RESEARCH ARTICLE

Reconstruction of Combined Oral Mucosa-Mandibular Defects Using the Vascularized Myoosseous Iliac Crest Free Flap

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Abstract

The authors present five cases of combined oral mucosa-mandible defects reconstructed with the vascularized internal oblique-iliac crest myoosseous free flap. This technique has many advantages compared to other conventional methods such as the radial flap, scapula flap, and fibula flap. Vascularized iliac crest flaps provide sufficient high-quality bone suitable for reconstructing segmental madibular defects. Although fibular flaps allow longer donor bone tissue to be harvested, the iliac crest can provide an esthetic shape for mandibular body reconstruction and also provides sufficient bone height for dental implants. Conventional vascularized iliac crest myoosseous flaps have excessive soft tissue bulk for reconstruction of intraoral soft tissue defects. The modification discussed in the present article can reduce soft tissue volume, resulting in better functional reconstruction of the oral mucosa. Another advantage is that complete replacement of the oral mucosa is observed in as early as one month post-operation. The final mucosal texture is much better than that obtained with other skin paddle flaps, which is especially beneficial for the placement of dental implant prostheses. Donor site morbidity looks to be similar to, if not less than that observed for other modalities in terms of function and esthetics. For combined oral mucosa-mandible defects, the vascularized internal oblique-iliac crest myoosseous free flap shows good results with respect to hard and soft tissue reconstruction.

Key words: iliac crest flap - deep circumflex iliac artery (DCIA) flap - mandible reconstruction

Asian Pacific J Cancer Prev, **13**, 4137-4140

Introduction

Esthetic and functional reconstruction of continuity defects of the mandible is still a daunting challenge in the field of reconstructive surgery. Techniques utilizing metal reconstruction plates, free autogenous bone grafts, heterografts, xenografts, and bone substitutes have been utilized, and still remain as viable options. Although there have been many developments and improvements in these techniques, autogenous bone grafting currently produces the best results. Bones such as the calvarium, ribs, iliac bone, tibia, radius, and scapula have been regarded as suitable candidates for donor sites. However, a number of problems have been encountered with autogenous bone grafting in cases with compromised blood supply resulting from radiation therapy or in cases with extensive defects, which include complications such as infection and graft resorption (Genden and Haughey, 1996). Vascularized bone grafts have become an indispensable modality to avoid such problems, and have shown favorable results in terms of healing. The long-term success rate of microanastomosis is reported to be over 90 per cent at present (Hidalgo and Pusic, 2002). Different types of flaps including the fibula flap, scapula flap, radial flap, and anterior iliac crest flap are commonly employed for microanasotomis (Mehta and Deschler, 2004). Each technique is selectively chosen for every case because of the differences in the shape, size, quality, and quantity of donor bones. Mandibular defects commonly accompany intra- or extraoral soft tissue defects, making soft tissue reconstruction an important factor in the flap selection process.

Introduced first by O'Brien, the free vascularized anterior iliac crest flap uses the deep circumflex iliac artery and vein system, and can provide tissue of up to 14-16 cm in length (O'Brien et al., 1977). It allows reconstruction of various forms of mandibular defects, and can include muscles and skin from the inguinal region to reconstruct any accompanying soft tissue defects. Although the bony component of the composite flap provides excellent quality and quantity for hard tissue reconstruction, the soft tissue component often

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has excessive bulk, compromising esthetics and function (Thoma et al., 2005). To circumvent this problem, Urken et al. introduced a technique utilizing the vascularized internal oblique-iliac crest myoosseous free flap to reconstruct combined oral mucosa-mandible defects (Urken et al., 1989). The vascularized internal oblique-iliac crest myoosseous free flap exposes the internal oblique muscle to the oral cavity and induces secondary epithelialization to restore intraoral mucosal defects (Figure 1).

The present article aims to present clinical cases utilizing the vascularized internal oblique-iliac crest osteomyocutaneous free flap for mandibular reconstruction performed at the Department of Oral and Maxillofacial Surgery at Yonsei University Medical Center, and discuss the viability and value of the technique.

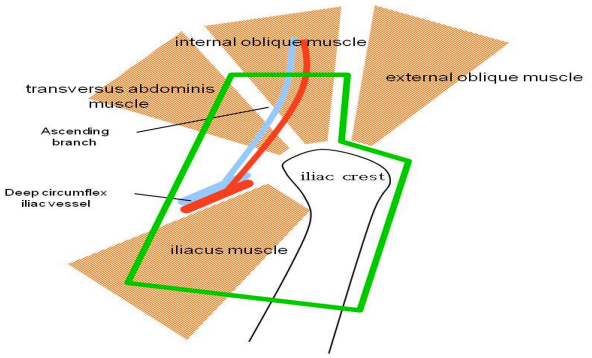


Figure 1. Tissues Included in Vascularized Internal Oblique-iliac Crest Myoosseous Free Flap

Materials and Methods

A total of 7 flaps in five patients were investigated (Table 1). Cases 1, 2 and 3 presented osteoradionecrosis due to radiation therapy following tumor ablation including neck dissection for oral cancer, resulting in compromised blood supply and vascularity in the recipient areas. After reconstruction, the patients of case 1 and 2 were developed osteoradionecrosis on the opposite site, necessitating treatment. Reconstructive surgery was performed again. Cases 4 and 5 had prolonged inflammation in the affected areas. All cases had accompanying soft tissue defects limited to the oral mucosa, and required segmental mandibulectomy due to extensive damage to the mandible. Reconstruction was performed immediately after mandibulectomy in all cases.

A 10 cm incision was made on the extension of a line connecting the symphysis pubis to the anterior superior iliac spine, and the skin was carefully dissected while palpating the femoral artery. The deep circumflex iliac artery and vein along with the ascending branch were identified and preserved. It was particularly important to preserve the ascending branch as the flap included the overlying muscle and skin layers. The flap included the iliac crest, the iliac muscles, the transversus abdominis muscle, and the internal oblique abdominis muscle. The fascia of the internal oblique abdominis muscle was positioned to replace the oral mucosa and was microanastomosed using conventional methods. The superior thyroid vessels were used in the recipient area with the exception of case 1, in which the donor vessels were anastomosed end-to-side to the internal jugular vein because of the compromised venous system as a result of the previously performed neck dissection and radiation therapy. The harvested bone segment was fixed to the recipient segment using plates and screws (Figure 2).

In case 2, aside from delayed healing and transient infection, no complications of any significance were noted and the vitality of the grafted tissue remained

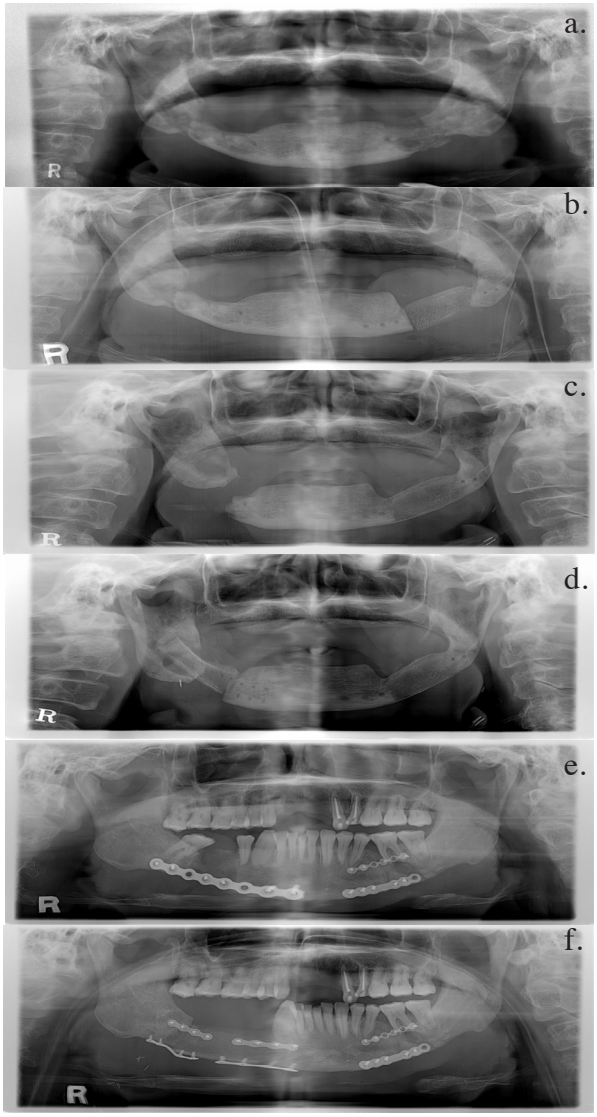


Figure 2. Panoramic X-ray before and after Surgery Case 1. Osteoradionecrosis with Pathologic Fracture on both Mandibular Body and Panoramic X-ray before and after Surgery Case 4. Osteomyelitis on Right Mandibular Body due to Nonunion. a. Before surgery, b. After reconstruction of mandibular left side, c. After management of inflammation on the mandibular right side, d. After reconstruction of mandibular right side, e. Before surgery, f. After segmantal mandibulectomy on the right side, and the reconstructive surgery was done.

stable. The internal oblique muscle exposed to the oral cavity showed signs of epitheilialization one week post-operation, undergoing metaplasia to tissue nearly identical to oral mucosa within one month (Figure 3). Partial exposure of the grafted bone was observed in case 3, but the vitality of the flap was stable. The case is currently being followed up, and is scheduled for second surgery after infection control and adequate soft tissue healing.

Results

Attempts to classify defects of the jaw and its soft tissues by location and size to propose appropriate methods for reconstruction have been made for many years (David et al., 1988; Jewer et al., 1989; Urken et al., 1991; Boyd et al., 1993). Various treatment methods have been proposed as a result of such endeavors, and new alternatives continue to be suggested. Many factors come into play in the process of choosing the appropriate method for reconstruction, including location and extent of the hard and soft tissue defect, dentition, possible complications, characteristics of the tissue, goals of the patient and medical staff, and operator preference. In the past, esthetics has been the main point of focus in reconstruction, while restoration of masticatory function relied only on removable prostheses in the form of dentures. With the vast improvements in dental implants, restoration of masticatory function using implant prostheses has become an integral factor in oral and maxillofacial reconstruction. Reported only occasionally starting in the late 1980s, the use of dental implants in reconstructed mandibles is now a crucial factor to be considered in jaw reconstruction (Riediger, 1988; Cheung and Leung, 2003; Thoma et al., 2005).

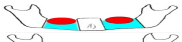
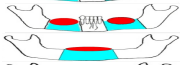
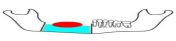
Commonly used methods of free vascularized bone transfer for mandibular reconstruction today commonly harvest bone tissue from the fibula, iliac crest, scapula, and radius, and can also include soft tissue. Scapula flaps and radial flaps are mostly used to restore soft tissue defects and offer a limited amount of harvestable bone and have poor quality, making them unsuitable options for hard tissue reconstruction. Thus, iliac crest flaps and fibular flaps are the most common methods employed for mandibular reconstruction.

The fibula flab can provide bone tissue of up to 25 cm and can also be used to reconstruct the condyle. Its abundant cortex ensures excellent bone quality. In addition, the vessels for anastomosis are long and have an adequate diameter, facilitating anastomosis. However, the fibula offers insufficient bone height for dental implants, and complicated additional procedures such as the double-barreled technique, and distraction osteogenesis are sometimes necessary to overcome this shortcoming (Hidalgo and Rekow, 1995).

The anterior iliac crest flap, although less than the fibula flap, provides up to 15 cm of harvestable bone tissue of excellent quality for mandibular reconstruction. It also has more bone height compared to the fibula flap, allowing the use of longer implant fixtures and attaining better crown-to-implant ratio. The structural similarity of the ipsiliateral iliac crest to the mandibular body allows esthetic reconstruction without additional modifications. The iliac crest can be easily reshaped if necessary for esthetic purposes.

Regarding soft tissue reconstruction, the soft tissue component of the fibula flap presents a number of drawbacks. The skin paddle heals slowly and its incompatible texture requires flap revision which results in scarring or fibrosis. Also, additional skin grafting is necessary for the resultant donor site defect. Anterior iliac crest flaps containing skin paddles also yield poor results due to the excessive bulk of the skin, often resulting in a more unsatisfactory outcome than that of fibula flaps. However, the bulk of the flap can be greatly reduced if only the internal oblique muscle is included. The healing period is also greatly shortened, which, based on the Department's experience took within approximately one month for the soft tissue defect to be replaced with tissue nearly identical in texture to the oral mucosa. In addition, because no skin defects are created in the donor site, primary closure can be attained, allowing better protection of the peritoneum and the internal organs. Also, this modification is reported to produce the best results in restoring the oral mucosa for dental implants compared to other skin flaps (Maranzano et al., 2005). In an investigation of the viability of this method, Klaus-Dietrich Wolff et al. reported that although this modification is not particularly suitable for reconstructing the buccal cheek, floor of mouth, or tongue, it is very useful for restoring defects of the hard palate, alveolar crest, and pharyngeal wall (Wolff et al., 1995). Sufficient blood supply, rapid inward epithelialization, neurologic atrophy and its subsequent reduction in volume, resulting in decreased thickness discrepancy make muscle flaps particularly useful for oral mucosa reconstruction. It is for these reasons that although vascularized internal oblique-iliac crest myoosseous free flaps aren't the ideal

Table 1. Case Presentation

Case	Age	Sex	Diagnosis	Defect site	Dentition	Mucosal defect
1	65	Male	Osteoradionecrosis Pathologic fracture		Edentulous	4 CM
2	53	Female	Osteoradionecrosis		Dentate	3 CM
3	59	Male	Osteoradionecrosis		Edentulous	2.5 CM
4	45	Male	Osteomyelitis Non-union d/t Comminuted mandibular fracture		Dentate	4.5 CM
5	60	Female	Graft failure s/p iliac free bone graft		Dentate	2.5 CM

choice for defects including the skin or lips, they produce the best results for soft tissue defects limited to the oral cavity.

In a long-term clinical study comparing the fibula flap to the anterior iliac crest flap carried out by Rogers et al. and a team of orthopedic surgeons, no significant differences were reported regarding problems associated with quality of life resulting from donor site morbidity (Rogers et al., 2003). Because fibula flaps require additional skin grafting for the defect created in the comparatively visible donor site, and because the resultant scarring makes certain types of clothing undesirable for social and esthetic reasons, they may not be a particularly reliable choice from a practical point of view. The vascularized internal oblique-iliac crest myoosseous free flap, on the other hand, creates no skin defects as it does not utilize skin flaps. Also, since the donor site is covered by clothing under normal social circumstances, there are less esthetic concerns. Although there are some known anatomic challenges such as difficulty in dissection and wide variations of blood vessels, the authors believe that such issues would not pose significant problems with sufficient experience.

Discussion

In there are many options for reconstruction of mandibular defects. The anterior iliac crest flap is a suitable choice for mandibular defects within 6-15 cm. In cases with accompanying mucosal defects limited to the oral cavity, the internal oblique muscle can be included to the flap to produce texturally superior results compared to skin flaps. Particularly, the operator can expect optimal results when functional reconstruction using implant prostheses is considered.

Acknowledgements

This work was supported by Korea Science and Engineering Foundation (KOSEF) grant funded by the Korea government (MEST). (No. R13-2003-013-03001-0)

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