

Review Article

Cortical Mandibular Bone Blocks Grafts and Piezoelectric Surgery in Complex Anterior Maxillary Alveolar Defects: A Case Report and Literature Review

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Abstract

The aim of this study is to assess the indication and efficacy of alveolar ridge reconstructions for complex horizontal and vertical augmentation procedures in the maxillary anterior area with Cortical Mandibular Bone Block Grafts (CMBBG).

Localized alveolar three-dimensional bone defects are among the most challenging problems in surgical implant dentistry. Treatment protocols, such as short implants or small diameter implants are not always offering the desired clinical and esthetic results.

The autogenous augmentation procedure can serve as an option, which allows a more biological reconstruction of the vertical and horizontal dimension of a complex bone defect in order to obtain sound replicas of natural teeth.

The clinical case of a cortical autogenous block graft in an anterior complex maxillary defect is presented along with a literature review. The presented case and the selected articles demonstrate that cortical ramus bone block grafts show relatively low graft resorption, low donor site morbidity and high implant success rates.

Keywords: Autologous Bone Grafts; Bone Defect; Ramus Graft; Cortical Block Graft; Bone Augmentation; Piezoelectric Surgery

Introduction

Different bone reconstructive or regenerative techniques have been proposed in the past: distraction osteogenesis, maxillary sinus floor elevation, onlay grafts with intraoral and extraoral autogenous bone blocks, guided bone regeneration with resorbable or non-resorbable membranes in association or not with tenting screws; and protected bone regeneration with non-customized or customized titanium meshes [1-6].

The autogenous block graft is still considered as the method of choice for three-dimensional and complex bone augmentation procedures in severely resorbed maxillary anterior alveolar segments. Bone augmentation can be performed using either bone blocks, particulate bone or a combination of both. The donor site can be either intraoral or extraoral. The mandibular ramus is the most preferable donor site.

The aim of this case study is to report and present the efficacy of alveolar ridge reconstructions for complex horizontal and vertical augmentation procedures in the maxillary anterior area with a cortical mandibular bone block graft from a retromolar donor site.

Material and Methods

An electronic search using PubMed and Google Scholar has been performed by utilizing keywords such as: “mandibular block graft” and “anterior maxilla”, “ramus graft”, “onlay intraoral block graft”, “autogenous augmentation”. References were selected based on systematic reviews, meta-analysis and randomized clinical trials written in the English language and published in highly respected international journals selected relevant articles were evaluated for data extraction [7]. Moreover, articles for comparison and discussion were further hand searched and selected without date restriction. The obtained information was evaluated for its significance to support autogenous bone grafts as gold standard in complex alveolar bone defects. 14 articles and one reference book have been selected.

Results

A 41-year-old male patient has been referred to the Department of Oral and Maxillofacial Surgery at NYU Dentistry for implant evaluation of an edentulous site of the left central incisor. The tooth has been extracted about 18 months ago. The patient’s medical history was non-remarkable. Intraorally, the edentulous site of the left maxillary central incisor presented with a severe horizontal post-extraction bone loss and a partial loss of the buccal plate. CBCT evaluation revealed 3 mm alveolar bone width (Fig. 1). Due to the complexity and amount of bone loss, a cortical autogenous block graft was indicated. After the preparation of the donor site, the graft was harvested from the ascending ramus by using an ultrasonic device. The graft was then adjusted and anchored in the residual maxillary bone using small diameter titanium micro screws (Fig. 2). The spaces between the cortical bone graft and the residual bone were filled with particulated harvested bone collected with a safe scraper and covered with a resorbable collagen membrane. A Vascularized Palatal Connective Tissue Flap (VIP-CT) and horizontal mattress sutures were used for safe wound coverage and adaptation (Fig. 3). No post-operative complications were noted. The implant has been inserted 4 months following the augmentation without any intra- or postoperative complications or further grafting procedures.

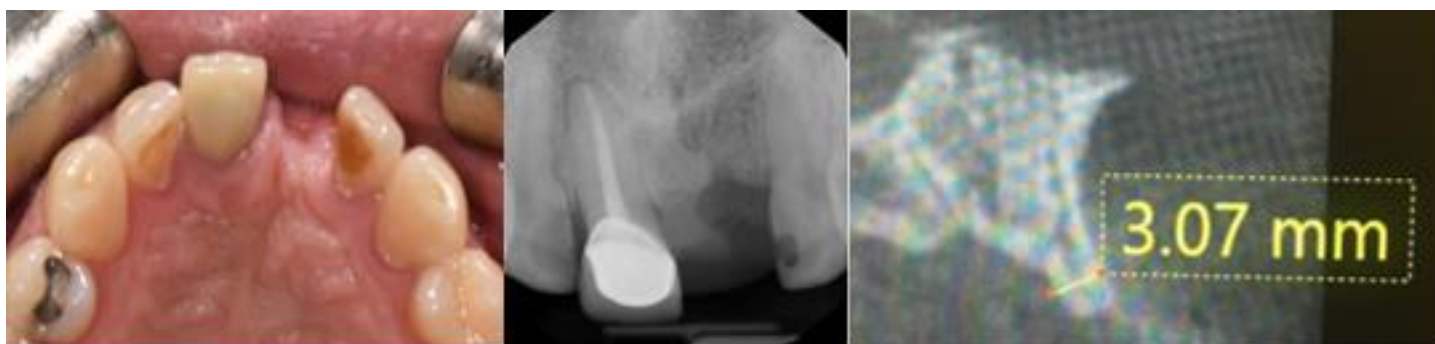


Figure 1: Preoperative clinical and radiographical evaluation showing a complex horizontal bone defect. CBCT evaluation revealed 3 mm residual alveolar bone width.



Figure 2: Intraoperative view with cortical block graft anchored in the residual maxillary bone using small diameter titanium microscrews.



Figure 3: Vascularized palatal connective tissue flap and horizontal mattress sutures used for safe wound coverage and soft tissue adaptation.

The most relevant clinical results of our literature review revealed:

1. Cortical ramus bone block grafts show a relatively low graft resorption (0.23 - 1.86 mm)
2. Implant success rates in grafted sites are ranging between 93.1 - 100% during a 6 - 33 months of follow-up periods (Table 1), showing similar success rates compared to implant placements in pristine bone.

Authors	Study design	Follow-up period	# of patients	Patient age (years)	Donor site	Grafting procedure	Complications	Graft resorption	Implant survival	Implant success
Chiapasco, 20052	Prospective	19 months on average	11	49.1	Ramus	Onlay/sinus floor augmentation	None	0.52 ± 0.45 mm	100%	93.1%
Chiapasco, 20133	Prospective	23.9 months on average	6	44.3 ± 18.3	Ramus	Onlay	Dehiscence at recipient site	1.86 ± 3.76 mm	100.0%	100%
Chiapasco, 20144	Prospective	33 months on average	10	40.9 ± 17	Ramus (tissue level implant)	Onlay	None	0.23 ± 0.3 mm	100%	100%
			11	44.8 ± 12.1	Ramus (bone level implant)		None	0.48 ± 0.42 mm	100%	93.5%
Clavero, 20035	Prospective	18 months	24	mean of 48 years	Ramus	Onlay / Inlay	Pain, bleeding, swelling, bruising, neurosensory disturbance	NA	NA	NA
Cordaro, 20116	Cross sectional	29 months on average	41	range 18-68	Ramus	Onlay/sinus floor augmentation	Swelling, bleeding, pain, sensory disturbance, prolonged healing	NA	NA	No difference between the two cohorts
Misch, 19977	Prospective	6 months	19	NA	Ramus	Onlay	Pain	Up to 25%	NA	NA
Raghoobar, 20078	Prospective	12 months	15	29 ± 7	Ramus	Onlay	Prolonged postoperative pain	NA	1 implant loss	NA

Table 1: Evaluation of the literature review.

Discussion

Bone grafts from intraoral donor sites offer several benefits like surgical accessibility, proximity of donor and recipient sites, less discomfort for the patient and less morbidity as compared with extraoral locations. The choice of the intraoral donor site is usually based on the amount, geometry, and type of bone required for alveolar reconstruction. Additionally, the incidence of intra- and postoperative complications should be considered [8].

The main advantage of a cortical mandibular ramus graft technique is that cortical block grafts are harvested from the external oblique ridge with a piezotome, making the procedure very safe and with a low risk of complications. Moreover, the amount of the bone block to be harvested can be reduced considerably, making the procedure much less invasive.

Cortical bone blocks are initially used to restore the contours of the alveolar ridge and the remaining gaps are then filled with autogenous bone chips. The resulting accelerated vascularization in the gap between the graft and the ridge and the volume stability of the avascular cortical bone plate reduces bone resorption to less than 10%, so the alveolar ridge contour can be restored with a predictable outcome [9]. The short- and long-term results after augmentation with the aid of the bone shell technique demonstrated low complication rates and excellent volume stability, even 10 years after surgery [10]. The ramus should be considered the site of choice when block grafts are needed for horizontal or vertical augmentation for maxillary anterior bone defects [11].

In addition, autologous onlay-grafts from the mandibular ramus offer sufficient bone volume to reconstruct the atrophic jaw segment without long-lasting harvesting morbidities. This site is an excellent treatment alternative with high patient acceptance when reconstruction is necessary before implant insertion. Besides a successful reconstruction of the alveolar crest with correct selection of the donor site, patient acceptance of the procedure is high, while the morbidity of the procedure is minimal showing no persistent nerve damage, which is considered the main disadvantage of autologous bone grafts in the past. The contribution of the use of piezoelectric surgery, grafting templates, and guided implant insertion to the reported result cannot not be addressed in this article, but with the described technique, predictable outcomes and lacking lasting morbidities can be achieved independently from surgical level and status of the provider. Based on the authors experience the piezoelectric technique is a safe method to prevent nerve damage and can be recommended in autologous intraoral bone harvesting. Studies have demonstrated that the harvesting technique plays an essential role in the process of graft consolidation [12]. This is usually attributed to the impact of the harvesting technique on the viability and activity of the transplanted cells. It has been shown that cell viability and the release of molecules affecting bone formation were higher in samples harvested by a bone scraper, like in the presented case, when compared with samples prepared by bone drilling [13].

The author attributed the low graft resorption to the short healing period of 4 months, which has proven to be sufficient for the revascularization of the graft and the secure insertion of dental implants as suggested in the past by various authors [14,15]. Therefore, it is suggested to limit the healing period after autologous bone grafting to a maximum of 4-5 months. This leads to earlier dental restorations compared to augmentations using bone substitutes, where the healing periods are often recommended up to 12 months [16].

The most relevant innovations in bone grafting during the past few years, such as computer-aided design/computer-aided manufacturing technologies have allowed customizing titanium meshes or bone/bone substitute blocks (e.g., computer-guided bone harvesting procedures, three-dimensional-printed bone models or allograft plates, three-dimensional-printed allogenic/xenogeneic/alloplastic bone blocks, etc.), are further reducing treatment time and restoring geometrically complex anatomic defects with accuracy and precision.

Future trends in bone defect augmentation may rely on new concepts in regenerative medicine and tissue engineering using stem cells on three-dimensional-printed scaffolds. However, their use is currently limited to research environments because of costs and legislation, but it is crucial that they provide additional benefits over current standard therapies (ie, guided bone regeneration, bone shell technique with autogenous bone) [17-24].

Conclusion

When considering the low harvesting morbidity and invasiveness, autogenous cortical ramus grafts still remain the “gold standard” in complex and advanced alveolar ridge reconstructions with resorption of the buccal plate prior to implant placement. We recommend a two - stage surgical protocol which includes connective tissue augmentation and implant placement approximately four months after the grafting procedure.

Conflict of Interest

The author has no conflict of interest to declare.

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