European Journal of Molecular & Clinical Medicine
ISSN 2515-8260 Volume 7, Issue 07, 2020

Vertical Ridge Augmentation : A review

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Type of article: Review

Abstract

Dimensional variations in the alveolar ridge after extraction often negotiations on achieving adequate implant stability and placement of implants in the right prosthodontic positions. These circumstances request augmentation of the residual ridge to accomplish successful implant placement and long-term survival. Vertical Ridge Augmentation is accomplished using both hard and soft tissue grafting procedures that intend to augment the alveolar ridge volume beyond the existing skeletal envelope; they are usually performed at the edentulous site of a deficient alveolar ridge . Although there are a large variety of alveolar ridge augmentation techniques with various degrees of success, this review concentrate on vertical ridge augmentation using guided bone regeneration, autogenous block and alveolar distraction osteogenesis . Vertical ridge augmentation procedures before or during dental implant placement are technically challenging and often encounter procedure-related complications. To minimize complications and promote success, a literature search was conducted to validate procedures used for Vertical Ridge Augmentation. A decision tree based on the amount of additional ridge height needed (<4, 4 to 6, or > 6 mm) is developed to improve the procedure-selection process. A decision tree guides selection of the most appropriate treatment modality and sequence for safe,

predictable management of the vertically deficient ridge in implant therapy. Though the available literature speaks of an excess of methods and agents for ridge augmentation, there is a comparative scarcity of quality evidence to guide the selection of suitable techniques and material. Henceforth, this paper is an endeavor to develop and describe an evidence-based decision pathway for the selection of suitable techniques for various clinical situations. Additionally, a descriptive overview of various techniques and materials is presented.

Key words: Guided bone regeneration, Block grafting , Distraction osteogenesis

Introduction

The fast pace of soaring popularity of implants in dentistry by clinicians and patients alike is substantiated by the existence of a booming share of implants in the global dental market[1]. Ever since Brånemark (1981) proposed a novel dental procedure, a machined titanium implant, a novel procedure[2]. In past few years, a success percentage of over 95% in non-compromised patients is reported [3] . Dental implants have become a trust worthy procedure choice for patients having one or multiple teeth to be replaced[4]. However, the local conditions may not always be favorable for implant placement as in cases of deficient bone volume after extraction. The sufficient horizontal as well as vertical bone dimensions are a prerequisite to warranty the success of implants [5-6] But the fact that the maintenance of the alveolar bone is reliant on the existence of teeth explains the high prevalence of paucity of sufficient bone after extraction[7-8] Hence, often there is the need to augment the available atrophic bone to make it amenable to implant placement in suitable prosthetic positions with desirable stability and aesthetics. To feed this need for augmentation, a plethora of agents and techniques are available with volumes of literature; yet there is an absence of consensus for the efficacy of any of these surgical techniques.

Aims of bone augmentation

- Reestablish sufficient quantity of bone dimensions for placing of implant
- Reestablish inter maxillary ridge correlation
- Confirm esthetic outcomes
- Achieve the biomechanical requisite of the prosthesis
- To get healthy bone to confirm osseointegration and persistence of implant[9]

Classification of ridge defects

Classification methods are usually made to create guiding principle for management of a specific condition in clinical practice

Seibert's classification(1983)

- Class I - Loss of buccolingual width but normal apicocoronal height.

- Class II- Loss of apicocoronal height but normal buccolingual width
- Class III - A combination of both buccolingual and apicocoronal loss of the ridge (both height and width) [10]

Allen's classification(1985)

Allen introduced severity as a classification criterion in the evaluation of alveolar deformities.

The ridge deformity was described by evaluating depth of the defect relative to the adjacent ridge.

- Mild: < 3mm
- Moderate: 3 to 6 mm
- Severe: > 6mm[11]

Misch and Judy's classification(1987)

It describes four divisions according to available bone height, width and angulation

A. Abundant bone- >5 mm in width, 10 to 13 mm in height and >7 mm in length.

B. Barely sufficient bone - 2.5 to 5 mm in width, >10 to 13 mm in height and >12 mm in length

C. Compromised bone - <10 mm in height &< 2.5 mm in width

D. Deficient bone - Bone is insufficient that requires hard tissue augmentation and is usually not acquiescent to implant rehabilitation[12]

4.Various methods for vertical ridge augmentation

a. Onlay grafting
b. Inlay grafting
c. Alveolar distraction osteogenesis
d. Guided bone regeneration

Onlay grafting

- Autologous bone graft material reported in 1975 by Brånemark is considered "Gold Standard"
- Autogenous onlay bone grafting is a definite technique frequently designated for cases having severe deficiency of alveolar bone in vertical dimension.

- Alveolar crest is a lesser amount than five millimeter high or a smaller amount than four millimeter wide
- The stated vertical bone improvement is 4 to 10 mm
- Disadvantages
    - Donor Site Morbidity
    - Soft Tissue Tension
- Advantages
    - Higher Primary Stability.
    - Enhance Angiogenesis
    - 3-dimensional Reconstruction[13]
- Complications
  - Like as exposure of graft, contamination, and failure of graft [14]

Inlay grafting

- The inlay bone graft technique, first described by Schettler in 1976
- The rationale of this techniques is that biomaterial positioned in the middle of two fragments of pedicle jawbone with internal cancellous jaw bone will go through fast and ample healing and graft integration with a lesser proportion of resorption in sagittal and vertical intermaxillary relationship dimensions

Disadvantages

- Transport segment fracture
- Transient postsurgical paresthesia

Advantages

- Reported success rates of at least 90%
- Spares the lingual periosteum
- Vertical bone gains of 4 to 8 mm

Complications

- Uneventful healing/consolidation (90–100%)
- Dehiscence (3.3 %)
- Incomplete/complete loss of the graft 1.4%
- Graft exposure and fractional damage of the graft 8 weeks following reconstruction[15]

4Alveolar distraction osteogenesis

- Constructed on the principle tension-stress defined by Dr Ilizarov 1989,involves an deliberate osteotomy of the suggested part charted by traction force given to the callus
- The procedure of continuing elongation causes differentiation of stem cells, angiogenesis, and mineralization

Histological examination done by Li et al.(1997) tells about amount for distraction-

- 0.3mm/day does not cause a stimulation for potential cell proliferation.
- 0.7mm/day is ideal for cell proliferation
- Advanced amount of 1.3mm/day obstructs physiologic soft tissue reaction throughout healing causing cell necrosis.
- As a result it is expected that there must be a uninterrupted distraction force of 1mm/day in a recurring way then a phase of consolidation and then removing of the distraction device[16-17]

- Disadvantages
  - A second operation
  - Pain
- Advantages
  - Greater bone gain
  - Simultaneous distraction
  - No donor site morbidity
- Complications
- Inferior alveolar and mental nerve damage. Prevention is possible through cautiously done flap advancement and osteotomy
- One of the key difficulties in the technique being compromised vector of elongation . Following periosteal tractions, transport segment is liable to tilting on palatal or lingual
- The device getting exposured. This is a recognized problem and might cause contamination, device exclusion, and inappropriate bony ossification.
- Transport segment or basal bone fracture[18]

Guided bone regeneration (GBR)

- The application of GBR for supracrestal regeneration was introduced and described by Tinti C in 1998.
- The achievement of the GBR method is chiefly influenced by the prohibition of soft tissue cells in the course of bone remodeling by means of gradually functioning osteoblasts

- GBR is a clinical procedure which rises the extent of alveolar ridge for implant placement by means of barrier membranes with or without bone substitutes
- While determining about the kind of method to be used for bone grafting to be given in cases needing it, following three important aspects should be taken into account:

  1. The well-being of the case, individually oral and systemic
  2. The dimensions and shape of the bone defect
  3. The ultimate prosthetic management intended for the case

- Deficiency of alveolar bone in vertical dimension along with absence of shape providing maintenance of space naturally is well done by non-resorbable membranes (titanium [Ti] mesh or membrane with Ti reinforcement), and a 50:50 mixture of autogenous bone chips and xenograft. In a number of circumstances, wherever the vertical part is a lesser amount of five millimeter, allograft could be taken in the graft mixture.[19]

Successful GBR follows pass principles,(Wang HL 2006)

- Primary wound closure
- Angiogenesis
- Space maintenance
- Stability of the clot[20]
- Disadvantages
  - Wound dehiscence
- Advantages
  - Simultaneous and staged
  - Vertical and horizontal gain
- Complications
  - Premature membrane exposure as a consequence of incision track getting opened causes reduced bone regeneration.
  - When incision track getting opened was not noted, postsurgical contamination of the operated spot will lead to failing of GBR
  - Absorbable membranes go through quick enzymatic degradation and a reduced amount of bone regeneration once early uncovered, however usually does not cause postoperative contamination.[21]

Decision pathway for ridge augmentation

The suitable technique and material for ridge augmentation is dependent on clinical characteristics of the patients, i.e., location and type of defect and the surgeon's own preference. Later is often affected by surgeon's clinical skill and expertise, and financial aspects but mostly it is dictated by principles laid by evidence. Here, in this section simplified evidence-based decision pathways for the selection of suitable techniques for ridge grafting are presented The foremost step in treatment planning, i.e., selection of the right technique as well biomaterial and timing of augmentation (staged versus simultaneous) is preoperative patient assessment. These preoperative considerations include systemic health status and

local factors, i.e., morphology of soft tissues and bone. Although it is advisable to employ cone beam computed tomography to scan the defect in three dimensions, panoramic radiographs in combination with suitable intraoral radiographs may also be used. It is essential to have sufficient soft tissue coverage to ensure primary tension-free closure over the planed area of augmentation. In cases of probable inadequacy of soft tissues, the augmentation of soft tissues must be planned prior to augmenting hard tissues. Assessment of bone morphology at the planned site of implant placement include adequacy of bone volume, ridge contour, and position of marginal bone of neighboring teeth [22] fig. 1

Forthcoming methods that can be considered for ridge-augmentation

Gene therapy is a somewhat innovative beneficial method built to provide different genomic material to the cell. The principal goal of restricted gene therapy remains toward rise the application of preferred growth or differentiation factors to improve the regenerative reaction thus accelerating the regeneration procedure in the required region [23]. The gene therapy was originally presented for assisting the body to supply high amounts of autogenous BMP to stimulate bone regeneration. This present process to transport increased concentrations of growth factors to limited bone augmentation location for extensive episodes of period demonstrations results but then require advance research to get satisfactory scientific outcomes and notably, to guarantee its safety. A cellular tissue engineering approach that feats the renewing ability of bone can contain the in vitro intensification of osteoblast cells or osteoprogenitor cells developed inside three dimensional concepts [24]. Methods exactly directing intraoral bone augmentation proved in vitro osteoblast intensification in diverse concepts. Instead, the usage of mesenchymal stem cells for construct seeding or progress of an immortalized osteoblast line displayed potential for bone regeneration. These intensification approaches, in amalgamation by means of gene therapy and molecular stimulation, can provide better methods for multifactorial tissue engineering plans directed at alveolar bone augmentation. Further tissue engineering methods comprise culture of cell to produce sheets of cell from fibroblasts, or scaffolds ample in cells which can procedure membranes, together with the usage of stem cells and immortalized dental follicle cells is still under research for bone formation and regeneration purposes.

Conclusions

A number of procedures have been established to help in impending a positive bone augmentation to enable getting a suitable bone proportions and precise placement of dental implants. Appropriate procedure need be carefully chosen once cautious assessment of defected region and study associated causes such as the size of the defect, patient inclination, surgeon skill, accessible materials and instruments, price, and comfort of definite techniques to be done. It is significant to evaluation completely practical effective procedures and accessible resources to improve appropriate choice of technique to influence greatest results and extraordinary achievements. It is suitable to practice an evidenced-based method as soon as a treatment plan is being established for bone augmentation patients to expect ultimate results and to set correct prospects of the ultimate outcomes of the augmentation technique. This can improve the quality of final implant being positioned and aid develop patient's satisfaction.

Conflicting Interest: The authors have no conflict of interest

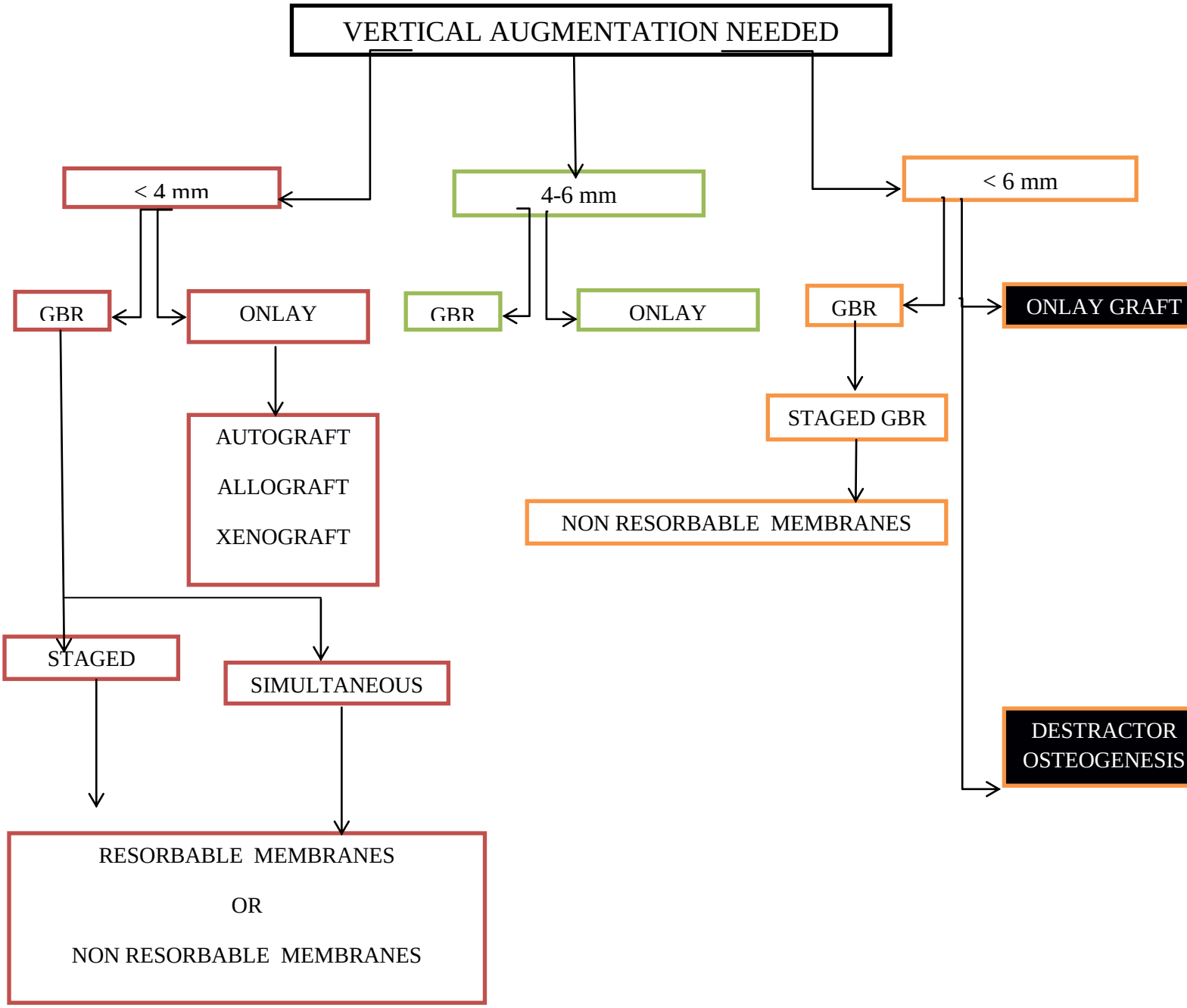

Fig1.;Decision pathway for ridge augmentation. GBR – Guided Bone Regeneration

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