Hard tissue augmentation for alveolar defects before implant placement

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ABSTRACT

Background. Often when planning implant therapy, there is a need to augment or replace bone that has been lost. The alveolar defects may occur as a result of tooth loss due to extraction, advanced periodontal diseases or trauma, long term use of removable appliances, dehiscence and fenestration defects, developmental defects/clefts, congenitally missing teeth and odontogenic cysts and tumors. Insufficient bone volume can be brought about by hard tissue augmentation. This techniques have led to increased predictability in reconstruction of alveolar ridge defects and functional implant placement. Purpose. To describe the methods of hard tissue augmentation which can be done with block grafts (autografts and allografts), particulate grafts (cortical and cancellous), xenografts, or synthetic materials. Review. The reconstruction of a normal alveolar housing, in height and width, is imperative to achieve a harmonious balance between biology, function, and aesthetics. Depending on the size and morphology of the defect, horizontal or vertical, various augmentation procedures can be used. Soft tissue management is a critical aspect of hard tissue augmentation procedures. Incisions, reflection, and manipulation should be designed to optimize blood supply and wound closure. The design and management of mucoperiosteal flaps must consider the increased dimensions of the ridge after augmentation as well as esthetics and approximation of the wound margins. The surgical procedure needs to be executed with utmost care to preserve the maximum vascularity to the flap and minimize tissue injury. Conclusion. Alveolar ridge defects can be classified by using Seibert's classification or HVC System. The treatment of alveolar ridge defect before implant placement can be done with hard tissue augmentation.

Keywords: implant placement; alveolar defects; hard tissue augmentation

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ABSTRAK

Latar Belakang. Sebelum merencanakan terapi implan, seringkali dibutuhkan penambahan atau penggantian tulang yang hilang (resorbsi). Defek alveolar dapat terjadi akibat kehilangan gigi setelah ekstraksi, penyakit periodontal lanjut, trauma, penggunaan jangka panjang peranti lepasan, defek dehiscence dan fenestration, kelainan perkembangan / (celah bibir), kelainan kongenital gigi, kista odontogenik dan tumor. Volume tulang yang tidak mencukupi dapat ditambah dengan hard tissue augmentation. Teknik ini dapat meningkatkan prediksi keberhasilan perbaikan defek alveolar dan pemasangan implan fungsional. Tujuan. Untuk mendeskripsikan metode hard tissue augmentation yang dapat menggunakan block graft (autograft dan allograft), particulate graft (cortical dan cancellous), xenograft atau bahan sintetis lainnya. Pembahasan. Perbaikan defek alveolar ridge ke posisi normal, dalam hal ketinggian dan ketebalan, sangat penting untuk mencapai keseimbangan harmonis di antara kondisi biologis jaringan, fungsi dan penampilan estetis. Berdasarkan ukuran dan morfologi defek alveolar, horizontal maupun vertikal, beberapa prosedur augmentasi dapat diaplikasikan. Manajemen jaringan lunak merupakan aspek penting dari prosedur augmentasi. Insisi, refleksi, dan manipulasi harus dirancang untuk mengoptimalkan suplai darah dan penutupan luka. Desain dan pengelolaan flaps mucoperiosteal harus mempertimbangkan peningkatan dimensi ridge setelah augmentasi serta estetika dan perkiraan margin luka. Prosedur bedah harus dijalankan dengan hati-hati untuk mempertahankan vaskularisasi maksimum untuk flap dan meminimalkan cedera jaringan. Kesimpulan. Defek alveolar ridge dapat diklasifikasikan dengan menggunakan klasifikasi Seibert maupun klasifikasi HVC System. Perawatan defek alveolar ridge sebelum pemasangan implan dapat dilakukan dengan hard tissue augmentation.

***Kata kunci** : pemasangan implan; defek alveolar; hard tissue augmentation*

INTRODUCTION

Resorption of alveolar bone is a common clinical problem which can be a physiologic or a pathologic process. The deformities and defects may occur as a result of tooth loss due to extraction, advanced periodontal diseases or trauma, long term use of removable appliances, dehiscence and fenestration defects, developmental defects/ clefts, congenitally missing teeth and odontogenic cysts and tumors. This resorption pattern formed alveolar ridge that is not suitable for prosthodontic rehabilitation , including implant placement.[1]

Successful implant therapy is dependent upon an adequate volume of bone at the site of implant placement. In principle, four methods have been described to increase the rate of bone formation and to augment bone volume: osteoinduction by the use of appropriate growth factors; osteoconduction, where a grafting material serves as a scaffold for new bone growth; distraction osteogenesis, by which a fracture is surgically induced and the two fragments are then slowly pulled apart; and finally, guided tissue regeneration (GTR), which allows spaces maintained by barrier membranes to be filled with new bone.[2]

The surgical methods used during the preprosthetic phase include correction of the ridge defect before implant placement by hard tissue augmentation. This method used to correct severe defects. The hard tissue augmentation can be done with block grafts (autografts and allografts), particulate grafts (cortical and cancellous), xenografts, or synthetic materials.[3]

LITERATURE REVIEW

In 1983, Seibert classified the different types of alveolar ridge defects that a clinician may encounter while planning a prosthetic rehabilitation. The classification described the following three clinical situations:[4]

1. Class I : alveolar ridge defects have a horizontal loss of tissue with normal ridge height.
2. Class II : alveolar ridge defects have a vertical loss of tissue with normal ridge width.
3. Class III : alveolar ridge defects have a combination of class I and class II resulting in loss of normal height and width.

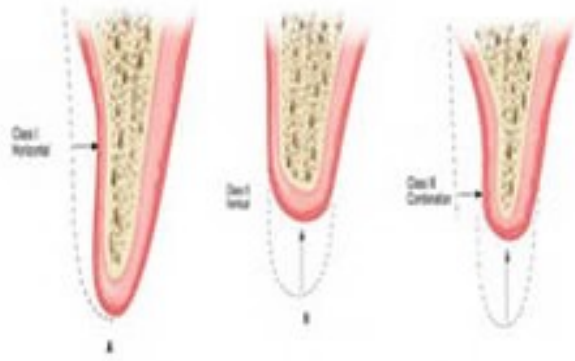

Figure 1. Seibert's classification.[5]

Another classification can be classified as to the extent of involvement: mild/small (less than 3 mm), moderate/medium (3 to 6 mm) and severe/large (more than 6 mm). A modified system (the HVC System) using the above two classification systems has been proposed. The Class I, II, and III defects are classified as horizontal (H), vertical (V), and combination (C) defects, respectively. Each of the categories is subdivided into small (s, ≤3 mm), medium (m, 4 to 6 mm), and large (l, ≥7 mm) subcategories. Therefore, a defect would be called an H-s for a small horizontal defect or C-m for a medium combination defect.[5]

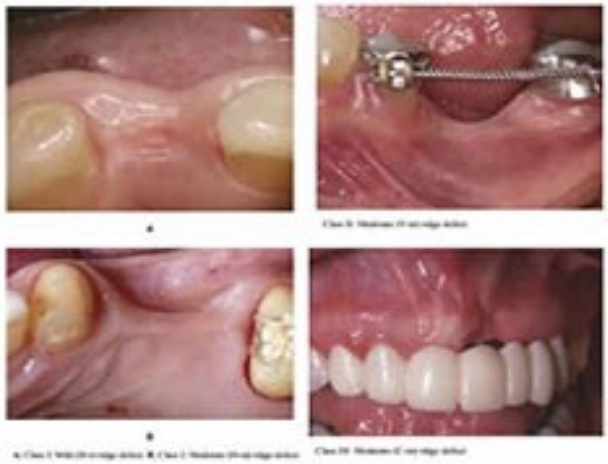

Figure 2. HVC System.[5]

Dibart et al. (2006) perform maintenance on the defect Class I Seibert using Hard Tissue Augmentation with allograft as shown in Fig.3. Preoperative condition shown in Fig. 3 (A, B). Fig. 3B showed occlusal view of the defect showing the buccal concavity that will be augmented with a bone graft. On Fig. 3C, a full-thickness flap has been elevated, with a horizontal incision that is slightly palatal to the midcrest and two vertical releasing incisions. A 10-mm OsteoMed screw has been inserted halfway through the alveolar bone.

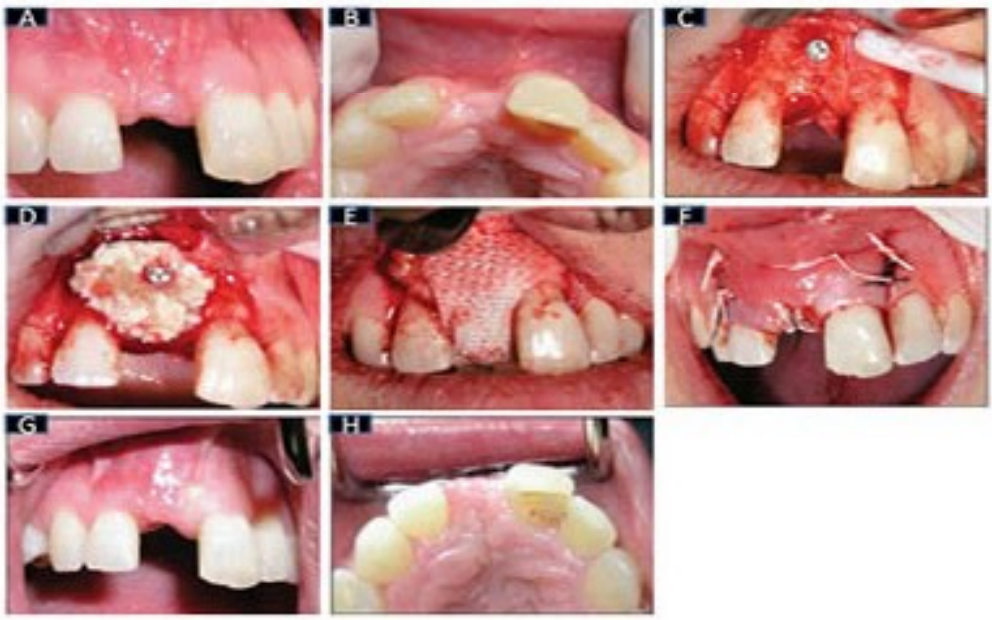

Figure 3. Hard Tissue Augmentation with allograft.[4]

This screw will serve as an anchor to the bone allograft that will be placed next. The area receiving the graft has been decorticated by using a small round carbide burr. Fig. 3D showed block graft (10 x10 x5 mm), once softened, has been pushed through the screw and molded to fit the defect. When the defect is large, a second screw and a bigger graft may be necessary. A resorbable membrane (Ossix) has been trimmed to the appropriate size and placed over the bone graft. The membrane is tucked under the palatal flap before suturing. The buccal flap is to be undermined to achieve coverage of the membrane and graft passively as shown in Fig. 3E. On Fig. 3F, a horizontal mattress buccally and palatally with a GoreTex suture will hold the flaps up without tension and keep the membrane down on the bone. Additional single interrupted sutures will close the wound by primary intention. Results of one year post-operative healing can be seen in Fig. 3 (G, H). Furthermore, it can be made the implants placement.[4]

Autograft *(autogenous graft)* can also be used for *hard tissue augmentation*. Pushparajan et al. (2013) conducted a maintenance defect Class I Seibert with this method. In the Fig. 4 (A) looked overview preoperative. Horizontal incisions were made slightly palatal to the midcrestal region with care taken to preserve keratinized tissue on both sides of the incision (Fig. 4B). Vertical incisions were made on the buccal surface from the mesial and distal extents of the horizontal incision extending to the mucogingival junction. A full-thickness mucoperiosteal flap was reflected on the buccal side, and a pouch was created on the palatal side to insert the barrier membrane (Fig. 4C). Fig.4D showed a full-thickness mucoperiosteal flap was reflected at the donor site *(symphysis Menti)*. The Ebner 502 expanded bone grafter was usedfor bone removal and autogenous grafting. The blade was used to shave bone from the cortical surfaces of the symphysis menti, producing shortconvoluted ribbons (Fig.4E). Then, the donor sitewas sutured. The particulate autogenous graft material, an osseous coagulum (Fig.4F), was then delivered with the handle directly in the prepared recipient bed covering the decortication site (Fig.4G). A layer of Bio-Oss cancellous granules (0.25-1.0 mm µm) was then mixed with particulate graft and placed in the recipient site (Fig.4 H,I). The rehydrated BioMend membrane was placed in direct contact with the bone graft and extended at least 3 mm beyond the graft border in all directions (Fig.4J). The flap was coronally repositioned for complete wound coverage without tension. Primary closure was then obtained using a nonresorbable monofilament suture (Fig. 4K). Sutures were removed 2 weeks postoperatively, and patients were followed up 6 months postoperatively and showed improvement as shown in Fig.4(L).[4]

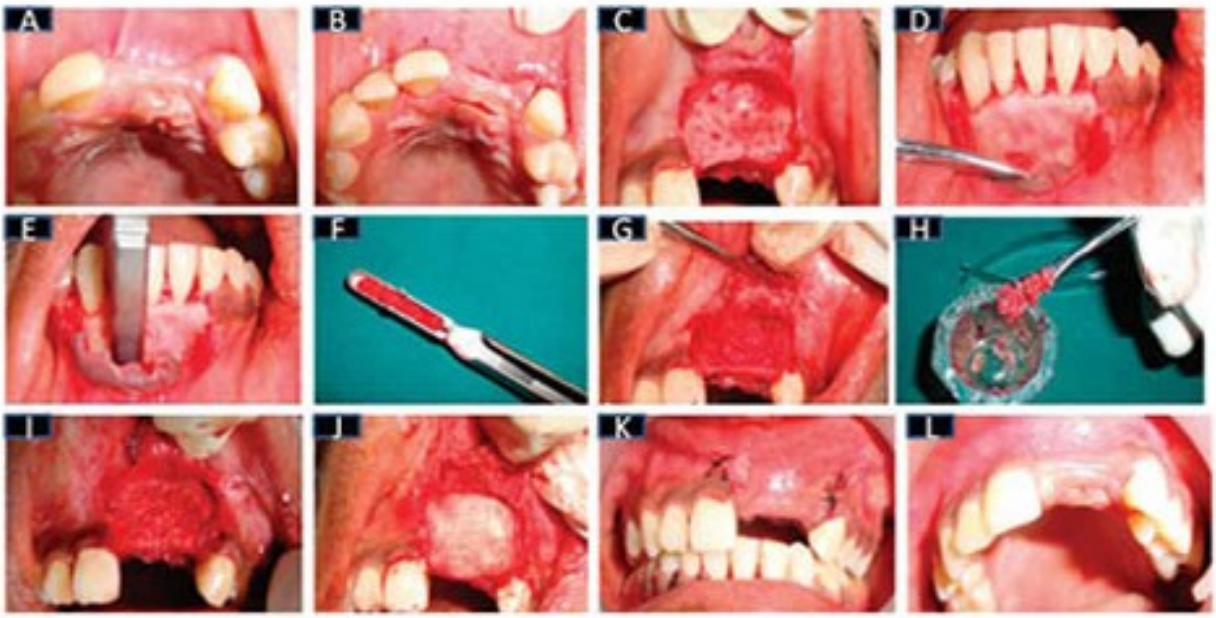

Figure 4. Hard tissue augmentation with autograft.[4]

Rachana et al. (2012) performed hard tissue augmentation with monocortical block graft in order to have enough place for implant placement. Fig. 5 (A) showed the pre-operative condition. A rectangular monocortical block graft was harvested from the mandibular symphyseal area (Fig. 5B). Also, cancellous bone from the same area was obtained in the form of particulate graft with the help of a Molt curette (Fig.5C). The block graft was cut to appropriate size and anchored to fit the recipient site intimately. Once properly positioned, the graft was fixated with two titanium screws of 1.5 mm diameter each passing though the graft into the remaining native alveolar bone (Fig. 5D). Particulate graft was placed in the right central incisor area since the length of the block graft was not sufficient to cover the entire edentulous span (Fig 5E). The entire area was covered with the help of a resorbable membrane made of fish collagen (Fig. 5F). Following this, the flap was replaced and the area was sutured (Fig.5G).

On reflection of the donor site, periapical granuloma was noticed with respect to the lower left central and lateral incisors, which had already been root canal treated. Hence, apicectomy was done for these teeth before closing the donor site (Fig.5H). Once the donor site was sutured (Fig.5I), periodontal dressing was given for additional protection, and pressure bandage was given externally. Significant improvement in the ridge width was noticed at six months (Fig.5J). Further, the placement of implant: Maxillary right central incisor shown in Fig.5(K). Fig. 5 (L) showed the patient's teeth with a final prosthesis with good aesthetics.[7]

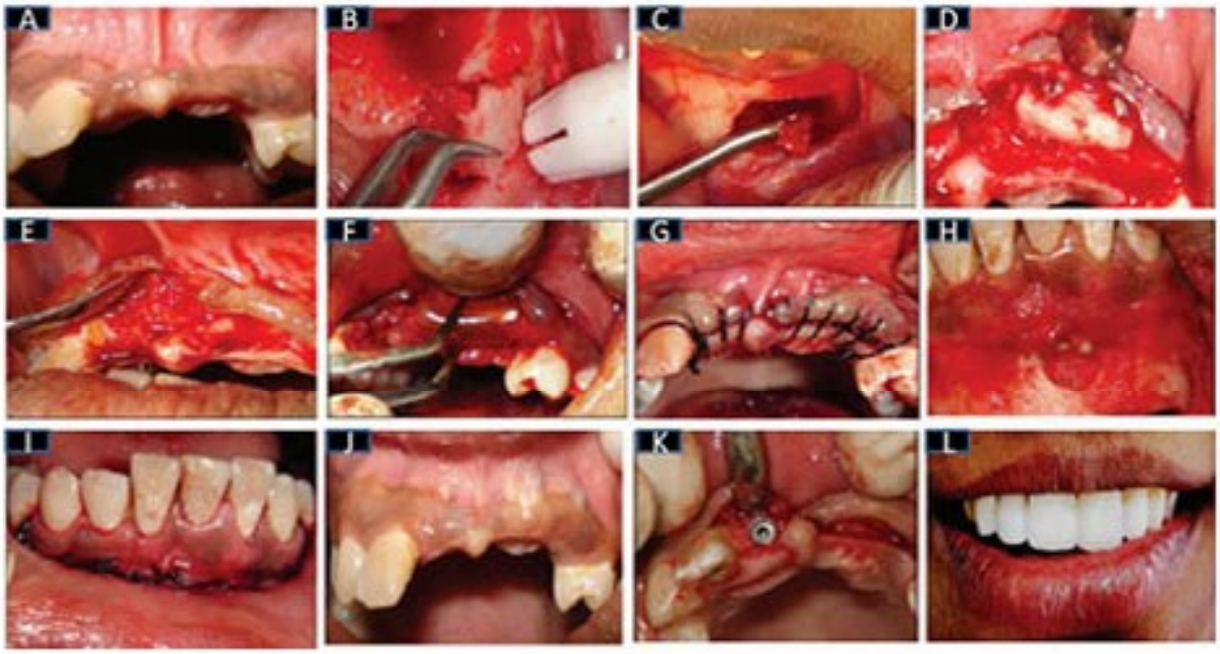

Figure 5. *Hard Tissue Augmentation with monocortical block graft.*[7]

Santiago (2007) performed alveolar defect treatment using regenaform before implant placement as shown in Fig. 6. Regenaform is a combination of assayed freeze-dried, demineralized bone allograft and cortical cancellous chips in a thermoplastic matrix. It has a hard, rubbery consistency at body temperature, but becomes soft and moldable by warming to a temperature of 43° to 49°C. Regenaform onlay block graft procedure is as follows: full-thickness flap is elevated, cortical plate is decorticated, placement of graft material in water bath for approximately 15 minutes, placement of graft in surgical site, placement of resorbable or non-resorbable membrane and tension free primary closure.[8]

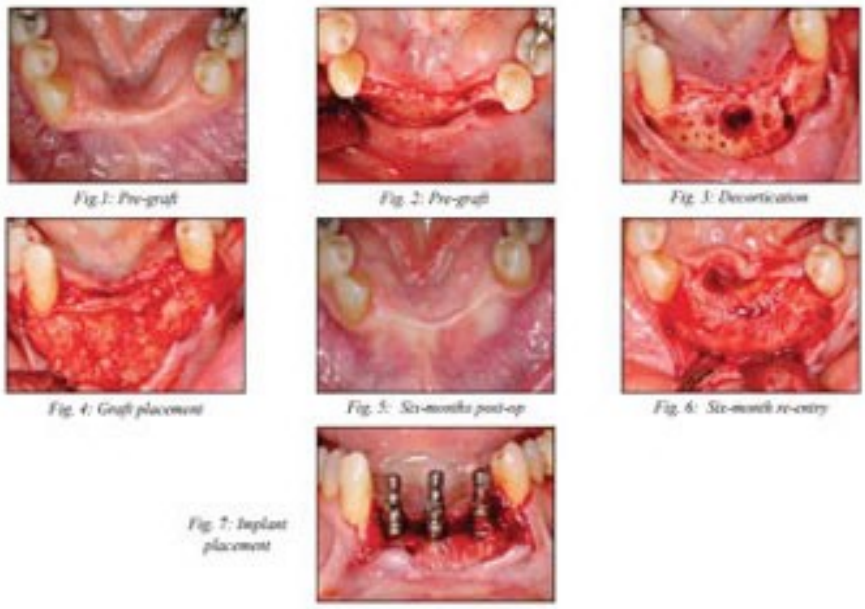

Figure 6. Hard tissue augmentation with regenaform.[8]

DISCUSSION

Defects of the alveolar ridge is the loss of the horizontal and vertical dimensions of bone and surrounding soft tissue. This defect is related with the rest of the bone due to tooth extraction. Problems caused by this defect is the main aesthetic problems, and other problems are a function of the placement of a prosthesis or implants.[9]

When planning treatment for corrective surgery, it is important to inform the patient that a single procedure may not repair the defect, so a second, or sometimes even a third, procedure is sometimes warranted. A Seibert class I defect is easier to treat than a class II, which, in turn, is easier to treat than a class III. A class III defect will require multiple grafting. In addition, the prognosis is better in the case of horizontal defects as opposed to vertical or combined defects.[4]

The reconstruction of a normal alveolar housing, in height and width, is imperative to achieve a harmonious balance between biology, function, and aesthetics. Depending on the size and morphology of the defect, horizontal or vertical, various augmentation procedures can be used. Soft tissue management is a critical aspect of bone augmentation procedures. Incisions, reflection, and manipulation should be designed to optimize blood supply and wound closure. The design and management of mucoperiosteal flaps must consider the increased dimensions of the ridge after augmentation as well as esthetics and approximation of the wound margins. The surgical procedure needs to be executed with executed carefully care to preserve the maximum vascularity to the flap and minimize tissue injury.[10,11]

Several flap techniques maintain a submerged position of bone grafts and barrier membranes during the entire healing process, including a remote or displaced incision. The advantage of a remote incision is that the wound opening is positioned away from the graft. A conventional crestal incision can be used, even in large supracrestal defects, as long as periosteal releasing incision and coronal advancement of the flap achieve the tension free closure. Most reports suggest removing sutures approximately 10 to 14 days after surgery. It is also suggested that no prosthesis be inserted for 2 to 3 weeks after surgery to avoid pressure over the wound during the early healing period.[11]

General concepts for flap management associated with hard tissue augmentation include the following:[1] (1) Whenever possible, it is desirable to make incisions remote relative to the placement of barrier membranes (e.g., vertical releasing incisions at least one tooth away from the site to be grafted). In the anterior maxilla, keeping vertical incisions remote is also an

esthetic advantage; (2) Full mucoperiosteal flap elevation at least 5 mm beyond the edge of the bone defect is desirable; (3) The use of vertical incisions, although often required for surgical access, should be minimized whenever possible; (4) Use of periosteal releasing incision to give the flap elasticity and permit tension-free suturing is essential. This permits complete closure without stress on the wound margins; (5) Avoid postoperative trauma to the surgical site (i.e., no removable appliance should be inserted over the wound for a postoperative period of 2 weeks or more); (6) Wound closure should incorporate a combination of mattress sutures to approximate connective tissues and interrupted sutures to adapt wound edges.

CONCLUSION

Alveolar ridge defects can be classified by using Seibert's classification or HVC System. The treatment of alveolar ridge defect before implant placement can be done with hard tissue augmentation. The hard tissue augmentation consists of Guided Bone Regeneration (GBR) with block grafts (autografts and allografts), particulate grafts (cortical and cancellous), xenografts, or synthetic materials.

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