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Review Article

Role of alveolar ridge resorption and occlusal changes in denture instability over time

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ABSTRACT

Complete dentures remain an established treatment for edentulous patients, yet their stability may progressively deteriorate as the oral supporting structures change over time. Residual alveolar ridge resorption is a continuous biological process following tooth loss, characterized by reductions in ridge height, width, and morphology. These changes modify the denture-bearing foundation and gradually reduce the adaptation of the denture base to the underlying tissues. The mandibular ridge is particularly vulnerable to extensive resorption, making lower denture instability a frequent long-term clinical problem. Loss of intimate tissue contact reduces support and resistance to horizontal and rotational displacement, particularly during mastication. Changes in the residual ridge can also modify maxillomandibular relationships and disturb previously established occlusal contacts. Denture settling, artificial tooth wear, tissue displacement, and progressive ridge remodeling may produce premature contacts and occlusal interferences that generate unfavorable lateral or tipping forces. The interaction between reduced anatomical support and altered occlusion can therefore accelerate functional deterioration of an otherwise satisfactory prosthesis. Clinically, persistent instability may be presented as impaired mastication, reduced bite force, mucosal soreness, difficulty during speech, food avoidance, and decreased confidence while wearing dentures. These effects may negatively influence patient satisfaction, dietary choices, social functioning, and oral health-related quality of life. Long-term management requires periodic assessment of residual ridge morphology, denture base adaptation, border extension, occlusal relationships, tissue health, and functional movement of the prosthesis. Occlusal adjustment and clinical remount procedures may correct discrepancies, while relining or rebasing can restore adaptation when tissue changes have compromised fit. Denture replacement may become necessary when extensive structural or occlusal deterioration is present. For patients with severe mandibular ridge resorption and persistent instability, implant-retained overdentures can provide improved retention and functional stability. Regular prosthodontic maintenance remains essential because anatomical remodeling and prosthetic wear continue throughout denture service.

Keywords: Alveolar ridge resorption, Denture stability, Complete dentures, Occlusal changes, Edentulism

INTRODUCTION

Complete dentures remain an important prosthodontic treatment for restoring oral function, appearance, and quality of life in completely edentulous patients. Successful treatment depends largely on achieving adequate support, retention, and stability; however, these conditions are not static after denture delivery. The oral tissues continue to undergo biological and anatomical changes following tooth loss, and these alterations can gradually affect the relationship between the denture base and its supporting structures. Among the most clinically significant changes is residual alveolar ridge resorption, which continues over many years and can progressively compromise the foundation on which complete dentures depend.[1,2]

Residual ridge resorption is a chronic, progressive, and irreversible process involving continuous remodeling of the alveolar bone after tooth extraction. Although the rate of resorption varies considerably between individuals, bone loss is generally most pronounced during the initial period following extraction and continues at a slower rate thereafter. Long-term observations have demonstrated that mandibular ridge reduction is typically greater than maxillary ridge reduction, producing progressive alterations in ridge morphology and inter-arch relationships.[1] The process is multifactorial and may be influenced by anatomical characteristics, systemic and metabolic conditions, mechanical loading, and differences in osteoblastic and osteoclastic activity.[2]

Progressive resorption alters the size and shape of the denture-bearing area and can therefore reduce the adaptation of an existing denture to the underlying tissues. As the residual ridge changes while the denture base maintains its original form, gaps and uneven areas of support may develop between the prosthesis and the mucosa. This loss of adaptation can permit horizontal, vertical, and rotational movement of the denture during mastication and speech. Severe mandibular residual ridge resorption has been associated with poorer lower denture stability, reduced chewing ability, and lower patient satisfaction, emphasizing the functional consequences of continued anatomical change in long-term denture wearers.[3]

Changes in the supporting tissues can also influence the occlusal relationships established when the dentures were initially fabricated. Progressive ridge resorption may allow the dentures to settle, rotate, or shift from their original positions, contributing to changes in occlusal contacts and the distribution of functional forces. Occlusal discrepancies may subsequently produce unfavorable horizontal or tipping forces that further destabilize the prosthesis during function. Although different occlusal schemes can provide satisfactory function in patients with favorable residual ridges, greater attention to occlusal balance and control of destabilizing forces becomes important when ridge anatomy and denture stability are compromised.[1,4]

REVIEW

Residual alveolar ridge resorption is an important determinant of the long-term functional performance of complete dentures because progressive changes in ridge morphology alter the anatomical foundation supporting the prosthesis. Reduction in residual ridge height and unfavorable ridge forms can decrease the resistance of the denture to displacement during functional movements. Clinical evidence indicates that mandibular residual ridge height and morphology are significantly associated with masticatory performance in complete denture wearers. Furthermore, the total occlusal contact area contributes to masticatory performance, demonstrating that anatomical deterioration and occlusal characteristics act together in determining the functional outcome of complete dentures. Consequently, advanced ridge resorption may result in reduced denture stability, compromised chewing efficiency, and increasing difficulty in maintaining satisfactory prosthetic function over time.[5]

Occlusal changes become particularly important as residual ridge resorption progresses because the ability of the supporting tissues to resist lateral and displacing forces is reduced. The selection and maintenance of an appropriate occlusal scheme can therefore influence denture behavior in patients with severely resorbed ridges. A clinical comparison of lingualized occlusion and fully bilateral balanced articulation demonstrated that the degree of mandibular residual ridge resorption influenced masticatory performance and mandibular denture movement. Patients with severe ridge resorption showed more favorable functional outcomes with lingualized occlusion, suggesting that occlusal design should be adapted to the condition of the residual ridge rather than considered independently from the supporting anatomy.[6]

Alveolar ridge resorption and progressive loss of denture stability

Residual ridge resorption continues after tooth loss because the alveolar process no longer receives the functional stimulation associated with the natural dentition and undergoes prolonged structural remodeling. The rate and extent of this change are highly variable, reflecting differences in ridge anatomy, bone quality, mucosal characteristics, systemic metabolism, functional loading, and prosthetic conditions. This variability explains why patients with a similar duration of edentulism may present with markedly different residual ridge forms. As resorption advances, the available surface and contour capable of resisting denture displacement diminish, particularly in the mandible, where the supporting area is relatively limited.[7]

For a complete denture, this progressive anatomical alteration creates a mismatch between the rigid denture base and the changing tissues beneath it. A prosthesis that

was closely adapted at insertion may gradually lose uniform contact with its supporting mucosa, producing localized loading and allowing movement during function. The reduction of ridge height also weakens resistance to lateral and rotational displacement, so forces generated during chewing can more readily tip or shift the denture. Preservation of the residual alveolar foundation is therefore closely connected with maintaining the functional efficiency of complete dentures over extended periods of wear.[8]

The mechanical environment created by the prosthesis may itself influence the behavior of the residual ridge. Evidence concerning alveolar bone loss under prosthodontic treatment indicates that loading patterns, denture movement, and the distribution of forces across the supporting tissues may contribute to continuing resorption. Conventional mandibular dentures are particularly susceptible because limited support can increase movement under function, while progressive bone loss further reduces the capacity of the ridge to resist that movement. This relationship can create a clinical pattern in which deterioration of the supporting anatomy is accompanied by progressively poorer retention and stability.[9]

Support must also be considered in relation to the biological tolerance of the tissues rather than simply the amount of ridge remaining. Functional stresses should be directed toward areas capable of accepting load, while vulnerable regions require protection from excessive pressure. When ridge resorption changes these supporting relationships, an existing denture may concentrate force on smaller or less tolerant areas, encouraging rocking and displacement during mastication. Continued assessment of tissue contact and load distribution is therefore relevant as the denture-bearing foundation changes with time.[10]

Occlusal changes and their influence on denture stability

Occlusion in complete dentures is closely linked to the position of the prosthetic bases on movable, compressible supporting tissues. Unlike natural teeth, dentures do not have periodontal support capable of accommodating functional contacts independently. Occlusal forces are transferred through the denture bases to the residual ridges, making the direction and distribution of these forces relevant to stability. When contacts are uneven or concentrated away from the supporting areas, the resulting leverage can produce tipping, rotation, or displacement. Systematic evidence comparing complete denture occlusal designs has shown differences in masticatory performance and patient-related outcomes between schemes, although no single arrangement provides superior results under all clinical conditions.[11]

Occlusal relationships established at insertion may also change during use. Denture base settling, tissue displacement, residual ridge remodeling, and wear of artificial teeth can modify the location and intensity of contacts. Even relatively small discrepancies can become clinically noticeable when the mandibular denture has limited resistance to horizontal movement. Premature contacts may shift the base during closure, while eccentric interferences can generate lateral forces during chewing. Clinical remount procedures have been shown to reduce changes in occlusal patterns and postoperative soreness, illustrating how correction of occlusal discrepancies can improve the functional behavior of complete dentures after placement.[12]

The influence of occlusal design becomes more apparent when the denture-bearing anatomy provides limited mechanical stability. Lingualized, bilateral balanced, and monoplane arrangements distribute forces differently, and their clinical effects depend partly on ridge form, neuromuscular control, tooth position, and denture base adaptation. A randomized clinical trial comparing different occlusal arrangements reported differences in patient satisfaction, with lingualized occlusion showing favorable results in several assessed domains. Such findings suggest that occlusal form can affect the patient's perception of stability and function rather than serving solely as a technical feature of tooth arrangement.[13]

Evidence synthesized from systematic reviews also indicates considerable heterogeneity in the reported advantages of specific occlusal schemes. Differences in study populations, ridge anatomy, follow-up periods, outcome measures, and denture fabrication procedures make direct comparisons difficult. Recent evaluation of systematic reviews found that several occlusal concepts can provide acceptable clinical performance when dentures are appropriately constructed, while the condition of the supporting tissues and individual functional requirements remain influential in determining how effectively a given scheme performs.[14]

Clinical effects and management of long-term denture instability

Long-term denture instability can gradually affect oral function beyond the physical movement of the prosthesis. Patients may experience difficulty chewing firmer foods, reduced bite force, soreness of the supporting mucosa, and diminished confidence during eating or speaking. These problems are especially evident with mandibular dentures, where the smaller denture-bearing area and movement of the tongue and surrounding musculature make stabilization more difficult. Persistent instability can influence oral health-related quality of life because comfort and the ability to function socially with the prosthesis contribute strongly to patients' perception of successful treatment. Clinical evidence has linked the fit and stability of complete dentures with chewing ability and patient-reported functional outcomes.[15]

Management begins with determining why a previously satisfactory denture has become unstable rather than treating movement as an isolated complaint. Examination

should assess adaptation of the denture base, residual ridge morphology, border extension, occlusal contacts, vertical dimension, mucosal condition, and the degree of movement during function. Where the denture remains otherwise acceptable, relining can restore closer contact between the fitting surface and tissues that have changed through residual ridge resorption.

Improvements in oral health-related quality of life have been reported following complete denture relining, supporting its use when loss of adaptation contributes to pain, poor retention, or instability.[16]

Advanced ridge resorption may limit the improvement achievable through conventional adjustment or relining. Implant retention can provide a more stable mechanical foundation for patients who continue to experience difficulty with mandibular complete dentures. Long-term prospective evidence comparing implant-retained mandibular overdentures with conventional dentures has demonstrated favorable clinical outcomes and patient satisfaction with implant treatment, particularly where lack of retention and stability had previously affected denture function.[17]

Implant therapy does not eliminate the need for maintenance, since attachment components, denture bases, and supporting tissues remain subject to functional wear and biological change.

The maintenance burden therefore continues throughout the service life of the prosthesis. Attachment wear, loss of retention, denture base fracture, relining requirements, and replacement of prosthetic components may occur with implant overdentures, while conventional dentures may require periodic adjustment as ridge morphology changes. Systematic assessment of mandibular implant overdentures shows that maintenance requirements vary according to attachment design and prosthetic configuration, making planned follow-up part of long-term management rather than an intervention reserved only for symptomatic failure.[18]

CONCLUSION

Alveolar ridge resorption progressively alters denture support and contributes to declining retention and stability over time. Changes in denture position and occlusal relationships may further increase displacement during mastication and other functional movements. Long-term instability can compromise chewing efficiency, comfort, and patients' oral health-related quality of life. Regular follow-up, correction of denture fit and occlusion, and appropriate use of relining, replacement, or implant-assisted treatment are essential for maintaining function.

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