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Review Article

Bone Augmentation Procedure Before Placing the Dental Implant: A Literature Review

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ABSTRACT

Addition of alveolar bone to implant treatment is a common practice to obtain the function and aesthetics expected in areas of inadequate bone. Bone augmentation is a surgical procedure to correct the shape and size of the alveolar bone in preparation for receiving or maintaining a dental prosthesis. Correction of bone deficiencies will not only allow ideal implant placement in terms of angulation and size, but also allow correction of soft tissue deficiencies to improve overall esthetics. Several bone augmentation techniques for correcting inadequate bone conditions include interpositional grafts, onlay block bone grafting, ridge split / ridge expansion, guided bone regeneration and osteogenesis distraction.

Keywords: Bone Augmentation, Dental implants, Graft, Guided bone regeneration

INTRODUCTION

Dental rehabilitation using implants in patients who have lost part or all of their teeth has become a common treatment with long-term reliable results.¹ More than 90% of patients expressed satisfaction with implant therapy.² The success of implant therapy depends on adequate bone thickness at the implant site.³ Inadequate bone condition due to atrophy, periodontal disease, trauma or vertical, horizontal and sagittal interaxillary relationships can result in insufficient bone volume for implant placement.⁴ Assessment of bone morphology as the implant placement site consisted of volume, ridge contour and marginal bone position of neighboring teeth. Bone augmentation is a surgical procedure to correct the shape and size of the alveolar ridge to create adequate contours for implant placement.⁵ A reconstructive approach to bone augmentation includes several techniques with varying success rates, such as interpositional grafts, onlay block bone grafting, ridge split / ridge expansion, guided bone regeneration and osteogenesis distraction.⁶ The choice of bone augmentation technique depends on several factors, including clinical

characteristics, namely the location, type and morphology of bone defects, degree of atrophy, type of prosthesis, and dentist and patient preferences.⁷ The important factors for success before performing the augmentation procedure are the selection of techniques, biomaterials, appropriate timing, systemic conditions and local factors including soft tissue and bone morphology.⁸ The soft tissue present must be sufficient to cover the augmentation area, and if this is insufficient then the soft tissue augmentation must be performed first before the hard tissue.⁷

LITERATURE REVIEW

Bone augmentation for implant treatment it's a common practice to obtain the function and aesthetics expected in areas of inadequate bone. The bone augmentation technique can be used for socket grafts, horizontal ridge augmentation and vertical ridge augmentation. The bone augmentation technique used to reconstruct ridge defects depends on the extent of horizontal and vertical defects.²⁸ Following is the flow of selecting the appropriate technique for ridge augmentation of the maxilla and mandible.⁸

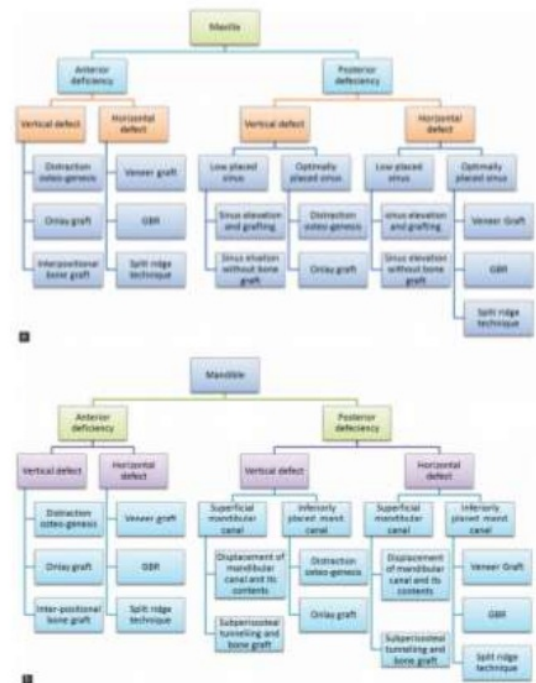


Fig.1:Flow of selection of ridge augmentation technique (a) ridge augmentation in the maxilla and (b) ridge augmentation in the mandible. 8

Interpositional bone graft (Sandwich Technique)
 Interpositional bone graft is a practical and predictable procedure with a low incidence of complications and a high success rate for increasing vertical bone height in the maxilla and mandible. The interpositional bone graft shows better vertical augmentation results by grafting between bone segments after osteotomy. This graft functions as a layer (sandwich) by producing good vascularization between the segments and the graft and results in a lower resorption rate than the onlay graft technique.^{9,10} The indication for the interpositional bone graft was in cases lack of vertical bone with dimensions of at least 4-5 mm in ¹¹ and without soft tissue deficits. A vestibular incision was made on the non-keratinized mucosa to reveal the facial aspect which was planned as an area of augmentation. Vertical corticotomy and osteotomy were performed using microreciprocating and exposed the bone around the roots of adjacent teeth, followed by horizontal corticotomy and osteotomy to mobilize ²⁶ the segment. The minimum distance from vital structures such as the maxillary sinus or mandibular canal is a minimum of 3-5 mm. The increase in height should be adjusted according to the exposed soft tissue to achieve better flap coverage. Segment retrieval can also be increased in the buccal or lingual section

according to the desired prosthodontic position. A bone graft block ¹⁷ usually using an autogenous corticocancellous graft is placed between the removed segment and the basal bone. The graft is fixed using a miniplate and the periosteal flap is returned to its position to aid closure.^{8,11}

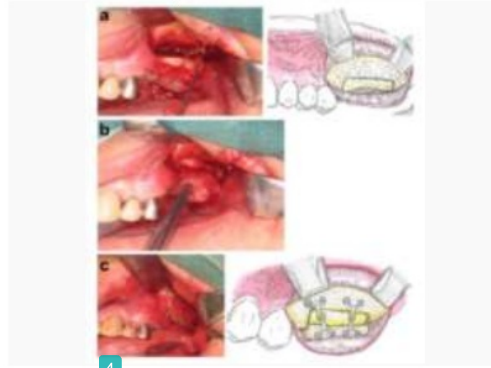


Fig.2: (a) Paracrestal incision is made in the buccal side, followed by horizontal and vertical osteotomy (b) placement of bone graft block (c) fixation of bone graft block between bone segments.9

Onlay block bone grafting
 Onlay block bone grafting is an augmentation technique used in horizontal and vertical bone

defects. After the mucoperiosteal flap is removed, using a bur several holes are made to reach the base of the spongy bone as the recipient site. The graft is then shaped according to the shape of the bone defect to be placed in the recipient site as a veneer or block. Inverted J block grafts are usually used for vertical and combined bone defects whereas veneers are used for horizontal bone defects. The block graft is fixed using screws. Block grafts can be obtained from an autogenous intraoral, extraoral, xenograft or alloplast.⁸

Ridge splitting / ridge expansion: Ridge splitting is an alternative to horizontal augmentation indicated by a 2-5mm shortage of horizontal bone, as well as a narrow ridge with a lingual buccal width of only 3mm or more. The separation of the alveolar bone begins with the use of ²⁵ chisel, osteotome or piezosurgical function to increase the width of the horizontal ridge. The buccal and lingual cortical plates should not be fused and there must be intervention of multiple cancellous bones between the cortical plates to prevent the bone from breaking and separating. This technique results in increased horizontal ridge width, provides good vascularization, bone segment stabilization and soft tissue protection with the combination of ²⁴ positional bone graft treatment.⁸

Guided Bone Regeneration: The guided bone regeneration technique of bone augmentation has been widely used for implant treatment and has shown a very good and effective success rate for bone regeneration. The guided bone regeneration technique is well accepted because it shows predictable results and is relatively non-

invasive when compared to other bone augmentation techniques. Guided bone regeneration can be done before or simultaneously with ¹⁸ implant placement, using bone graft materials such as autograft, allograft, xenograft or alloplasts and non-resorbable or absorbable membranes.^{12,13,14}

⁷ Bone graft material has osteogenesis, osteoinduction and osteoconduction properties. Osteogenesis is the formation of new bone by the material contained in the graft. Osteoinduction is a characteristic of graft material that can induce adjacent cells to become osteoblasts that form new bone. The nature of osteoconduction is the nature of the graft material which forms a scaffold between existing bones, so that cells that are far from the graft material can enter and form new bone.^{13,15} Step initial patient inlocal infiltration anesthesia, then performed operation surgery flap with the incision and flap were opened with a full thickness flap then performed debridement / optimal cleaning with a combination of scaler and curette, and irrigation with saline clear of granulation tissue and subgingival debris/calculus. After decortication of the bone to be augmented, application of bone graft material that is directly mixed with new bleeding that occurs in the alveolar bone in the region underwent flap surgery, on it is used an absorbable membrane containing collagen. Then suturing it with non-absorbable thread. The patient is given antibiotics and analgesics as well as instructions for cleaning the oral cavity. Two weeks postoperatively, suture removal was performed, membrane removal was performed four weeks postoperatively.^{16,17}

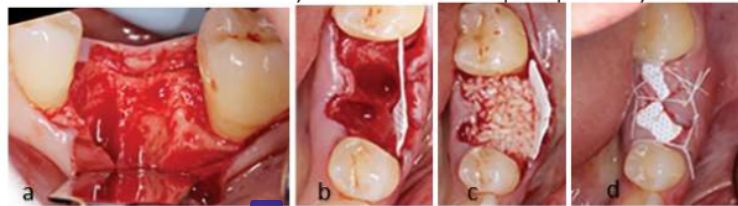


Fig.3: Guided Bone Regeneration (a) full thickness buccal flap showing the area of bone to be augmented (b) placement of the membrane on the buccal aspect of the post extraction socket (c) placing the graft in the socket (d) suturing closure.¹⁶

Osteogenesis Distraction

Osteogenesis distraction is a technique of widening the remaining alveolar bone available, which follows the body's natural healing mechanism, by generating new bone for the increase in alveolar bone height. This method is to prepare an adequate volume of bone for implant by cutting the bone in the region to be elevated and then the separate bone segments are distracted, and applied a gradual force.¹⁷

Segment distraction can be performed in a vertical and / or horizontal direction. This technique has the ability to simultaneously increase the volume of bone and soft tissue deficiency, offers predictable results with a fairly low level of abnormality, as well as infection and healing times are relatively short to the progress of implant rehabilitation (12 weeks) when compared to other methods.¹⁸ The surgical procedure for distraction osteogenesis is divided

into vertical and horizontal distraction osteogenesis. The vertical distraction osteogenesis technique begins with local anesthesia, the incision is made along the alveolar, then the mucoperiosteal vesicular flap is removed. Keep the mucoperiosteum attached to the lingual area to the area that moves. The moving segment is cut into an inverted trapezoidal shape, so as not to interfere with movement during the distraction procedure. Osteotomy was performed using rotary instruments (bur, discs, and reciprocating saws) and chisels. The displaced segments are moved as a whole despite remaining adhesions to the mucoperiosteum in the lingual area.¹⁷ Once the distractor has been placed, without suturing the mucoperiosteal flap, during the same surgery, the moving part is immediately opened to a height of 5 mm to ensure adequate movement and proper direction of movement and there is no intervention between the moving part and the basal bone. The moving segment is then returned to its original position. Distraction was started 7 days later with 0.5 mm daily every 12 hours for 5 days. After 12 weeks, the distractor is removed and the implant is placed. At week 14 after the implant was placed, prosthetic restoration was started.¹⁹

DISCUSSION

Successful implant placement requires knowledge of various concepts and techniques. Treatment planning prior to implant placement, hard and soft tissue augmentation, surgical techniques and implant prosthetics must be of utmost concern in implant placement. Dental implants that are placed in a three-dimensional position that are not ideal can cause peri-implantitis, malfunction and aesthetics and even loss of the implant. One of the key factors for implant placement is the availability of alveolar bone in the area. Inadequate height, width and quality of the alveolar bone will determine the final outcome. In addition, the soft tissue profile is also greatly influenced by bone height and width. Correction of bone deficiencies will not only allow ideal implant placement in terms of angulation and size.^{20,21,22}

Bone augmentation procedures are increasingly being used in implant care. Bone augmentation is intended to provide the expected function and aesthetics in cases with insufficient bone quantity. Several bone augmentation techniques such as bone graft are known as attempts to overcome excessive alveolar bone resorption by means of bone grafting techniques so that it is hoped that the alveolar bone will return to an ideal condition for implant placement. In addition, Guided Bone Regeneration is a surgical technique to increase

the formation of new bone cells in an effort to add alveolar bone. This technique requires a fairly high skill because this technique is very sensitive.^{23,24,25,26,27}

No one clinical technique is optimal for every augmentation procedure. The technique should be selected after careful evaluation of the defect area and taking into account related factors such as the extent of the damage, patient preferences, the expertise of the surgeon, available materials and instruments, cost, as well as ease of special procedures to be performed. The techniques commonly used for horizontal bone augmentation are guided bone regeneration, ridge splitting and expansion and block grafts while for vertical bone augmentation are autogenous bone graft, vertical guided bone regeneration, and alveolar distraction osteogenesis. Very important to review all successfully applied techniques and materials available for improve the selection of the right method to achieve the best results and high success rates.^{23,24,28,29}

CONCLUSION

Various bone augmentation techniques have been shown to be effective in correcting inadequate bone conditions prior to implant placement. Selection of the right bone augmentation will result in the availability of adequate alveolar bone for implant placement that is biologically acceptable and aesthetically pleasing. In addition, the success of bone augmentation also depends on the experience and ability of the dentist.

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