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Alveolar Ridge Augmentation – A Review

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Abstract:

Bone Grafts and bone graft substitutes support regeneration of bone in bone defects and can be used for bone augmentation. Alveolar ridge augmentations are classified based on their morphology and severity. Bone graft augmentation techniques can be used for the application of socket defect grafting, horizontal ridge augmentation, vertical ridge augmentation and sinus augmentation[(1)]. To yield maximum results for each of these applications, a variety of different techniques is employed.This topic gives an overview on Alveolar ridge augmentation and various materials used and its application in the field of implant dentistry and oral and maxillofacial surgery.

Keywords: Alveolar Ridge Augmentation, Bone Grafts, Bone Substitutes

INTRODUCTION:

Bone Grafts and bone graft substitutes support regeneration of bone in bone defects and can be used for bone augmentation. Alveolar ridge augmentations are classified based on their morphology and severity. Bone graft augmentation techniques can be used for the application of socket defect grafting, horizontal ridge augmentation, vertical ridge augmentation and sinus augmentation.[(2)] To yield maximum results for each of these applications, a variety of different techniques is employed. The bone grafting methods include particulate grafting, membrane use, block grafting, and distraction osteogenesis, either alone or combination. With the availability of various grafting materials like autograft, allograft, xenograft and alloplast, though the autograft considered the “gold standard” by which other materials are osteoinductive, osteoconductive and osteogenic properties no risk of infections disadvantages of autograft are low availability of bone volume, required second operative site, morbidity associated with their harvesting, mainly from chin, particulate autografts resorption rate is high[(3)]. The disadvantages of allografts are possible infections and antigenicity risks. The artificial bone substitutes include combinations of calcium phosphates fabricated under different conditions, which yields different physical properties and resorption rates and it is readily available and easy to use. If an autogenous bone transplant is difficult to perform also it has low flexibility and ability to resorb and remodel to adapt to changing conditions fillings with artificial bone substitutes can be performed. some literature recommended the use of hydroxy apatite, beta tricalcium phosphate for alveolar ridge augmentation procedure. approximately 25% bone loss occur after the first year of the bone and 40–60% loss of alveolar volume occur during the first 3 years after a tooth is lost. Thus, the resulting ridge deficiency is primarily the result of the gradual loss of the horizontal dimension accompanied by a rapid loss of bone height (Carlsson et al. 1967). alveolar bone loss could be congenital, trauma, pathology, infection, or a consequence of periodontal disease and tooth extraction.

PRINCIPLES:

To promote primary wound closure passive and tension-free wound closure. In orderto reduce the risk of membrane exposure, wound contraction, patient discomfort. Factors Assist in proper wound healing, enhancing cell proliferation and differentiation provides blood, oxygen, and nutrients to the tissues also acts as a source of angiogenic and osteogenic cells[4]. Protecting initial wound stability and integrity the placement of bone grafting materials to favour and promote healing in osseous defects or to augment edentulous ridges to allow installation of dental implant become a gold standard treatment in implant dentistry. Cell Exclusion is used to prevent gingival fibroblasts and / or epithelial cells from gaining access to the wound site. Space is created beneath the barrier membrane, completely isolating the defect to be regenerated from the overlying soft tissue. Scaffolding: the space which is present initially becomes occupied by a fibrin clot, and it serves as a scaffold for the bone cells. protecting the clot is important for the formation of granulation tissue and subsequent bone formation (Schenk et al. 1994)[11,12].

TREATMENT OBJECTIVES:

The objective behind any crestal bone augmentation procedure is to establish sufficient bone availability for safe and predictable dental implant therapy, as well as for getting adequate bone thickness around the installed implant.[10]

To achieve long-term stability of peri-implant health and good esthetics and avoid complications around functional implants by get at least 2 mm of bone on the buccal side

DIAGNOSIS AND TREATMENT PLANNING:

While diagnosing and treatment planning relative contraindications are need to be taken into consideration:

Medical conditions that may impair normal bone healing - diabetes mellitus (Colombo et al. 2011; Schlegel et al. 2013). when compared between controls diabetic to healthy patient in osseointegration was achieved in both groups (Retzepi et al. 2010)[5]. In previous studies, uncontrolled diabetes showed an increased rate of infection complications and a less predictable outcome

Smoking has also been found to affect the long-term prognosis of Osseointegration Clinical studies have reported that in smokers higher rates of implant failure.Larger number of complications around successfully integrated implants (Roos-Jansaker et al. 2006)[13,14], showed higher incidence of peri-implant mucositis and periimplantitis (Heitz-Mayfield 2008) (Bain &Moy 1993)[8]. non-smokers, the augmentation procedure was successful in 95% of the cases, whereas in smokers it was successful in only 63%

Cologne Classification of Alveolar Ridge Defects (2013)[7]

Cologne used Three-part codes to describe the effect of the alveolar ridge as comprehensively as possible with a view to existing therapeutic options:

Part 1: Orientation of the defect

h: horizontal

V: vertical

c: combined

S (or +S): sinus area

Part 2: Reconstruction needs associated with the defect

1. low: <4mm

2. medium: 4-8mm

3. high: >8mm

Part 3: Relation of augmentation and defect region

i: internal, inside the contour

e: external, outside the ridge contour

DEFECT CLASSIFICATION: According to Seibert (1983), alveolar crest defects

Class 1 defects: when the bone deficiency is predominantly present in the horizontal dimension

Class 2 defects: when the bone deficiency is predominantly present in the vertical dimension

Class 3 defects: when the bone deficiency is affecting both the vertical and horizontal dimensions.

HÄMMERLE AND JUNG CLASSIFICATION OF CREST DEFECTS IN FRESH EXTRACTION SOCKETS:

Class I: extraction socket having intact bone walls after tooth extraction

Class II: extraction socket having marginal dehiscence fenestration of the buccal bone wall after tooth extraction

Class III: extraction socket having large dehiscence of the buccal bone wall after tooth extraction.

Bone Augmentation Therapies:

Melcher (1976), He developed the concept of using barrier membranes to “guide” the biologic process of wound healing. Previous experimental studies demonstrated that the soft tissue invasion of the defect can be excluded by means of a barrier membrane[(6)], thereby allowing the cells with regenerative potential to migrate to the site (which was derived from the periodontal ligament or bone marrow) and promoted periodontal regeneration (Nyman et al. 1982).

Regenerative Materials are barrier membrane, Bone grafts and Bone substitutes.[(15)]

Barrier membranes Purpose is to prohibit the penetration of cells, primarily epithelial, through its structure. There are five criteria that has been considered to be important in the design of barrier membranes used for GBR 1. biocompatibility, 2. cell occlusion properties, 3. integration by the host tissue, 4. Space making capacity. 5. clinical manageability

Types of barrier membranes: Barrier membranes have been derived based on two principal varieties:

1- Non resorbable as titanium,e-PTFE(expanded PTFE) non-degradable barrier membranes require a second surgical intervention to remove them.The material of choice usually depends on the amount of bone regeneration needed, mainly in the vertical dimension. e-PTFE barrier membranes have demonstrated more favorable results when compared with resorbable devices, mainly due to their betterspace-making capacity, longer barrier function, lack of a resorbption process that may affect bone formation (Hämmerle& Jung 2003).
dPTFE(High-density polytetrafluoroethylene), Textured dPTFE(Cytoplast)[9]
2- Resorbable membrane:
A.Synthetic: 1.polylactide,2.polyglycolic acid,3.vicryl mesh,Cargile membrane

Autogenous

Autogenous intraoral (obtained from chin, mandibular ramus, maxillary tuberosity)

Autogenous Extraoral (obtained from tibia, anterior ilium, posterior ilium, cranial bone)

Block and particulate

Xenograft

Bovine

Porcine

Block and particulate

Allograft

Demineralised freeze-Dried bone

Freeze dried bone allograft

Block and particulate

Alloplast

Bioactive glass

Calcium phosphate

Calcium sulphate

Calcium carbonate

Synthetic polymers

Particulate HA

Biological agents

PRF, PRP

Growth factors

BMP

Comparison of different grafting materials:

Xenografts and allografts resulted in least loss of socket dimensions

Alloplast has the larger amount of vital bone and the less amount of remnant graft material and remnant connective tissue.

Ridge augmentation procedures:

1) Ridge preservation
2) Bone regeneration in fresh extraction sockets
3) Horizontal bone augmentation
4) Ridge splitting/expansion
5) Vertical ridge augmentation

CONCLUSION:

ridge augmentation procedures and using bone grafts for the procedures have become increasingly predictable. The proper selection and application of the available techniques and biomaterials are key to determinants of implant survival/success rates.

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Conflict of interest – nil

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