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Case Report

Horizontal Ridge Augmentation Using Piezo-Assisted Autogenous Bone Block Grafting and Platelet-Rich Fibrin: A Clinical Case Report

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Abstract

Horizontal alveolar ridge deficiency caused by congenitally missing mandibular incisors can limit implant placement due to inadequate bone volume. This case report describes successful ridge reconstruction in a 23-year-old male using a piezo-assisted autogenous symphyseal block graft combined with particulate bovine xenograft and a platelet-rich fibrin (PRF) membrane. At six months, clinical and cone-beam computed tomography evaluations demonstrated successful graft integration with approximately 6.5 mm of horizontal bone gain, providing sufficient ridge width for implant placement. This case highlights that the combined use of piezoelectric bone harvesting, autogenous block grafting, particulate xenograft, and PRF represents a predictable regenerative approach for the management of localized horizontal alveolar ridge deficiencies, yielding favorable clinical and radiographic outcomes.

Keywords: Horizontal Ridge Augmentation; Autogenous Bone Block Graft; Piezoelectric Surgery; Platelet-Rich Fibrin; Bovine Xenograft; Dental Implants

Introduction

Congenitally missing teeth in the anterior mandible, often result in reduced ridge width and insufficient bone volume, compromising implant placement and esthetic outcomes [1]. Bone augmentation is often recommended to achieve the necessary ridge width and height. Various methods, including guided bone regeneration (GBR), ridge splitting, block grafting, and distraction osteogenesis, have shown promising results [2]. Autogenous bone grafts are widely considered the gold standard for alveolar ridge augmentation because of their unique ability to promote bone formation through osteogenesis, osteoinduction, and osteoconduction. These block grafts can be harvested from intraoral or extraoral sites [3]. Among the available donor sites, mandibular symphysis and ramus are commonly used intraoral sources for obtaining corticocancellous bone grafts. Owing to their favorable composition of dense cortical bone and supportive cancellous bone, symphysis grafts are well-suited for augmenting localized ridge deficiencies and restoring alveolar bone volume. Furthermore, it offers convenient surgical access and a reliable source of high-quality autogenous bone [4]. Despite its advantages, the use of autogenous bone block grafts may lead to donor site morbidity and exhibit unpredictable volumetric resorption during healing. To promote graft stability and maintain graft volume, particulate xenografts may be used adjunctively around block grafts. These materials exhibit excellent osteoconductive properties, promote enhanced cellular attachment, and support the regeneration and integration of surrounding tissues [5].

Platelet-rich fibrin (PRF) is an autologous fibrin matrix rich in growth factors, cytokines, platelets, and leukocytes that promotes cellular proliferation, migration, and osteogenic differentiation. Owing to its biocompatibility, ease of preparation, and regenerative potential, PRF is widely used in bone tissue engineering to enhance tissue healing and bone regeneration [6]. Furthermore, piezoelectric surgery facilitates precise and minimally traumatic bone harvesting, preserving vital structures while reducing postoperative pain, edema, and donor site morbidity [7]. Therefore, this case report highlights the successful reconstruction of a severe horizontal ridge deficiency associated with a congenitally missing mandibular central incisor using an autogenous symphyseal block graft combined with particulate xenograft.

Case Presentation

A 23-year-old male patient undergoing comprehensive orthodontic treatment for correction of malocclusion was referred to the Department of Periodontology for replacement of congenitally missing tooth. The patient was systemically healthy, with no significant medical history, history of smoking, or medications that could interfere with normal wound healing. The patient presented with congenitally missing mandibular central incisors (31 and 41). During orthodontic treatment, a localized horizontal ridge deficiency with a knife-edge alveolar crest was observed in the edentulous mandibular anterior region, necessitating augmentation before implant placement.

Clinical examination

Intraoral examination revealed a Seibert Class I ridge defect [8] extending across the edentulous sites of 31 and 41. The alveolar ridge exhibited a knife-edge morphology with marked buccolingual deficiency, whereas the overlying soft tissues appeared healthy with an adequate width of keratinized gingiva (Figure 1). The adjacent teeth were periodontally healthy, and oral hygiene was satisfactory.

Radiographic examination

A cone-beam computed tomography (CBCT) scan was obtained for three-dimensional assessment of the recipient site. CBCT revealed severe horizontal alveolar ridge resorption in the edentulous sites of 31 and 41, resulting in inadequate bone dimensions for conventional implant placement. In contrast, adequate bone dimensions were observed for teeth 32, 33, 42, and 43. Cross-sectional analysis demonstrated D2/D3 bone quality with a thin and narrow alveolar crest. The edentulous 31 region exhibited inadequate ridge height and width, with a labial undercut measuring approximately 3.8 mm and a crestal ridge width of 2.8 mm (Figure 2). Similarly, the 41 region demonstrated inadequate ridge width, characterized by a narrow crestal morphology with a crestal width of approximately 2.9 mm (Figure 3). No pathological lesions were observed in the areas of interest. Based on the clinical and radiographic findings, a diagnosis of localized horizontal alveolar ridge deficiency associated with congenitally missing mandibular central incisors was made.

Figure 1: Preoperative clinical view showing missing tooth - 31,41.

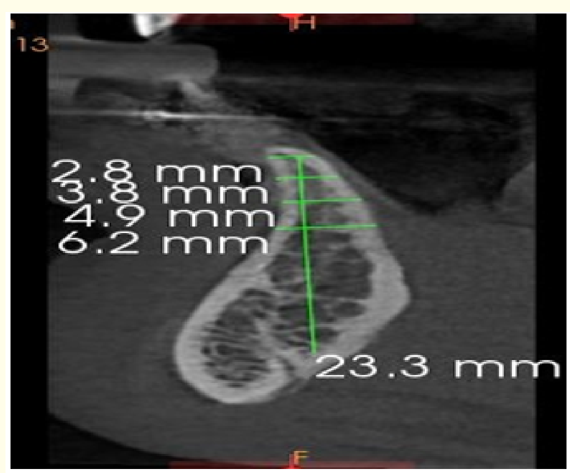

Figure 2: Pre-operative CBCT – 31 (Sagital View).

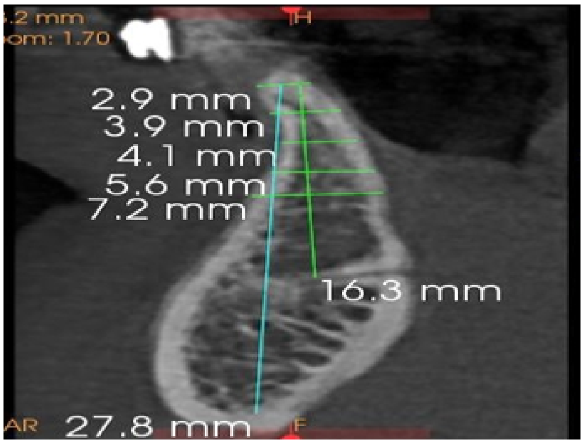

Figure 3: Preop CBCT – 41 (Sagital View).

Treatment plan

The treatment protocol included piezo-assisted harvesting of an autogenous corticocancellous bone block from the mandibular symphysis, fixation of the graft at the recipient site, placement of particulate bovine xenograft around the graft to minimize postoperative resorption, and coverage with an autologous platelet-rich fibrin (PRF) membrane to enhance soft tissue healing and bone regeneration. Implant placement was planned after a six-month healing period following confirmation of satisfactory ridge augmentation.

Surgical procedure

Prior to the procedure, extraoral antisepsis was achieved using 5% povidone–iodine solution, and 0.2% chlorhexidine digluconate was administered as a pre-procedural mouth rinse for intraoral antisepsis. Local anaesthesia was obtained using 2% lignocaine with 1:100,000 epinephrine at the surgical site. A full-thickness mucoperiosteal flap was elevated along the alveolar ridge following a mid-crestal incision with sulcular extensions to the adjacent teeth and vertical incisions to expose the horizontally deficient alveolar ridge and donor site (symphyseal cortex) (Figure 4). Multiple decortication perforations were created at the recipient site using a round bur under continuous saline irrigation to facilitate vascularization and promote graft incorporation. Following completion of recipient site preparation, the mandibular symphysis was selected as the intraoral donor site for harvesting an autogenous corticocancellous bone block.

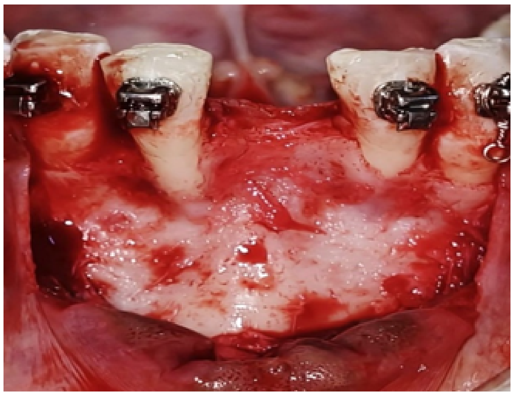

Figure 4: Flap elevation: Recipient site and Donor site.

The dimensions of the recipient site were measured, and the outline of the donor graft was marked on the symphyseal cortex. A minimum safety margin of 5 mm was maintained from the root apices of the mandibular anterior teeth, mental foramina, and inferior border of the mandible to prevent injury to vital anatomical structures.

Osteotomy was performed using a piezoelectric surgical unit equipped with bone-cutting inserts under continuous sterile saline irrigation. Sequential horizontal and vertical corticotomy cuts were made along the predetermined outline to the desired depth (Figure 5). The osteotomy was completed with controlled piezoelectric micro-vibrations, allowing precise cutting of mineralized tissue while minimizing the risk of damage to adjacent soft tissues, blood vessels, and nerves. After completing the osteotomy, thin chisels, bone elevators or osteotomes were gently used to mobilize and retrieve the corticocancellous bone block without causing graft fracture.

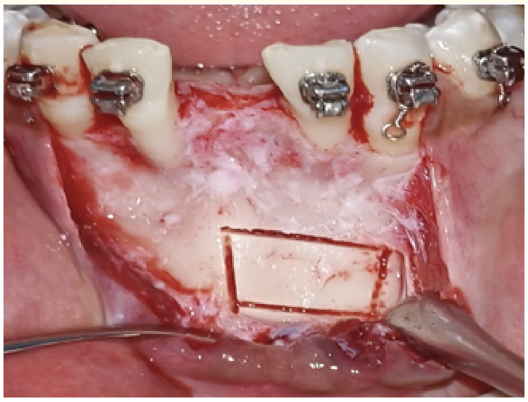

Figure 5: Horizontal and Vertical Osteotomy cuts at donor site.

The harvested graft was immediately placed in sterile saline to preserve its viability and prevent dehydration (Figure 6). The donor site was inspected for sharp bony edges, thoroughly irrigated with sterile saline, and hemostasis was achieved. The harvested corticocancellous bone block was meticulously trimmed and contoured to match the morphology of the recipient site, ensuring intimate adaptation and stable contact with the native alveolar bone prior to rigid fixation. It was rigidly stabilized using a titanium fixation screw (Bone Fixation Screw) (Figure 7). Residual gaps around the block graft were filled with particulate bovine xenograft* (Geistlich Bio-Oss) to improve ridge contour and reduce postoperative graft resorption.

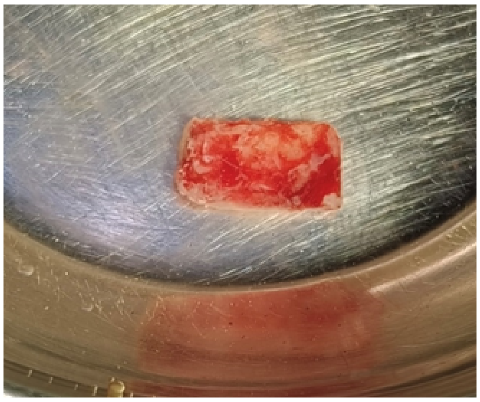

Figure 6: Harvested block graft.

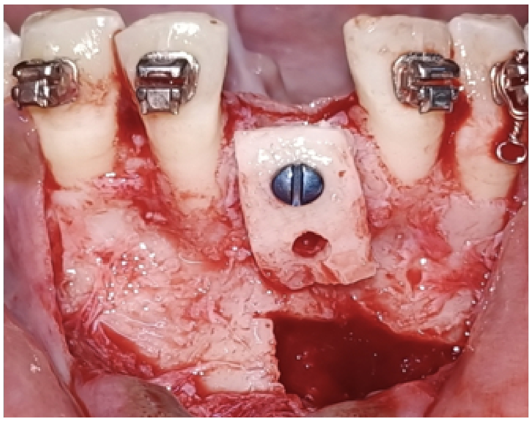

Figure 7: Placement of the autogenous bone block graft at the recipient site and stabilization with a fixation screw.

Platelet-rich fibrin (PRF) was prepared immediately before surgery using the standard protocol described by Choukroun. Approximately 10 mL of the patient's venous blood was collected in sterile glass tubes without anticoagulant and immediately centrifuged at 2700 rpm for 12 min. Following centrifugation, the PRF clot was retrieved from the middle layer, separated from the red blood cell fraction, and gently compressed between sterile gauze to obtain an PRF membrane. The membrane was then placed over the augmented site to enhance angiogenesis, support soft tissue healing, and promote bone regeneration (Figure 8).

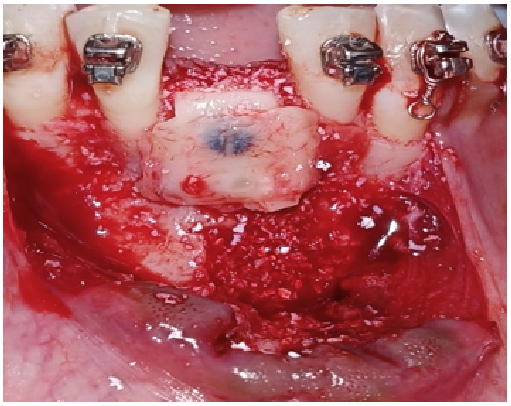

Figure 8: Placement of particulate xenograft around the autogenous bone block graft and coverage with a PRF membrane.

Periosteal releasing incisions were made to obtain passive, tension-free flap closure. Primary wound closure at both the recipient and donor sites was achieved using interrupted 4-0 non-resorbable sutures (Figure 9). Piezoelectric surgery facilitates precise osteotomy, reduces surgical trauma, minimizes intraoperative bleeding, and improved operator control during graft harvesting.

Figure 9: Primary wound closure following ridge augmentation.

Post operative care

Postoperatively, the patient was prescribed systemic antibiotic therapy consisting of amoxicillin 500 mg with clavulanic acid 100mg administered three times daily and metronidazole 400 mg administered three times daily for 5 days along with analgesics comprising aceclofenac, paracetamol, and serratiopeptidase combination administered twice daily for 5 days. Additionally, pantoprazole 40 mg was prescribed once daily for 5days as a gastroprotective agent and a 0.12% chlorhexidine mouth rinse. The patient was instructed to maintain meticulous oral hygiene, follow a soft diet and avoid trauma to the surgical sites during the healing period. Sutures were removed two weeks postoperatively. Clinical and radiographic evaluations at the six-month follow-up demonstrated satisfactory horizontal ridge augmentation, with a horizontal bone gain of 6.5 mm in the 31 and 41 regions, following which implant placement was planned (Figure 10).

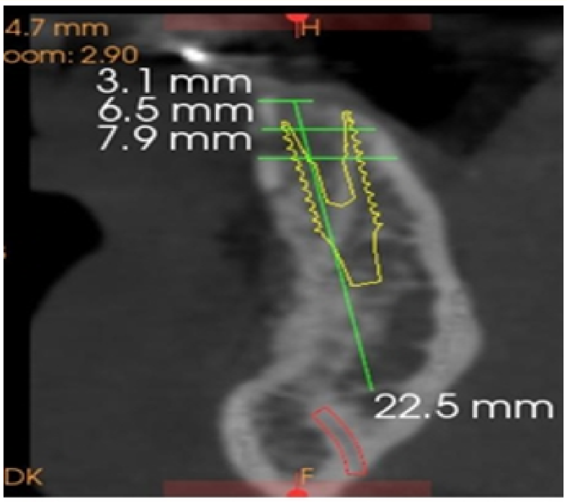

Figure 10: Six Months post-operative CBCT with virtual implant placement (Sagital View).

Measurement Level	Preoperative Ridge Width (mm)	Postoperative Ridge Width (mm)
At crest	2.8	3.1
2 mm below the alveolar crest	3.8	6.5
4 mm below the alveolar crest	4.9	7.9

Table 1: Comparison of preoperative and 6-month postoperative horizontal alveolar ridge width measured 2 mm apical to the alveolar crest.

Discussion

Horizontal alveolar ridge deficiency is a frequent finding in patients with congenital absence of teeth because the lack of physiological tooth eruption and functional stimulation results in inadequate alveolar bone development. Consequently, the residual ridge often lacks sufficient buccolingual width to permit prosthetically driven implant placement, necessitating ridge augmentation before implant rehabilitation [9]. In the present case, reconstruction of the deficient anterior mandibular ridge was achieved using a piezo-assisted autogenous symphyseal block graft supplemented with particulate bovine xenograft and covered with a platelet-rich fibrin (PRF) membrane. This combined regenerative approach resulted in predictable horizontal ridge augmentation and sufficient bone volume for planned implant placement. These findings are consistent with previous reports demonstrating the effectiveness of autogenous block grafting for localized ridge reconstruction.

Autogenous bone remains the gold standard for alveolar ridge augmentation because it possesses viable osteogenic cells and growth factors in addition to its osteoinductive and osteoconductive properties. Unlike bone substitute materials, autogenous grafts actively participate in new bone formation and integrate rapidly with the recipient site through creeping substitution and revascularization [10]. For localized ridge defects, intraoral donor sites offer several advantages over extraoral sources, including lower surgical morbidity, reduced operative time, absence of hospitalization and provide bone of intramembranous origin with favorable biological behaviour [11]. In the present case, the mandibular symphysis was selected because it provides a corticocancellous graft with adequate volume and favorable biological characteristics while allowing convenient surgical access. When appropriate anatomical safety margins are maintained, symphyseal graft harvesting has been shown to be a predictable and safe procedure with a low incidence of postoperative complications.

Sakkas., *et al*. (2017) reported that autogenous bone grafts provide predictable and reliable outcomes for alveolar ridge augmentation, with a graft survival rate of 95.6% and a low early implant failure rate of 0.38%. Their findings further support the continued use of autogenous bone as the gold standard for dentoalveolar ridge reconstruction [12]. Although autogenous block grafts demonstrate excellent regenerative potential, postoperative remodeling and partial graft resorption remain recognized limitations. To overcome these drawbacks and reduce the need for autogenous bone harvesting, alternative grafting materials, including allografts and xenografts, have been developed for reconstructive implant therapy [13]. In the present case, the xenograft served as an osteoconductive scaffold, filling peripheral voids, improving ridge contour, and reducing graft resorption during the healing process. The combination of autogenous bone and a slowly resorbing xenograft is intended to combine the osteogenic properties of autogenous bone with the volume-maintaining characteristics of bovine minerals, thereby improving long-term stability of the augmented ridge. Thoma., *et al*. and Cordaro., *et al*. reported that covering autogenous block grafts with DBBM reduces postoperative resorption and improves volumetric stability. While autogenous grafts may undergo 5.5–22% resorption, with reports of up to 60%, DBBM helps preserve ridge dimensions during healing [14].

The adjunctive use of a PRF membrane likely contributed to the successful regenerative outcome by promoting clot stabilization, enhancing hard and soft tissue healing, and preventing the ingrowth of non-osteogenic tissues into the augmented sites. PRF contains several bioactive molecules, including transforming growth factor-β1 (TGF-β1), vascular endothelial growth factor (VEGF), bone morphogenetic proteins (BMPs), platelet-derived growth factor (PDGF), and insulin-like growth factor (IGF), which collectively promote angiogenesis, cellular proliferation, collagen maturation, and osteoblastic differentiation. The favorable postoperative healing observed in the present case is consistent with the findings of Paul., *et al*. who reported that the adjunctive use of platelet-rich fibrin (PRF) with an autogenous bone graft enhanced soft tissue healing and supported successful bone augmentation before implant placement [15].

Piezoelectric surgery was used for symphyseal graft harvesting because it enables precise and selective osteotomy with minimal trauma to adjacent soft tissues and neurovascular structures. Compared with conventional rotary instruments, it reduces surgical trauma and helps preserve bone vitality, thereby facilitating favorable graft healing and integration [16]. The favorable regenerative outcome observed in the present case is consistent with the long-term clinical observations of Majewski, who reported that piezoelectric harvesting of autogenous bone blocks resulted in more predictable bone regeneration and favorable healing than conventional rotary instruments [17].

At the six-month follow-up, clinical and CBCT evaluations demonstrated successful horizontal ridge augmentation with a horizontal bone gain of approximately 6.5 mm in the 31 region, providing adequate ridge width for prosthetically guided implant placement. The amount of horizontal bone gain observed in the present case is comparable to previous reports evaluating autogenous symphyseal block grafts for localized ridge augmentation [9]. The successful clinical outcome observed in the present case may be attributed to the synergistic effect of meticulous recipient site preparation, rigid fixation of the corticocancellous block graft, augmentation with particulate bovine xenograft, biological enhancement with PRF, and minimally traumatic graft harvesting using piezoelectric surgery which together created a favorable environment for predictable bone regeneration. Although the present report demonstrated favorable clinical outcomes, its findings were limited to a single case. Therefore, long-term prospective studies and randomized clinical trials with larger sample sizes are warranted to validate the predictability and effectiveness of this combined regenerative approach.

Conclusion

Within the limitations of this case report, piezo-assisted harvesting of an autogenous symphyseal block graft combined with particulate bovine xenograft and an autologous PRF membrane proved to be a predictable approach for the management of localized horizontal alveolar ridge deficiency. The combined regenerative strategy achieved substantial horizontal bone augmentation, favorable healing, and adequate ridge dimensions for prosthetically-driven implant placement. These findings suggest that integrating autogenous bone grafting with xenografts, PRF, and piezoelectric surgery may enhance clinical outcomes by improving graft stability and supporting predictable bone regeneration. Nevertheless, long-term prospective studies with larger sample sizes are required to validate the effectiveness and long-term predictability of this treatment.

Patient Consent

Written informed consent was obtained from the patient for the publication of this case report and accompanying clinical and radiographic images. The patient understood the nature of the publication and provided consent for the use of anonymized clinical information and images.

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