Free Proximal Gracilis Muscle and Its Skin Paddle Compound Flap Transplantation for Complex Facial Paralysis

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Gracilis functioning free-muscle transplantation for the correction of pure facial paralysis has been a preferred method used by many reconstructive microsurgeons. However, for complex facial paralysis, the deficits include facial paralysis along with soft-tissue, mucosa, and/or skin defects. No adequate solution has been proposed. Treatment requests in those patients are not only for facial reanimation but also for correction of the defects. Of 161 patients with facial paralysis treated with gracilis functioning free-muscle transplantation from 1986 to 2002, eight patients (5 percent) presented with complex deficits requiring not only facial reanimation but also aesthetic correction of tissue defects. The tissue defects included an intraoral defect created following contracture release (one patient), infra-auricular radiation dermatitis with contour depression (one patient), temporal depression following a temporalis muscle–fascia transfer (one patient), ear deformity (two patients), and infra-auricular atrophic tissue with contour depression (three patients). A compound flap, consisting of a gracilis muscle with its overlying skin paddle separated into two components, was transferred for simultaneous correction of both problems. The blood supply to the gracilis and to the skin paddle originated from the same source vessel and therefore required the anastomosis of only one set of vessels. The versatility of this compound flap allows for a wide arc of rotation of the skin paddle around the muscle. All flaps were transferred successfully without complications. Satisfactory results of facial reanimation were recorded in five patients after all stages were completed. The remaining three patients are undergoing physical therapy and waiting for revision of the skin paddle. (*Plast. Reconstr. Surg.* 113: 126, 2004.)

Although facial paralysis is not the most serious affliction, its presence can have a devastating psychological impact on the affected individual.[1,2] Causes of facial paralysis include tumor surgery (such as acoustic neuroma or preauricular or infra-auricular tumor excision), Bell palsy, congenital anomaly, and trauma.[3] Facial paralysis usually presents as an isolated problem with the need only for facial reanimation.

Facial paralysis accompanied by a soft-tissue, mucosa, and/or skin deficiency presents an added challenge to the reconstructive microsurgeons. The need for both a functioning muscle to reanimate the paralyzed face and a skin flap to replace the missing or inadequate soft-tissue, mucosa, and/or skin defect is evident. The defect can be either an intraoral or an external face defect. The intraoral defect presents after contracture release or after tumor excision. In the extraoral area, some present with a contour deformity in the cheek, temporal, infra-auricular, retroauricular, or even auricular region. The goal of treatment in these situations is to achieve both an aesthetic and a functional reconstruction. There are no articles in the literature discussing this type of complex facial paralysis and its treatment.[4–13]

The gracilis has been the donor muscle preferred by many reconstructive microsurgeons[4–10] for functioning free-muscle transplantation to treat pure facial paralysis. The blood supply to the overlying skin paddle is through both musculocutaneous perforators and septocutaneous skin vessels.[14–17] Most of these skin vessels are located in the proximal third of the gracilis muscle. By using concepts from perforator flap surgery,[18–20] the overlying skin paddle can be safely separated from the

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underlying gracilis muscle and transformed from a musculocutaneous flap into a compound flap with two components: muscle and skin, both nourished by the same mother vessel. The septocutaneous skin vessels, traversing the fascia between the adductor longus and the gracilis muscle, connect well with the gracilis dominant pedicle vessels proximally. The muscle is used for facial reanimation, and the skin flap is used for correction of the intraoral or extraoral defects. This separation allows for the skin component to be shifted medially or laterally or even rotated up to 180 degrees without compromising the blood supply to this compound flap.

PATIENTS AND METHODS

Patients

Between 1986 and 2002, 161 patients with facial paralysis underwent surgical correction using 162 functioning free-muscle transplantations. All patients were treated at Chang Gung Memorial Hospital by the same surgeon (Chuang) using the gracilis muscle as a donor muscle for reanimation of the paralyzed face. One patient with Moebius syndrome underwent bilateral facial reanimation using bilateral gracilis muscle transfers. Eight of 161 patients (5 percent) had significant soft-tissue, mucosa, or skin defects accompanying the facial paralysis.

The defects consisted of an intraoral defect created following contracture release in one patient, an infra-auricular radiation dermatitis with contour depression in one patient, a temporal depression created following a temporalis muscle–fascia transfer in one patient, ear deformity in two patients, and infra-auricular atrophic tissue with contour depression in three patients. All eight patients received a classic two-stage procedure: cross-face nerve grafting followed by a proximal gracilis functioning free-muscle and skin paddle compound flap transplantation.

Operative Method

With the patient in a frogleg position, the required proximal gracilis muscle and its overlying skin are marked (Fig. 1, *above*). The anterior skin incision is made down to the fascia of the adductor longus muscle. Half of the fascia is incised in a semicircular fashion and elevated medially. With anterior retraction of the adductor longus muscle, the main vascular

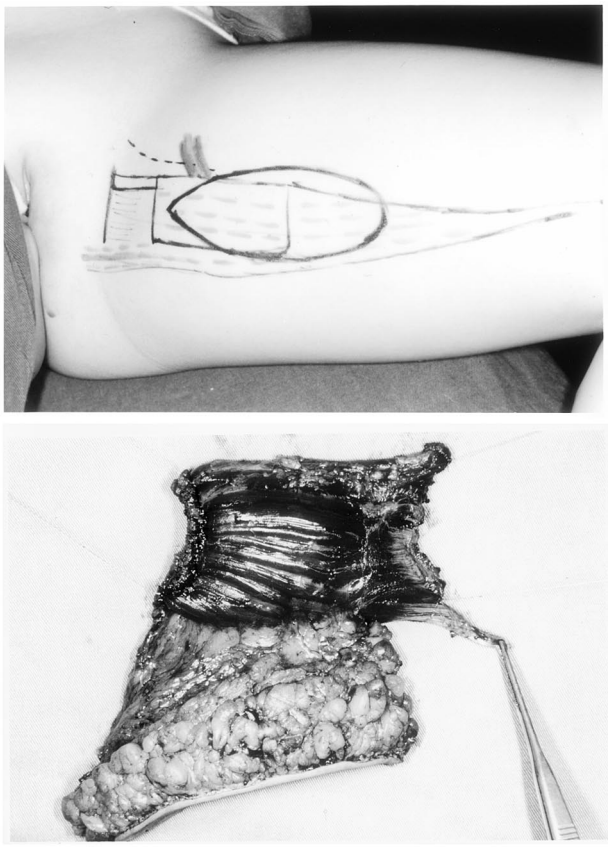

FIG. 1. (*Above*) The proximal gracilis muscle and the overlying skin paddle required are designed and drawn. The skin paddle can be located over the proximal or middle portion of the gracilis muscle. The skin paddle circulation can be checked by needle puncture or knife cut, after the flap is elevated and made into a compound flap. (*Below*) The gracilis muscle and skin compound flap is ready for transfer.

pedicle along with the obturator nerve is visualized, approximately 10 cm below the pubic tubercle, which is the origin of the gracilis muscle. The remaining skin incision is made down to the gracilis muscle. The proximal gracilis musculocutaneous flap is then elevated. The dissection between the skin paddle and the gracilis muscle is then performed toward the intermuscular septum between the gracilis and the adductor longus muscles. Many small musculocutaneous vessels perforating the gracilis muscle going to the overlying skin are coagulated with a bipolar coagulator. The dissection is stopped once the septum is met. Some of the musculocutaneous perforating vessels at the muscle edge near the septum are preserved whenever possible. Those musculocutaneous perforators could be coagulated if further skin paddle rotation and movement are required at the recipient site to avoid excessive tension on the pedicle. The septocuta-

neous skin vessels can be visualized inside the septum between the gracilis and the adductor longus muscles. These skin vessels, taking either a septocutaneous or a musculocutaneous course, connect well with the proximal main pedicle and supply the skin over the proximal third of the gracilis muscle. The skin flap circulation can be checked by needle puncture or by making a superficial incision in the skin. The proximal 8 to 10 cm in length of muscle is then exposed and shaped into a minitrapezoid shape based on the measurement performed at the face.[21] This compound flap is then harvested and transferred to the face (Fig. 1, *below*). The muscle is inset into the appropriate location, and the skin paddle is inset into the area with tissue deficiency. The skin paddle can be rotated and placed in an intraoral or an extraoral location, or it can be rotated up to 180 degrees and advanced to the temporal region.

Results

All eight patients underwent successful transfer of the compound muscle and skin flap. No skin or muscle necrosis resulted, and no complications were observed. Satisfactory results of facial reanimation were recorded in five patients after all stages were completed. The remaining three patients are undergoing physical therapy and waiting for revision of the skin paddle.

Case Reports

Case 1

An 18-year-old woman presented with complete right facial paralysis associated with a contour depression and radiation dermatitis in the right infra-auricular area that was the result of treatment for a malignant parotid gland tumor (mucoepidermoid cancer; Fig. 2, *above, left* and *center*). The deformity resulted from surgical resection of the tumor, which was followed by radiation therapy. She underwent surgical correction using this compound flap (Fig. 2, *above, right*). She had two additional surgical procedures of deepithelialization, augmentation, and debulking to achieve a satisfactory result (Fig. 2, *below*). She had a gold weight placed for lagophthalmos of her right eye.

Case 2

A 38-year-old woman developed intraoral fibrosis and left facial paralysis after more than 10 surgical procedures performed for treatment of a left-side oral hemangioma (Fig. 3, *above*). At the time of this compound muscle and skin flap transfer, the intraoral contracture release was performed. The muscle component was used for facial reanimation, and the skin component of the flap was inset to correct the intraoral defect (Fig. 3, *center*). An improvement in mouth opening was achieved in addition to reanimation of her paralyzed face (Fig. 3, *below*).

Case 3

A 31-year-old woman presented with a left ear deformity and left facial paralysis that resulted from resection of a cholesteatoma of the middle ear that was complicated by a postoperative infection at the age of 11 (Fig. 4, *above, left, and below, left*). The gracilis muscle was transplanted for facial reanimation, and the skin component was transferred to the infra-auricular area to attempt to correct the contracted lower lobe of the ear (Fig. 4, *below, center*). She achieved a good smile and a satisfactory result of the ear lobe position after the two additional procedures with release of the contracted ear lobe and skin flap debulking and transposition (Fig. 4, *above, right, and below, right*). She had a gold weight placed for lagophthalmos of her left eye.

Discussion

The complex function of facial muscles can be restored by nerve repair (primary or secondary, with or without nerve graft),[22] nerve transfer,[23] regional muscle transfer,[24] or functioning free-muscle transplantation.[4–13] For a chronic facial paralysis or an acute but unrepaired facial nerve injury (such as nerve lesion at the stylomastoid foramen or more proximally), cross-face nerve graft followed by free-muscle transplantation as a two-stage procedure is preferred,[4–13] because of the better results achieved with more synchronous, natural, and symmetric facial movement. The choices of muscles used for reanimating the paralyzed face include the gracilis, pectoralis minor, serratus anterior, latissimus dorsi, rectus abdominis, rectus femoris, and other muscles.[25–28] However, the potential opportunities for using the muscle and the overlying skin paddle as a compound flap nourished by the same vessel pedicle are few, including the rectus abdominis, rectus femoris, latissimus dorsi, vastus lateralis, and gracilis muscles.

The reliability of the skin island over the gracilis muscle is often in question, even though the blood supply has been defined.[14–17] The importance of including the intermuscular septum between the adductor longus and the gracilis muscles to achieve a reliable skin paddle has not been emphasized.[28] In this article, we report the reliability of the proximal gracilis muscle transferred with its overlying skin as a compound flap. This compound flap is a flap that transforms the gracilis musculocutaneous flap into a muscle and skin two-component compound flap. Both components are supplied by the proximal main pedicle with

FIG. 2. Case 1. (*Above*, *left* and *center*) An 18-year-old woman experienced right facial paralysis and a contour depression with dermatitis pigmentation in the right infra-auricular and retroauricular area following surgery and radiation for a malignant parotid gland tumor. (*Above*, *right*) One year after inset of the compound flap. (*Below*) The contour depression was improved after a revision procedure (deepithelialization, augmentation, and debulking). Note the improvement in facial reanimation after gracilis muscle transplantation.

its skin vessels. The skin vessels are mainly septocutaneous, with some musculocutaneous perforators at the muscle edge. Both originate from the proximal main pedicle. The nutrition of the skin flap over the muscle has been studied extensively by Whetzel and Lechtman.[14] Our experience since 1990[28] has shown that a large gracilis musculocutaneous flap can be harvested safely if the harvest includes the whole gracilis muscle and the fascias of the adductor longus, adductor magnus, and sartorius. This finding is similar to that of Whetzel and Lechtman. Although there are many musculocutaneous perforators traversing the gracilis muscle to supply the overlying skin, there are limited numbers of septocutaneous vessels in this region supplying the same skin.[14] It has been shown that most of the musculocutaneous and septocutaneous skin vessels are present in the upper third of the gracilis muscle.[15] This anatomic relationship explains the success we had with separating the gracilis muscle from its overlying skin island in the proximal third of the muscle. The skin island after separation from the muscle is nourished either exclusively by the septocutaneous vessels or by

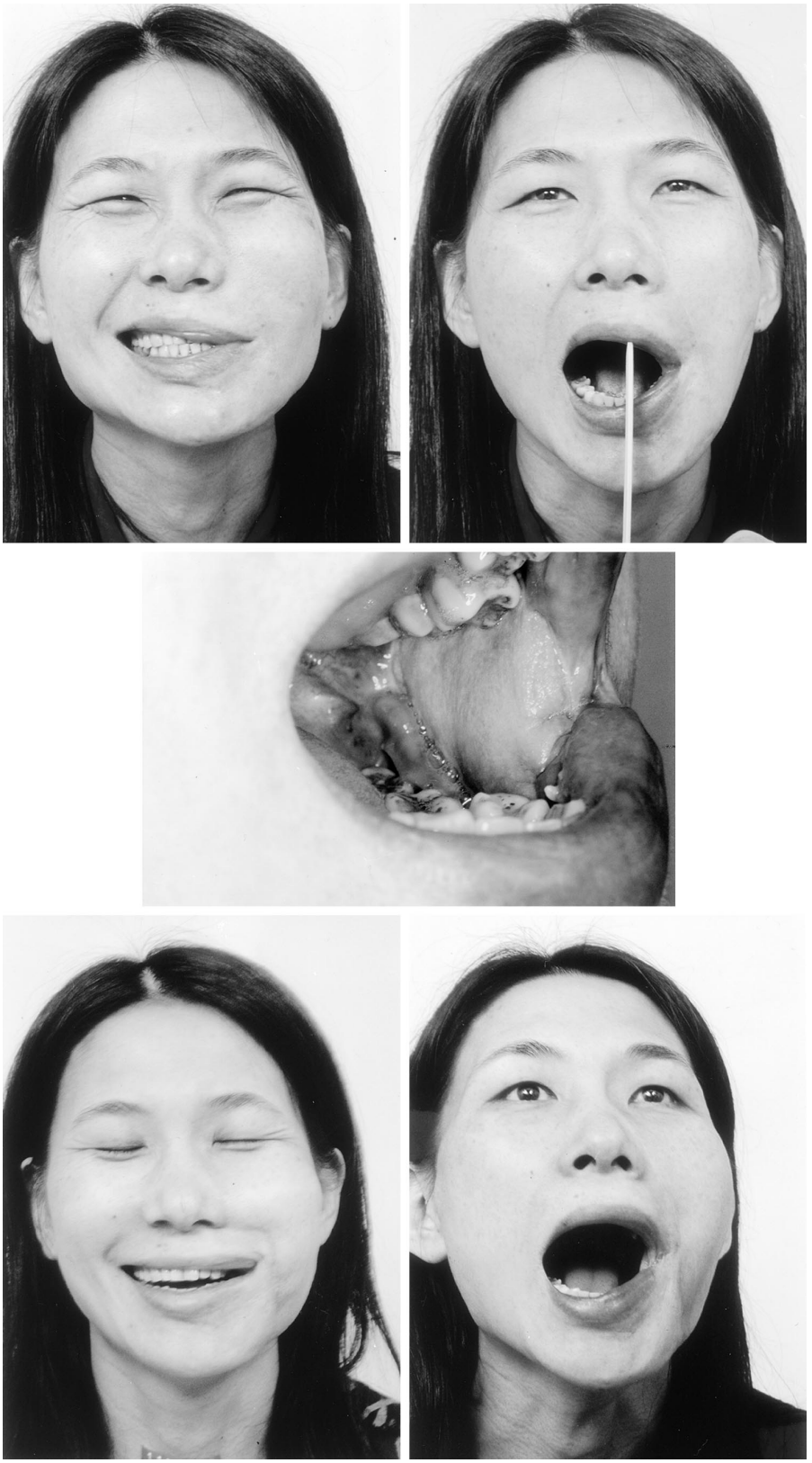

FIG. 3. Case 2. (*Above*) A 38-year-old woman had left facial paralysis and left intraoral fibrosis resulting from hemangioma treatment. (*Center*) The skin component was inset intraorally for replacement of the mucosa defect that resulted after contracture release. (*Below*) Improved oral opening and facial reanimation after gracilis muscle and skin compound flap transplantation.

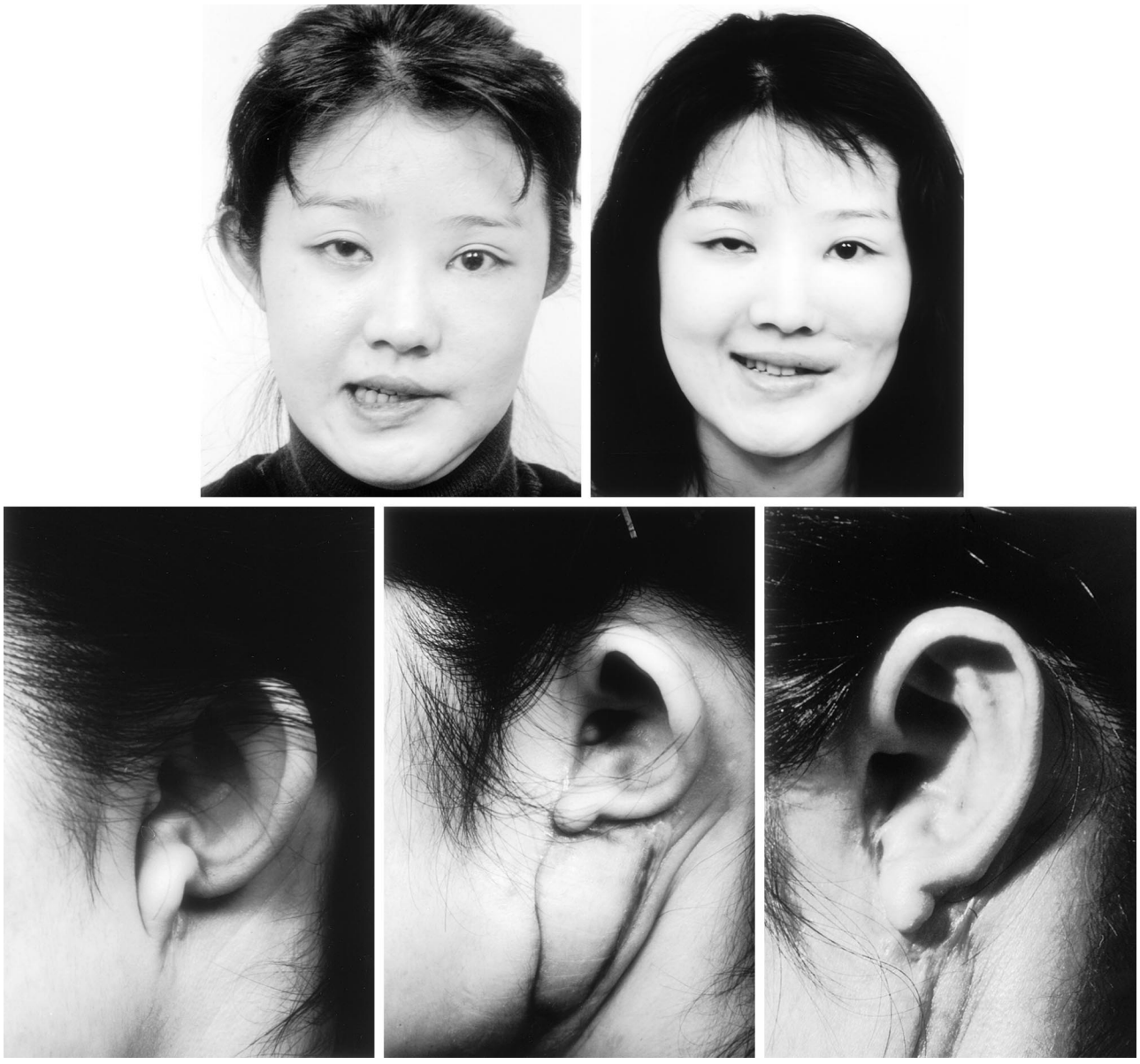

FIG. 4. Case 3. (*Above, left, and below, left*) A 31-year-old woman had left facial paralysis associated with left ear deformity caused by middle ear surgery and infection. (*Below, center*) A view of the compound flap 1year after inset. (*Above, right, and below, right*) Facial reanimation and ear contour correction was finally achieved after revision of the skin component.

both the septocutaneous vessels and some preserved musculocutaneous perforators at the muscle edge.

For the purpose of facial reanimation, we routinely harvest a proximal segment of gracilis muscle measuring approximately 8 to 10 cm in length.[28] The size of skin paddle that can be harvested has not been defined in this series; a 5 × 10-cm skin paddle was used routinely, with reliable results. The skin paddle can be rotated up to 180 degrees safely without compromising the circulation. The skin flap can be used to cover intraoral defects or to augment tissue deficiencies such as temporal hollowness, cheek depression, and infra-auricular or retroauricular tissue loss and distortion, and even to correct ear deformities. This compound flap can potentially be applied for immediate reconstruction following facial tumor ablation whenever sacrifice of the facial muscles and/or facial nerve associated with intraoral mucosa or external facial skin defects is met. This compound flap can be used in this setting for immediate correction of both facial paralysis and tissue defects.

CONCLUSIONS

This series demonstrates the safety and reliability of using the proximal gracilis muscle for facial reanimation along with its overlying skin island based on perforating skin vessels as a compound flap for correction of intraoral or external face defects. The promising results achieved in this series have been a source of encouragement for us to continue the use of this compound flap for treating these aesthetically and/or functionally devastating deformities of the face.

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