Secondary Bone Grafting with Simultaneous Auto-Tooth Transplantation to the Alveolar Cleft

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Running title: SECONDARY BONE GRAFTING WITH AUTO-TOOTH TRANSPLANTATION.

Abstract

One of the most important purposes of secondary bone grafting of the alveolar cleft is to stabilize the maxillary alveolar arch with completion of the dental arch. We report here a case of secondary bone grafting with simultaneous auto-tooth transplantation to the alveolar cleft, using particulate cancellous bone and marrow (PCBM) combined with platelet-rich plasma (PRP), which contains many growth factors. The patient was born with a bilateral cleft lip and left buccal-localized cleft alveolus. We performed a bone grafting to the cleft using PCBM with PRP, and a transplantation of the supernumerary tooth under general anesthesia at 11 years and 10 months of age. The postoperative course was uneventful and without any complications. Orthodontic treatment was nearly complete 10 months after the operation. The transplanted tooth was stable, and normal gingival contour was attained over the 2-year follow-up period. The case was successful in achieving a stable occlusal condition in a short period of time. We suggest the secondary bone grafting with simultaneous

auto-tooth transplantation as an option for alveolar cleft treatment.

Introduction

Major purposes of secondary bone grafting to the alveolar cleft includes closing the oronasal fistula[1], improving alveolar ridge height [2], promoting tooth eruption adjacent to the cleft, and stabilizing the maxillary alveolar arch with the completion of the dental arch, which provides long-term stability of the occlusal condition.

Orthodontic treatment of the displaced or impacted teeth[3, 4] is usually performed to establish the dental arch; however, the permanent tooth that should erupt into the cleft is occasionally congenitally missing[5]. Prosthetic appliance[6], dental implants[7, 8], or auto-tooth transplantation[5, 9] are alternatives for the missing tooth. Among these, auto-tooth transplantation is superior because it provides stable periodontal tissue, resulting in a local environment that promotes the longevity of the dentition.

If the tooth is available, it is favorable to the patient that tooth placement is completed simultaneously with bone grafting. Furthermore, the

transplanted tooth may prevent resorption of the grafted bone, which generally occurs due to the lack of functional stress, leading to an insufficient amount of alveolar bone to complete the dentition[10].

We report here a case of secondary bone grafting with simultaneous auto-tooth transplantation to the alveolar cleft, using particulate cancellous bone and marrow (PCBM) combined with platelet-rich plasma (PRP), which contains many growth factors and increases bone formation [1].

Case Report

The patient was born with a bilateral cleft lip and a left buccal-localized cleft alveolus. Left and right lip closures were performed by Cronin procedure at 3 and 6 months of age, respectively. Occlusal management was started by an orthodontist at 3 years of age and a wait-and-see approach was taken for the left cleft alveolus. Later, a bone graft to the patient's left alveolar cleft was planned for at 11 years of age.

Extra-orally, the alinasal deformity was slight, and a linear scar was observed at the left upper lip (Fig. 1). Intra-orally, a trough-like depression

was observed at the cleft alveolus falling under the position of the left upper lateral incisor and connecting to the palatal bone. A supernumerary tooth was identified behind the upper right lateral incisor (Fig. 2). Occlusal radiograph and panoramic radiograph showed the cleft alveolus between the left upper central incisor and canine. A radiolucent area, which indicates a nasopalatal fistula, was observed (Fig. 3). Three-dimensional imaging from computed tomography (3D-CT) showed the cleft alveolus between the left upper central incisor and canine (Fig. 4). At 11 years and 10 months of age, we performed a bone grafting to the cleft using PCBM from the iliac bone with PRP, and transplantation of the supernumerary tooth under general anesthesia. IRB at Imaki-ikre General Hospital approved the procedure. An intracrevicular incision was made and a mucoperiosteal flap was elevated (Fig. 5A, 5B). PRP was separated from venous blood by centrifugation, and PCBM was harvested from ilium bone. PRP was then added to the PCBM (Fig. 5C). PCBM with PRP was packed into the alveolar cleft and the extracted supernumerary tooth was

transplanted into the cleft. The wound was closed with tension-free mucoperiosteal flaps (Fig. 5D, 5E). An orthodontic bracket was applied to the transplanted tooth and fixed to the main wire.

The postoperative course was uneventful and without any complications. Orthodontic alignment of the transplanted tooth was initiated 1 month postoperatively (Fig. 6). Orthodontic treatment was nearly complete 10 months after the operation. The grafted bone and transplanted tooth were in good condition 1 year and 2 months postoperatively (Fig. 7). Occlusal radiograph revealed the bone-grafted site had become more radiopaque. Periodontal space and lamina dura were observed around the tooth, and root resorption was not seen (Fig. 8). 3D-CT images showed new bone formation at the cleft area and closure of the space between the floor of the nasal cavity and oral cavity (Fig. 9). After 2 years and 3 months, stability of the transplanted tooth was normal and a relatively normal gingival contour was attained. There were no signs of infection, such as discharge of pus, reddening of the gingiva, or tenderness of the apical area

(Fig. 10).

Discussion

In the present case, an auto-transplanted tooth was successfully taken into PCBM grafted into the alveolar cleft, and the permanent dentition was completed after orthodontic treatment.Lamina dura was observed radiographically, indicating the proper formation of the periodontal ligament. It is well known that PCBM contains not only osteoprogenitor cells but also mesenchymal stem cells; these cells along with periodontal ligament cells from the transplanted tooth may synergistically generate the complicated periodontal tissue.

Simultaneous auto-tooth transplantation with bone grafting has additional advantages. First, only a relatively short period of time, 10 months, was required after surgery to complete the dentition; simultaneous formation of alveolar bone and periodontal ligament may reduce the duration of the treatment. Second, neither root resorption nor ankylosis were observed in

the present case, despite being known complications of auto-tooth transplantation [11, 12]. This is because there was no compression of the periodontal ligament in the soft PCBM host bed.

PCBM is widely utilized for secondary bone grafting because it is easy to harvest in a sufficient amount and possesses high osteoinductive ability. Despite these advantages of PCBM, resorption of newly formed bone may occur, and the height and width of the regenerated residual ridge may decrease unless functional stress is applied to the transplanted site [13, 14]. In the present case, there was no bone resorption either in the height or width of the newly formed bone. The transplanted tooth may have provided the required functional stress. The early formation of viable periodontal ligament may also have prevented bone resorption.

We used PRP to promote new bone formation. It has been reported that PRP in conjunction with autogenous bone significantly increases the activity of osteoprogenitor cells [15, 16], because PRP contains many growth factors such as PDGF, TGF-ß, and vascular endothelial growth factor

(VEGF) [17]. On the other hand, it has also been reported that PRP application does not have a significant benefit for bone regeneration[18, 19]. However, even if PRP does not provide a benefit for secondary bone grafting, it does not prevent bone formation[13]. Furthermore, PRP promotes easier handling of PCBM due to the fibrin in PRP working as a “glue” to bind the bone chips together. Additionally, the narrow alveolar cleft, sufficient grafted bone, and a thick palatal bone may have contributed to the successful result of the present case.

Although the treatment showed in this report was a single case, this treatment may be successful with careful selection of the case, which should have the adequate supernumerary tooth, and attentive procedure. Points which may have contributed to the success of the case include sufficient volume of grafted bone, compact and tight graft of PCBM, unscathed periodontal ligament of the transplant tooth, and the absence of excess occlusal interference by lower incisor teeth. SBG is usually performed before the eruption of capsid, this procedure is more suitable to apply after

the eruption.So further studies are needed to clarify the efficiency of this treatment, keeping in mind that this is a single case report.

We showed in the present case successful treatment with alveolar bone grafting and simultaneous auto-tooth transplantation. Although a new practice, we suggest this treatment as an option with many advantages for treatment of alveolar cleft and also assume that the idea may be applied to alveolar bone reconstruction after cystectomy or tumor resection.

There is no conflict of interest concerning this report.

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Figure legends

Figure 1: The alinasal deformity is slight, and a linear scar is observed at the upper left lip.

Figure 2: A trough-like depression is seen at the cleft alveolus falling under the area of the upper left lateral incisor (A), and the depression connects to the palatal bone (B).

Figure 3: Occlusal radiograph (A) and panoramic radiograph (B) shows the cleft alveolus between the upper left central incisor and upper left canine. A radiolucent area, suggestive of a nasopalatal fistula, is shown.

Figure 4: Three-dimensional imaging from computed tomography (3D-CT) shows the cleft alveolus between the upper left central incisor and upper left canine.

Figure 5: An intracrevicular incision (A) was made and a mucoperiosteal flap was elevated (B). PCBM was added to the PRP (C). The extracted supernumerary tooth (D) was transplanted into the cleft, then closed with tension-free mucoperiosteal flaps (E).

Figure 6: Orthodontic alignment of the transplanted tooth was initiated 1 month postoperatively.

Figure 7: The grafted bone and transplanted tooth were in good condition 1 year and 2 months postoperatively.

Figure 8: Periodontal space and lamina dura are observed around the tooth, and root resorption is not seen.

Figure 9: 3D-CT images show new bone formation at the cleft area and closure of the space between the floor of the nasal cavity and oral cavity.

Figure 10: After 2 years and 3 months, stability of the transplanted tooth was normal and a normal gingival contour was attained. There were no signs of infection, such as discharge of pus, reddening of the gingiva, or tenderness of the apical area.

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

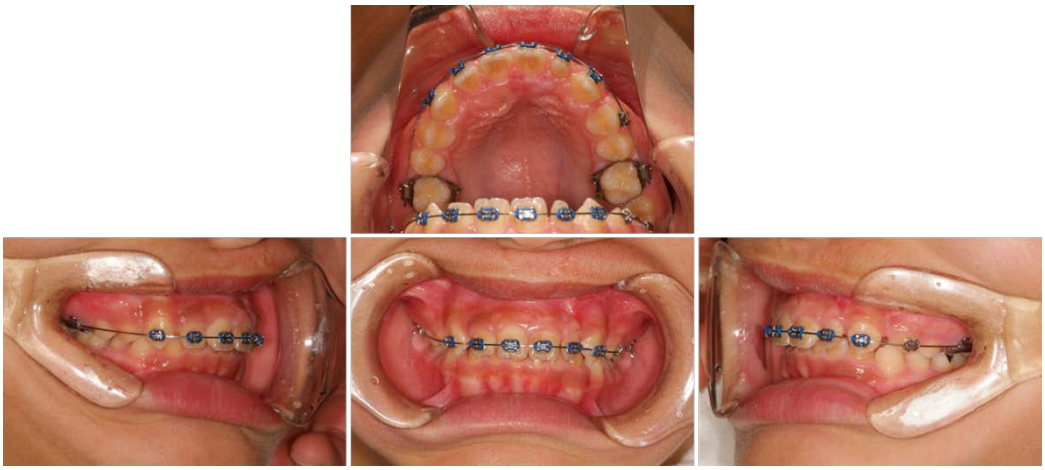

Figure 7

Figure 8

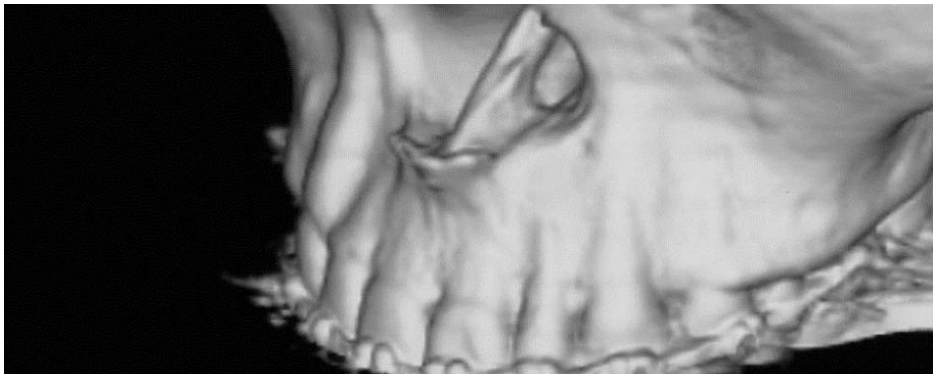

Figure 9

Figure 10