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Intraoral anastomosis of a vascularized iliac-crest flap in maxillofacial reconstruction

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Abstract Intraoral anastomosis of free flaps was introduced to avoid extraoral scars. In addition, advances in vascularized iliac-crest flap have greatly facilitated jaw reconstruction. The primary aim of this study was to evaluate feasibility and outcomes of intraoral anastomosis of vascularized iliac-crest flaps used for jaw reconstruction.

Methods: From December 2015 to June 2018, 10 (3 men and 7 women) patients aged 12-55 (median, 28) years were treated at the Peking University School and Stomatology Hospital, China. Six patients underwent maxillary reconstruction, and four patients underwent mandibular reconstruction with the intraoral anastomosis of vascularized iliac-crest flaps.

Conclusion: In all cases, the facial artery was easily identified by intraoral Doppler ultrasound. The operative time for the preparation of facial vessels by the intraoral approach was 30-60 minutes. All DCIA flaps were successfully harvested. All intraoral anastomoses were successfully established and survived in 9 patients. However, one flap for maxillary reconstruction was lost because of arterial spasm. Nine patients with survived flaps had unrestricted mobilization and showed facial symmetry after surgery. No healing complications were reported in the transplant region in nine patients with survived flaps, and no serious donor site complications were observed during the follow-up period.

Introduction

Jaw reconstruction is a challenging task for oral and maxillofacial surgeons because of the esthetic importance of this region and its central role in speech, swallowing, supporting the tongue, airway function, and chewing.[1-3] Vascularized

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bone grafting is a favorable choice for the reconstruction of osseous defects in the maxillofacial area.

Typically, jaw reconstruction is required following oncologic resection or facial trauma, wherein extraoral approaches for oncologic resection or management of facial trauma can be used for vessel preparation and anastomoses. Intraoral anastomosis of free flaps was introduced by Gaggl et al.[4] to avoid extraoral scars produced with transcervical anastomoses. In addition, advances in vascularized iliac-crest flap have greatly facilitated jaw reconstruction.[2,5-7] The primary purpose of this study was to evaluate feasibility and outcomes of intraoral anastomosis of vascularized iliac-crest flaps used for jaw reconstruction.

Materials and methods

Patient details and characteristics

From December 2015 to June 2018, 10 (3 men and 7 women) patients aged 12–55 (median, 28) years were treated at Peking University School and Stomatology Hospital, China. Nine patients received an intraoral anastomosis of a deep circumflex iliac artery (DCIA) flap for the reconstruction of a jaw defect after simultaneous resection of a tumorous mass, and one patient underwent secondary maxillary reconstruction with an intraoral anastomosis of DCIA. Six patients underwent maxillary reconstruction, and four patients underwent mandibular reconstruction. Patient characteristics are summarized in Table 1. Treatment in all cases was approved by the Ethics Committee of Peking University School and Hospital of Stomatology. All patients provided written informed consent before participating in the study.

Table 1 Patient and treatment characteristics.

Characteristics	Number
Sex (n)	
Male	3
Female	7
Age (years)	
Median	28
Range	12-55
Simultaneous reconstruction	9
Secondary reconstruction	1
Jaw defect	
II (classification of maxillary defects by Brown)	6
B (classification of mandibular defects by Urken)	4
Length of iliac bone (cm)	
For maxillary reconstruction	
Median	4.5
Range	4-5
For mandibular reconstruction	
Median	5
Range	4-7
Height of the iliac bone (cm)	2.5
For maxillary reconstruction	
Median	2.5
Range	2-3
For mandibular reconstruction	
Median	2.5
Range	2-3
Complications	
Flap failure (for maxillary reconstruction)	1
Mild sensory deficits	3

Surgical Technique

Before surgery, panoramic radiographs and computed tomography (CT) scans were recorded to assess the side with the defect. Recipient vessels were examined by performing Doppler ultrasound of facial and labial arteries, as well as angular and facial veins before surgery.

Transplant beds including maxillary and mandibular defects were prepared after tumor ablation in the nine patients who received simultaneous reconstruction and directly in the one patient who underwent secondary reconstruction, along with simultaneous harvesting of the iliac-crest flap.

Maxillary reconstruction

A vertical buccal incision was created anterior to the Stensen duct, connecting the incision of the maxillary vestibule and effectively avoiding any parotid duct injury. A myomucosal flap of the buccinators was raised, and the facial artery and vein were exposed through blunt dissection. The facial artery and vein were dissected retrograde along approximately 4 cm to facilitate intraoral anastomoses and to allow adequate vessel caliber.

Six DCIA flaps were simultaneously harvested. Anterior superior iliac spine (ASIS) was not needed for the flap, and attachments of the inguinal ligament and sartorius were preserved.

The osseous flap was placed over the defect and trimmed to fit with monocortical screw fixation. Arterial and venous anastomoses were completed in an end-to-end fashion (Figures 1–7). Excellent inflow and outflow were confirmed. The overlying mucosa was closed.

Mandibular reconstruction

A segmental mandibular resection was performed in four patients. Resection margins of clinically unchanged bone were chosen: at least 0.5 cm for benign tumors and 1.0 cm for malignant tumors.

Before the facial artery was prepared, beginning at the mandibular border, the submandibular gland was removed. The marginal mandibular branch of the facial nerve was identified, running laterally to the artery, to avoid any subsequent nerve damage. The artery was prepared for a length of 4 cm to allow subsequent transposition to the angle of the mouth. Subsequently, the facial vein was prepared in the same way, running slightly more distally from the artery.

Following mandibulectomy, occlusion was fixed. The harvested iliac flap was shaped and fixed to the remaining mandibular bone. After fixing the grafted bone, it was anastomosed to the facial artery and vein in an end-to-end fash-

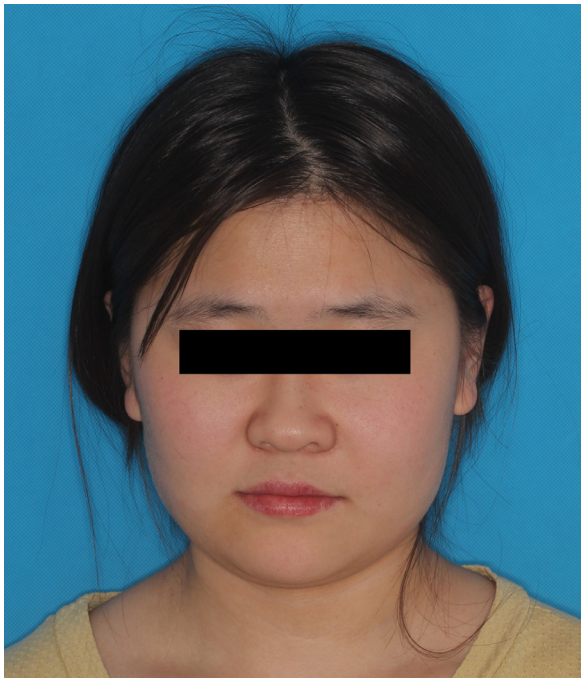

Figure 1 Preoperative frontal view of a patient from a representative case.

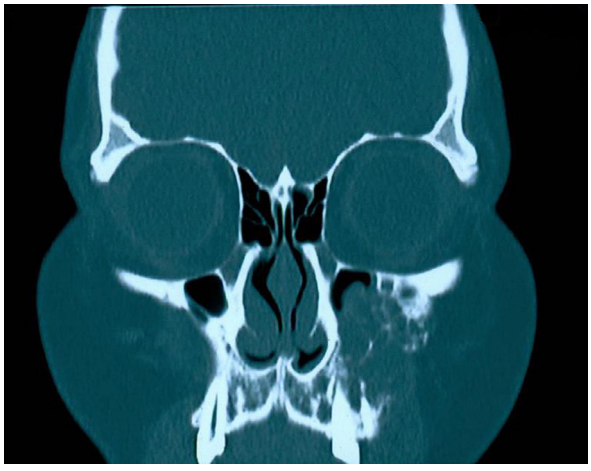

Figure 2 Computed tomography scan demonstrating a lesion in the maxilla.

ion (Figure 8-14). Excellent inflow and outflow were confirmed. The overlying mucosa was closed.

Results

In all cases, the facial artery was easily identified through intraoral Doppler ultrasound. The facial vein was located approximately 1 cm distal to the artery, as measured in the paramandibular region. Both vessels could be identified and prepared for later anastomoses in all cases. Recipient vessels could be prepared along a 4-cm length. The operative time for preparation of facial vessels through the intraoral approach was 30-60 minutes. All DCIA flaps were successfully harvested. The length of the microvascular pedicle was

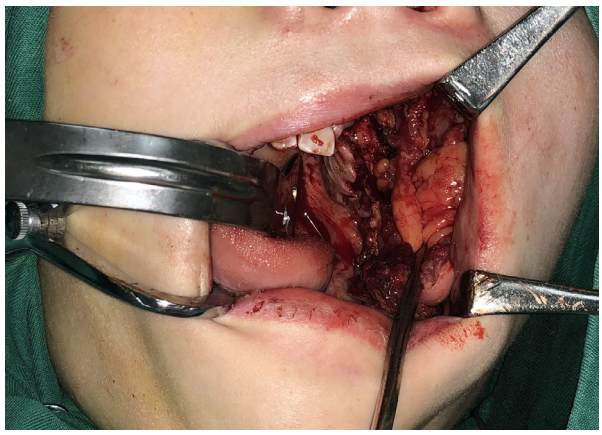

Figure 3 Maxillary defect (Brown II) after tumor removal.

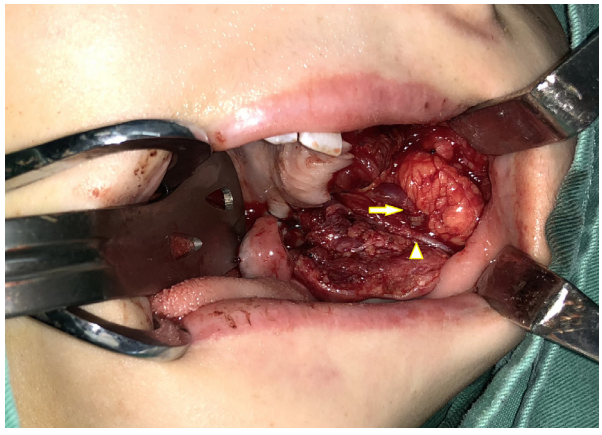

Figure 4 Intraoral microvascular anastomosis depicting the facial artery to the deep circumflex iliac artery anastomosis (arrowhead) and the facial vein to deep circumflex iliac vein anastomosis (arrow).

4.5-6.0 cm, and the bony components ranged 4.5-7.0 cm in length and 2.5-3 cm in height (Table 1).

All anastomoses were successfully established and survived in nine patients. However, one flap for maxillary reconstruction was lost due to arterial spasm. Nine patients with survived flaps had unrestricted mobilization and showed facial symmetry after surgery. No healing complications were reported in the transplant region in nine patients with survived flaps. In addition, no serious complications such as hernia, bone fracture, and gait disturbances were observed at the donor site during the follow-up period. However, sensory deficits were noted across distribution of the lateral femoral cutaneous nerve after surgery in three patients; however, they reported complete recovery from these deficits at 2 months after surgery.

Discussion

Numerous approaches can be adopted for jaw reconstruction. It is well known that the success rate of microvascular bone grafts is higher than that of nonvascularized bone

Figure 5 Frontal view of the patient 2 months after surgery.

Figure 6 Intraoral appearance at the 2-month follow-up.

grafts.[8] Microvascular free bone transfer has become an extremely reliable procedure during the past few years.[9,10]

New anastomosing techniques and better technical equipment make microvascular surgery safer and possible in nearly every patient.[11-14] Presently, microvascular reconstruction in the oral and maxillofacial region is performed with a focus on preserving an esthetic facial appearance. Attempts are made to reduce scarring of the face by placing skin incisions in areas where scars are not easily visible while identifying vessels for microvascular anastomoses—for example, the use of preauricular incisions to access temporal vessels.[15,16] However, with an intraoral anastomosis, extraoral scarring can be completely avoided.[4,17] In addition, the intraoral technique facilitates identification of facial nerve branches, thereby preventing injury and paralysis.[18] Moreover, this technique is safe, and the success rate is comparable to that of extraoral techniques.[19]

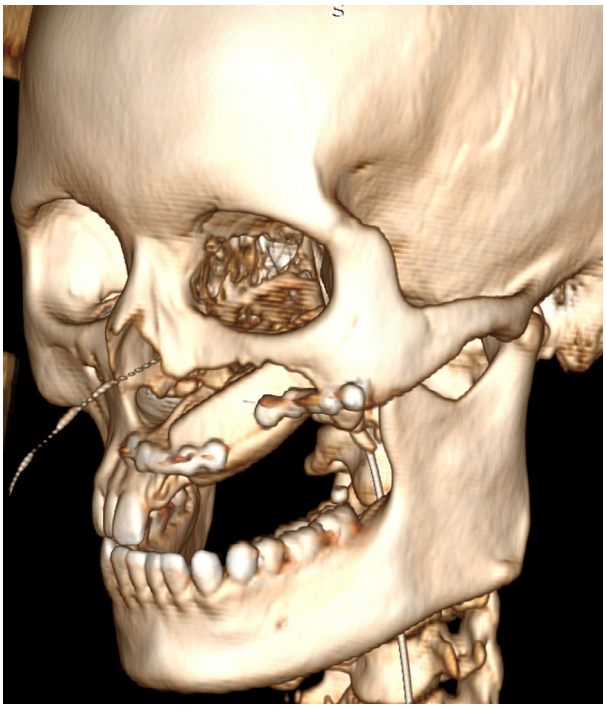

Figure 7 Postoperative 3D computed tomography scan showing reconstruction contour of the maxilla and the bone.

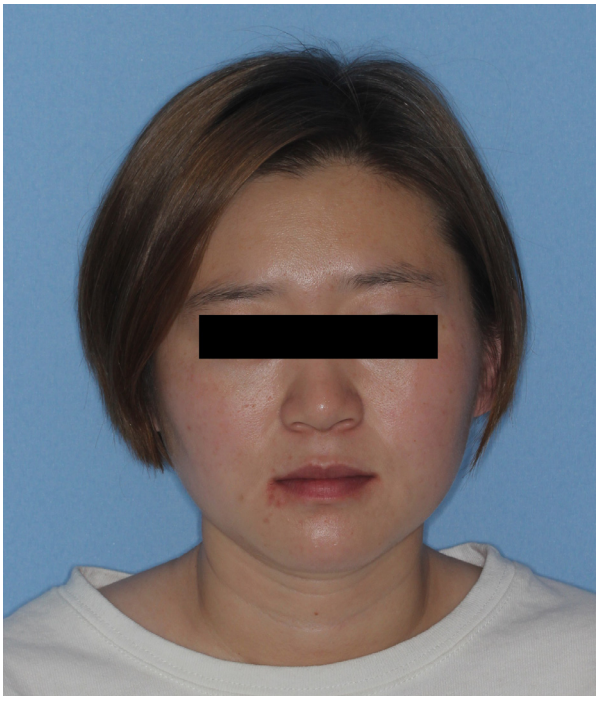

Figure 8 Preoperative frontal view of another patient.

However, identifying facial vessels by an intraoral approach is more difficult than that by the conventional technique that uses extraoral skin incisions.[4]

The facial artery is superficial to the buccinator muscle, and the facial vein is almost always located posterior to the facial artery.[19] The facial vein is prepared

Figure 9 Preoperative panoramic radiograph showing a lesion in the right mandible.

Figure 10 Mandibular defect (Urken B type) after tumor removal.

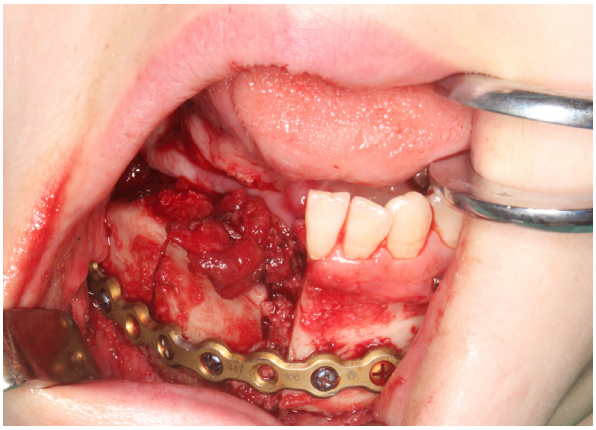

Figure 11 Iliac bone graft in the final position after intraoral microvascular anastomosis.

in the depth of the fat pad of the cheek. Around the mandible, the facial artery and vein travel extremely close together and diverge from each other as they travel up toward the nose.[20-22] Hence, in the present study, the myomucosal flap of the buccinator was raised, and both facial artery and vein were exposed through blunt dissection

Figure 12 Frontal view of the patient 2 months after surgery.

Figure 13 Intraoral appearance at the 2-month follow-up.

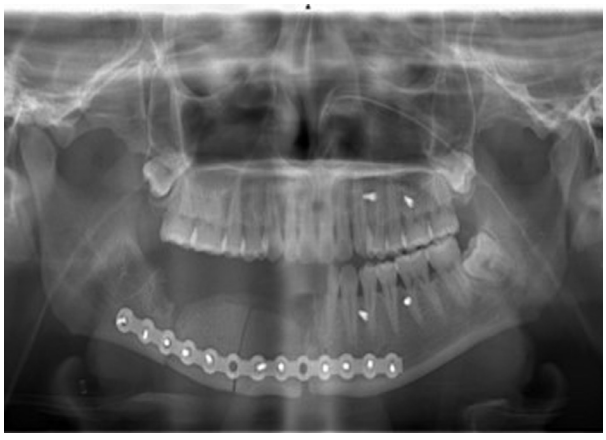

Figure 14 Panoramic radiograph showing reconstruction contour of the mandible and bone.

while the recipient vessels of maxillary reconstruction were prepared.

Preparation of recipient vessels of mandibular reconstruction was initiated at the mandibular border. The submandibular gland was removed to avoid any pressure of the submandibular soft tissue on the anastomosis vessels.

Various donor sites are used for harvesting microvascular grafts to reconstruct the continuity of jaws.[23-25] In the present study, low donor site morbidity and high esthetic compatibility were the criteria used for donor site selection. The iliac-crest flap DCIA was the flap of choice for this type of reconstruction; the large amount of available bone combined with acceptable donor site morbidity justified this choice.[26,27]

In addition, according to recent studies, the iliac-crest flap, owing to its shape and height, has been considered an ideal choice for jaw reconstruction.[2,5,28-30] Although rare, donor site morbidity can cause gait disturbances,[31] which did not occur in this study because ASISs and attachments of the inguinal ligament and sartorius were preserved. Furthermore, DCIA flaps offer an additional advantage of a discreetly hidden donor- site scar.[32,33]

With DCIA flaps, the intraoral anastomosing technique presents another main advantage: the pedicle of DCIA is approximately 5 cm and thus too short to reach the submandibular or preauricular vessels, particularly for maxillary reconstruction. Therefore, it would be beneficial for the intraoral recipient vessel preparation to be close to the defect site. Taken together, the intraoral approach for facial vessels is the optimal approach to avoid pedicle elongation with vein grafts.

Conclusion

In summary, the intraoral anastomosing technique that uses facial vessels and the transmucosal approach is optimal for the reconstruction of small bone defects with microvascular bone flaps in the jaw. In terms of advantages, the intraoral anastomosing technique not only helps avoid extraoral approaches and extraoral scars but also eliminates the need for a long pedicle. No severe complications were reported. Nevertheless, additional studies are warranted to show comparable rates of success to corollary, extraoral, and standard techniques for this technique to gain universal acceptance within the microsurgical and craniofacial community.

Conflicts of interest

The authors have no conflicts of interest to declare.

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