

ALVEOLAR BONE GRAFTING IN A PATIENT WITH UNILATERAL CLEFT LIP AND PALATE USING BETA-TRICALCIUM PHOSPHATE COMBINED WITH PLATELET-RICH FIBRIN: A CASE REPORT

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ABSTRACT

Background: Secondary alveolar bone grafting is a key component in the comprehensive management of patients with cleft lip and palate. It restores alveolar continuity, supports eruption of permanent teeth, facilitates orthodontic treatment, and improves conditions for future prosthetic rehabilitation. Although autogenous bone remains the gold standard, its use is associated with donor-site morbidity, increased operative time, and additional cost.

Beta-tricalcium phosphate (β -TCP) combined with platelet-rich fibrin (PRF) may represent a promising alternative because of its osteoconductive properties, gradual resorption, and potential for replacement by newly formed autologous bone without interfering with tooth eruption. **Objective:** To report the clinical and radiographic outcomes of secondary alveolar bone grafting using β -TCP combined with PRF in a patient with unilateral cleft lip and palate, with particular emphasis on bone regeneration and eruption of the permanent canine into the grafted site. **Case Presentation:** A 10-year-old female patient with left-sided cleft lip and palate, previously treated with lip and palate repair and interceptive orthodontic therapy, presented with an alveolar cleft measuring 6 mm in width and a defect volume of 0.852 cc. Secondary alveolar bone grafting was performed using 1.2 cc of β -TCP combined with A-PRF+ and S-PRF.

Results: Healing was uneventful, with no postoperative infection, wound dehiscence, or graft rejection. Radiographic follow-up demonstrated progressive bone regeneration and formation of a continuous alveolar bone bridge with density comparable to adjacent native bone. The permanent maxillary canine erupted into the grafted site and was subsequently guided into proper position with orthodontic traction. **Conclusion:** β -TCP combined with PRF appears to be a safe, feasible, and effective alternative to autogenous bone for secondary alveolar bone grafting in selected patients with unilateral cleft lip and palate.

This approach may reduce donor-site morbidity while providing favorable bone regeneration and support for canine eruption.

Keywords: cleft lip and palate; secondary alveolar bone grafting; beta-tricalcium phosphate; platelet-rich fibrin; alveolar cleft.

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GHÉP XƯƠNG Ổ RĂNG CHO BỆNH NHÂN KHE HỞ MÔI-VÒM MIỆNG MỘT BÊN BẰNG BETA-TRICALCIUM PHOSPHATE KẾT HỢP FIBRIN GIÀU TIỂU CẦU: BÁO CÁO CA LÂM SÀNG

TÓM TẮT

Đặt vấn đề: Ghép xương ổ răng là một bước quan trọng trong điều trị toàn diện bệnh nhân dị tật khe hở môi-vòm miệng, giúp tái tạo cấu trúc xương ổ và tạo điều kiện cho mọc răng vĩnh viễn, chỉnh nha và phục hình. Tuy nhiên vật liệu ghép xương thường có nguồn gốc tự thân gây nguy cơ tăng biến chứng và chi phí phẫu thuật. Beta-tricalcium phosphate (β -TCP) kết hợp với fibrin giàu tiểu cầu (PRF) là vật liệu nhân tạo, có khả năng chuyển hóa hoàn toàn thành xương tự thân, không gây cản trở sự mọc răng, có thể ứng dụng trong ghép xương ổ răng cho bệnh nhân dị tật khe hở môi-vòm miệng. **Mục tiêu:** Báo cáo hiệu quả lâm sàng và sự mọc răng nanh vào vùng ghép của việc sử dụng vật liệu β -TCP kết hợp với PRF trong điều trị một trường hợp khe hở môi-vòm miệng một bên.

Ca bệnh: Bệnh nhân nữ, 10 tuổi, được chẩn đoán khe hở môi-vòm miệng bên trái, đã được tạo hình môi và vòm miệng, chỉnh nha sơ khởi trước đó. Khe hở ổ răng rộng 6 mm, thể tích xương thiếu hồng là 0,852cc. Bệnh nhân được ghép 1,2cc xương ổ răng bằng vật liệu β -TCP kết hợp với A-PRF+ và S-PRF. **Kết quả:** Sau 3 năm theo dõi, răng nanh đã mọc vào vùng ghép xương, hình ảnh X-quang cho thấy có sự tái tạo xương tốt, độ đặc xương đạt mức tương đương xương lành. Không ghi nhận biến chứng nhiễm trùng hay đào thải vật liệu.

Kết luận: Vật liệu β -TCP kết hợp PRF là lựa chọn an toàn, khả thi và hiệu quả trong ghép xương ổ răng ở bệnh nhân khe hở môi-vòm miệng một bên.

Từ khóa: khe hở môi-vòm miệng, ghép xương ổ răng, beta-tricalcium phosphate, fibrin giàu tiểu cầu.

I. INTRODUCTION

Cleft lip and palate is one of the most common congenital craniofacial anomalies, occurring in approximately 1 in 700 live births, with alveolar clefts present in nearly 75% of affected patients¹. If left untreated, alveolar clefts may result in persistent oronasal fistula, impaired speech, maxillary hypoplasia, insufficient bony support for adjacent teeth, dental crowding, and facial asymmetry. Secondary alveolar bone grafting is an essential stage in the multidisciplinary management of patients with cleft lip and palate. The procedure is typically performed when the permanent maxillary canine has reached one-half to two-thirds of root development, which is considered the optimal timing to facilitate eruption through the grafted site. Successful canine eruption is an important determinant of long-term alveolar continuity, periodontal support, and subsequent orthodontic and prosthetic rehabilitation². Autogenous bone grafts, particularly from the iliac crest or mandibular symphysis, have traditionally been considered the gold standard for alveolar reconstruction because of their osteogenic, osteoinductive, and osteoconductive properties. However, harvesting autogenous bone requires a second surgical site, which may increase operative time, postoperative pain, hospital stay, cost, and donor-site morbidity.

Beta-tricalcium phosphate (β -TCP) is a synthetic bone substitute with a porous structure similar to that of cancellous bone and the ability to undergo gradual resorption and replacement by newly formed bone³. Platelet-rich fibrin (PRF) is an autologous platelet concentrate rich in growth factors that can promote angiogenesis, soft tissue healing, and bone regeneration⁴. The combination of β -TCP and PRF may therefore enhance graft stability and biological integration while avoiding the disadvantages associated with autogenous bone harvesting.

This report describes the clinical and radiographic outcomes of secondary alveolar bone grafting using β -TCP combined with PRF in a patient with unilateral cleft lip and palate.

II. CASE PRESENTATION

A 10-year-old female patient with a history of left-sided cleft lip and palate presented for secondary alveolar bone grafting. She had previously undergone cheiloplasty and palatoplasty at 6 and 12 months of age, respectively.

Prior to surgery, the patient had received orthodontic treatment for maxillary arch expansion and relief of anterior dental crowding. Clinical examination revealed a repaired cleft lip and palate with a residual oronasal fistula in the alveolar region. A supernumerary tooth was present within the fistulous tract (Figure 1). Panoramic radiography and Cone-Beam Computed Tomography (CBCT) demonstrated that tooth 23 had reached approximately two-thirds of root development (Figures 2 and 3), indicating an appropriate stage for secondary alveolar bone grafting. The alveolar defect extended from the region of tooth 22 to the nasal floor, with a mesiodistal width of 6 mm. The calculated defect volume was 0.852 cc.

III. SURGICAL PROCEDURE

3.1. Graft Preparation

Two red tubes (A-PRF+) and two green tubes

(S-PRF) were centrifuged at 1300 rpm for 14 minutes. Approximately 1.2 cc of β -TCP bone substitute, corresponding to 130% of the calculated defect volume to compensate for anticipated postoperative resorption, was prepared⁵. The β -TCP particles were mixed with the liquid fractions of A-PRF+ and S-PRF to create a cohesive “sticky bone” graft. The solid fraction of A-PRF+ was compressed to form PRF membranes according to the manufacturer’s instructions⁶. Preparation of the graft material and PRF membranes was performed simultaneously with surgical exposure of the cleft site.

3.2. Surgical Technique

The procedure was performed under general anesthesia with oral endotracheal intubation. The patient was placed in the supine position. Local anesthesia was administered using two cartridges of 2% lidocaine with epinephrine 1:100,000 to provide hemostasis and postoperative analgesia. Mucoperiosteal flaps were elevated through vertical releasing incisions on both sides of the cleft (Figure 4). Scar tissue within the cleft was carefully excised, and hinged flaps were created toward the palatal and nasal aspects to reconstruct the nasal and palatal floors (Figure 5).

A PRF membrane was first placed over the reconstructed nasal and palatal floors. The prepared sticky bone graft was then packed into the alveolar defect and covered with an additional PRF membrane (Figure 6). The vestibular flap was subsequently released to achieve tension-free closure and sutured using horizontal mattress and interrupted Vicryl 4-0 sutures (Figure 7).

3.3. Postoperative Management

Postoperative medications included:

- Antibiotics: Amoxicillin-clavulanic acid and Metronidazole for 7 days
- Anti-inflammatory agent: prednisone for 3 days
- Analgesic: Paracetamol for 3 days

The patient was reviewed at 1 week and 1 month postoperatively to assess wound healing and soft tissue closure. Orthodontic treatment was continued to facilitate eruption and alignment of tooth 23. Long-term clinical and radiographic follow-up was performed to evaluate bone regeneration and tooth eruption.

IV. RESULTS

At 6 months postoperatively, primary wound healing was achieved without signs of infection, wound dehiscence, or graft rejection. The gingival tissues appeared healthy, and no vestibular shortening was observed (Figure 8). Panoramic radiography demonstrated progressive eruption of tooth 23 into the grafted region. The grafted site exhibited greater radiopacity than the surrounding bone, consistent with ongoing mineralization and maturation (Figure 9). At 12 months postoperatively, CBCT imaging revealed formation of a continuous alveolar bone bridge with density comparable to that of native bone. The buccolingual width of the regenerated alveolar ridge measured 9.34 mm at the level of the apex of tooth 21 (Figure 10). At 15 months, tooth 23 had erupted into the grafted site (Figure 11). However, the eruption path was unfavorable, necessitating orthodontic traction for proper guidance (Figure 12).

At 24 months, tooth 23 had been positioned appropriately within the dental arch (Figure 13). Follow-up radiographs confirmed maintenance of a continuous alveolar bone bridge with density similar to that of the adjacent alveolar bone (Figure 14).

At 3 years of follow-up, the grafted site remained stable, and the erupted canine demonstrated satisfactory positional and periodontal support.

V. DISCUSSION

Since the first report by Boyne in 1970, autogenous bone has remained the gold standard for secondary alveolar bone grafting in patients with cleft lip and palate⁷.

Its widespread use is supported by its well-established osteogenic potential and predictable clinical outcomes. Nevertheless, autogenous bone grafting is associated with several limitations, including limited graft availability, variable resorption, increased operative time, additional hospitalization in some cases, and donor-site morbidity.

Alternative grafting materials, including allografts, xenografts, and synthetic substitutes, have been investigated to overcome these limitations. However, their routine use in alveolar cleft reconstruction remains limited because of concerns related to disease transmission, immunologic response, graft stability, and the potential to interfere with eruption of adjacent teeth^{8,9}. In the present case, β -TCP was selected as the primary grafting material because of its favorable biological and structural characteristics. β -TCP is a synthetic calcium phosphate ceramic with excellent biocompatibility and a porous scaffold that supports osteoconduction. In addition, some studies have suggested that it may exhibit osteoinductive potential under appropriate biological conditions^{10,11}. Previous reports have shown that β -TCP can support early bone formation within approximately 6 weeks and may be gradually resorbed and replaced by newly formed autologous bone within 24 months¹². This pattern of remodeling is particularly advantageous in alveolar cleft grafting because it reduces the likelihood of interference with eruption of the permanent canine and adjacent tooth germ development¹³. Recent studies have reported encouraging outcomes with β -TCP in alveolar cleft reconstruction, including rates of bone fill and spontaneous tooth eruption comparable to those achieved with iliac crest bone grafting^{14,15}.

In the present case, radiographic evaluation demonstrated formation of a continuous bone bridge with density similar to that of adjacent

native bone, while clinically the permanent canine successfully erupted through the grafted site. These findings are consistent with the reported biological performance of β -TCP in the cleft environment. PRF was added to enhance the regenerative potential of the graft. As a second-generation platelet concentrate, PRF contains a fibrin matrix rich in platelets, leukocytes, cytokines, and growth factors that can promote angiogenesis, soft tissue healing, and osteogenesis¹⁶. In this case, PRF served not only as a biological adjunct but also as a membrane and cohesive agent for the β -TCP particles, allowing preparation of a “sticky bone” construct that improved graft handling and stability within the defect. When combined with β -TCP, PRF may enhance vascular infiltration, accelerate early bone formation, and improve graft integration¹⁷. The favorable outcome observed in this case—uneventful healing, radiographic bone regeneration, and successful canine eruption—suggests that β -TCP combined with PRF may be a viable alternative to autogenous bone in selected patients undergoing secondary alveolar bone grafting. However, this report represents a single case, and its findings should be interpreted cautiously. Larger prospective studies with standardized radiographic and clinical outcome measures are needed to determine the long-term predictability of this approach and to compare it directly with autogenous bone grafting.

VI. CONCLUSION

Within the limitations of this case report, β -TCP combined with PRF appears to be a safe, feasible, and effective alternative to autogenous bone for secondary alveolar bone grafting in patients with unilateral cleft lip and palate. This technique may reduce donor-site morbidity while providing satisfactory bone regeneration, maintenance of alveolar continuity, and support for eruption of the permanent canine.

Further studies with larger sample sizes and longer follow-up are required to validate these findings.

ETHICS STATEMENT

The treatment described in this report was performed as part of standard clinical care. Written informed consent was obtained from the patient’s parent/legal guardian for publication of this case report and the accompanying clinical and radiographic images.

CONFLICT OF INTEREST

The author(s) declare no conflict of interest.

FUNDING

This study received no external funding.

AUTHOR CONTRIBUTIONS

Conceptualization: [Lam Hoai Phuong, Nguyen Van Tuan, Bui Hoang Minh]

Data curation: [Bui Hoang Minh]

Investigation: [Bui Hoang Minh]

Methodology: [Lam Hoai Phuong, Nguyen Van Tuan, Bui Hoang Minh]

Surgical treatment: [Lam Hoai Phuong, Nguyen Le Huu Khoa, Bui Hoang Minh]

Orthodontic management: [Nguyen Le Huu Khoa] Writing – original draft: [Lam Hoai Phuong, Nguyen Van Tuan, Bui Hoang Minh]

Writing – review & editing: [Lam Hoai Phuong, Nguyen Van Tuan, Bui Hoang Minh] All authors have read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this case report are available from the corresponding author upon reasonable request.

SUGGESTED FIGURE LEGENDS



Figure 1. Clinical preoperative view showing the residual alveolar fistula and supernumerary tooth within the cleft region.

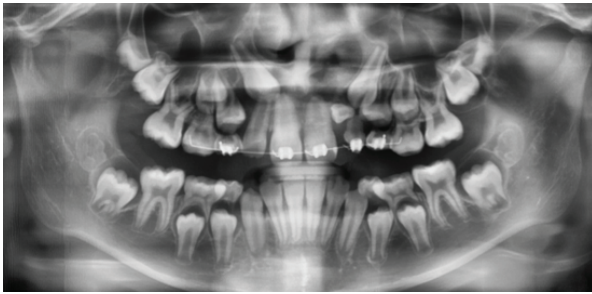


Figure 2. Preoperative panoramic radiograph showing the mixed dentition stage and development of tooth 23.

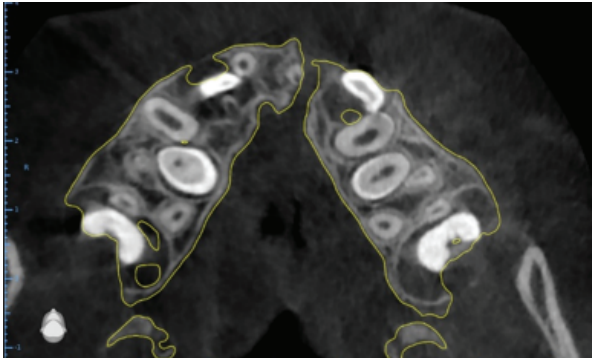


Figure 3. Preoperative CBCT image demonstrating the alveolar cleft defect extending from the region of tooth 22 to the nasal floor.

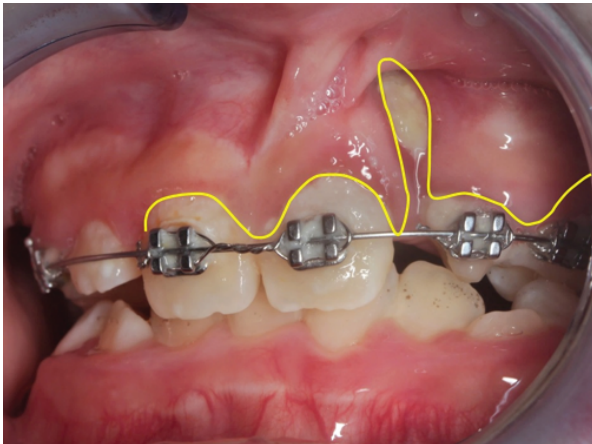


Figure 4. Intraoperative view after elevation of mucoperiosteal flaps on both sides of the cleft.

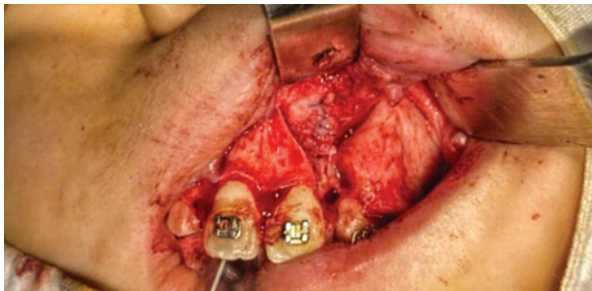


Figure 5. Reconstruction of the nasal and palatal floors using hinged flaps after excision of scar tissue.

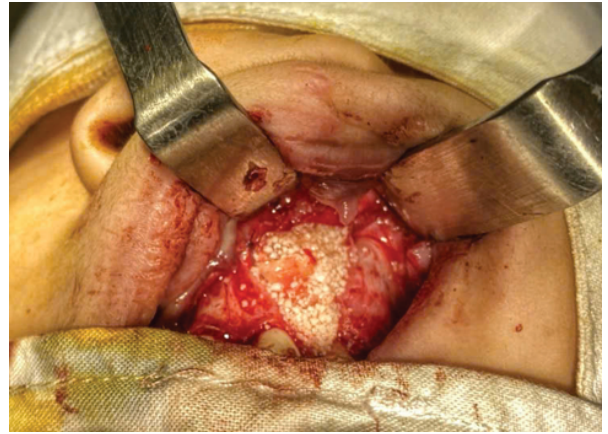


Figure 6. Placement of PRF membrane and β-TCP/PRF “sticky bone” graft within the alveolar defect.



Figure 7. Tension-free closure of the surgical site with interrupted and horizontal mattress sutures.



Figure 8. Clinical appearance at 6 months postoperatively showing healthy gingival tissues and satisfactory soft tissue healing.



Figure 9. Panoramic radiograph showing eruption of tooth 23 into the grafted site and progressive mineralization of the grafted area.

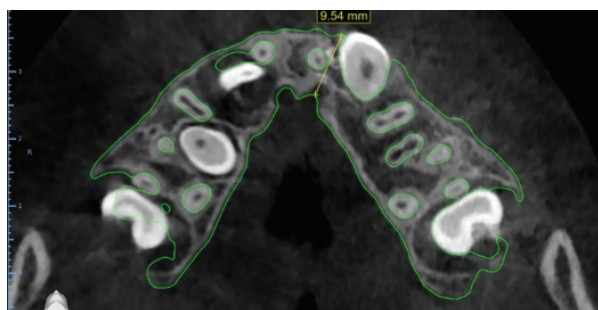


Figure 10. CBCT image at 12 months demonstrating formation of a continuous alveolar bone bridge and satisfactory buccolingual bone width.



Figure 11. Clinical view showing eruption of tooth 23 into the grafted region at 15 months.



Figure 12. Orthodontic traction applied to guide tooth 23 into a favorable position within the dental arch.



Figure 13. Clinical view at 24 months showing appropriate alignment of tooth 23.

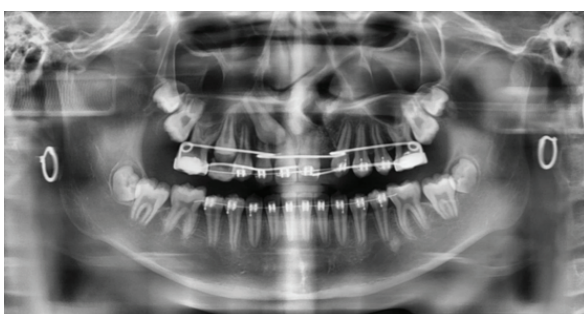


Figure 14. Follow-up radiograph confirming maintenance of a continuous alveolar bone bridge with density comparable to adjacent bone.

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