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Prophylactic cross-face nerve flap for muscle protection prior to facial palsy☆

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Summary The facial muscles of a 28-year-old woman with left acoustic neuroma were successfully protected with a vascularised cross-face nerve flap using a vascularised lateral femoral cutaneous nerve along with a perforator of the lateral circumflex femoral system. It was transferred as a vascularised cross-face nerve flap to bridge a 15-cm-long defect between the bilateral buccal branches. Three months after the nerve flap transfer, the total tumour including the facial nerve was resected. Postoperatively, rapid nerve sprouting through the nerve flap and excellent facial reanimation were obtained 3–6 months after resection. This method is a one-stage reconstruction procedure, has minimal donor-site morbidity and results in strong postoperative muscle contraction. To our knowledge, this is the first report on a prophylactic cross-face nerve flap technique for the protection of facial muscles before facial nerve transection, and also the usefulness of vascularised lateral femoral cutaneous nerve flap.

Reconstruction for facial palsy after resection of intracranial acoustic neuroma is challenging. To date, various methods have been developed for the protection of the affected facial muscle. In the case of accessory[1] or hypoglossal[2] nerve transfer from the ipsilateral side, it is well known that the denervated muscles can be easily reinnervated, but the patient cannot smile, because of the pattern of motor nerve reinnervation. It is also well known that the smiling function of the facial muscles can be repaired using the contralateral facial nerve as a motor source. In the case of a non-vascularised cross-face nerve grafting method,[3–5] the patient can theoretically smile, but the ultimate strength of the muscle contraction is weak, because longer periods, frequently of nearly a year,

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are required for muscle innervation through a longer nerve graft. Terzis's babysitter method,[6] which uses both hypoglossal nerve transfer and cross-face nerve graft, seems to be more reliable because the hypoglossal axons protect the denervated muscles until the axons from the contralateral facial nerve reach the muscles. However, this method is a two-stage repair and thus requires a longer period until muscle movement, frequently over 1 year.

To overcome these disadvantages, a new vascularised cross face nerve flap method was developed. This method is compromised of a one-stage, smile-oriented orientated reconstruction because the contralateral facial nerve is the new origin of reinnervation for the facial muscle. A regenerated nerve from the contralateral facial nerve can enter the affected denervated facial muscles within 3 months, enabling muscle protection be achieved. To our knowledge, this is the first report on a prophylactic cross-face nerve flap technique using the lateral femoral cutaneous nerve for protection of the facial muscles before facial nerve transection.

Anatomy and flap elevation

The lateral femoral cutaneous nerve branches off from the lumbar nerve plexus in the retroperitoneal cavity and penetrates the deep fascia on the inguinal region of the antero-lateral thigh (ALT). Then, it runs downwards through the lateral intermuscular septum between the rectus femoris and tensor fasciae latae (or vastus lateralis) muscles. The nerve locates just above the deep fascia within the deeper layer of the adiposal tissue of the thigh. The nerve finally distributes into several branches in the distal thigh.

Regarding the blood supply of the nerve, at just below the inguinal ligament, the terminal of the deep branch of the superficial circumflex iliac artery feeds the proximal upper thigh portion of the nerve. At the distal end of the tensor fasciae latae muscle, perforators from the transverse branch of the lateral circumflex femoral artery penetrate the muscle to feed the nerve. In the proximal one-third to the middle point of the thigh, a single dominant perforator usually nourishes the lateral femoral cutaneous nerve as well as subcutaneous tissue on the ALT skin portion (ALT flap).

Obtaining a vascularised nerve flap

Doppler detection of perforators of the lateral circumflex femoral system is very useful. With a longitudinal incision through the lateral intermuscular septum on the anterior thigh, the lateral femoral cutaneous nerve is exposed. In the proximal one-third of the thigh, a perforator entering the nerve and cutaneous portion (ALT flap) can usually be detected. The nerve flap is always obtained along with the surrounding adiposal tissue, and 15 cm in length of the nerve flap can typically be harvested along with a perforator and a short length of the proximal descending branch with a monitoring flap (short pedicle ALT neurocutaneous flap.[7] There might be cases without perforator from the lateral descending branch. In these cases, the nerve flap may be available with a tensor fasciae latae perforator originating from the transverse branch of the lateral circumflex femoral system or a deep branch of the superficial circumflex iliac artery.

Case report

A 28-year-old woman with a large acoustic neuroma originating from the left facial nerve exhibited no preoperative facial paralysis. During the resection of the tumour, the tumour was found to have invaded the facial nerve, so partial resection of the tumour, excluding the facial nerve, was performed to preserve nerve function. After the primary resection, the patient was transferred to our department with complete palsy, with a neurosurgeon's request for prophylactic protection of the left facial muscles before the secondary complete resection, including the facial nerve.

Our planning for affording prophylactic protection was as follows: The first step is a reinnervation of the affected left facial muscles through the vascularised cross-face nerve flap from the contralateral facial nerve. After the nerve sprouting reached the left facial muscles, the secondary resection of the total tumour including the facial nerve was carried out.

Eight months after the primary resection, the muscle contraction strength had increased, but facial animation was still in incomplete. However, the size of the tumour had increased to the preoperative size. Therefore, surgery for muscle protection with cross face nerve flap was performed.

On 20 May 2003, with small incisions of 5 mm in length on the bilateral buccal regions, the buccal branches of the facial nerve were dissected. In addition, using a small sulcus incision on the posterior aspect of the upper lip, a subcutaneous tunnel through the nerve flap was created. A vascularised cross-face nerve flap, 15 cm in length, along with a monitoring flap, was obtained from the antero-lateral aspect of the left thigh (Figure 1).

A nerve flap was transferred with intraoral approach through the subcutaneous tunnel and the bilateral buccal branch ends were pulled up over skin surface through bilateral small incisions. Then, on the non-affected side, the nerve flap was connected to the proximal end of the single buccal branch in an end-to-end fashion. On the affected side, the flap was joined to the distal end of the single buccal branch with 50 μm of 11/0 nylon. Vascular anastomoses to the right facial vessels were carried out through a small submandibular incision. The monitoring flap exhibited good blood flow, but it was too bulky to fix the posterior aspect of the upper lip, and it was sacrificed 3 months postoperatively. Without the flap, the patient exhibited no dysfunction due to flap resection (Figure 2).

Three months after the cross face nerve flap, a total resection of the tumour, including the facial nerve, was performed resulting in complete facial paralysis.

Postoperative nerve recovery through the nerve flap was rapid, and 3 months later, there was slight movement observed at the left corner of the mouth. Six months after the secondary resection, the patient did achieve some amount of zygomatic muscle contraction, but the orbicularis oculi muscle contraction was weak. One year after the secondary resection, the patient attained acceptable function of the facial muscles and left eyelid closure was functional (Figure 3).