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CASE REPORT

Masticatory Rehabilitation of a Patient With Cleft Lip and Palate Malformation Using a Maxillary Full-Arch Reconstruction With a Prefabricated Fibula Flap

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For full-arch reconstruction of an atrophied cleft maxilla with missing premaxilla, a prefabricated microvascular free bony flap is a relevant option. A fibula flap was prefabricated in a cleft patient who received six dental implants and an epithelial layer. Six weeks later, maxillary reconstruction was performed. The inpatient period could be confined to 2 weeks. A fixed provisional prosthesis was delivered after an additional 2 weeks. A prefabricated flap allows for the reduction of the interval without a dental prosthesis to only a few weeks, even when a complex full-arch reconstruction of the maxilla is required.

KEY WORDS: *dental implant, fibula flap, prefabrication, prelamination, vascularized free flap*

Background

Well-structured multidisciplinary concepts for the treatment of cleft lip and cleft palate (CLP) malformations significantly reduce the impairment of speech, hearing, masticatory function, and esthetics of the affected patients (Schuster et al., 2012; Nkenke and Stelzle et al., 2013; Nkenke and Vairaktaris et al., 2013). However, poor levels of oral hygiene are often encountered in CLP patients (Huynh-Ba et al., 2009). This problem may result in tooth loss, which is followed by atrophy of the edentulous alveolar crests. As a consequence, oral rehabilitation with conventional prostheses is inhibited, while the placement of dental implants to support prostheses requires sophisticated procedures such as bony augmentations. One of these sophisticated procedures is the use of vascularized free flaps, which have a surprisingly high success rate in patients with cleft lip and palate malformation (Zemann et al., 2011). Although microvascular free flaps have been described for the reconstruction of the anterior maxilla in CLP patients (Gaggl et al., 2012), there is only limited information on the use of prefabricated microvascular bony flaps that contain dental implants. In particular, full-arch reconstruction with this type of flap is not described in the current literature on cleft patients. Therefore, it is the aim of the present case report to describe the course of treatment of a full-arch maxillary reconstruction with a prefabricated microvascular fibula flap.

Case Report

A 52-year-old man with a repaired complete bilateral cleft lip, palate, and alveolus malformation presented at the Department of Oral and Maxillofacial Surgery. He complained about loosening of the remaining five teeth in the maxilla (Fig. 1). As a consequence, the tooth-borne maxillary denture was mobile and did not allow adequate chewing. Lip repair had been performed at the age of 6 months. As a complication of this operation, the premaxilla was lost (Fig. 2). Closure of the soft palate was carried out at the age of 13 months. The hard palate was closed at the age of 6 years. However, an oroantral fistula remained that was repaired with a tongue flap at the age of 9 years. Corrective surgery to the nose was performed when the patient was 19 years old. The patient did not suffer from general diseases.

On clinical examination, all remaining five maxillary teeth showed Class III mobility according to the Miller classification. There was excessive plaque accumulation (periodontal index score 3 according to Silness and Loe, 1964) and pronounced bleeding on probing (sulcus bleeding index score 3 according to Mühlemann and Son, 1971). A panoramic radiograph showed pronounced alveolar bone loss around the remaining maxillary teeth (Fig. 3).

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FIGURE 1 The palatal view of the maxillary dentition.

Moreover, a wide bony defect was detectable in the anterior maxilla.

Based on the clinical and radiologic findings, the prognosis of the maxillary teeth was rated as poor with respect to midterm survival. Therefore, the removal of these teeth was recommended. As far as the prosthodontic rehabilitation was concerned, the patient was not willing to wear a mucosally based removable full denture as a reaction to his experiences with the tooth-borne removable denture. Because of the pronounced atrophy of the lateral maxillary ridges and the missing anterior bony maxilla, conventional reconstruction procedures with block bone grafts, bilateral sinus floor augmentations, and the placement of dental implants after a healing interval would have left the patient without a prosthesis for several months. The patient was not willing to accept this treatment option. Therefore, he was encouraged to undergo full-arch maxillary reconstruction with a prefabricated vascularized free fibula flap. The patient was informed that this procedure could reduce the time interval without an implant-borne prosthesis following bony reconstruction to a few weeks.

FIGURE 2 A 3D skull model. The premaxilla is missing.

FIGURE 3 The preoperative panoramic radiograph.

A computed tomography scan of the left fibula was used as the basis for the fabrication of a three-dimensional (3D) model by means of a 3D printer (Zprinter 650, Z Cooperation, Oldenburg, Germany). Impressions of the mandible and maxilla were taken, and plaster casts were made. Based on the dimensions of the maxilla and mandible, the reconstruction with the fibula flap was planned. It was decided to perform osteotomies such that three fibula segments would reconstruct the complete maxillary arch. Subsequently, a surgical template was fabricated that included information on the positions of the osteotomies and allowed for drillings during the dental implant site preparation. Each bony segment received two implants.

The first step of actual surgery was the prefabrication of the bone graft under general anesthesia. Six dental implants 4.1 mm in diameter and 10 mm in length (Straumann bone level RC, Straumann AG, Basel, Switzerland) were placed in predetermined positions in the lateral aspect of the left fibula (Figs. 4 and 5). Simultaneously, a 0.5-mm split-thickness skin graft was harvested from the left upper arm and was attached to the fibula segment that contained the implants.

Six weeks later, the prefabricated fibula was osteotomized such that the six implants were distributed in pairs of two over three segments (Fig. 6). The surgical template that was used for placing the implant served as a cutting guide. Two bony wedges were removed between the segments. The three bony segments remained connected by the vascular pedicle. Stage 2 surgery of the implants was performed, and healing abutments were fixed to the implants. Subsequently, the three segments of the bone graft were transferred to the maxillary defect (Fig. 7). They were fixed to the pristine maxillary bone with four osteosynthesis plates and 5-mm-long 2.0-mm osteosynthesis screws (KLS-Martin, Tuttlingen, Germany). The fibular vascular pedicle was guided to the left submandibular

FIGURE 4 The surgical template positioned on the exposed aspect of the lateral right fibula. The tubes were used to guide the initial drillings for the preparation of the implant sites. The triangular spared regions in the the template indicate the wedges that have to be removed to create the three fibular segments.

region along a tunnel at the lingual aspect of the ascending ramus of the mandible to establish microvascular anastomoses with the superior thyreoid artery and the internal jugular vein following a submandibular incision.

The postoperative course was uneventful. The patient was able to leave the hospital 2 weeks after surgery. He was advised to adhere to a soft diet for 6 weeks. Two weeks after the reconstructive procedure, impression copings were connected to the six implants in the reconstructed maxilla, and an impression was made for the fabrication of a provisional fixed denture. The denture could be delivered after an additional 2 weeks. The most distal implant on each side was not included in the provisional denture because the mouth opening was reduced. The patient was advised to carry out mouth-opening exercises with stacked tongue depressors four times a day for 10 minutes. The stretching effect was achieved by increasing the number of tongue depressors until the patient experienced light pain. The patient was instructed to avoid excessive pain.

FIGURE 5 Fixation of the split-thickness skin graft to the lateral aspect of the fibula following implant placement.

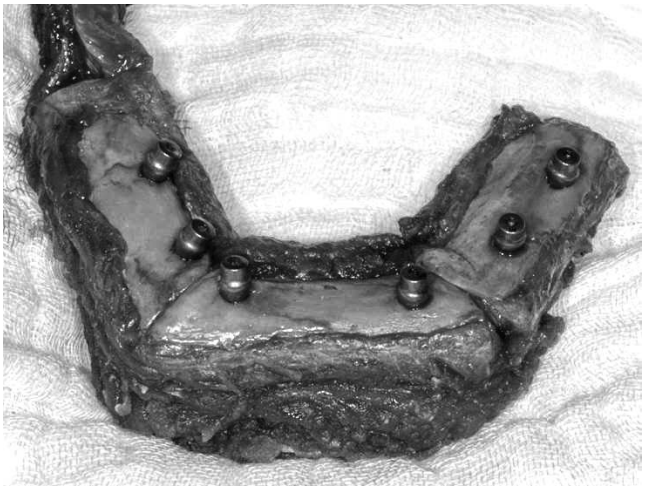

FIGURE 6 The osteotomized prefabricated fibula flap with three segements. The implants have received healing abutments.

After an additional 2 months, the patient presented with a swelling of the right cheek. On clinical examination, exposed osteosynthesis material in the upper right buccogingival sulcus was identified. Therefore, all osteosynthesis plates and screws were removed under general anesthesia. Intraoperatively, fusion of the bony segments of the fibula was visible. The postoperative course was uneventful. The postoperative panoramic radiograph confirmed bony consolidation of the three fibula segments.

After an additional healing period of 6 weeks, impression copings were connected to the implants, and a new impression was made for the fabrication of the final prosthesis. A removable bar-retained overdenture was chosen to facilitate oral hygiene for the patient (Figs. 8 and 9). Twelve months after the reconstruction procedure, the patient had regained an interincisal distance of 42 mm on maximum mouth opening. He felt no restrictions as far as mastication was concerned.

Discussion

For repair of premaxillary defects in patients with cleft lip and palate malformations, vascularized free flaps from the lateral upper arm as well as the radial forearm have been

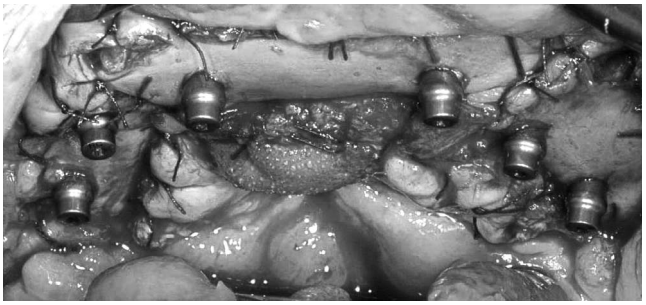

FIGURE 7 The situation after fixation of the flap to the pristine maxilla.

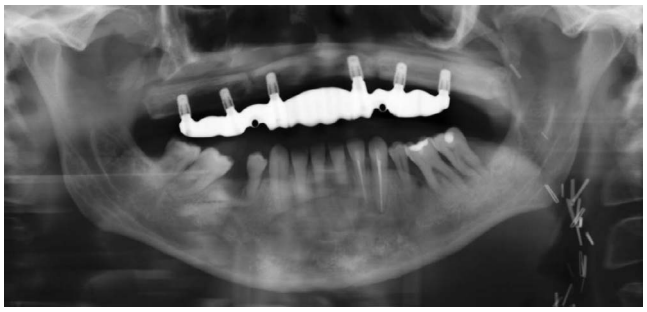

FIGURE 8 The panoramic radiograph with a bar connected to the implants.

described (Hallock, 1997; Krimmel et al., 2005). However, it has been criticized that that these flaps can be harvested only with bony portions of limited size. As a consequence, they do not allow for the reconstruction of the missing premaxilla such that dental implants can be placed. Therefore, vascularized free bony flaps from other donor sites have been introduced to CLP surgery (Gaggl et al., 2012).

Reconstructing the bony maxilla with a vascularized free fibula flap is a well-described technique (Rodriguez et al., 2007). However, when an osteomyocutaneous fibula flap has to be adopted to close a palatal defect, the skin paddle can be of unfavorable thickness. As a consequence, additional debulking procedures and vestibuloplasties will become necessary before treatment with dental implants can be considered. To prevent these interventions, prelamination of fibula flaps with split-skin grafts has been described (Santamaria et al., 2012). However, despite this sophisticated procedure, the patient is still left without dental implants as a basis for fixed or removable dentures (Schneider et al., 2012). It has been stated that, often, a time interval of 6 months is needed before prosthetic rehabilitation is possible in these cases (Rohner et al., 2002). Prefabrication of vascularized free flaps with a split-skin graft and the simultaneous placement of dental implants in the bony portion of the graft can help to significantly reduce this time interval (Nkenke and Eitner, 2014).

The aim of prefabrication is to contour the graft such that the defect is filled with adequate amounts of soft tissue and bone to resemble the original anatomy in the best way possible. Dental implants are placed prosthetically in the graft, and a thin epithelial tissue layer is established at the donor site (Rohner et al., 2002). The latter is important to establish stable peri-implant conditions in the long term and to ensure implant success over time. So far, a full-arch reconstruction of the maxilla with a prefabricated flap that contains dental implants has not been described in patients with cleft lip and palate malformations in the current literature. Therefore, the aim of the present case report was to introduce this technique.

FIGURE 9 The frontal view of the final dentition.

The use of prefabricated bone grafts is gaining popularity because, on average, patients regain full oral function within 10 weeks independent of the indication for the grafting procedure (Rohner et al., 2003). In the present patient case, a provisional fixed metal-based prosthesis could be connected to the implants after 4 weeks. However, limited mouth opening during the initial weeks after the reconstruction procedure prevented the connection of the prosthesis to the most distal implants on both sides. Still, the patient regained masticatory function with a shortened maxillary dental arch. Moreover, adequate esthetics of the upper dentition was achieved.

The occurrence of limitations in mouth opening following the use of vascularized free fibular flaps is a well-known complication (Rohner et al., 2003). However, the present case report shows that the problem can be overcome by mouth-opening exercises, which were successful when applied four times a day for 10 minutes over a period of 3 months.

It has been described that the prefabrication of the bony flap can be combined with the prefabrication of either a provisional or a definitive denture (Jaquiéry et al., 2004). In the present patient case, prefabrication of the prosthesis was not taken into account. When a full-arch reconstruction is carried out, sometimes the positions of the different bony segments slightly deviate from the preoperative plan. As a consequence, it is difficult to connect the prefabricated prosthesis to all implants located in three different flap segments with a passive fit. Therefore, we decided to start with the fabrication of the prosthesis only after the completion of the bony reconstructive procedure, which led to a 4-week delay in oral rehabilitation. The patient received the provisional prosthesis after 4 weeks. This time interval equals the period needed to regain full ambulation without pain after the harvest of a fibula flap (Ling and Peng, 2012). Therefore, the delay in oral rehabilitation seems to be acceptable and does not increase the patient's time away from work.

A relevant alternative to the use of a prefabricated vascularized free bony flap would have been performing a bilateral sinus floor elevation, placing implants in a second step, and loading these implants after an additional time interval. Compared to the solution that was chosen in the present patient case, this treatment concept is less complex, and surgery can be carried out under local anesthesia.

However, the time interval until delivery of the final prosthesis would have been significantly extended. When different therapy options are available, it is most important to inform the patient about all of the advantages and disadvantages of each treatment. With this knowledge, the patient is empowered to choose the therapy option that fulfills his or her personal needs in the best possible way. For the present patient, the primary reason for his decision was the significantly shorter time interval until oral rehabilitation with the prefabricated flap.

Conclusion

The use of a prefabricated vascularized free fibula flap allowed for the successful reconstruction of an extremely atrophied maxilla with missing premaxilla in a patient with a cleft lip, palate, and alveolus malformation. The inclusion of the implants in the flap reduced the time without a dental prosthesis to only a few weeks. The exposure of osteosynthesis material in the maxillary buccogingival sulcus has to be considered a relevant complication that required reoperation but did not delay the treatment course.

References

Gaggl A, Bürger H, Virnik S, Schachner P, Chiari F. The microvascular corticocancellous femur flap for reconstruction of the anterior maxilla in adult cleft lip, palate, and alveolus patients. *Cleft Palate Craniofac J*. 2012;49:305–313.

Hallock GG. Repair of an untreated cleft palate in an adult using a prefabricated radial forearm flap. *Ann Plast Surg*. 1997;38:69–73.

Huynh-Ba G, Brägger U, Zwahlen M, Lang NP, Salvi GE. Periodontal disease progression in subjects with orofafial clefts over a 25-year follow-up period. *J Clin Periodontol*. 2009;36:836–842.

Jaquiéry C, Rohner D, Kunz C, Bucher P, Peters F, Schenk RK, Hammer B. Reconstruction of maxillary and mandibular defects using prefabricated microvascular fibular grafts and osseointegrated dental implants: a prospective study. *Clin Oral Implants Res*. 2004;15:598–606.

Krimmel M, Hoffmann J, Reinert S. Cleft palate fistula closure with a mucosal prelaminated lateral upper arm flap. *Plast Reconstr Surg*. 2005;116:1870–1872.

Ling XF, Peng X. What is the price to pay for a free fibula flap? A systematic review of donor-site morbidity following free fibula flap surgery. *Plast Reconstr Surg*. 2012;129:657–674.

Mühlemann HR, Son S. Gingival sulcus bleeding: a leading symptom in initial gingivitis. *Helv Odontol Acta*. 1971;15:107–113.

Nkenke E, Eitner S. Complex hemimaxillary rehabilitation with a prefabricated fibula flap and cast-based vacuum-formed surgical template. *J Prosthet Dent*. 2014;111:521–524.

Nkenke E, Stelzle F, Vairaktaris E, Knipfer C. Do cleft lip and palate patients opt for secondary corrective surgery of upper lip and nose, frequently? *Head Face Med*. 2013;9:38.

Nkenke E, Vairaktaris E, Stelzle F, Knipfer C. Single horizontal Y-V vermillion plasty including orbicularis muscle repair for secondary correction of the whistling defect: a universal technique. *Med Oral Patol Oral Cir Bucal*. 2013;18:e257–e262.

Rodriguez ED, Martin M, Bluebond-Langner R, Kahlifeh M, Singh N, Manson PN. Microsurgical reconstruction of posttraumatic high-energy maxillary defects: establishing the effectiveness of early reconstruction. *Plast Reconstr Surg*. 2007;120(7 Suppl 2):103S–107S.

Rohner D, Bucher P, Kunz C, Hammer B, Schenk RK, Prein J: Treatment of severe atrophy of the maxilla with the prefabricated free vascularized fibula flap. *Clin Oral Implants Res*. 2002;13:44–52.

Rohner D, Jaquiéry C, Kunz C, Bucher P, Maas H, Hammer B. Maxillofacial reconstruction with prefabricated osseous free flaps: a 3-year experience with 24 patients. *Plast Reconstr Surg*. 2003;112:748–757.

Santamaria E, Correa S, Bluebond-Langner R, Orozco H, Ortiz-Monasterio F. A shift from the osteocutaneous fibula flap to the prelaminated osteomucosal fibula flap for maxillary reconstruction. *Plast Reconstr Surg*. 2012;130:1023–1030.

Schneider R, Fridrich K, Chang K. Complex mandibular rehabilitation of a self-inflicted gunshot wound: a clinical report. *J Prosthet Dent*. 2012;107:158–162.

Schuster M, Maier A, Bocklet T, Nkenke E, Holst A, Eysholdt U, Stelzle F. Automatically evaluated degree of intelligibility of children with different cleft type from preschool and elementary school measured by automatic speech recognition. *Int J Pediatr Otorhinolaryngol*. 2012;76:362–369.

Silness J, Loe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand*. 1964;22:121–135.

Zemann W, Kruse AL, Lübbers HT, JacobseN C, Metzler P, Obwegeser JA. Microvascula tissue transfer in cleft palate patients: advocacy of the prelaminated radial free forearm flap. *J Craniofac Surg*. 2011;22:2006–2010.