Cross-Face Nerve Graft with Free-Muscle Transfer for Reanimation of the Paralyzed Face: A Comparative Study of the Single-Stage and Two-Stage Procedures

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The most accepted method for reanimation of the paralyzed face is the two-stage method that combines cross-face nerve graft with free-muscle transfer. Although the results of reconstruction with this method are satisfactory, there is an excessive delay between stages, which prolongs the period of rehabilitation. In 1995, Kumar overcame this and presented his preliminary results from a single-stage transfer of the gracilis. We compared the long-term results of the single-stage with the two-stage method of reconstruction. Patients selected the method of reconstruction on the basis of the information, photographs of scars, and video recording of results given to them at a special facial palsy clinic. Ten patients selected the single-stage reconstruction and 15 selected the two-stage reconstruction. The mean follow-up period was 3 years. The results of the two methods are comparable, with 90 percent of the patients who underwent the single-stage and 93 percent of those who underwent the two-stage procedures having good and fair results. However, the two-stage method scored good symmetry at rest in 67 percent, compared with 20 percent for the single-stage method. There were fewer complications with the single-stage method, and none of the patients had any problems relating to the donor site. The period of rehabilitation was reduced by 10 months with the single-stage method. (*Plast. Reconstr. Surg.* 109: 451, 2002.)

Cross-face nerve graft with free-muscle transfer has become the accepted method to restore spontaneous smile in patients with longstanding facial paralysis. This operation is usually performed in two stages, involving a cross-face nerve graft in the first stage and free-muscle transfer in the second stage that is done 6 to 12 months later.

The main disadvantage of the two-stage procedure is the delay between the stages.[1] To overcome this, O'Brien and Kumar[1] in 1991 proposed a single-stage procedure of cross-face nerve graft and free-muscle transfer using the gracilis muscle. In the single-stage procedure, the nerve to the donor muscle is kept long and tunneled across the upper lip to be connected to the contralateral intact facial nerve.

In 1994, Koshima et al.[2] reported a similar procedure using the rectus femoris muscle. In 1995, the senior author (P.A.V.K.)[3] reported the preliminary results of his first three cases using the single-stage procedure.

This article reports the long-term results in 25 patients and compares the results of the single-stage technique with those of the standard two-stage technique. We used the classic two-stage technique in 15 patients and the single-stage technique in 10 patients. The results were graded using a modification of the point system suggested by O'Brien et al.[4]

Patients and Methods

All patients with longstanding facial palsy operated on by the senior author between 1989 and 1999 were included in this study. Patients were counseled in the special facial palsy clinic. They were shown video recordings and photographs of the scars and expected results. Patients selected the procedure that they would like on the basis of this information.

From Merseyside Regional Plastic Surgery Centre, Whiston Hospital. Received for publication February 23, 2001; revised April 30, 2001.

Presented at the Winter Meeting of the British Association of Plastic Surgeons, in London, England, in December of 1999. Awarded the Annual Memorial Award for the Best Research Presentation at the 18th Annual Meeting of the Egyptian Society of Surgeons, in Cairo, Egypt, in February of 2000.

The gracilis was the muscle of choice in both the single-stage and two-stage methods. All patients were available for follow-up. The follow-up period ranged from 7 months to 6.5 years (mean, 3.5 years).

Results were analyzed objectively by clinical examination, preoperative and postoperative photographs, and video recordings. The patients were assessed for symmetry at rest and smiling, muscle bulk, independent muscle movement, elevation of the nasolabial fold, closure of the mouth, and involuntary muscle movements. A modification of the point system of O'Brien et al.[4] was used to grade the result (Fig. 1). The overall results were graded as good when the score was greater than 16, fair when the score was between 14 and 16, and poor when the score was less than 14. In addition, a patient questionnaire was used to record patient satisfaction.

The Two-Stage Procedure

The first stage (cross-face nerve graft). A modified parotidectomy incision with submandibular extension was used to expose the branches of the facial nerve on the nonparalyzed side (Fig. 2, *left*). These were identified along the anterior and superior borders of the masseter muscle using loupe magnification.

These branches were marked with 5-0 silk suture loops for later reidentification. About half of these branches could be safely divided and joined to the nerve graft without weakening the donor half of the face. We always made sure that the buccal branch (sizeable branch) was one of these donor branches. Simultaneously, the sural nerve graft was harvested using multiple small transverse incisions. The nerve graft was reversed in the face so that the regenerating axons would not be dissipated through the branches. After the sural nerve graft was anastomosed to the donor facial nerve branches, the nerve graft was tunneled under the chin through a small submental incision and brought anterior to the tragus on the paralyzed side. The graft was anchored to the dermis by silk suture. We preferred to use the longer submental route than going across the upper lip to avoid the risk of damaging the nerve during subsequent cheek dissection. Nerve regeneration was monitored clinically by the progress of the Tinel sign along the course of nerve graft. The Tinel sign usually reached the tragus on the paralyzed side in 4 to 8 months after cross-face nerve graft.

The second stage (free-muscle transfer): donor dissection. The gracilis muscle was exposed using an inverted L-shaped incision made in the proximal medial thigh along a line between the adductor tubercle and the medial femoral condyle (Fig. 2, *center*). This line corresponds to the posterior margin of the adductor longus muscle. The anterior border of the gracilis muscle is posteromedial to the adductor longus. The vascular pedicle was identified at the anterior border of the gracilis at the junction of its upper quarter and lower three-quarters. The vascular pedicle was mobilized to its origin from the profunda vessels by dividing all branches to the overlying adductor longus muscle. The nerve to the gracilis, which arises from the anterior division of the obturator nerve, entered the muscle at the vascular hilum. It was traced proximally up to 5 to 6 cm.

Thinning of the muscle was carried out in situ before division of the vascular pedicle. This reduced ischemia time and secured hemostasis, thereby reducing the risk of facial hematoma after the transfer. The muscle fascia was incised on its posterior border. The

No.	Criteria
I	Symmetry of midface at rest
	1. Marked asymmetry; midline pull to other side by normal facial muscles
	2. Mild asymmetry of facial commissure
	3. No detectable asymmetry
II	Symmetry of midface on smiling
	1. Marked asymmetry; midline pull to other side by normal facial muscles
	2. Mild asymmetry
	3. No obvious asymmetry
III	Muscle bulk
	1. Marked cheek bulk producing asymmetry
	2. Mild increase in cheek bulk
	3. No obvious increase in cheek bulk
IV	Independent movement of the transferred muscle
	1. No independent contraction seen
	2. Partial contraction of muscle requires strong contraction of the normal side
	3. Good independent muscle contraction with no movement of the normal side
V	Elevation of nasolabial fold
	1. No elevation
	2. Minimal elevation
	3. Normal elevation with good facial symmetry
VI	Ability to close the mouth
	1. Oral incompetence
	2. Weak incomplete mouth closure
	3. Normal mouth closure
VII	Involuntary movements of the transferred muscle
	1. Marked involuntary movement with dyskinesia or mass movement of the face
	2. Minimal involuntary movement; only with strong contraction of the other side
	3. No noticeable involuntary movement

FIG. 1. Standard criteria for objective assessment of operative results (grading: 1, poor; 2, fair; 3, good).

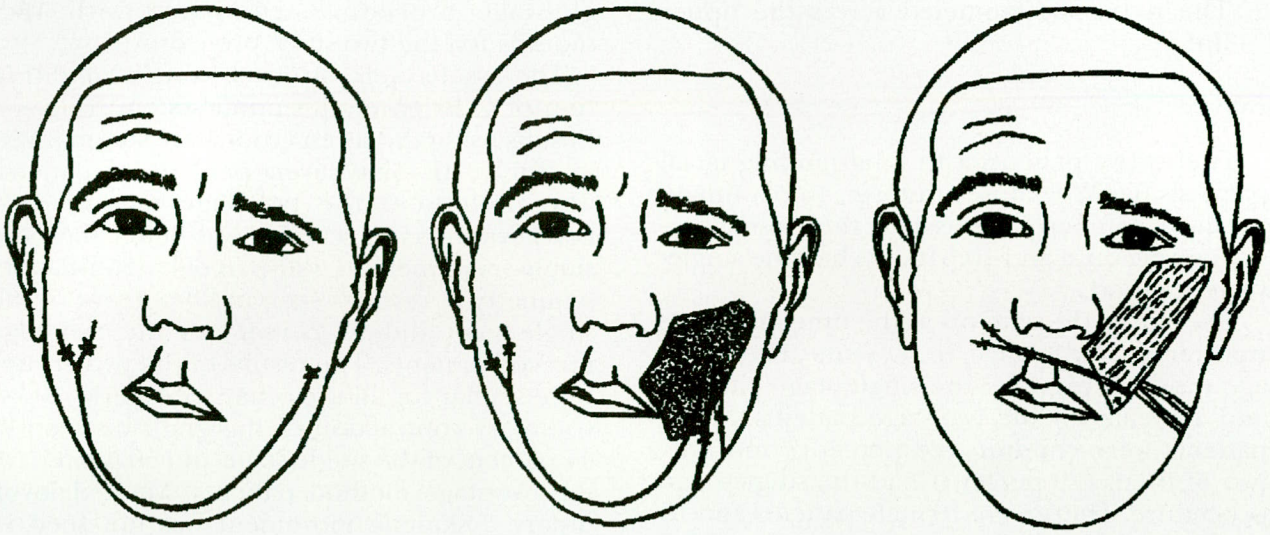

FIG. 2. (*Left*) The first stage of the two-stage procedure (cross-face nerve graft). (*Center*) The second stage of the two-stage procedure. Free-muscle transfer connected to the end of cross-face nerve graft and to facial vessels on the paralyzed side. (*Right*) The single-stage procedure. The muscle is reversed so that the neurovascular hilum is inferior. From Kumar, P. A. V. Cross-face reanimation of the paralysed face, with a single stage microneurovascular gracilis transfer without nerve graft: A preliminary report. *Br. J. Plast. Surg.* 48: 83, 1995. Used with permission.

fascia was elevated from the medial and lateral surface of the muscle. The muscle was split longitudinally, which took about one-half to one-third of the muscle with the main vascular pedicle. The muscle fascia was then wrapped around the graft and sutured with fine absorbable sutures. This prevented muscle tethering. The usual length of muscle required is 6 to 8 cm. The muscle was divided with the vascular pedicle in the middle of the graft. The remaining part of the gracilis muscle was then left in the thigh, gaining its blood supply from other minor vascular pedicles.

The second stage (free-muscle transfer): recipient dissection. A modified parotidectomy was done on the paralyzed side. The skin flaps were elevated to the upper lip. The facial vessels and the cross-face nerve graft were identified and prepared for anastomosis. The gracilis muscle graft was moved to the face with its vascular pedicle on the deep surface. This allowed subsequent thinning of the muscle if required. The proximal end of the muscle graft was sutured to the alar base, upper lip, and modiolus. The distal end of the muscle graft was sutured to the inferior orbital margin and zygoma. The vascular pedicle was now in a suitable position for microvascular anastomosis with facial vessels. The cross-face nerve graft was sutured to the nerve to the gracilis very close to the hilum of the muscle.

The Single-Stage Procedure

In the single-stage method (Fig. 2, *right*), the donor dissection differed in the following manner:

1. The contralateral gracilis muscle was harvested.
2. The nerve to the gracilis was traced up to the obturator foramen. With intraneural dissection, we harvested 10 to 12 cm of the nerve while preserving the other branches to the adductor longus and the brevis. Care was taken to preserve the tiny vasa nervosa that ran in the fascia on the outer surface of the nerve to maintain blood supply to the distal end of the nerve.
3. The proximal end of the gracilis was divided close to the vascular pedicle, so that most of the muscle graft was distal to the vascular pedicle. When the muscle was moved to the face, it was reversed. The neurovascular pedicle was now close to the nasolabial fold, thereby allowing the nerve to reach the contralateral side of the face without requiring a nerve graft.

The recipient dissection differed in the following aspects:

1. The donor nerve was exposed on the normal side of the face through an incision made 1 cm lateral and parallel to the nasolabial fold.

2. The nerve was tunneled across the upper lip.

Results

Twenty-five patients with longstanding facial paralysis had free-muscle transfer to reanimate the face. Fifteen patients had the classic two-stage procedure and 10 patients had the single-stage method.

The age of the patients at the time of muscle transfer ranged from 7 to 60 years. The mean age was 39.9 years for the single-stage patients and 24 years for the two-stage patients. Seven patients were children (28 percent) and only two of them (29 percent) had the single-stage procedure. There were 10 male patients and 15 female patients. Thirteen female patients had the two-stage reconstruction.

The etiology of facial palsy is illustrated in Table I. Congenital (44 percent) and acoustic neuroma (32 percent) were the most common causes. Congenital facial palsy was the cause in 67 percent of the patients in the two-stage group and 10 percent of the patients in the single-stage group.

Facial paralysis was right sided in 17 patients (68 percent) and left sided in eight patients (32 percent). Six patients (24 percent) had incomplete facial palsy in which the function of the upper half of the face was retained, and 19 patients (76 percent) had complete facial palsy in which the whole hemiface was involved. Paralysis of the lower half of the face was complete in all cases (Table II).

The duration between first and second stages for the two-stage procedure ranged from 8 to 17 months (mean, 12.1 months). The mean operative time was 7 hours 52 minutes for the single-stage procedure and 8 hours 48 minutes for the two-stage procedure, including first and second stages together. The mean duration from the first operation to the start of muscle contraction was 8.1 months for the single-stage procedure, compared with 18.2 months for the two-stage procedure.

TABLE I
Etiology of Facial Palsy

Etiology	Single-Stage Procedure	Two-Stage Procedure
Congenital	1	10
Removal of acoustic neuroma	4	4
Bell palsy	2	1
Parotidectomy	1	0
Trauma	2	0
TOTAL	10	15

The results were assessed using a modification of O'Brien et al.'s point system[4] (Fig. 1). Results using the seven criteria are summarized in Table III. Sixty-seven percent of patients who underwent the two-stage method had good symmetry at rest that was better than the single-stage method (20 percent). Satisfactory symmetry at rest was seen in 90 percent of the single-stage and 93 percent of the two-stage method patients. The results of the two groups were similar for all the other six criteria. Good voluntary contraction of the graft was seen in 47 percent of the single-stage and 50 percent of the two-stage method patients. Marked involuntary dyskinetic movement was not seen in either group of patients.

The overall results (Table III) were satisfactory in 90 percent of the single-stage and 93 percent of the two-stage reconstructions. It was good in 60 percent of the single-stage patients and 73 percent of the two-stage patients (Figs. 3 through 7). Eight patients from the single-stage group and 13 from the two-stage reconstruction group returned their questionnaires. Their results are summarized in Tables IV and V. The majority of the single-stage procedure patients (62.5 percent) considered the overall results as excellent or very good, and one patient (12.5 percent) was unsatisfied with the results. Sixty-nine percent of patients who had the two-stage procedure considered results as excellent or very good, and one patient (8 percent) had fair results. Despite their overall satisfaction with the reconstruction, 88 percent of patients with the single-stage reconstruction and 77 percent who had the two-stage reconstruction were conscious of a persistent asymmetry. Four patients, all from the two-stage group, complained of donor-site problems, namely, widening of the scar, persistent numbness of the lateral border of the foot, scar hypertrophy, and worsening of osteoarthritis. All those patients were women, and the problems were related to the first stage of sural nerve harvest. None of the patients in the single-stage group complained of donor-site problems. Persistent facial swelling up to 6 months after surgery was a complaint of all patients who underwent the single-stage procedure and 38 percent of the patients who had the two-stage procedure.

The complications are illustrated in Table VI. Two patients from the two-stage group had

TABLE II
Patient Criteria

Criteria	Single-Stage Procedure (n = 10)	Two-Stage Procedure (n = 15)
Mean age (years)	39.9 (range, 10–60)	24 (range, 7–49)
Adult:child (ratio)	8:2	10:5
Sex (M:F ratio)	8:2	2:13
Mean follow-up (years)	3.2 (range, 1–6.5)	3.7 (range, 7 months–6.5 years)
Incomplete:complete	9:1	11:4
Mean duration of palsy (years)	9 (range, 4 months–23 years)	13.8 (range, 1–36)

TABLE III
Evaluation of Results

Criteria	Single-Stage Procedure			Two-Stage Procedure		
	Good (%)	Fair (%)	Poor (%)	Good (%)	Fair (%)	Poor (%)
Symmetry at rest	2 (20)	7 (70)	1 (10)	10 (66.6)	4 (26.7)	1 (6.7)
Symmetry on smiling	0	9 (90)	1 (10)	1 (6.7)	13 (86.6)	1 (6.7)
Muscle bulk	6 (60)	4 (40)	0	6 (40)	9 (60)	0
Independent movement	4 (40)	3 (30)	3 (30)	8 (53.3)	6 (40)	1 (6.7)
Nasolabial fold elevation	5 (50)	4 (40)	1 (10)	7 (46.6)	6 (40)	2 (13.4)
Ability to close the mouth	8 (80)	2 (20)	0	11 (73.3)	4 (26.7)	0
Involuntary movement	7 (70)	3 (30)	0	10 (66.7)	5 (33.3)	0
Overall result	6 (60)	3 (30)	1 (10)	11 (73.3)	3 (20)	1 (6.7)

hematoma and required reexploration. In one case, the bleeding was from the anastomosis; in the other, it was from the cut end of the muscle. There were two graft failures, one in each group. The patients who had graft failure developed an abscess that required drainage.

A list of secondary surgical procedures following muscle transfer is shown in Table VII. Temporalis transfer to the eye was performed in four patients at the time of the single-stage procedure to help eye closure. With the two-stage procedure, temporalis transfer to the eye was performed with the first stage in three patients and as a secondary procedure in one patient. Tethering of the transferred muscle to skin was seen in one single-stage and two of the two-stage patients. Release of tethering was performed as a secondary procedure. Fat injection was added to treat a cheek dimple in one patient.

Discussion

Single-stage free nonvascularized and denervated muscle transfer using the extensor digitorum brevis was first described by Thompson[5] for the treatment of incomplete facial paralysis in 1971. The technique depended on neurotization of the muscle from the recipient bed. In 1976, Thompson and Gustavson[6] extended the use of free-muscle graft to cases of complete facial paralysis by including the motor nerve to the muscle. They kept the deep peroneal nerve attached to the muscle, tunneled it across the upper lip, and anastomosed it to the normal contralateral facial nerve. The technique was abandoned because the results were inconsistent.

In 1976, Harii et al.[7] were the first to transfer a free vascularized muscle by microvascular anastomosis of gracilis vessels to superficial temporal vessels. However, they anastomosed the gracilis nerve to the ipsilateral deep temporal nerve, which resulted in exaggerated asymmetric movement when the jaws were clenched. To avoid this, O'Brien et al.[8] in 1980 added cross-face nerve graft in the first stage. This two-stage method is the most accepted method of treatment in cases of complete long-standing facial paralysis. Using this technique, good results have been reported by O'Brien et al.,[1,4] Harii,[9] Sassoon et al.,[10] and Harrison.[11] The main disadvantage of the two-stage procedure is the delay of nearly 18 to 24 months before the results of reconstruction are apparent to the patient. A single-stage muscle transfer could overcome this delay.

O'Brien et al.[8] used vascularized innervated extensor digitorum muscle for single-stage facial reanimation. They failed to produce consistent symmetric movement of the transferred muscle. In 1990, O'Brien et al.[4] reported single-stage reconstruction with free-muscle transfer, when the proximal stump of ipsilateral facial

FIG. 3. A 45-year-old woman with complete right facial paralysis following the removal of acoustic neuroma 2 years previously. (*Above*) Preoperative views at rest, on smiling, and on eye closure, respectively. Note lateral tarsorrhaphy performed earlier that was not enough to solve eye problems. Reanimation was accomplished using two-stage free gracilis transfer to the angle of the mouth and temporalis transfer to the eye. (*Below*) Same views 3 years postoperatively. Good results were obtained (score, 20 out of 21) without any revisional surgery. Note the well-formed nasolabial fold and better symmetry of angles of mouth both at rest and on smiling.

nerve is available. This was possible in less than 5 percent of patients in series reported by O'Brien et al.[4] and Harii.[9] Most of their patients needed the two-stage reconstruction.

Both O'Brien et al.[4] and Harii[9] reported better results using ipsilateral facial nerve in the single-stage when compared with the two-stage method using cross-face nerve graft to the contralateral facial nerve. This is probably because of the decrease in number and size of the regenerated myelinated fibers at the distal end of cross-face nerve graft in the two-stage method. Harii therefore advised delaying the second stage for 12 months to permit increased myelination of regenerating axons. In contrast, in the single-stage method the regenerating axons have to contend with the scar barrier of only one suture line and have to

FIG. 4. A 34-year-old woman with congenital incomplete right facial paralysis (upper face is not involved). (*Above*) Preoperative views at rest and on smiling, respectively. Reanimation was accomplished using two-stage free gracilis transfer to the angle of the mouth. Plication of lip elevators was performed 3.5 years later to correct left mandibular fullness. (*Below*) Same views 5 years 8 months postoperatively. Good results were obtained (score, 17 out of 21). Note the natural symmetric smile and better symmetry of angles of the mouth.

traverse a shorter distance compared with the two-stage method.[4] The nerve graft is vascular,[1] and Taylor and Ham[12] and Taylor[13] have shown that the use of vascularized nerve graft produces more rapid axonal regeneration and myelination.

Koshima et al.[2] (using rectus femoris) and Kumar[3] (using gracilis) reported good results

FIG. 5. A 23-year-old man with complete traumatic right facial paralysis 11 years previously. (*Above*) Preoperative views at rest, on smiling, and on eye closure, respectively. A gold weight to the upper eye lid was performed previously elsewhere. Note that the gold weight is protruding and about to come out. Reanimation was accomplished using single-stage free gracilis transfer to the angle of the mouth and temporalis transfer to the eye after removing the gold weight. (*Below*) Same views 2 years 5 months postoperatively. Good results were obtained (score, 17 out of 21).

with a single-stage vascularized muscle transfer with a cross-face nerve graft. Kimata et al.[14] reported good results using single-stage free vascularized latissimus dorsi muscle connected to ipsilateral facial nerve branch stump after radical parotidectomy. Harii et al.[15] reported a large series of one-stage transfer of the latissimus dorsi muscle using the contralateral facial nerve. They reported 87 percent good results, which compares well with the two-stage method. The article does not report the results of the two-stage method.

This is the first study that compares the long-term results of the single-stage method with those of the two-stage method. The senior author operated on all cases over the same time period, eliminating any bias attributable to operator skill and experience. Having patients select the method of reconstruction did result in age and sex bias. The older male patients selected the single-stage method of reconstruction. The average age of the patients undergoing single-stage reconstruction was 40 years, compared with 24 years for the two-stage

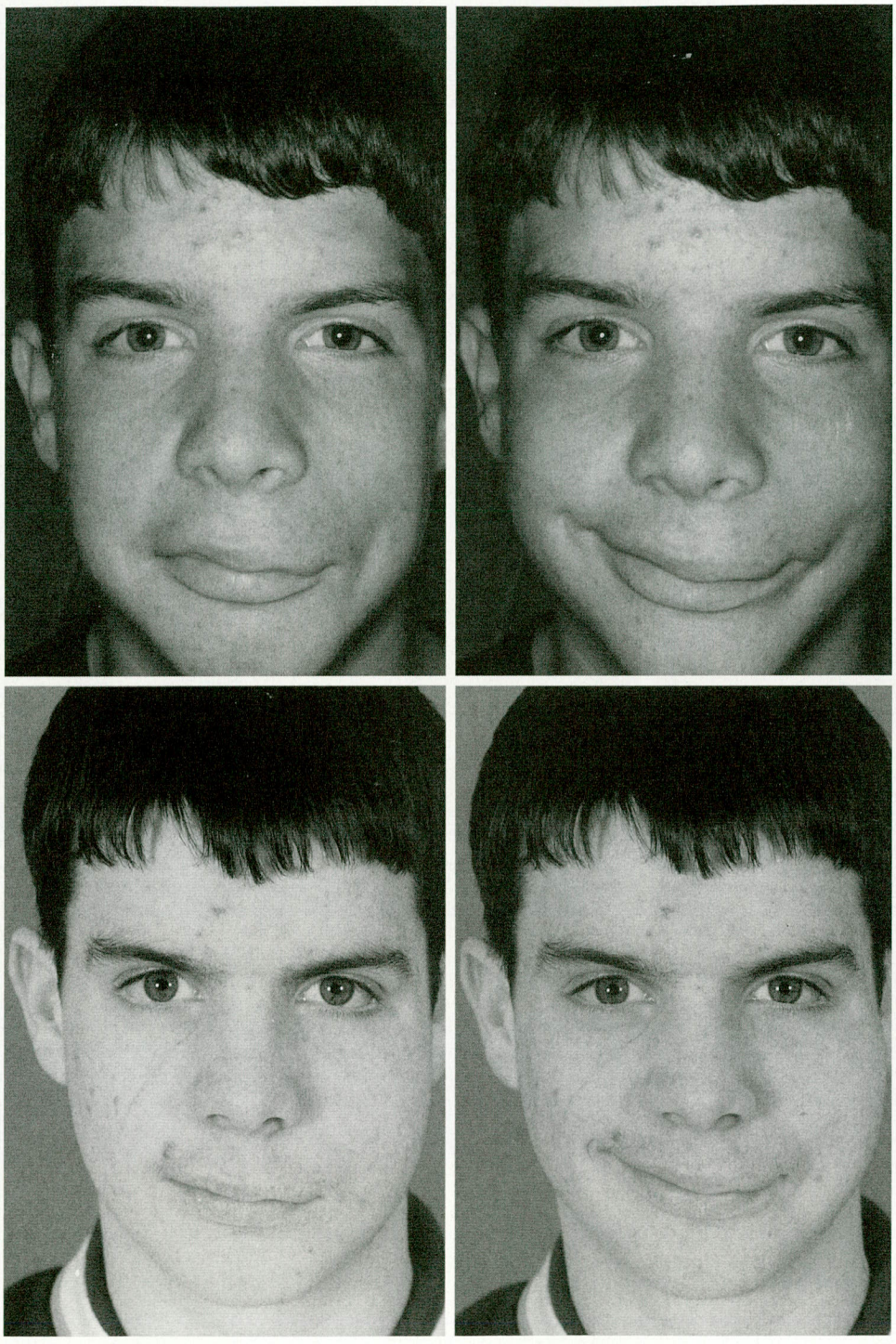

FIG. 6. A 15.5-year-old boy with congenital incomplete left facial paralysis. (*Above*) Preoperative views at rest and on smiling, respectively. Reanimation was accomplished using single-stage free gracilis transfer to the angle of the mouth. (*Below*) Same views 1 year 5 months postoperatively. Good results were obtained (score, 18 out of 21). Note improved symmetry of angles of mouth both at rest and on smiling.

method. Three of the patients in this group were in the fifth and sixth decades, the age when results are generally acknowledged to be poorer. Despite this, the results of the two methods were comparable, with 90 percent of the single-stage and 93 percent of the two-stage reconstructions having satisfactory results. Patient satisfaction scores were also similar. How-

FIG. 7. A 53-year-old woman with complete right facial paralysis following the removal of acoustic neuroma 11 years previously. (*Above*) Preoperative views at rest, on smiling, and on eye closure, respectively. Note gold weight performed earlier that was not enough to close the eye and was protruding and about to come out and causing notching of the upper eye lid. Reanimation was accomplished using single-stage free gracilis transfer to the angle of the mouth, superficial musculoaponeurotic system plication, removal of gold weight, and temporalis transfer to the eye. Release of muscle tethering to the skin and fat graft were performed 2 years postoperatively. (*Below*) Same views 4.5 years postoperatively. Good results were obtained (score, 18 out of 21). Note the well-formed nasolabial fold and improved symmetry of the angles of the mouth and eye closure.

TABLE IV
Patient Satisfaction with Overall Results

Satisfaction Rating	Single-Stage Procedure (%)	Two-Stage Procedure (%)
Excellent	4 (50)	2 (15.4)
Very good	1 (12.5)	7 (53.8)
Good	1 (12.5)	3 (23.1)
Fair	1 (12.5)	1 (7.7)
Bad	1 (12.5)	0

TABLE V
Patient Evaluation of Individual Criteria

	Single-Stage Procedure		Two-Stage Procedure	
Criteria	No (%)	Yes (%)	No (%)	Yes (%)
Facial asymmetry	1 (12.5)	7 (87.5)	3 (23)	10 (77)
Eating difficulty	8 (100)	0	11 (85)	2 (15)
Drinking difficulty	7 (87.5)	1 (12.5)	11 (85)	2 (15)
Cheek swelling after 6 months	0	8 (100)	8 (62)	5 (38)
Speech improvement	6 (75)	2 (25)	9 (69)	4 (31)
Donor-site complaints	8 (100)	0	9 (69)	4 (31)

ever, 50 percent of the patients who had single-stage reconstruction considered the results as excellent compared with only 15 percent of the two-stage patients.

The total operating time and hospital stay for the single-stage method were less than those for the two-stage method. In addition, the period of rehabilitation was reduced. The patients who had the single-stage procedure saw the benefits of surgery 10 months earlier.

TABLE VI
Procedural Complications

Complication	Single-Stage Procedure	Two-Stage Procedure
Hematoma	0	2
Infection	2	1
Muscle tethering to skin	1	2
Muscle graft failure	1	1
Donor-site problems	0	4
Others	1	1
TOTAL	5	11

TABLE VII
Secondary Surgical Procedures

Type of Surgery	Single-Stage Procedure	Two-Stage Procedure
Lateral canthoplasty	2	1
Eye brow hitch	3	0
Fascial sling to angle of mouth	1	0
Mini-face lift	1	1
Release or division of fascial sling to angle of mouth	2	0
Temporalis transfer to eye	2	1
Temporalis transfer to angle of mouth	0	1
Release tethering of muscle to skin	1	2
Fat injection or fat graft to cheek dimple	1	1
Insertion of gold weight	0	1
Removal of gold weight	1	0
Upper eye lid blepharoplasty	1	0
Release temporalis sling to eye	1	0
Plication of lip levators	0	1
Excision of redundant mucosa of lip	1	0
Transfer of anterior belly of digastric to lower lip	1	0
TOTAL	18	9

There were fewer complications with the single-stage method. All donor-site complaints in our series were because of sural nerve harvest in the two-stage procedure, and these were avoided in the single-stage procedure. Hematoma occurred in 8 percent and muscle tethering in 12 percent of our patients. This was less than that previously reported by O'Brien et al.[4] It is our opinion that thinning of the muscle in situ before dividing the vascular pedicle reduces the risk of hematoma, and preservation of the epimysium around the muscle graft reduces tethering.

One drawback of the single-stage procedure was the anterior cheek scar. This cheek scar usually settles nicely with time, and none of the single-stage patients specifically complained about this scar in their returned questionnaires. However, in the early follow-up period, only one patient was noticed to have scar hypertrophy that settled later on, and another patient showed tethering of the scar to the underlying tissues, resulting in a dimple on animation. The latter required release of tethering and fat injection to correct the dimple. Most female patients and children in our series preferred the two-stage procedure to avoid cheek scar. Most of the secondary procedures in the present series were performed to deal with coincident eye problems, and few of them were performed to deal with lip deformity.

Koshima et al.[2] preferred rectus femoris because it has a large arterial supply and long femoral nerve (more than 20 cm). The problems with this donor include functional limitation, scar contracture, and hyperesthesia. Added to that, this muscle has a relatively short vascular pedicle. The gracilis is preferred by us because of its reliable vascular anatomy and parallel muscle fibers (which allow thinning), and because it does not result in donor-site dysfunction. The nerve to the gracilis is short for a single-stage method; however, with careful dissection into the obturator foramen, up to 12 cm of the nerve can be harvested. This length of nerve is enough to reach the contralateral intact facial nerve. In addition, this muscle allows two teams to operate together without the need to reposition the patient.

Temporalis transfer to the eye was our preferred method to treat lagophthalmos. Gold weight is the most widely used method of treating lagophthalmos. This method causes cosmetically unacceptable bulging in patients with thin eyelid skin and an incidence of shifting and extrusion.[16] We therefore prefer to use temporalis transfer. We believe that temporalis transfer to the eye not only helps closure of eyelids but also corrects ectropion of the lower eyelid. Contraindications to the use of temporalis include the absence of reasonably contracting muscle on clenching of teeth (muscle atrophy) and unfitness of the patient for surgery. A small part of the muscle is taken to minimize the incidence of temporal hollow. The access is through a vertical temporal incision that will be hidden within the hair, and it can be an extension of the modified face lift incision used in the second stage of the two-stage gracilis transfer.

In our opinion, the single-stage cross-face reanimation of the paralyzed face is an improvement over the current methods because it significantly reduces the overall period of rehabilitation, with a lower rate of complications and less donor morbidity. We believe that the single-stage procedure should be offered as an alternative to the classic two-stage proce-

dure for all patients with longstanding facial paralysis.

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ACKNOWLEDGMENT

This work was supported by a fund from the Egyptian government through the scholarship awarded to the second author (K.M.H.).

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