

Alveolar Ridge Augmentation Using Autogenous Bone Graft and Platelet-Rich Fibrin to Facilitate Implant Placement

Abstract

The maxillary anterior region is considered to be the esthetic zone of human dentition. Missing teeth in this area leads to severely compromised esthetics and function. Endosseous implants are a viable treatment option in this scenario, but the placement of endosteal implants requires adequate bone volume for successful osseointegration. When the morphology of the bone does not allow proper implant placement, there are various bone augmentation procedures which aid in reconstruction of the residual alveolar ridge for ideal implant placement. The mandibular parasymphysis can act as an excellent source of autogenous bone for the augmentation of alveolar ridge deficiencies. This article describes successful augmentation of the maxillary alveolar ridge using block bone autografts harvested from the mandibular symphysis along with platelet-rich fibrin. At 6 months after surgery, implant was inserted, and after a healing period of 5 months, permanent restoration was placed.

Keywords: *Autogenous bone graft, dental implants, platelet-rich fibrin, symphysis block graft*

Introduction

The premaxilla is the most critical region of the mouth for the replacement of teeth because esthetics, phonetics, function, occlusal pattern, and patient awareness, all need to be considered to achieve a successful result. Loss of teeth in the anterior maxilla results in resorption of alveolar bone from the labial aspect, leaving a palatally positioned alveolar ridge. Teeth in the anterior maxilla are also at risk of traumatic loss, and there may be concomitant alveolar ridge defect. Hence, it will be necessary to augment the size of the alveolar ridge before implant placement using various grafting procedures. Without grafting, the implants may have to be placed in anatomically unfavorable positions or may have adverse angulations. These compromises can lead to unaesthetic restorations, mechanical overload, and ultimately failure of implant. Therefore, ridge augmentation becomes necessary to achieve harmonious balance among functional, biological, and esthetics before rehabilitation of the anterior maxillary region. There are a lot of procedures of autogenous bone grafting techniques such as distraction osteogenesis, guided bone regeneration, autogenous onlay block

grafting, inlay grafting, tent pole, and vertical reconstruction using titanium mesh that can be carried to increase the available bone height for implant placement.^[1-3] The morphology of the osseous defect, the crown-implant ratio, and the incisal edge position in relation to the implant body are factors that need to be considered when selecting an augmentation procedure. Autogenous bone graft can be harvested from intraoral^[2,3] and extraoral^[4,5] donor sites. The iliac crest has been the most common donor site for maxillofacial reconstruction procedures. However, using the mandibular symphysis as a donor for relatively small grafts offers ease of access, good bone quality for localized repair, a corticocancellous block graft morphology, low morbidity, and minimal graft resorption.^[3] Grafts harvested from the chin can typically provide a sufficient amount of bone to increase width deficiencies in sites of one or two teeth. After a bone block graft, the waiting period for implantation is 4–6 months to ensure bone integration, but no longer to avoid graft resorption.^[6] It is important to protect the grafted bone against surface resorption to ensure an adequate volume of bone surrounding the implant in the later stage. Platelet-rich fibrin (PRF), a biomaterial and a source of autologous growth factors, has

**Nayana Paul¹,
Shivangini Jyotsna¹,
M. P. Keshini²**

¹Department of Prosthodontics and Crown and Bridge, Buddha Institute of Dental Sciences and Hospital, Magadh University, Patna, Bihar, India, ²Department of Oral and Maxillofacial Surgery, JSS Dental College and Hospital, JSS Academy of Higher Education and Research, Mysore, Karnataka, India

Submitted : 10-Apr-2020
Revised : 01-Aug-2020
Accepted : 03-Apr-2021
Published : 23-Mar-2022

Address for correspondence:

Dr. Nayana Paul,
Room No - 403, R N
Enclave Apartment, Kanti
Factory Road, Kankarbagh,
Patna - 800 020, Bihar, India.
E-mail: noyobunu243666@
gmail.com

Access this article online

Website:
www.contempclindent.org

DOI: 10.4103/ccd.ccd_154_20

Quick Response Code:



How to cite this article: Paul N, Jyotsna S, Keshini MP. Alveolar ridge augmentation using autogenous bone graft and platelet-rich fibrin to facilitate implant placement. *Contemp Clin Dent* 2022;13:90-5.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

a positive effect on bone regeneration.^[7] The use of PRF and a barrier membrane aims to reduce graft resorption and promote graft maturation. This article presents a case report of localized alveolar ridge augmentation using block bone autografts harvested from the mandibular symphysis before implant placement. The block graft was covered with PRF and a resorbable membrane to aid in ridge augmentation.

Case Report

A 21-year-old female patient reported to our dental office with the chief complaint of missing upper front tooth. She lost her tooth due to trauma 4 years back and was wearing an upper anterior partial prosthesis since then. The patient presented with esthetic complaints and there was no relevant medical history. Clinical examinations showed the absence of anterior maxillary tooth [Figure 1a]. Preoperative imaging with computed tomography revealed that the alveolar ridge height was normal, but there was a lack of alveolar ridge width. Labiopalatal atrophy of the edentulous alveolar ridge made it intricate to place implants on 21 regions. Hence, it was decided to augment the alveolar crest horizontally. The proposed treatment involved reconstruction of the anterior maxilla through block graft and PRF followed by installation of implant 6 months later. The mandibular symphysis area was selected as the donor site for bone augmentation.

Preparation of recipient site

The patient received amoxicillin 2000 mg for antibiotic prophylaxis and 8 mg of dexamethasone (DEMSON-8) 1 h before surgery. Following intra- and extra-oral antiseptics and local anesthesia (4% articaine with 1:100,000 epinephrine, Septocaine, Septodont), a straight incision with a size 15 scalpel blade was executed along the maxillary alveolar ridge from the distal side of tooth 11 to the mesial side of tooth 22. Following that, a perpendicular releasing incision was performed on the distal sides of tooth 11. Using a

Molt elevator (Waldent Periosteal Elevator Molt No. 9), the full-thickness flap was reflected toward the base of the vestibule to expose the bone remnant. Next, the buccopalatal width and height of the alveolar bone were measured. The alveolar bone height was more than 10 mm. However, the width of the alveolar bone was about 1.8 mm at the crest and 4.3 mm in the middle third.

Preparation of donor site

After induction of anesthesia in the symphysis region by inferior alveolar nerve block/mental nerve block with local anesthesia (block and infiltration using 2% lidocaine with 1:1,00,000 epinephrine, Lignospan Standard, Septodont), a curved incision was made with a Bard Parker blade #15 apical to the mucogingival line, and a full-thickness flap was reflected to expose the symphysis region. Fissure bur was used to delineate the block graft 5 mm from the apices of the lower anterior teeth, 5 mm superior to the inferior border of the chin, and 5 mm anterior to the mental nerve posteriorly. Mallet and chisels were used to free the block harvested. After elevating the graft from the donor site, it was stored in a mixture of saline and the patient's blood, with addition of 80 mg gentamicin [Figure 1b and c]. Once this is accomplished, with a spiral drill, the holes for the bone block fixation screw were prepared at the recipient site. One or two screws of diameter 1.5 mm were used (1.5 mm × 8 mm, titanium, Orthomax) to stabilize the bone block graft at recipient site [Figure 1d]. After the graft was secured firmly, voids around the block graft were filled with cancellous bone graft or bone chips harvested from the donor site.

Platelet-rich fibrin preparation

A sample from patient's peripheral blood was collected and immediately centrifuged at 3000 rpm (HV-T6 3000 RPM Clinical Doctor Centrifuge Machine) for 10 min, according to the PRF protocol, leading to fibrin clot.^[8] The fibrin clot

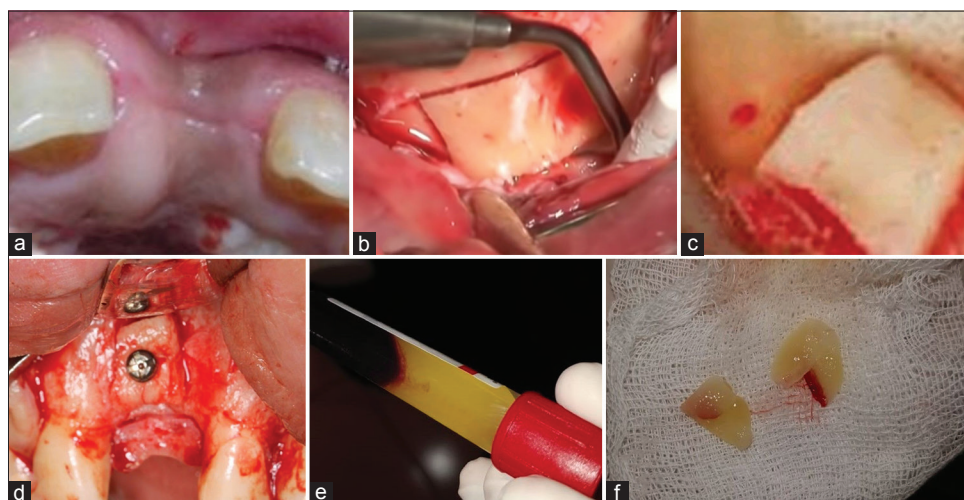


Figure 1: (a) Intraoral view showing missing anterior tooth (b), harvesting of bone block from symphysis, (c) harvested bone block, (d) block graft fixed at recipient site using osteosynthesis screws, (e) platelet-rich fibrin preparation, (f) platelet-rich fibrin membrane

was removed with the use of a surgical pincer, then separated from the red blood cells with the use of scissors, and then compressed to be used as a PRF membrane [Figure 1e and f].

The PRF membrane and a resorbable membrane (Bioteck Collagen Membrane) were used to cover the block graft. The sharp bony edges at donor site were smoothed, and primary wound closure was accomplished with mattress or single interrupted sutures (Ethicon Mersilk Black Braided Nonabsorbable Suture). A 7-day course of antibiotics in the form of amoxicillin 500 mg (mox 500) three times a day was prescribed. Analgesic medications such as ibuprofen 400 mg every 6 h (Brufen 400) and paracetamol 500 mg every 6 h (Calpol) were given for at least 3 days for control of postoperative pain. Patients were advised to rinse with chlorhexidine digluconate 0.2% (Hexidine Mouth Wash, Icpa Health Products Ltd.) twice daily for 1 week. The sutures were removed 10–14 days after the surgery.

After 4 months, an impression was made for preparation of a postoperative dental cast to be used for the measurement of final width gained. Cone-beam computed tomography (CBCT) scan showed an increase in bone width from 1.8 to 4.1 mm at the alveolar crest [Figure 2a and b]. The site was re-entered after 6 months for removal of the fixation screw and placement of the implants. Under local anesthesia, a mucoperiosteal flap was raised to expose the recipient area. 3.5 mm × 10 mm implant (narrowSKY Bredent) was placed for 21 regions. The implant was provided with cover screw [Figure 2c]. In the 10th postoperative month, a periapical radiograph was obtained to evaluate the osseointegration of the implant [Figure 3a]. During the prosthetic phase, healing abutments (SKY Bredent) were placed to achieve an esthetic soft tissue emergence profile. After stabilization of gingival tissues, implant

level impression was made using open tray impression coping (SKY Bredent), and a master cast was fabricated with implant body analogs [Figure 3b-d]. The casts were mounted on an articulator. The abutment (SKY standard line abutments Bredent) preparation was done, and the implant crowns were manufactured. The metal porcelain crowns were finished and cemented on to the implants using glass ionomer cement (Gc Gold Label 1) [Figure 3e-g].

The patient was satisfied regarding the function and esthetics of the final result and returned for a follow-up appointment 7 months after crown insertion and then 8 months. The patient was advised to come back for yearly follow-ups in addition to dental hygiene visits. Follow-up images at the end of 24 months are shown in Figure 4.

Discussion

In the present case, we have demonstrated a staged approach to augment anterior maxillary alveolar ridge. At the first surgical appointment, bone augmentation was done using mandibular block obtained from symphysis region and covered with PRF gel. After 6 months, dental implants were inserted. The treatment outcome was successful in terms of esthetics and comfort, and a mean gain of 2.3 mm was achieved in buccolingual ridge width.

Autogenous bone grafts have proven to be successful in terms of integration with the host bone due to their osteoinductive potential. Intramembranous autogenous osseous grafts including the mandibular ramus, mandibular symphysis, angle of mandible, maxillary tuberosity, and intraoral exostoses are the “gold standard” for improving intraoral osseous volume to facilitate placement of implants.^[9] Block grafts take longer to integrate than cancellous bone grafts. When a block graft is used, a staged surgical approach is recommended as opposed to placing the implants in conjunction with the graft.^[6,10] For this case, graft was harvested from mandibular symphysis, a cortical graft that provides primarily dense cortical bone and high concentration of promoter proteins (e.g., bone morphogenetic proteins [BMPs]). However, there are certain drawbacks of using symphysis graft which includes donor site morbidity and intraoperative complications such as swelling, pain, hematomas, and neurosensory disturbances such as a lack of sensation in the inferior lip, soft tissue of the chin, and inferior teeth.^[11,12] Necrosis of the block graft is the most undesired complication. To decrease the rate of this complication, aggressive decortication of the recipient area is recommended to enhance revascularization of the transferred bone graft.^[13]

Another reason for successful bone augmentation in this case is the use of PRF which plays an important role in clot stabilization while simultaneously preventing migration of nonosteogenic tissues into the area. The major growth factors in PRF are transforming growth factor-1, vascular endothelial growth factor, BMP-1, platelet-derived growth

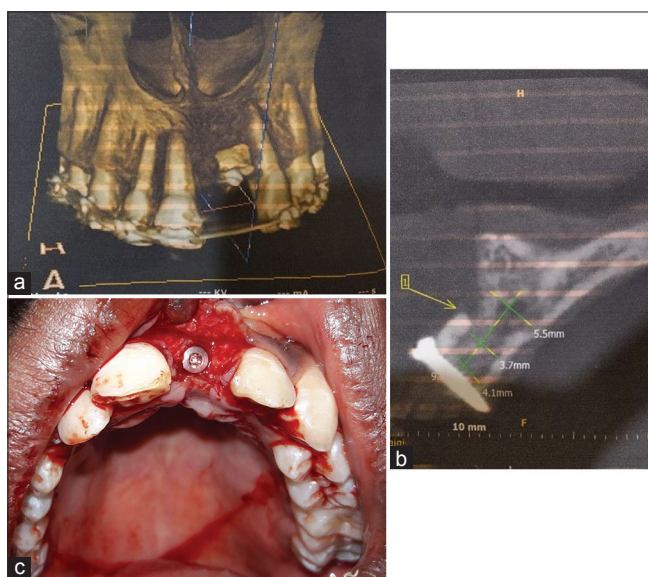


Figure 2: (a and b) Cone-beam computed tomography images 6 months after grafting showing increase in bone width, (c) implant placement with respect to 21 region



Figure 3: (a) Intraoral periapical radiograph obtained 6 months after implant placement, (b) open tray impression coping attached to the implant, (c) impression made using open tray technique, (d) impression removed from the mouth along with coping and implant analog attached, (e) jig trial, (f) abutment attached to the implant, (g) metal-ceramic crown cemented to the implant

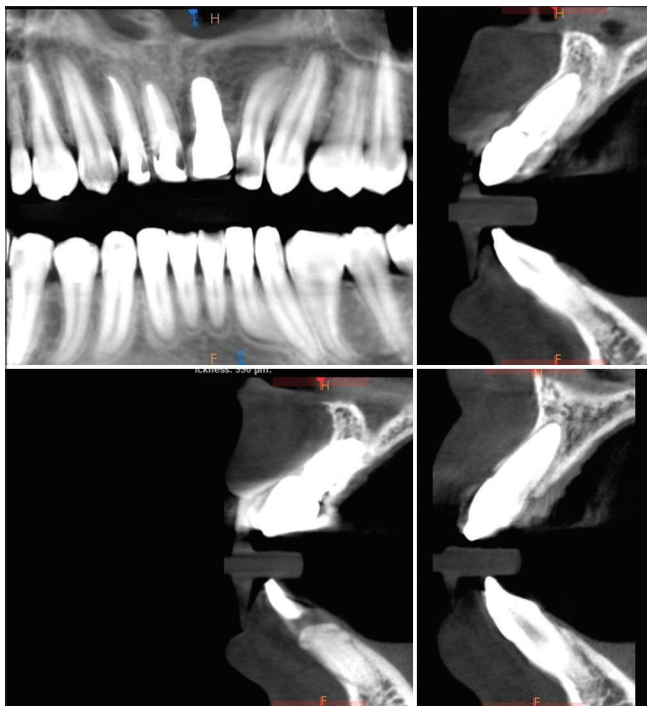


Figure 4: Cone-beam computed tomography images at 24 months of follow-up showing well-osseointegrated implant

factors, and insulin-like growth factors.^[14] Therefore, its role, especially in angiogenesis, has been systematically

studied, as well as its involvement in the proliferation and differentiation of mesenchymal cells into osteoblasts. Although there is a consensus regarding its use, the application of PRF needs standardization, controlled clinical trials, and major observations of interactions between peripheral blood with medications and other factors that may affect the clotting process before the blood collection.

Another point of discussion is the reconstruction of soft tissue defect. In our case, soft tissue buildup was done using pink ceramics. Soft tissue grafts can be used as an alternative option and have shown good esthetic results in soft tissue augmentation and preventing marginal peri-implant recession.^[15]

The various strategies adopted to replace bone volume loss in vertical or horizontal jaw defect have evolved over the years. Alternative treatment options for similar clinical situation could be the use of fresh frozen allografts, Khoury's cortical bone plate method, or narrow implants along with soft tissue management.^[16-18] A question of special interest in this context is the long-term prognosis and volume stability of the augmented tissue in the vertical dimension. In esthetically irrelevant areas, resorption processes can be tolerated to some extent, however, in the anterior zone, exposed implant components lead to relevant difficulties. Another important aspect is the technique sensitivity of all techniques and the patient morbidity

involved. A thorough clinical and radiological examination should be done to diagnose the exact quantity of bone loss, and accordingly, various bone augmentation procedures should be planned. Before choosing the prolonged reconstructive surgical approach, a prosthetic solution should always be considered and discussed with the patient to evaluate which is best and which the patient prefers.

The results of the present report pointed out that, in case of agenesis of the upper central incisors, bone grafting from the mandibular symphysis and delayed implant placement may provide satisfactory functional and esthetic outcomes on the long term. CBCT scans referring to anatomical landmarks^[19] were used for reliable follow-up of the change of bone thickness in the grafted area. Despite a certain resorption of the graft that may occur, correct management of the peri-implant soft tissues and the prosthesis is pivotal to maintain the success on the long term.

Conclusion

The rehabilitation of the atrophic maxilla is challenging due to severe bone mass loss. A general recommendation for the best treatment modality cannot be given; however, in very difficult cases such as the one presented here, the treatment option decision also depends on the surgical skills and experience of the clinician. Autogenous grafts from the mandibular symphysis can be used to augment the ridge, but the potential, as well as the stability, of the symphysis graft for alveolar ridge construction has to be evaluated scientifically in long-term observations. Although PRF has shown promising results in the past in bone generation due to the release of growth factors, the application of PRF still needs standardization. To achieve an esthetically pleasing and clinically successful result, an understanding of graft management and implant placement is essential.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

- Jeng MD, Chiang CP. Autogenous bone grafts and titanium mesh-guided alveolar ridge augmentation for dental implantation. *J Dent Sci* 2020;15:243-8.
- Maiorana C, Ferrario S, Poli PP, Manfredini M. Autogenous chin block grafts in the aesthetic zone: A 20-year follow-up case report. *Case Rep Dent* 2020;2020:6525797.
- Atef M, Osman AH, Hakam M. Autogenous interpositional block graft vs onlay graft for horizontal ridge augmentation in the mandible. *Clin Implant Dent Relat Res* 2019;21:678-85.
- Nguyen TT, Eo MY, Kuk TS, Myoung H, Kim SM. Rehabilitation of atrophic jaw using iliac onlay bone graft combined with dental implants. *Int J Implant Dent* 2019;5:11.
- Garcia-Júnior IR, Souza FÁ, Figueiredo AA, Poli PP, Benetti F, Ferreira S, *et al.* Maxillary alveolar ridge atrophy reconstructed with autogenous bone graft harvested from the proximal ulna. *J Craniofac Surg* 2018;29:2304-6.
- Deluiz D, Oliveira L, Pires F, Reiner T, Armada L, Nunes M, *et al.* Incorporation and remodelling of bone block allografts in the maxillary reconstruction: A clinical randomized trial. *Clin Implant Dent Relat Res* 2016;19:180-94.
- Liu Y, Sun X, Yu J, Wang J, Zhai P, Chen S, *et al.* Platelet-rich fibrin as a bone graft material in oral and maxillofacial bone regeneration: Classification and summary for better application. *Biomed Res Int* 2019;2019:3295756.
- Kobayashi M, Kawase T, Horimizu M, Okuda K, Wolff LF, Yoshie H. A proposed protocol for the standardized preparation of PRF membranes for clinical use. *Biologicals* 2012;40:323-9.
- Ersanli S, Arisan V, Bedeloğlu E. Evaluation of the autogenous bone block transfer for dental implant placement: Symphyseal or ramus harvesting? *BMC Oral Health* 2016;16:4.
- Pikos MA. Mandibular block autografts for alveolar ridge augmentation. *Atlas Oral Maxillofac Surg Clin North Am* 2005;13:91-107.
- Pereira RS, Pavelski MD, Griza GL, Boos FBJD, Hochuli-Vieira E. Prospective evaluation of morbidity in patients who underwent autogenous bone-graft harvesting from the mandibular symphysis and retromolar regions. *Clin Implant Dent Relat Res* 2019;21:753-7.
- Reininger D, Cobo-Vázquez C, Monteserín-Matesanz M, López-Quiles J. Complications in the use of the mandibular body, ramus and symphysis as donor sites in bone graft surgery. A systematic review. *Med Oral Patol Oral Cir Bucal* 2016;21:e241-9.
- Pikos MA. Block autografts for localized ridge augmentation: Part II. The posterior mandible. *Implant Dent* 2000;9:67-75.
- Castro AB, Cortellini S, Temmerman A, Li X, Pinto N, Teughels W, *et al.* Characterization of the leukocyte- and platelet-rich fibrin block: Release of growth factors, cellular content, and structure. *Int J Oral Maxillofac Implants* 2019;34:855-864.
- Frizzera F, de Freitas RM, Muñoz-Chávez OF, Cabral G, Shibli JA, Marcantonio E Jr. Impact of soft tissue grafts to reduce peri-implant alterations after immediate implant placement and provisionalization in compromised sockets. *Int J Periodontics Restorative Dent* 2019;39:381-9.
- Baldan RC, Coracin FL, Lins L, Mello WR, Santos PS. Atrophic maxilla reconstruction with fresh frozen allograft bone, titanium mesh, and platelet-rich fibrin: Case report. *Transplant Proc* 2017;49:893-7.
- Vieira JS, Brandão-Filho EM, Deliberador FR, Zielak JC, Giovanini AF, Deliberador TM. Dental implant placement with simultaneous anterior maxillary reconstruction with block and particulate fresh frozen allograft bone: A case report with 24-month follow-up data. *Case Rep Surg* 2017;2017:1565973.
- Khoury F, Antoun A, Missika P. *Bone Augmentation in Oral Implantology*. Berlin, London: Quintessenz; 2007.
- Bornstein MM, Scarfe WC, Vaughn VM, Jacobs R. Cone beam computed tomography in implant dentistry: A systematic review focusing on guidelines, indications, and radiation dose risks. *Int J Oral Maxillofac Implants* 2014;29 Suppl:55-77.