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CASE REPORT
Reconstructive

Multiple Buttress Reconstruction for Extended Total Maxillectomy by Mixed Use of Vascularized and Nonvascularized Fibula

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Summary: Reconstruction of extended total maxillectomy is challenging. This study aimed to isolate the skull base from the nasal cavity to avoid intracranial infection, cerebrospinal fluid fistula, and palate closure to maintain feeding and conversation. However, facial appearance and symmetry are important for quality of life. We report primary multiple buttress reconstruction using a removed nonvascularized fibula that reduced the risk of infection and exposure. A 74-year-old woman experienced a local recurrence of right maxillary sinus cancer after subtotal maxillectomy and postoperative radiotherapy (60 Gy). We performed extended total maxillectomy, including the right eyeball, orbit, temporal bone, palate, and zygomatic arch. Primary reconstruction was performed using fibular and anterolateral thigh free flaps. The proximal fibula bone was resected to obtain the length of the peroneal vessels, and the distal 9 cm of the fibula was made into two pieces while keeping the peroneal vessels attached. The nonvascularized 5-cm fibula was split sagittally with an L-shaped section to maintain the strength of the fragments. An anterolateral thigh flap was elevated from the ipsilateral thigh attached to the partial vastus lateralis muscle, which was divided into proximal (to the cheek skin and prosthetic eye bed) and distal (to the nasal cavity and palate) skin islands. Two nonvascularized bone fragments were fixed at the lateral and infraorbital rims. The dead space around the built-up pillar made of transferred bone was filled with vastus lateralis muscle to prevent infection and depression. This approach allowed for one-stage multiple buttress reconstruction for extended total maxillectomy.
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The reconstruction methods for extended total maxillectomy depend on the surgeons because no definitive reconstruction strategies have yet been established.[1] The first priority is to isolate the skull base from the nasal cavity to avoid intracranial infection and cerebrospinal fluid fistulas. The second priority is to close the palate to maintain both feeding and conversation abilities. Facial appearance and symmetry are the third priority; therefore, most surgeons select reconstruction using soft tissue flaps. Secondary cosmetic reconstruction using hard tissue (eg, costal cartilage) can be selected[2]; however, postoperative skin atrophy, radiotherapy, and patient reluctance to undergo further surgery may lead to patients avoiding subsequent cosmetic surgery. Hard-tissue reconstruction is not essential for life, but challenges should be addressed regarding the patient's quality of life.[3] We herein report a case of primary multiple buttress reconstruction for extended total maxillectomy using a removed nonvascularized fibula.

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CASE

The patient was a 74-year-old woman who had undergone subtotal maxillectomy for right maxillary sinus cancer 1 year previously. Postoperative radiotherapy (60 Gy) was administered. Unfortunately, she experienced local recurrence, thus resulting in a second surgery, which

Disclosure statements are at the end of this article, following the correspondence information.

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consisted of extended total maxillectomy including the right eyeball, orbit, temporal bone, palate, and zygomatic arch with surrounding soft tissue, including the mandibular condyle and fossa (Fig. 1). We planned to perform primary reconstruction using a fibular free flap and an anterolateral thigh (ALT) free flap.

Tumor resection was performed by otorhinolaryngologists, whereas flap elevation was simultaneously initiated. First, the right 14-cm fibular osteo flap was elevated using a tourniquet on the right thigh. Next, fibula osteotomy was performed at two locations: namely, a 5-cm proximal bone was resected to obtain the length of the peroneal vessels and the distal 9 cm of the fibula was separated into two pieces (5 and 4 cm in size) while keeping the peroneal vessels attached to them. These were then fixed to a prebent 2-mm-thick titanium plate (Matrix Mandible angle reconstruction plate; Johnson & Johnson) based on a three-dimensional model. The removed 5-cm extra fibula was sagittally split with an L-shaped section to maintain the strength of the fragments (Fig. 2). Next, the right thigh tourniquet was removed, and the ALT flap was elevated from the ipsilateral thigh. Three perforators from the descending branch of the lateral circumflex femoral artery were dissected by attaching part of the vastus lateralis muscle. The flap was then divided into two chimeric islands, with the plan to use the proximal 10×7 cm island to provide two skin paddles for the cheek and prosthetic eye bed, whereas the distal 16×7 cm island was to provide two skin paddles for lining of the nasal cavity and palate.

Fig. 1. Intraoperative view of right extended total maxillectomy, including the eyeball, orbit, temporal bone, palate, and zygomatic arch with surrounding soft tissue and skin. The yellow dotted line shows the exposed dura mater.

The free fibula osteo flap was fixed to the residual base of the right zygomatic arch and left maxilla using 2.4 mm locking screws. Two nonvascularized bone fragments were fixed as lateral and infraorbital rims with titanium miniplates around the zygomatic eminence. [**See figure, Supplemental Digital Content 1**, which shows the postoperative computed tomography (CT) findings 2 weeks postoperatively. **http://links.lww.com/PRSGO/D277**.] The peroneal artery and vein were microscopically anastomosed to the right superficial temporal artery and vein. Finally, the ALT flap was positioned as follows: the distal skin flap was sutured to the palatal defect and nasal cavity, and then the proximal skin flap was passed through the fibula to the cheek area and sutured to the right cheek and prosthetic eye bed. The dead space around the built-up pillar made of the transferred bones was filled with a de-epithelialized skin paddle and vastus lateralis muscles to prevent infection and depression deformation. The descending branch of the lateral femoral circumflex artery and vein were anastomosed to the right lingual artery and internal jugular vein. The ALT flap was monitored by color and pin-prick tests, whereas the fibula osteo flap was buried without any further monitoring. The ischemic times of the fibula and ALT flaps were 66 and 111 minutes, respectively. The total operative time was 14 hours and 3 minutes.

Twelve months postoperatively, no cerebrospinal fluid or palatal fistula was observed (Fig. 3). The patient was able to eat normal food. Because the inserted prosthetic eye was visually unnatural, she wore an eyepatch when going out. (**See figure, Supplemental Digital Content 2**, which shows the reconstructed zygomatic prominence. **http://links.lww.com/PRSGO/D278**.) CT at 12 months postoperatively showed a symmetrical skeletal structure (Fig. 4). No motor or sensory disturbances were observed at the donor sites.

DISCUSSION

Considering the concept of maxillary buttress reconstruction,[4] we reconstructed the zygomaticomaxillary and pterygomaxillary buttresses using four bone fragments. Reconstruction using soft tissue free flaps such as ALT flaps and deep inferior epigastric perforator flaps combined with costal cartilage achieves cosmesis in subtotal and total maxillectomy[5,6]; however, hard-tissue reconstruction associated with extended total maxillectomy requires more of the buttress to be repaired. The abbreviation for buttress reconstruction results in concave deformation and flap drooping.

Perez et al[7] reported the successful use of a nonvascularized fibular cortex for additional buttress support in a

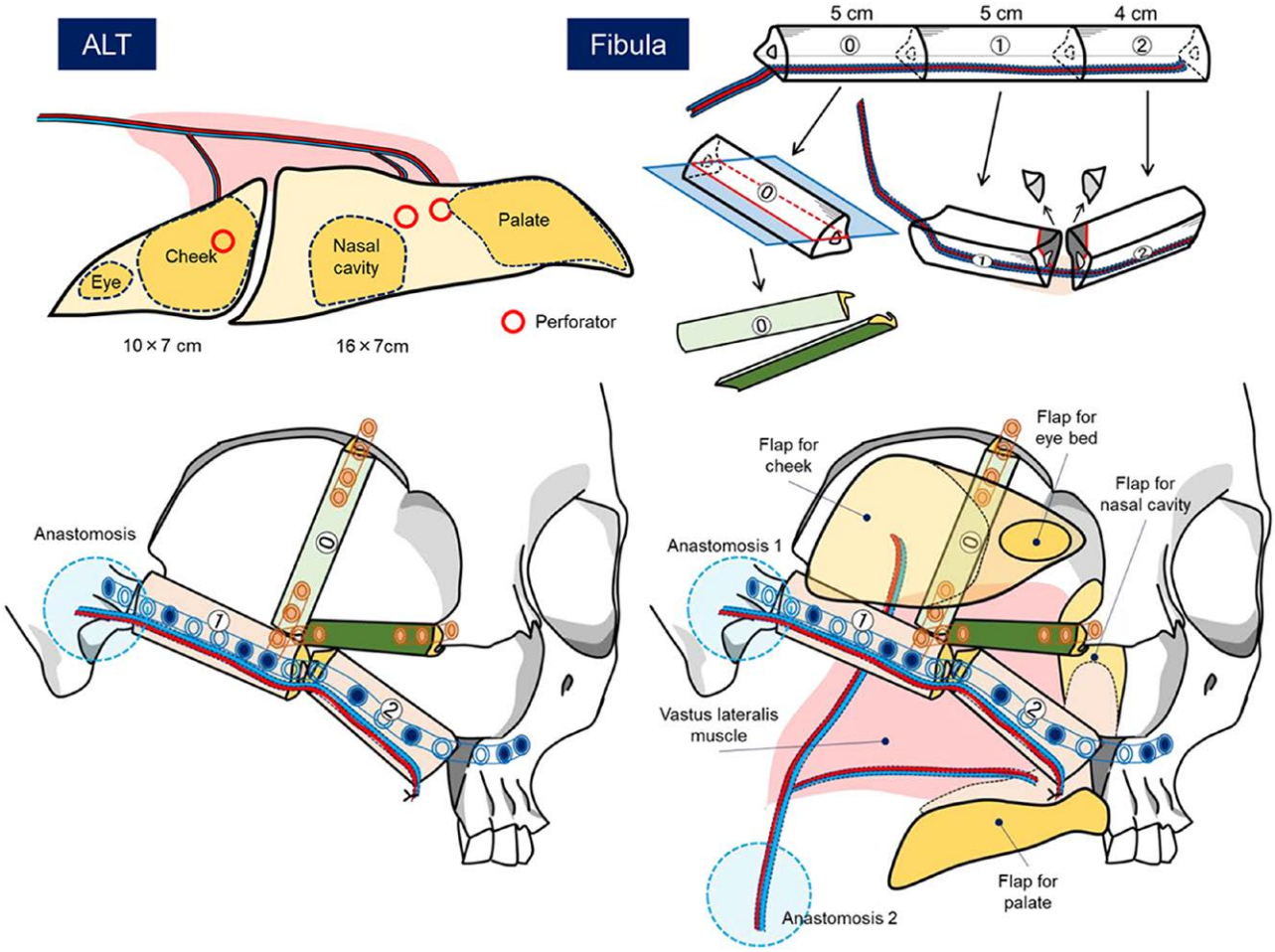

Fig. 2. Details of the multiple buttress reconstruction using nonvascularized fibular cortex grafts with ipsilateral double free flaps of the fibula and anterolateral thigh. Fibular bone segments 1 and 2 were vascularized for reconstruction from the right zygomatic arch to the left maxilla. Segment 0 was removed to obtain the length of peroneal artery and vein as a pedicle, which was separated by sagittal splitting and thereafter was fixed on the lateral and infraorbital buttress as nonvascularized cortex grafts. Two divided ALT flaps were positioned, and the posterior cavity of the transferred bones was filled.

nasomaxillary buttress. Recent mandibular reconstruction studies support less absorption of nonvascularized fibula cortex pieces.[8,9] The length of nonvascularized bone grafts was reportedly associated with a successful surgical outcome, with a 6-cm length considered to be the cutoff for safe transfer in mandibular reconstruction in nonirradiated patients.[10] We used 5-cm nonvascularized bone fragments to increase the pedicle length. The risks include infection and exposure due to the insertion of a redundant fibula with no blood circulation. Two efforts have been made to overcome these difficulties. The first is filling the dead space around the nonvascularized bone grafts with well-vascularized vastus lateralis muscle and de-epithelialized ALT flaps. The second is splitting the 5-cm nonvascularized bone segment into two cortex pieces of the L-shaped cross section to make them thinner while maximizing the three-dimensional durability. Postoperative radiotherapy may worsen the successful reconstruction rate. This patient was unable to undergo postoperative radiation due to the fact that she had previously received 60 Gy of radiotherapy.

We believe the use of the removed nonvascularized fibula allows for the successful performance of one-stage multiple buttress reconstruction for extended total maxillectomy.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

PATIENT CONTENT

The patient provided written consent for the use of her image.

Fig. 3. Postoperative appearance at 12 months after surgery. Multiple buttress reconstruction maintained the zygomatic prominence and prevented the occurrence of a depression at the nasal alar base.

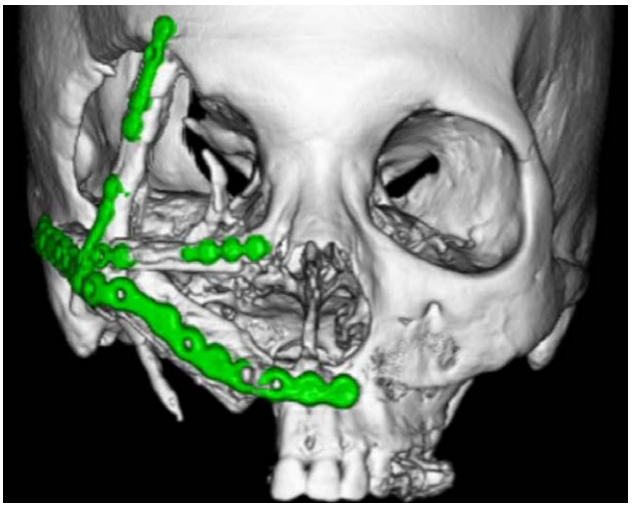

Fig. 4. Postoperative three-dimensional CT at 12 months after surgery. All four bone segments were maintained without any fracture or absorption.

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