Maxillary Functional Reconstruction Using a Reverse Facial Artery–Submental Artery Mandibular Osteomuscular Flap With Dental Implants

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Purpose: This clinical study assessed the reverse facial artery–submental artery mandibular osteomuscular flap with titanium dental implants for the functional reconstruction of maxillary defects.

Patients and Methods: Class 2a defects in 5 patients were repaired with a reverse facial artery–submental artery mandibular osteomuscular flap with titanium dental implants (n = 21). All patients received a fixed partial denture after a 3- to 6-month healing period.

Results: All lesions were widely excised in an area extending to the maxilla. Of the implants, 20 (95.2%) were loaded and 1 was lost before loading. Reconstruction with a fixed partial denture was successful in all patients. The patients were followed up for 12 to 20 months (mean, 15.8 months), and no recurrence was observed.

Conclusion: The reverse facial artery–submental artery mandibular osteomuscular flap with titanium dental implants is safe, quick, and simple to elevate and is reliable for the functional reconstruction of maxillary defects.

The treatment of choice for large, destructive, and expansive lesions is surgical removal, usually involving the sacrifice of adjacent teeth. Reconstruction procedures after tumor resection are challenging in patients with continuity defects of the maxilla who have lost several teeth. For better esthetic and functional results, the final goal should be successful oral rehabilitation and the restoration of dental occlusion with prostheses.

Many pedicled and free-tissue transfer techniques, with and without bone graft tissue flaps, have been used for maxillary reconstruction. However, these microsurgical methods are limited in the functional and esthetic restoration of young patients and are associated with risks in patients who have been operated on previously and have inadequate recipient vessels. Moreover, patients may prefer more conservative and less complex treatments.

We have previously reported a successful maxillary reconstruction technique that uses a reverse facial artery–submental artery mandibular osteomuscular flap with dental reconstruction. In this study we evaluated the success of this flap technique with titanium dental implants and subsequent restoration with an implant-supported fixed prosthesis for the functional reconstruction of patients with maxillary defects after the removal of benign tumors.
Patients and Methods

PATIENTS

This retrospective study included 5 patients (3 men and 2 women) with benign tumors involving the maxilla. The patients ranged in age from 23 to 35 years (mean, 29.0 years). Maxillary odontogenic myxoma was present in 2 cases, maxillary ameloblastoma in 2, and chondromyxoid fibroma in 1. The remaining defects were determined to be Class 2a according to the system of Brown et al.7 Subtotal maxillectomy was performed in all patients. All patients underwent surgical resection and sequential maxillary reconstruction with a reverse facial artery-submental artery mandibular osteomuscular flap with titanium dental


implants (Institut Straumann, Basel, Switzerland) between June 2007 and September 2009 at the Department of Oral and Maxillofacial Surgery, Second Affiliated Hospital, Sun Yat-sen University, Guangzhou, China. The Institutional Review Board of the Second Affiliated Hospital of Sun Yat-sen University approved this study. Four or five titanium implants were inserted into the transferred mandibular bone of each patient. In total, 21 implants were assessed in this study. All patients were provided a fixed partial denture after a healing period of 3 to 6 months.

SURGICAL TECHNIQUE

Doppler mapping was used to preoperatively identify the facial and submental arteries. With the patient under general anesthesia via nasoendotracheal intubation, the surgeon resected the lower 5 walls of the maxilla (including the palate) while leaving the oral mucosa and sparing the orbital floor (Fig 1). The reverse facial artery–submental artery mandibular osteomuscular flap with titanium dental implants was then raised. For surgery, each patient was placed in the supine position with the head and neck moderately extended. The flap was outlined to include the left anterior belly of the digastric muscle and a 1.0 × 8.0-cm mandibular flap (Fig 2). Because the marginal mandibular branch of the facial nerve lay beneath the flap, a standard submandibular incision was made. This incision extended from the operating site to the midline of the mandible, with the lateral margin set below the mandibular angle.

The skin and platysma were raised, the marginal mandibular branch of the facial nerve was identified and preserved; and the depth of the platysma, the overlying proximal facial artery, and the distal facial artery were exposed (Fig 3). Temporary palsy of the marginal mandibular branch of the facial nerve can be avoided. The inferior border of the mandible was exposed with the periosteum, and 4 or 5 Straumann implants (4.1 × 10 mm in size) were inserted into the transferred mandibular bone of each patient (Fig 4). A 1.0 × 8.0-cm portion of the inferior border of the mandible with the implants was sectioned with an oscillating saw. To preserve the inferior alveolar nerve and thus mental nerve, harvesting of the inferior border of the mandible must be performed under the inferior alveolar canal. The anterior belly of the digastric muscle was included in the flap to prevent venous congestion. The facial artery was traced proximally to its passage behind the submandibular gland, and the submental artery was revealed by downward retraction of the gland. The submandibular gland can be included in the flaps. The submental vein was identified by its position on the surface of the gland and its drainage into the facial and common facial veins. During this procedure, the proximal facial artery and common facial vein to the branching point of the submental pedicle were ligated, and the flap was...
returned to a reverse-flow pattern, supplied by the distal facial pedicle (Fig 5). It is not necessary to bend the mandibular bones into the shape of the maxilla. The flap was then rotated into the post-ablative defect and passed under the marginal mandibular nerve. In this way, further pedicle advancement and a greater arc of rotation can be achieved for the defects. The tunnel should be broad enough to avoid compression of the flap. Excessive stretching of the flap and suture tension should be avoided. The flap was fixed rigidly with microplates and screws (Fig 6), and the palatal mucosa was then recovered (Fig 7). The mandibular defects were repaired with a MEDPOR Surgical Implant (Porex Surgical, College Park, GA) and fixed with microplates and screws. The donor area was closed primarily. The patients were provided with fixed partial dentures after a healing period of 3 to 6 months.

**Results**

All of the lesions were widely excised in an area extending to the maxilla. Primary reconstruction of the Class 2a maxillary defects was performed with a reverse facial artery—submental artery mandibular osteomuscular flap with titanium dental implants. No palsy of the marginal mandibular branch of the facial nerve or flap failures occurred. In total, 20 implants (95.2%) were loaded, and 1 implant was lost before loading. Reconstruction with a fixed partial denture was successful in all patients after 3 to 6 months. Proper esthetics and complete functionality were obtained (Fig 8), and mastication was normal in all patients. No numbness of the lower lip occurred. There were no donor-site problems.
The patients were followed up for 12 to 20 months (mean, 15.8 months), and no recurrence was observed.

Discussion

The facial artery is the principal superficial artery of the face. After leaving the submandibular gland, it gives off the submental artery branch. This branch passes between the mylohyoid muscle and the mandible. In 70% of dissections, it is deeper than the anterior belly of the digastric muscle, and in 30% of cases, it runs superficial to the muscle. Several perforators from the artery supply the platysma muscle and overlying skin. Two major perforators are usually present, proximal and distal to the digastric muscle. Minor perforators pass directly through the anterior belly of the digastric muscle.8 The submental artery terminates near the mandibular symphysis in a subdermal plexus, anastomoses extensively with the contralateral terminal branches, and gives off several branches to the mandible. Several perforators from the submental artery supply the mandibular margin bone.

In this study 5 patients with benign tumors involving the maxilla underwent surgical resection and functional reconstruction of Class 2a maxillary defects by use of a reverse facial artery-submental artery mandibular osteomuscular flap with titanium dental implants. No flap failure occurred. Martin et al9 believed that an island flap, based on the submental artery, could form the interior mandibular margin. Yilmaz et al10 successfully used a flap, including the anterior belly of the digastric muscle, to treat various

FIGURE 7. The palatal mucosa was recovered.

FIGURE 8. Patient at 13 months after surgery and 10 months after loading of fixed partial denture. A, Intraoral view after reconstruction and dental restoration. B, Three-dimensional computed tomography scan confirmed volume maintenance and anatomic continuity of the mandibular bone graft, as well as successful loading of the implants. One implant in the distal mandible was lost before loading. The inferior mandibular border defects were repaired with a MEDPOR Surgical Implant, which was fixed with microplates. C, Excellent esthetic results were attained.
defects in 14 patients. We have previously reported excel-
lent outcomes using reverse facial artery–submental artery
mandibular osteomuscular flaps to reconstruct the maxil-
lae of 8 patients with benign tumors involving the maxil-
lae. The anterior belly of the digastric muscle was
included in these flaps to prevent venous congestion. Be-
cause all patients had benign tumors and their flaps in-
cluded the submandibular gland, the volume of the flap for
repairing the defect of the maxillary.

In this study 1 implant in the distal mandible was lost
before loading, and 20 implants (95.2%) were loaded.
Reconstruction with fixed partial dentures was success-
ful in all patients. Proper esthetics and complete func-
tionality were obtained. The mandible does not need to
be bent into the shape of the maxilla and supplies
sufficient bone for the insertion of dental implants. This
study showed that 4.1 × 10-mm implants can be used
and that 4 implants can be placed reliably. The main
advantages of this technique include not only the suc-
cessful reconstruction of maxillary defects, but also the
ability to efficiently restore dental occlusion and to elim-
inate the need for a second reconstructive surgery. The
flap is safe, quick, and simple to elevate. We believe that
this technique provides a base that enables full dental
and prosthetic rehabilitation with either implant-re-
tained or conventional prostheses.

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