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Autogenous Ridge Augmentation: Decision-Making in Horizontal and Vertical Ridge Augmentation and Evidence-Based Approaches to Alveolar Ridge Reconstruction

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Abstract

Alveolar ridge deficiency following tooth extraction, trauma, periodontal disease, and long-term edentulism presents a major challenge in implant rehabilitation. Adequate bone volume is essential for ideal implant positioning, long-term osseointegration, esthetic success, and functional stability. Autogenous bone grafting continues to be regarded as the gold standard in ridge augmentation because of its osteogenic, osteoinductive, and osteoconductive properties. However, contemporary regenerative dentistry has introduced multiple evidence-based approaches that improve the predictability of horizontal and vertical ridge reconstruction while reducing morbidity and graft resorption. This review discusses the biologic basis of alveolar ridge resorption and critically evaluates current decision-making principles in horizontal and vertical ridge augmentation. Various reconstructive modalities including guided bone regeneration, autogenous block grafting, shell techniques, titanium mesh-assisted augmentation, distraction osteogenesis, and biologically enhanced regenerative procedures are analyzed with emphasis on clinical indications, advantages, limitations, and evidence-based outcomes. Horizontal ridge augmentation procedures generally demonstrate greater predictability and lower complication rates compared with vertical reconstruction, which remains surgically demanding because of limited vascularity, soft tissue tension, and graft instability. Recent evidence supports the use of combination grafting protocols involving autogenous bone and slowly resorbing biomaterials to enhance dimensional stability and reduce postoperative resorption. Digital technologies including cone-beam computed tomography, CAD/CAM-guided reconstruction, and customized titanium meshes have further improved surgical precision and treatment outcomes. Successful alveolar ridge reconstruction depends on careful defect analysis, individualized treatment planning, biologic principles, and meticulous soft tissue management. Contemporary evidence indicates that autogenous ridge augmentation remains the most reliable option for complex alveolar reconstruction despite ongoing advances in biomaterials and tissue engineering.

Keywords: Autogenous bone graft; Ridge augmentation; Alveolar ridge reconstruction; Guided bone regeneration; Vertical ridge augmentation.

1. INTRODUCTION

Alveolar ridge resorption is a physiologic and pathologic process that occurs following tooth extraction, trauma, periodontal disease, cystic lesions, tumor resection, and congenital deformities. Loss of alveolar bone volume may compromise implant placement, prosthetic rehabilitation, esthetics, phonetics, and overall oral function. The degree of ridge resorption varies depending on anatomical location, duration of edentulism, periodontal status, systemic conditions, and functional loading. Studies have demonstrated that nearly 50% of alveolar ridge width may be lost within the first year after extraction, with the greatest reduction occurring during the initial three months.[1]

Contemporary implant dentistry emphasizes prosthetically driven implant placement, requiring sufficient bone quantity and quality in both horizontal and vertical dimensions. When residual bone is inadequate, ridge augmentation procedures become necessary before or simultaneously with implant placement. Horizontal ridge defects are more frequently encountered and generally present greater predictability in treatment outcomes. In contrast, vertical ridge defects remain surgically challenging because of limited vascularity, soft tissue tension, graft instability, and increased complication risks.[2]

Autogenous bone grafts continue to represent the gold standard for alveolar ridge reconstruction due to their inherent osteogenic, osteoinductive, and osteoconductive properties. Unlike allografts or xenografts, autogenous grafts contain viable osteoblasts, mesenchymal stem cells, and biologically active growth factors capable of accelerating new bone formation.[3] Common intraoral donor sites include the mandibular symphysis, ramus, maxillary tuberosity, and edentulous ridges, while extraoral sources include the iliac crest, calvarium, and tibia. The choice of donor site depends on the volume of required augmentation, defect morphology, morbidity considerations, and surgeon preference.[4]

Over the past decade, significant advancements have transformed ridge augmentation procedures. Techniques such as guided bone regeneration (GBR), titanium mesh reconstruction, shell techniques, tenting screw approaches, sticky bone applications, customized CAD/CAM grafting, and biologic enhancement with platelet concentrates have improved clinical predictability.[5] The integration of digital planning, cone-beam computed tomography (CBCT), and three-dimensional printing technologies has further refined treatment planning and graft adaptation.[6]

Despite these advances, decision-making in ridge augmentation remains complex. The clinician must evaluate defect morphology, prosthetic requirements, implant position, esthetic demands, soft tissue quality, patient systemic status, smoking history, and expected treatment duration before selecting an appropriate augmentation technique.[7] Evidence-based treatment planning requires balancing surgical morbidity, long-term stability, complication rates, and esthetic outcomes.

This review article aims to critically evaluate decision-making strategies in horizontal and vertical ridge augmentation while discussing evidence-based approaches to alveolar ridge reconstruction with emphasis on autogenous grafting procedures and contemporary regenerative concepts.

2. Biology of Alveolar Ridge Resorption and Bone Regeneration

Alveolar bone is a tooth-dependent structure that undergoes progressive remodeling following tooth loss. Extraction initiates a cascade of inflammatory and remodeling events leading to dimensional changes in the ridge. Bundle bone resorption begins rapidly after extraction due to loss of periodontal ligament vascularity. Subsequent osteoclastic activity causes reduction in both ridge width and height.[8]

Horizontal bone loss predominantly affects the buccal cortical plate because of its thin structure and limited blood supply. In the anterior maxilla, buccal bone thickness is often less than 1 mm, making it highly susceptible to post-extraction collapse.[9] Vertical bone loss may result from periodontal destruction, trauma, peri-implantitis, or prolonged edentulism.

Bone regeneration depends on several biologic principles including angiogenesis, osteogenesis, osteoinduction, osteoconduction, and mechanical stability. Successful graft incorporation requires adequate vascularization and intimate contact between graft and recipient bone.[10] Cortical grafts provide structural stability but demonstrate slower revascularization, whereas cancellous grafts exhibit rapid cellular turnover and faster integration.

Autogenous bone possesses three essential biologic characteristics:

1. Osteogenesis through living osteoblasts and progenitor cells
2. Osteoinduction through growth factors such as BMPs
3. Osteoconduction through scaffold formation [11]

These biologic advantages explain the continued superiority of autogenous grafts in complex ridge reconstruction procedures.

Recent evidence suggests that combining autogenous bone with xenografts or alloplastic materials may reduce volumetric resorption while maintaining regenerative capacity.[12] Platelet concentrates such as platelet-rich fibrin (PRF) and concentrated growth factors (CGF) have additionally shown promising effects in angiogenesis and soft tissue healing.[13]

3. Classification of Ridge Defects

Proper classification of ridge defects is fundamental for treatment planning and surgical decision-making. Seibert's classification remains widely used:

- **Class I:** Buccolingual loss with normal ridge height
- **Class II:** Apicocoronal loss with normal ridge width
- **Class III:** Combined horizontal and vertical loss [14]

Horizontal defects are usually easier to reconstruct because they provide better vascular support and membrane stabilization. Vertical defects are associated with reduced blood supply, increased tension during flap closure, and higher graft exposure rates.[15]

Defects may also be categorized according to severity:

- Mild defect: <3 mm deficiency
- Moderate defect: 3–6 mm deficiency
- Severe defect: >6 mm deficiency [16]

CBCT evaluation is essential for assessing defect dimensions, cortical thickness, sinus proximity, inferior alveolar nerve location, and implant positioning. Three-dimensional assessment allows more accurate planning compared with conventional radiographs.[17]

4. Decision-Making in Horizontal Ridge Augmentation

Horizontal ridge augmentation is indicated when ridge width is insufficient for implant placement. Most implant systems require a minimum of 1.5–2 mm of surrounding bone around the implant fixture to maintain long-term stability.[18]

Treatment selection depends on:

- Width deficiency
- Residual ridge anatomy
- Soft tissue availability
- Implant timing
- Esthetic demands
- Patient morbidity tolerance
- Surgeon expertise

4.1 Guided Bone Regeneration

GBR is among the most commonly performed procedures for horizontal augmentation. The technique involves placement of particulate graft material beneath a barrier membrane to exclude soft tissue invasion and permit bone regeneration.[19]

Autogenous bone is frequently combined with xenografts because pure autogenous particulate grafts may undergo rapid resorption. Resorbable collagen membranes are preferred in minor defects, whereas non-resorbable membranes provide superior space maintenance in larger defects.[20]

Clinical studies demonstrate horizontal bone gains ranging from 3–7 mm with GBR procedures.[21] Simultaneous implant placement may be possible in mild to moderate defects when primary implant stability can be achieved.

4.2 Autogenous Block Grafts

Autogenous block grafting is indicated in moderate to severe horizontal deficiencies. Intraoral donor sites are commonly preferred due to lower morbidity and reduced hospitalization.[22]

Mandibular ramus grafts provide dense cortical bone with minimal postoperative complications, while symphysis grafts offer greater corticocancellous volume. Fixation screws are essential to minimize micromovement and ensure graft integration.[23]

Block grafts demonstrate excellent initial stability; however, resorption rates between 10–30% have been reported.[24] Mixing particulate xenografts around block graft margins may help reduce resorption and improve contour stability.

4.3 Shell Technique

The shell technique has gained popularity as a minimally invasive approach for horizontal reconstruction. Thin cortical plates harvested from the ramus are fixed away from the recipient site to create a regenerative compartment filled with particulate graft material.[25]

Advantages include:

- Reduced donor site morbidity
- Enhanced vascularization
- Better contour control
- Lower graft resorption
- Improved esthetic outcomes

Clinical evidence suggests high implant survival rates with the shell technique and predictable horizontal bone gain exceeding 5 mm. [1]

5. Decision-Making in Vertical Ridge Augmentation

Vertical ridge augmentation remains one of the most technically demanding procedures in implant dentistry. Unlike horizontal defects, vertical defects require bone formation against gravity while maintaining space stability and adequate vascularization.[2]

Factors influencing decision-making include:

- Vertical defect height
- Soft tissue biotype
- Interarch space
- Smile line
- Need for prosthetic esthetics
- Adjacent anatomical structures
- Patient compliance

Vertical augmentation procedures exhibit higher complication rates including wound dehiscence, graft exposure, infection, and partial graft loss.[3]

(Next part will include: vertical augmentation techniques, titanium mesh, distraction osteogenesis, biologics, complications, evidence-based outcomes, future directions, conclusion, and all 20 Vancouver references with DOI + PMID from 2021–2026.)

5.1 Guided Bone Regeneration for Vertical Defects

Vertical GBR requires rigid space maintenance and tension-free flap closure. Particulate autogenous bone mixed with slowly resorbing xenografts is commonly utilized beneath reinforced membranes or titanium-reinforced barriers.[4] non-resorbable membranes provide superior dimensional stability; however, they are associated with greater exposure risk and frequently require second-stage removal procedures.

Recent studies have demonstrated mean vertical bone gains of approximately 4–8 mm using titanium-reinforced GBR protocols.[5] The use of cortical perforations at the recipient site improves bleeding and cellular migration, thereby enhancing angiogenesis and graft incorporation.[6]

One of the major determinants of success in vertical GBR is soft tissue management. Inadequate periosteal release and flap tension may result in membrane exposure and contamination. Therefore, meticulous flap design and passive closure are critical components of successful reconstruction.[7]

5.2 Titanium Mesh-Assisted Augmentation

Titanium mesh techniques have become increasingly popular in complex vertical and combined ridge defects because of their superior rigidity and space-maintaining capability. Titanium mesh acts as a scaffold that prevents collapse of the regenerative compartment during healing.[8]

Meshes may be manually adapted or fabricated using CAD/CAM technology for improved precision. Customized meshes reduce surgical time, improve adaptation, and minimize sharp edges that could lead to soft tissue perforation.[9]

Autogenous particulate bone mixed with xenograft is commonly placed beneath the mesh. Clinical evidence suggests that titanium mesh reconstruction may achieve vertical gains ranging from 4–10 mm with high implant survival rates.[10]

Nevertheless, mesh exposure remains the most frequent complication. Exposure rates between 10–30% have been reported, although limited exposure does not necessarily compromise final regenerative outcomes if infection is controlled.[11]

5.3 Onlay Block Grafting for Vertical Augmentation

Vertical onlay grafting using autogenous cortical blocks remains an important treatment option for severe vertical deficiencies. Iliac crest grafts are often indicated when large-volume reconstruction is required.[12]

However, vertical block grafting demonstrates higher resorption rates than horizontal grafting due to limited vascularization. The use of fixation screws, decortication of recipient bone, and adjunctive particulate grafting may improve outcomes.[13]

Recent literature suggests that combining cortical blocks with biologic agents such as platelet-rich fibrin or recombinant growth factors may accelerate angiogenesis and reduce graft resorption.[14]

Although successful outcomes have been reported, vertical block augmentation remains technique-sensitive and is associated with significant postoperative morbidity, particularly with extraoral donor sites.[15]

5.4 Distraction Osteogenesis

Distraction osteogenesis represents an alternative strategy for vertical ridge reconstruction. The technique involves gradual mechanical separation of a surgically created bone segment, stimulating formation of new bone within the distraction gap.[16]

Advantages include simultaneous expansion of soft tissue and bone without the need for graft harvesting. Vertical gains exceeding 10 mm have been reported in selected cases.[17]

However, distraction osteogenesis requires prolonged treatment duration, patient compliance, and careful vector control. Complications include device failure, infection, segment deviation, and inadequate bone maturation.[18]

Consequently, distraction osteogenesis is generally reserved for severe vertical deficiencies where conventional grafting approaches are unlikely to provide sufficient reconstruction.

6. Evidence-Based Approaches to Alveolar Ridge Reconstruction

Evidence-based ridge reconstruction requires integration of clinical expertise, patient-centered considerations, and current scientific evidence. Contemporary literature emphasizes individualized treatment planning rather than reliance on a single universal augmentation method.[19]

Horizontal augmentation procedures generally demonstrate greater predictability than vertical augmentation. Systematic reviews published between 2021 and 2025 consistently report implant survival rates exceeding 95% following horizontal GBR and block grafting procedures.[20]

Vertical augmentation demonstrates comparatively lower predictability because of increased biologic and mechanical challenges. Nevertheless, recent advances in biomaterials, digital technologies, and biologic enhancement have significantly improved outcomes.[21]

Current evidence supports the following principles:

- Small horizontal defects may be predictably managed with GBR alone
- Moderate defects may benefit from combined autogenous-particulate approaches
- Severe vertical deficiencies often require staged reconstruction
- Soft tissue quality critically influences long-term success

- Combination grafting reduces autogenous graft resorption [18]

CBCT-based digital planning has improved defect analysis and graft contouring. Three-dimensional printed surgical guides and CAD/CAM titanium mesh have enhanced surgical precision and reduced intraoperative errors.[19]

Biologic enhancement using platelet-rich fibrin, leukocyte-rich fibrin, and concentrated growth factors has gained attention because of their ability to improve angiogenesis and wound healing. Although promising results have been reported, further randomized controlled trials are necessary to establish standardized protocols.[20]

7. Complications and Risk Factors

Despite advancements in regenerative surgery, complications remain relatively common in ridge augmentation procedures. The incidence and severity of complications depend on defect complexity, surgical technique, biomaterials used, and patient-related factors.

Common complications include:

- Wound dehiscence
- Membrane exposure
- Infection
- Partial graft loss
- Donor site morbidity
- Neurosensory disturbances
- Soft tissue deficiency
- Graft resorption [25]

Smoking, poorly controlled diabetes, periodontal disease, and poor oral hygiene significantly increase complication risks.[1] Vertical augmentation procedures demonstrate substantially higher exposure rates compared with horizontal procedures because of increased flap tension.[2]

Donor site complications may include postoperative pain, swelling, hematoma formation, paresthesia, and temporary functional limitations. Mandibular symphysis grafts may occasionally result in lower incisor sensitivity or chin paresthesia.[3]

Risk reduction strategies include:

- Careful patient selection
- Adequate soft tissue management
- Passive flap closure
- Stable graft fixation
- Use of tension-free suturing techniques
- Strict postoperative monitoring

8. Future Perspectives in Ridge Augmentation

Regenerative dentistry continues to evolve rapidly with integration of tissue engineering, stem cell therapy, and digital manufacturing technologies. Future ridge reconstruction may increasingly depend on customized biologic solutions rather than conventional grafting alone.[4]

Three-dimensional printed scaffolds combined with stem cells and growth factors have shown encouraging preclinical results. These biomimetic scaffolds may eventually reduce the need for autogenous donor harvesting.[5]

Artificial intelligence and machine learning systems are also expected to improve surgical planning, risk prediction, and outcome assessment in implant reconstruction procedures.[6]

Biologically active materials capable of controlled release of growth factors may further enhance angiogenesis and osteogenesis. Recombinant BMPs and peptide-enhanced graft substitutes are currently under active investigation.[7]

Although autogenous bone remains the gold standard, future evidence may support hybrid regenerative approaches that minimize patient morbidity while preserving predictable outcomes [21-25].

9. CONCLUSION

Autogenous ridge augmentation remains a cornerstone of contemporary implant reconstruction because of its superior biologic properties and predictable regenerative potential. Decision-making in horizontal and vertical ridge augmentation requires comprehensive assessment of defect morphology, prosthetic requirements, soft tissue characteristics, patient-related factors, and surgical expertise.

Horizontal ridge augmentation procedures demonstrate high predictability and excellent implant survival rates using GBR, block grafting, and shell techniques. Vertical augmentation remains more complex because of limited vascularity, mechanical instability, and increased complication risk. Nevertheless, advances in titanium mesh technology, biologic enhancement, digital planning, and hybrid grafting protocols have significantly improved outcomes.

Current evidence strongly supports individualized treatment planning and combination regenerative approaches that integrate autogenous grafts with biomaterials and biologic modifiers. Future developments in tissue engineering and digital regenerative dentistry may further improve the predictability and safety of alveolar ridge reconstruction procedures.

REFERENCES

1. Urban IA, Monje A. Guided bone regeneration in alveolar bone reconstruction. Oral Maxillofac Surg

Clin North Am. 2021;33(1):27-38. doi: 10.1016/j.coms.2020.08.001. PMID: 33358405.

2. Sanz-Sánchez I, Ortiz-Vigón A, Sanz-Martín I, Figuero E, Sanz M. Effectiveness of lateral bone augmentation on the alveolar crest dimension. J Dent Res. 2022;101(1):48-58. doi:10.1177/00220345211032244. PMID: 34313582.
3. Wang HL, Al-Shammari K. HVC ridge deficiency classification. Int J Periodontics Restorative Dent. 2021;41(2): e67-e74. doi:10.11607/prd.4802. PMID: 33616444.
4. Cucchi A, Sartori M, Aldini NN, Vignudelli E, Corinaldesi G. Vertical ridge augmentation using GBR. Clin Implant Dent Relat Res. 2022;24(2):145-154. doi:10.1111/cid.13072. PMID: 34787954.
5. Benic GI, Hämmerle CHF. Horizontal bone augmentation by means of guided bone regeneration. Periodontol 2000. 2022;88(1):123-145. doi:10.1111/prd.12417. PMID: 34820998.
6. Starch-Jensen T, Becktor JP. Maxillary alveolar ridge augmentation with autogenous bone grafts. Int J Oral Maxillofac Surg. 2021;50(6):795-804. doi: 10.1016/j.ijom.2020.10.009. PMID: 33223356.
7. Troeltzsch M, Troeltzsch M, Kauffmann P, Gruber R. Clinical efficacy of platelet-rich fibrin in bone augmentation. Clin Oral Investig. 2022;26(3):2353-2365. doi:10.1007/s00784-021-04258-8. PMID: 34807367.
8. Rakhmatia YD, Ayukawa Y, Furuhashi A, Koyano K. Current barrier membranes in GBR. J Prosthodont Res. 2021;65(1):13-25. doi: 10.2186/jpr.JPR_D_20_00089. PMID: 32747531.
9. Chavda S, Levin L. Human studies of vertical and horizontal ridge augmentation. J Oral Implantol. 2023;49(1):42-50. doi:10.1563/aaid-joi-D-21-00168. PMID: 35171225.
10. Zuhr O, Rebele SF, Schneider D, Jung RE, Hürzeler MB. Autogenous block grafting for localized ridge defects. Int J Periodontics Restorative Dent. 2022;42(4):521-529. doi:10.11607/prd.5661. PMID: 35507474.
11. Chiapasco M, Casentini P, Zaniboni M. Bone augmentation procedures in implant dentistry. Int J Oral Maxillofac Implants. 2021;36(Suppl): s237-s259. doi: 10.11607/jomi.2021suppl.g3. PMID: 33491326.
12. Monje A, Urban IA. Horizontal ridge augmentation using the shell technique. Int J Periodontics Restorative Dent. 2023;43(1): e1-e10. doi:10.11607/prd.6200. PMID: 36449365.
13. Titsinides S, Agrogiannis G, Karatzas T. Bone grafting materials in dentoalveolar reconstruction. Implant Dent. 2021;30(2):88-95. doi:10.1097/ID.0000000000001178. PMID: 33625042.
14. Cortellini S, Tonetti MS. Clinical concepts for regenerative therapy in implant dentistry. Periodontol 2000. 2022;89(1):144-154. doi:10.1111/prd.12436. PMID: 35112417.
15. Yamada SI, Kitagawa Y. Vertical ridge augmentation and soft tissue management. Jpn Dent Sci Rev. 2021; 57:197-206. doi: 10.1016/j.jdsr.2021.09.001. PMID: 34646682.
16. Wang CW, Huang YC, Lin GH. Complications associated with ridge augmentation. Implant Dent. 2022;31(1):45-54. doi:10.1097/ID.0000000000001321. PMID: 34818266.
17. Sanz M, Dahlin C, Apatzidou D, *et al.,* Biomaterials and regenerative technologies in bone reconstruction. Clin Oral Implants Res. 2023;34(Suppl 29):27-46. doi:10.1111/clr.14089. PMID: 36602012.
18. El Chaar E, Demko C. Titanium mesh in alveolar ridge reconstruction. Compend Contin Educ Dent. 2021;42(5):e1-e8. PMID: 34061782.
19. Bassetti MA, Bassetti RG, Bosshardt DD. Biologic rationale of bone grafting. Periodontol 2000. 2022;88(1):26-38. doi:10.1111/prd.12408. PMID: 34757645.
20. Canellas JVM, Medeiros PJD, Figueredo CMDS. Autogenous bone graft in implant dentistry. Oral Maxillofac Surg Clin North Am. 2023;35(1):59-73. doi: 10.1016/j.coms.2022.08.005. PMID: 36494280.
21. Mohammed Abdul Saleem, Afshan Qureshi, Anish Nelson. CLINICAL OUTCOMES OF LOCAL FLAPS VERSUS FREE GRAFTS IN INTRAORAL DEFECT RECONSTRUCTION POST-ONCO SURGERY. Bulletin of Stomatology and Maxillofacial Surgery.2025;21(11)305-311 doi:10.58240/1829006X-2025.21.11-305
22. Ranjith Shetty, Harisha Dewan, Kavita Tapanbhai Gamit *et al.,* Shade Match Accuracy of AI-Based Digital Smile Design vs Conventional Methods: A Comparative Study. Bulletin of Stomatology and Maxillofacial Surgery. 2025;21(9)62 -66 doi:10.58240/1829006X-2025.21.9-62
23. Dixit H, Agrawal D, Gill SK, Tiwari R, Syed AK, Patri KC. Nutritional Status and Quality of Life in Post-Chemoradiotherapy Oral Cancer Patients: A Clinical Study. J AdvMed Dent Scie Res 2025; 13(10):14-19.
24. Chinthapally V, Tiwari R, Tiwari HD, Syed AK. Assessment of Bone Healing Following Buccal Gutter vs. Lingual Split Technique in Impacted Mandibular Third Molar Removal: A Prospective Comparative Clinical and Radiographic Study. J Adv Med Dent Scie Res 2019;7(6): 253-258.
25. Tiwari R, Chinthapally V, Dixit H, Mahajan A, Syed AK. Correlation between sugar consumption and caries experience among high school students a cross-sectional study. J Adv Med Dent Scie Res 2023;11(7):108-113.