An Alveolar Bone Augmentation Technique to Improve Esthetics in Anterior Ceramic FPDs: A Clinical Report

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This clinical report describes guided bone augmentation for treatment of a facial maxillary alveolar bone defect to enhance the esthetic result for an all-ceramic fixed partial denture (FPD). A combination of decalcified freeze dried bone allograft and resorbable human pericardium, in conjunction with cortical channel expansion, was used for the augmentation process to eliminate a secondary surgical procedure. Post-operative examinations showed improvement in the alveolar bone contour. The regeneration of the missing osseous structure was accomplished to support the future esthetic soft tissue contours. This osseous regenerative technique significantly increased the functional and esthetic outcome of the final FPD by restoring the alveolar ridge defect to its original dimension.

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PREPROSTHETIC SURGERY is designed to establish the best hard and soft tissue bases for prosthetic appliances.[1,2] Its scope spans the spectrum from simple extraction technique and preparation of the mouth for dentures to bone grafts and endosseous implants.[3,4] The development of new biomaterials and improved prosthetic techniques, along with a better understanding of oral physiology, has contributed to great strides in the success of prosthetic applications for patients.[5]

The success of a fixed partial denture (FPD) should be measured by the satisfactory restoration of function and esthetics.[6] The replacement of teeth in esthetically demanding areas requires a prosthesis of correct form and shade, along with establishment of a natural appearance of the periodontal tissue surrounding the restorations. Loss or deficiency of the alveolar ridge can affect phonetics and esthetics, with the latter being especially problematic in patients with a high smile line (Fig 1).[6] When the supporting bone structure of the soft tissue is lost for pathological reasons or due to excision or trauma, it does not regenerate to its original dimensions.[7] This can complicate the clinical recovery process and may mandate special recontouring procedures, some of which have been typically unpredictable. One technique for reestablishing the contour of the alveolar ridge with deep facial alveolar bone defects is guided bone regeneration.[8]

Onlay bone grafting can improve the height and width of the maxillary alveolar bone and can be used for both anterior and posterior defects.[9] Autogenous and allogenous bone grafts can be used for alveolar ridge augmentation.[10,11] Autogenous bone grafting in any reconstructive procedure is considered the primary choice because of high success rates;[12,13] however, harvesting of the graft requires a second surgical site, which could increase the level of postoperative discomfort. Allografts can be an alternative to autogenous grafts.[14] The advantages of allografts include ready availability, elimination of donor site surgery, reduced anesthesia and surgical time, and decreased blood loss.[14] A potential disadvantage of allographs is their quality, since

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Figure 1. Patient's smile line exposes the alveolar defect area and complicates the esthetics.

the osseoconductivity of the graft material can vary.

When using bone grafts, Fonseca demonstrated that smaller bone particles had a more rapid onset of osteogenesis and a greater yield of bone than did large particle bone grafts.[9] Also an application of a resorbable regenerative membrane with an onlay particulate graft material is essential for obtaining the desired post-operative shape and size.[15] Boyne has reported the outcomes of ridge augmentation techniques using a membrane with a particulate graft.[16] Guided bone regenerative membranes are used to separate tissues during healing, retard apical migration of epithelium to the site, maintain the necessary space for bone growth (tenting) and protect the graft material in the defect.[17] Combination of membrane use with bone-grafting materials for space maintenance tends to improve the guided bone regeneration outcomes.[18]

All-ceramic restorations represent one of the most successful treatment methods for esthetic improvement of anterior teeth. In comparison to metal ceramic restorations, all-ceramic restorations can mimic the natural translucency of enamel and can provide better esthetics.[19] The Empress 2 ceramic restoration system (Hot Pressed Lithium Disilicate composite, Ivoclar AG, Schaan, Liechtenstein) was chosen for this patient to maximize the esthetic outcome of the treatment.[20] This clinical report describes the use of a maxillary alveolar bone augmentation technique with ceramic restorations to achieve the maximum esthetic outcome.

Clinical Report

A 28-year-old male Caucasian with an extracted right maxillary lateral incisor was evaluated for

Figure 2. The defect area in the edentulous maxillary right lateral incisor region.

restorative treatment. His medical history did not reveal any systemic disease. The patient had metal ceramic crowns on both maxillary central incisors and the right lateral incisor for many years; however, his maxillary right lateral incisor had to be extracted because of an apical cyst and severe mobility (Fig 1). Clinical and radiographic examinations revealed a facial alveolar ridge defect in the labial part of the edentulous region 6 months after the extraction (Fig 2). A FPD restoration with a pontic with a long crown height would be required to fill the gap between the occlusal area and alveolar ridge; however, this type of restoration would not provide optimal esthetics. Restorative options were discussed and explained to the patient, who selected bone augmentation of the defect area in the maxillary alveolar ridge to improve the esthetics. After thorough consultation, it was decided to increase the buccal-lingual width of the alveolar ridge, since vertical height was sufficient to construct a FPD without any esthetic problem.

Surgical Procedure

A combination of cortical channel expansion technique and a particulate onlay bone graft was used to augment the defect area. Indications for this technique are horizontal ridge defects and alveolar ridge dehiscence/fenestration defects.[21] Other potential indications are alveolar ridge augmentation/preservation and immediate

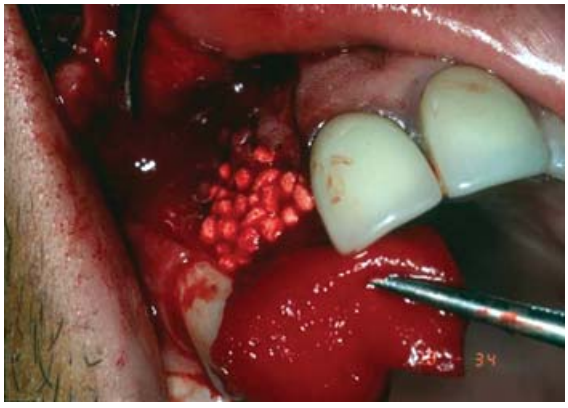

Figure 3. Graft adapted to defect region.

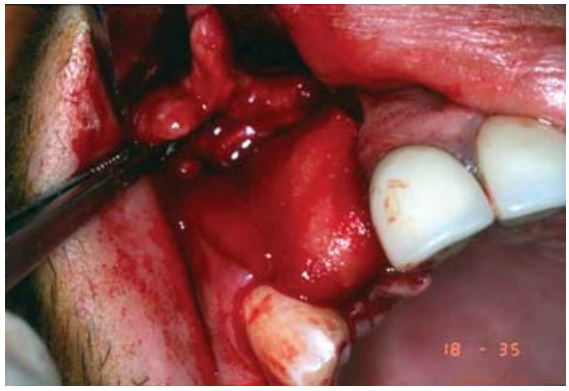

Figure 4. Resorbable membrane covering the graft material.

implant replacement. Alveolar bone augmentation techniques include conventional onlay/inlay grafts, sandwich osteotomies, guided bone regeneration with membranes, and distraction osteogenesis.[22-25] However, use of a combination of cortical channel expansion technique with onlay bone grafting and a membrane is beneficial when the stabilization of the treatment site is unachievable due to the lack of buccal-lingual alveolar bone quantity.[26]

A prophylactic antibiotic medication was started (Amoxicillin 500 mg every 8 hours) 3 days prior to surgery and continued for 4 days after surgery. Crestal incisions were made from the mesial of tooth #6 to the distal of tooth #8, with two vertical releasing incisions on the facial, and a mucoperiostal flap was reflected on the labial side. A thin groove with a depth of 1 cm was prepared on the alveolar ridge between the two neighboring teeth using a surgical bur. Distal and mesial sides of the groove were extended for 1 mm to the labial side to weaken the cortical bone. The alveolar ridge was widened from this groove region to the labial side using a thin chisel. After obtaining a width of 0.5 cm, the gap between the labial and palatal edges of the alveolar ridge was filled with demineralized human bone (Spongioza microchips, Tutoplast, Neunkirchen, Germany) (Fig 3). The particle size of the demineralized bone allograft material was between 0.25 and 1.00 mm. Resorbable human pericardium (Pericardium, Tutoplast, Neunkirchen, Germany) was placed on the graft material to propagate guided bone regeneration to aid in space maintenance and to avoid a second surgical procedure (Fig 4).[14] Small incisions were made on the periosteum to facilitate wound closure. Surgical healing was uncomplicated.

Fixed Partial Denture Placement

Eight months later, a radiographic and clinical examination was performed to reassess the amount of augmentation prior to starting tooth preparation for the FPD. The augmentation site was completely closed and showed a radiological density distinguishable in the area filled with grafting material. The buccal-palatal contours of the alveolar ridge were now acceptable to place an esthetic FPD (Fig 5). The tooth shade was determined, and abutment teeth were prepared with subgingival chamfer finish lines because of the discoloration of the tooth structure. An impression was made

Figure 5. Augmented alveolar ridge 8 months after the surgical procedure.

Figure 6. Finished all-ceramic restoration 1 year after cementation.

and a master cast was poured in improved stone. A three unit all-ceramic FPD (teeth #6–8) and a single crown (tooth #9) (Empress 2, Ivoclar, Schaan, Liechtenstein) were fabricated in the laboratory. Fit of the restorations were confirmed and occlusal adjustments were performed prior to cementation. A resin cement (Variolink II, Vivadent, Schaan, Liechtenstein) was used for cementation.

The patient was scheduled for recall appointments at 2 weeks post-cementation and then on a 6-month recall period. After 1 year of clinical service, there was no relapse of the augmented area compared with the alveolar bone quantity at the cementation appointment. Esthetics and function of the restoration were satisfactory (Fig 6).

Discussion

Allogenous bone augmentation techniques are options for restoring the esthetics and function in patients with alveolar bone defects. A clinical treatment was presented which combined cortical channel expansion, decalcified freeze dried bone allograft, and resorbable membranes for guided bone regeneration. The superiority of autogenous bone graft is well-known and accepted; however, a secondary surgical site for the donor area complicates this technique. Even though the regenerative potential of allogenous grafting is not as reliable as autogenous grafting, it can be used in bone defects using an additional resorbable membrane. This technique can be employed to avoid the risk of rapid resorption by preventing epithelial down growth and aiding in graft containment. In addition, allogenous grafts used in treating osseous defects have other clinical shortcomings: the blood supply to the graft can be minimized,[26] there is an increased risk of surgical morbidity, and the graft may lose 30% or more of its overall size due to post-operative bone remodeling.[27] Guided bone regenerative membranes can help in treating facial osseous defects, but the inherited physical property of the membrane to collapse due to the pressure of the overlying soft tissues (thus reducing the space required for regeneration) makes the overall amount of regenerated bone questionable. The physical characteristics of the membranes can be improved by the application of allogenous grafts. This procedure allows the preservation of the space for regeneration.

Optimal soft tissue closure on the top of the membrane is a vital clinical step that contributes to the success of the grafting procedure, because any opening of the incision line can jeopardize augmentation success.[28]

An alternative to resorbable membranes can be a nonresorbable titanium mesh; however, a second surgery is required to remove the mesh. The clinician must give priority to thorough presurgical planning and consider the least invasive procedure to obtain the most predictable result. In this case a single surgical procedure was selected as the optimal treatment and an all-ceramic FPD was selected as the best restorative option. The patient preferred FPD placement to avoid performing an additional invasive procedure. A hot-pressed, lithium disilicate ceramic FPD system was selected to maximize the esthetic outcome.

After augmentation and placement of the prosthesis, the patient was examined on a 6-month recall period in which the clinical criteria for failure of treatment were evaluated, i.e., sign of pain or discomfort, inflammation or infection, mobility of the abutment teeth, radiolucency, or radiographic detectable bone loss.

In conclusion, this clinical report suggests that guided bone augmentation with decalcified freeze dried bone allograft, in conjunction with cortical channel expansion, is a viable treatment to provide esthetically acceptable contours to the alveolar ridge before prosthetic treatment. The combination of a preprosthetic surgical procedure and ceramic FPD represent an alternative treatment option to provide excellent esthetics in compromised patients.

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