prevent contamination and wear. 6. Bar attachment systems connect multiple implants to support overdentures and improve force distribution; precise fabrication and careful storage are required to prevent mechanical damage. 7. Polyvinyl siloxane impression materials capture fine anatomical details of severely resorbed ridges; they must be stored at controlled temperatures to maintain dimensional accuracy. 8. Zinc oxide-eugenol impression paste provides mucostatic impressions for atrophic ridges and requires storage in tightly sealed tubes to prevent premature setting and contamination. 9. Acrylic denture teeth resist wear and distribute occlusal forces; proper storage away from heat and light maintains color stability and mechanical integrity. 10. Denture adhesives temporarily improve retention in severely resorbed ridges and should be stored according to manufacturer recommendations to maintain efficacy. Each material was evaluated for clinical performance, biological compatibility, and long-term effectiveness.

Results: Conventional complete dentures on severely resorbed ridges often demonstrate reduced retention, limited stability, and compromised function. Modified impression techniques, including functional, selective pressure, and neutral zone approaches, improved adaptation and retention. Implant-supported overdentures significantly enhanced prosthesis stability, masticatory efficiency, and patient satisfaction. Fixed implant-supported prostheses provided the highest stability and esthetic outcomes but required adequate bone volume or augmentation procedures. Soft liners improved comfort in patients with thin mucosa but required periodic replacement. Attachment system selection influenced load distribution, peri-implant tissue health, and overall prosthetic longevity. Material handling and proper storage were critical in maintaining prosthesis accuracy and long-term performance. Multimodal rehabilitation strategies, including implants, overdentures, and precision attachments, yielded the best functional and biological outcomes in cases of severe ridge resorption.

Discussion: Prosthodontic management of severely resorbed alveolar ridges necessitates individualized, biologically guided treatment planning. Conventional dentures remain an option for patients with financial or medical limitations, but stability and retention often remain suboptimal. Implant-supported prostheses, including overdentures, provide predictable improvements in function, comfort, and esthetics and may reduce residual ridge resorption progression by transmitting occlusal forces more physiologically. The choice of materials, such as heat-cured acrylic bases, resilient liners, and appropriate denture teeth, significantly influences load distribution, soft tissue response, and prosthesis longevity. Careful storage and handling of all prosthetic components ensure dimensional stability and biological safety. Surgical augmentation, soft tissue conditioning, and precision attachment systems further improve outcomes. A multidisciplinary approach and patient-specific planning are essential for restoring function, esthetics, and oral health in these challenging cases.

Conclusion: Prosthodontic rehabilitation of patients with severe alveolar ridge resorption requires a comprehensive, individualized approach that integrates anatomical assessment, prosthesis design, and material selection. Conventional dentures, implant-supported overdentures, and fixed implant

prostheses offer varying levels of functional and esthetic improvement depending on patient-specific factors. Proper handling and storage of materials are essential for maintaining prosthetic accuracy, biological compatibility, and long-term durability. Early identification of residual ridge morphology, meticulous impression making, and precise prosthesis fabrication are critical for achieving optimal outcomes. Integrating biomechanical principles, advanced materials, and patient-centered strategies allows restoration of function, esthetics, and quality of life while minimizing complications and enhancing prosthesis longevity.

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