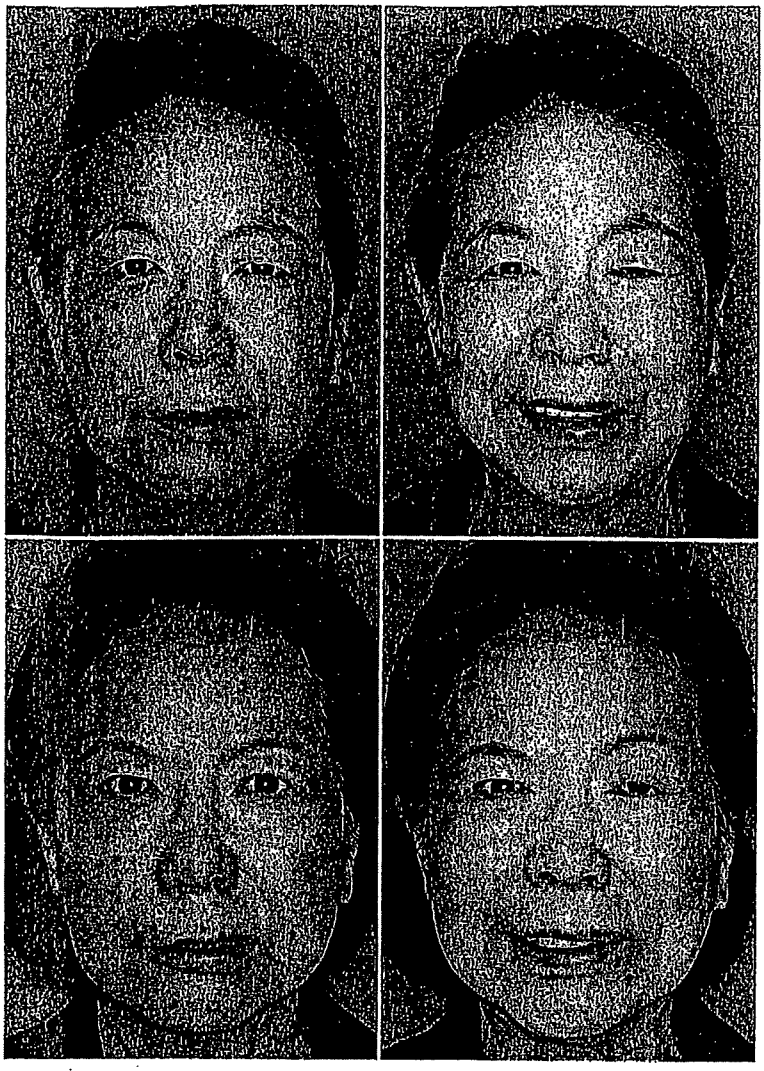
(a) 術前の状態
笑うと患側の瞼裂狭小化が見られる。

(b) 術後1年8カ月の状態
異常共同運動の改善が見られる。

図9　ハント症候群後の陳旧性左不全麻痺症例（51歳，女性）

との対称性が得られると考えている。一方で，陳旧性不完全麻痺の多くの症例に見られる異常共同運動に対する外科的治療法としては，選択的筋切除術[6]や，選択的神経切除術[7]の報告が見られる。Guerrissi[6]が施行しているのは鼻唇溝の異常共同運動に対して大頬骨筋を切除する方法であるが，この異常共同運動を示す症例では随意的な鼻唇溝の動きが小さい場合が多い。したがって，われわれはこのような不完全麻痺の症例では遊離筋肉移植が適応となると考えている[19]。一方，Nakamuraら[7]は，1例に対して頬骨枝が眼輪筋に入る部分で選択的神経切断を行っているが，文中にも述べたとおり，眼輪筋眼窩部で筋体ごと切除した方がより確実な結果が得られると考える。一方，われわれの渉猟し得た限り，異常共同運動に対する外科的治療として，眼輪筋眼窩部での選択的神経・筋切除術を施行した報告は見ら



(a) 術前の状態
左；頬部のたるみ，深い鼻唇溝が見られる。
右；笑うと患側の瞼裂狭小化が見られる。

(b) 術後2年の状態
頬部の対称性と異常共同運動の改善が見られる。

図10　ハント症候群後の陳旧性左不全麻痺症例（71歳，女性）

れない。術後1年以上経過したわれわれの症例では，ある程度の異常共同運動の再発は見られるものの，十分な改善が獲得できている。しかし，異常共同運動を定量的に測定し，統計学的な分析を行って本手法の妥当性を評価する必要があるため，現在，コンピューターソフトウエアを用いて定量的測定を行っており，その結果を今後報告予定である。

まとめ

陳旧性不完全麻痺の患者にしばしば見られる顔面の非対称や異常共同運動に対して，われわれは美容外科において発展してきたface-lifting法を応用した手術方法を行っている。異常共同運動を伴う場合，顔面神経は

hypersensitivityの状態となっているため，face-liftingの切開より選択的神経・筋切除術を行うことにより，これを抑制し，目立たないようにすることが可能である。陳旧性不完全麻痺の症例は個々によって症状の差があり，それぞれの症例に対応していくためにはある程度の経験が必要である。しかし，閉瞼障害などの機能的な問題がないために放置されている潜在的な患者は多いと思われ，本稿で紹介したような美容外科的な手術による積極的な関与が有効であるので，われわれの方法を紹介した。

引用文献

1) 波利井清紀，朝戸裕貴，多久鳩亮彦：顔面神経麻痺の形成外科的治療．JOHNS 16：444−449, 2000
2) 多久鳩亮彦，波利井清紀，百澤明ほか：陳旧性顔面神経麻痺に対するTotal Facial Reanimation (TFR) の考え方．形成外科 49：373−382, 2006
3) 村田清高：顔面神経麻痺後の異常連合運動．JOHNS 16：331−334, 2000
4) Brach JS, VanSwearingen JM, Lenert J, et al : Facial neuromuscular retraining for oral synkinesis. Plast Reconstr Surg 99 : 1922−1931, 1997
5) Rogers CR, Schmidt KL, VanSwearingen JM, et al : Automated facial image analysis ; Detecting improvement in abnormal facial movement after treatment with botulinum toxin A. Ann Plast Surg 58 : 39−47, 2007
6) Guerrissi JO : Selective myectomy for postparetic facial synkinesis. Plast Reconstr Surg 87 : 459−466, 1991
7) Nakamura K, Murakami T, Kozawa T, et al : Surgical treatment of synkinesis. Eur Arch Otolaryngol : S 380−S 382, 1994
8) Montserrat L, Benito M : Facial synkinesis and aberrant regeneration of facial nerve. Advances in Neurology, edited by Jankovic J, et al, pp148−155, Ravan Press, New York, 1988
9) Nacimiento W, Podoll K, Graeber MB, et al : Contralateral early blink reflex in patients with facial nerve palsy ; Indication for synaptic reorganization in the facial nucleus during regeneration. J Neurol Sci 109 : 148−155, 1992
10) Graeber MB, Bise K, Mehraein P : Synaptic stripping in the human facial nucleus. Acta Neuropathol 86 : 179−181, 1993
11) Moran CJ, Neely G : Patterns of facial nerve synkinesis. Laryngoscope 106 : 1491−1496, 1996
12) 福田慶三，中西雄二：トータルリフト．PEPARS 8：77−83, 2006
13) Rohrich RJ, Pessa JE : The retaining system of the face ; Histologic evaluation of the septal boundaries of the subcutaneous fat compartments. Plast Reconstr Surg 121 : 1804−1809, 2008
14) Lowe JB 3rd, Cohen M, Hunter DA, et al : Analysis of the nerve branches to the orbicularis oculi muscle of the lower eyelid in fresh cadavers. Plast Reconstr Surg 116 : 1743−1749, 2005
15) Freilinger G, Gruber H, Happak W, et al : Surgical anatomy of the mimic muscle system and the facial nerve ; Importance for reconstructive and aesthetic surgery. Plast Reconstr Surg 80 : 686−690, 1987
16) Mendelson BC, Muzaffar AR, Adams WP : Surgical anatomy of the midcheek and malar mounds. Plast Reconstr Surg 110 : 885−896, 2002
17) Rose EH : Autogenous fascia lata grafts ; Clinical applications in reanimation of the totally or partially paralyzed face. Plast Reconstr Surg 116 : 20, 2005
18) Horlock N, Sanders R, Harrison D : The SOOF lift ; Its role in correcting midfacial and lower facial asymmetry in patients with partial facial palsy. Plast Reconstr Surg 109 : 839, 2002
19) Harii K, Asato H, Yoshimura K, et al : One-stage transfer of the latissimus dorsi muscle for reanimation of a paralyzed face ; A new alternative. Plast Reconstr Surg 102 : 941, 1998

ABSTRACT

The Role of Face-Lifting in the Treatment of Facial Paralysis

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Acute unilateral facial paralysis such as Bell's palsy and Hunt syndrome is mostly a benign neurologic condition that mostly resolves in a few months. However, incomplete return of facial motor function continues to be long-term sequela in a percentage of patients. Patients with incomplete facial paralysis sometimes endure and adapt to cosmetic sequelae

rather than functional problems such as lagophthalmos. There is a narrow palpebral fissure and deep nasolabial fold at rest, both of which are probably caused by muscle contracture producing facial asymmetry. Synkinesis, which mainly includes involuntary closure of the eyes while whistling or smiling, is always a big annoyance to patients. To overcome these problems, we employ face lifting to acquire facial symmetry. Furthermore, to reduce aberrant movements of the facial muscles, we use selective neurectomy and myectomy. The purpose of this paper is to present our surgical techniques and results of treatment of incompletely paralyzed face.

By a face lift incision, a cheek pocket is created and the pars orbitalis of the orbicularis oculi muscle in the lateral orbital rim region where the zygomatic branches run through is dissected. A small volume of orbicularis oculi muscle including the zygomatic branches is then resected. Since a slight drooping of the cheek is seen in most patients, cheek skin is lifted up by fixing the SMAS plane upwards. In case of patients whose nasolabial fold is rather deep, a subcutaneous plane is cut by a steel wire with lipoinjection to make the nasolabial fold shallow and inconspicuous.

Synkinetic movement was reduced in most cases, and an additional face lift operation and the use of steel wire improved the cosmetic results.

The results of cosmetic approaches in the treatment of incomplete facial paralysis were encouraging. However, the rate of recurrence of synkinetic movement in a long follow-up period is unknown, although aberrant movements were reduced in most cases about one year postoperatively.

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Availability of Latissimus Dorsi Minigraft in Smile Reconstruction for Incomplete Facial Paralysis: Quantitative Assessment Based on the Optical Flow Method

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Background: Acute unilateral facial paralysis, such as occurs in Bell palsy and Hunt syndrome, is mostly a benign neurologic morbidity that resolves within a few months. However, incomplete or misdirected return of the affected nerve results in unfavorable cosmetic sequelae in some patients. Although functional problems such as lagophthalmos are rare, facial asymmetry on smiling resulting from a lack of mimetic muscle strength in the cheek is often psychologically annoying to patients.
Methods: To obtain a more natural smile, the authors transfer latissimus dorsi muscle to assist in cheek movement. A small, thinned muscle (mini–latissimus dorsi) is sufficient for transplant in this situation. In this study, 96 patients with incomplete facial paralysis who underwent mini–latissimus dorsi transfer were examined. In this series, along with evaluation using the grading scale used in previous reports, preoperative and postoperative videos of 30 patients were analyzed for quantitative assessment using newly developed computer software.
Results: Temporary deterioration of paralysis was recognized in three cases but did not last more than a few months. Signs of transferred muscle contraction were recorded after 4 to 12 months among 91 patients. No apparent clinical signs of contraction were recognized in one patient, and four patients could not be followed postoperatively. The synchronized ratio of vertical movement and the symmetrical ratio of horizontal movement both in the cheek and in the lower lip between healthy and paralyzed sides among 30 patients were statistically improved.
Conclusions: Statistical analysis using newly developed computer software revealed that a more symmetrical smile can be achieved by muscle transfer among patients with incomplete facial paralysis. Mini–latissimus dorsi transfer can avoid postoperative muscle bulkiness of the cheek and can achieve more natural cheek movement. (*Plast. Reconstr. Surg.* 123: 1198, 2009.)

Acute unilateral facial paralysis, such as occurs in Bell palsy and Ramsay Hunt syndrome, is mostly a benign neurologic morbidity that resolves within a few months. However, incomplete or misdirected return of the affected nerve results in unfavorable cosmetic sequelae in some patients. Although functional problems such as lagophthalmos are rare, these patients often demonstrate poor static position of the mouth, with weak cheek movements. Unnatural synkinetic movements also cause great stress to pa-

Disclosure: *None of the authors has any financial interests to disclose.*

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Received for publication April 30, 2008; accepted October 10, 2008.
Presented at the 8th Korea-Japan Congress of Plastic and Reconstructive Surgery, in Jeju, Korea, June 1 through 3, 2006.

DOI: 10.1097/PRS.0b013e31819e2606

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tients. Methods to improve static appearance include plication of the sagging facial muscles[1] and subperiosteal midface lift.[2] Although these procedures improve static facial appearance, cheek asymmetry on smiling has frequently been overlooked in the treatment of incomplete facial paralysis, probably because neither good treatment modalities nor methods of evaluation have been developed.

We have been transferring the neurovascular latissimus dorsi muscle in one stage for the treatment of facial paralysis.[3–5] In this method, the thoracodorsal nerve of the latissimus dorsi was crossed through the upper lip and sutured to a contralateral facial nerve branch in one operation. Therefore, the shorter period of recovery from the paralysis is advantageous, compared with the two-stage method, in which free-muscle transfer is combined with cross-face nerve grafting. This may also have a role to play in patients with incomplete paralysis. In this situation, the latissimus dorsi works to assist the original cheek movement. A small, thinned muscle (mini–latissimus dorsi) is thus sufficient for transplant. This manipulation avoids the overpowered, bulky cheek seen when a large-volume muscle is transferred. The present study examined 96 patients with incomplete facial paralysis who underwent mini–latissimus dorsi transfer.

To evaluate the results of neurovascular free muscle transfer, we have been using the grading scale originally developed by Harii et al.[5,6] Clinical and electromyographic findings are combined to create the grading in this system. The results of all 96 patients were evaluated according to this system. However, patients with incomplete paralysis display rather symmetrical facial movements compared with those with complete facial paralysis, resulting in a relatively high score even before muscle transfer. Accurate quantification of improvements following muscle transfer thus cannot be evaluated using this grading system in patients with incomplete paralysis, as no preoperative values are given for comparison. Thus, along with the classic grading evaluation method, the present study analyzed preoperative and postoperative videos of 30 patients for quantitative assessment by the optical flow method using recently developed software [Facial Expression and Motion Analysis System-1 (FEMAS-1); MEL Co., Japan] to clarify the precise degree of facial movement.[7] Improvements in facial symmetry by mini–latissimus dorsi transfer could be evaluated with this software.

PATIENTS AND METHODS

Between May of 1995 and August of 2006, mini–latissimus dorsi transfer was performed for 96 patients with incomplete facial paralysis by the authors (Table 1). Mean patient age at the time of muscle transfer was 37.8 years (range, 5 to 70 years). Ancillary procedures included temporal muscle transfer for eyelid closure (n = 11), lid loading using a gold plate for the upper eyelid (n = 9), eyebrow lift (n = 34), and face lift on the healthy side (n = 3). The recipient vessels were facial vessels in 87 patients, superficial temporal vessels in seven patients, and superior thyroid artery and external vein in two patients. The motor nerve was the contralateral facial nerve branches in all patients.

The usual neurovascular muscle transfer in the treatment of complete facial paralysis improves not only cosmetic appearance but also functional problems such as speech difficulties and drooling. However, such problems are rare among patients with incomplete facial paralysis. More refined operative techniques are thus required, as the aim of this type of treatment is rather cosmetically oriented. The operative procedure for mini–latissimus dorsi transfer is almost the same as that described in previous reports.[5] Some exceptional points are as follows. First, the facial nerve that has partially recovered must not be damaged when dissecting the subcutaneous plane for the pocket of the muscle. Second, to obtain a more natural smile, a relatively small segment of the latissimus dorsi muscle is transferred into the paralyzed cheek to avoid cheek protrusion from an overpowered, bulky transfer. The muscle segment required in the usual setting for a completely paralyzed face is approximately 3 to 4 cm wide, 8 to 10 cm long, and more

Table 1. Cause of Incomplete Facial Paralysis

Cause	No.
Congenital	31
Bell palsy	26
Acoustic tumor	12
Viral infection	9
Parotidectomy	7
Trauma	4
Mastoidectomy	3
Brain tumor	2
Mandibulectomy	1
Unknown	1
Total	96

than 1 cm thick. The mini–latissimus dorsi is approximately the same length and perhaps slightly smaller in width, but thickness is almost the half that in the usual graft.

Statistical Analysis

Results for all 96 patients were evaluated at the clinical site by one of us (K.H.) according to the grading scale in Table 2. However, the preoperative extent of partial recovery of the facial nerve varied among patients with incomplete paralysis. Quantitative and objective assessment is thus required for evaluation of the mini–latissimus dorsi. In this series, facial movements were assessed by the first author (A.T.) using FEMAS-1 software, which presents the degree of precise movements in the face. With this software, facial movements can be analyzed by depicting optical flows that indicate apparent velocities of moving objects in consecutive image sequences (Fig. 1).[7] To calculate the optical flow, the gradient method was used. This method is based on a concept that the flow velocity has two components, including an image brightness gradient and smoothness. This two-constraints concept enables calculation of the optical flow without any distinct landmarks. To validate the accuracy of this method, the scores achieved by FEMAS-1 were compared with those achieved by the pattern-matching method.[8] As a result, high correlation between the two methods was obtained. The correlation was also studied between the optical flow index and the score of Yanagihara's 40-point grading scale because this software was originally developed to evaluate the extent of recovery of facial paralysis.[7] The correlation was very high within normal healthy subjects and patients with facial nerve palsy. With the validity of this method, FEMAS-1 was then applied to evaluate the effectiveness of mini–latissimus dorsi transfer.

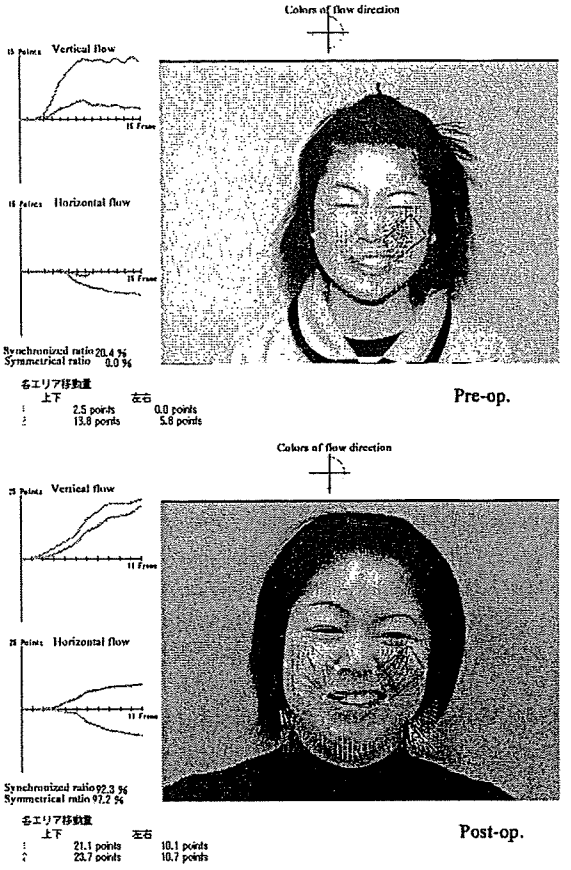

Fig. 1. Optical flows of preoperative and postoperative cheek surrounded by the rectangular area in case 3. *Green line graphs* indicate the vertical and horizontal flow of the left (healthy) side. *Red line graphs* indicate the vertical and horizontal flow of the right (paralyzed) side. The synchronized ratio in the vertical direction between the cheeks improved from 20.4 percent to 92.3 percent. The symmetrical ratio in the horizontal direction improved from 0 percent to 97.2 percent.

In the treatment of facial paralysis, symmetry of facial movements is more important than movement of the transferred muscle itself.[9,10] The FEMAS-1 software can analyze synchronized ratio (percent)

Table 2. Evaluation Criteria

Grade	Description
5	Symmetric balance and good facial tone at rest; sufficient muscle power on voluntary contraction; synchronous and natural expression on emotional facial movements, especially on smiling; EMG demonstrating relatively high amplitudes with full interference patterns and high evoked potentials obtained on stimulation of the contralateral facial nerve
4	Symmetric balance and good facial tone at rest; active muscle contraction acquired but not sufficiently synchronous (too strong or slightly weak)
3	Symmetric balance and good facial tone at rest; insufficient contraction of the muscle; low volitional EMG spikes with discrete interference patterns
2	Reduced symmetric balance on smiling; no effective contraction of the muscle; EMG with no interference patterns
1	No correction; electrically silent EMG
0	No follow-up

EMG, electromyography.

in the vertical direction and symmetrical ratio (percent) in the horizontal direction for the selected area. We selected the cheek and lower lip area for quantitative evaluation of the mini–latissimus dorsi. Thirty patients for whom facial videos could be recorded both preoperatively and postoperatively were evaluated using this approach. The paired *t* test was used to analyze differences between preoperative and postoperative symmetrical ratio.

RESULTS

(**See Video, Supplemental Digital Content 1,** which displays a 27-year-old woman with a left incomplete paralysis, ***http://links.lww.com/A774.*** Movement of the left modiolus is improved.)

(**See Video, Supplemental Digital Content 2,** which displays a 7-year-old boy with a congenital left incomplete facial paralysis, ***http://links.lww.com/A775.*** Movement of the cheek is improved.)

(**See Video, Supplemental Digital Content 3,** which displays a 20-year-old woman with a right incomplete paralysis, ***http://links.lww.com/A776.*** Movement of the left modiolus is improved.)

Four patients had hematomas in the cheek pocket postoperatively, and surgical treatment was required in one patient. One donor site was infected, which healed with conservative treatment. Two patients and one patient had radial and ulnar nerve temporary paralysis, respectively. Slight deterioration of incomplete facial paralysis was temporarily recognized in three cases. However, this did not last more than a few months. The first signs of reinnervation that were confirmed as transferred muscle contraction by the patient and authors were recorded after 4 to 12 months among 91 patients. Clinical symptoms that indicated transferred muscle contraction could not be recognized in one patient. Results according to the grading scale, which were evaluated at least 6 months after the muscle movement was recognized, were as follows: grade 5 in 65 patients, grade 4 in 23 patients, grade 3 in three patients, grade 2 in one patient, and grade 0 in four patients. Representative cases for these results are shown in Figures 2 through 4.

Five patients underwent debulking of the transferred muscle and one patient had fascial graft to the lower lip for lip elevation as a revisional operation. These patients and the patient in whom muscle contraction was not recognized were excluded from video analysis.

Assessment of Functional Improvement by Video Analysis

Scores indicate the synchronized ratio of vertical flow and the symmetrical ratio of horizontal flow. Thus, minus scores in the synchronized ratio of vertical flow indicate the movement is reverse between the left and right face, and minus scores in the symmetrical ratio of horizontal flow indicate the left and right face move to the same direction.

Mean ± SD synchronized ratio of vertical flow between healthy and paralyzed cheeks among the 30 patients was 18.1 ± 31.2 preoperatively and 57.2 ± 28.4 postoperatively. The standard deviations of the measured ratios are very large because the extent of facial movements varies among the patients with incomplete facial paralysis. Statistical analysis revealed significant improvements in the synchronized ratio of vertical flow in the cheek ($p < 0.001$) (Fig. 5).

The mean symmetrical ratio of horizontal flow between healthy and paralyzed cheeks was 5.3 ± 37.2 preoperatively and 40.4 ± 45.6 postoperatively. The symmetrical ratio of horizontal flow in the cheek was improved significantly ($p < 0.001$) (Fig. 6).

The mean synchronized ratio of vertical flow between the healthy lip and the paralyzed lower lip among 30 patients was 24.2 ± 43.8 preoperatively and 41.9 ± 36.6 postoperatively. The synchronized ratio of vertical flow in the lower lip was improved significantly ($p < 0.05$) (Fig. 7).

The mean symmetrical ratio of horizontal flow between the healthy lip and the paralyzed lower lip was 37.2 ± 42.5 preoperatively and 45.6 ± 39.9 postoperatively. The symmetrical ratio of horizontal flow in the lower lip was improved significantly ($p < 0.05$) (Fig. 8).

DISCUSSION

The goal of treatment for incomplete facial paralysis is to obtain facial symmetry as natural as possible in the resting position and spontaneous synchronous animation. Although the extent of facial nerve paralysis varies among incompletely recovered patients, asymmetric static position of the modiolus and weak facial movement caused by the lack of facial muscle strength is often recognized. In static control, suspension using autogenous fascia[11] or implants such as Gore-Tex (W. L.

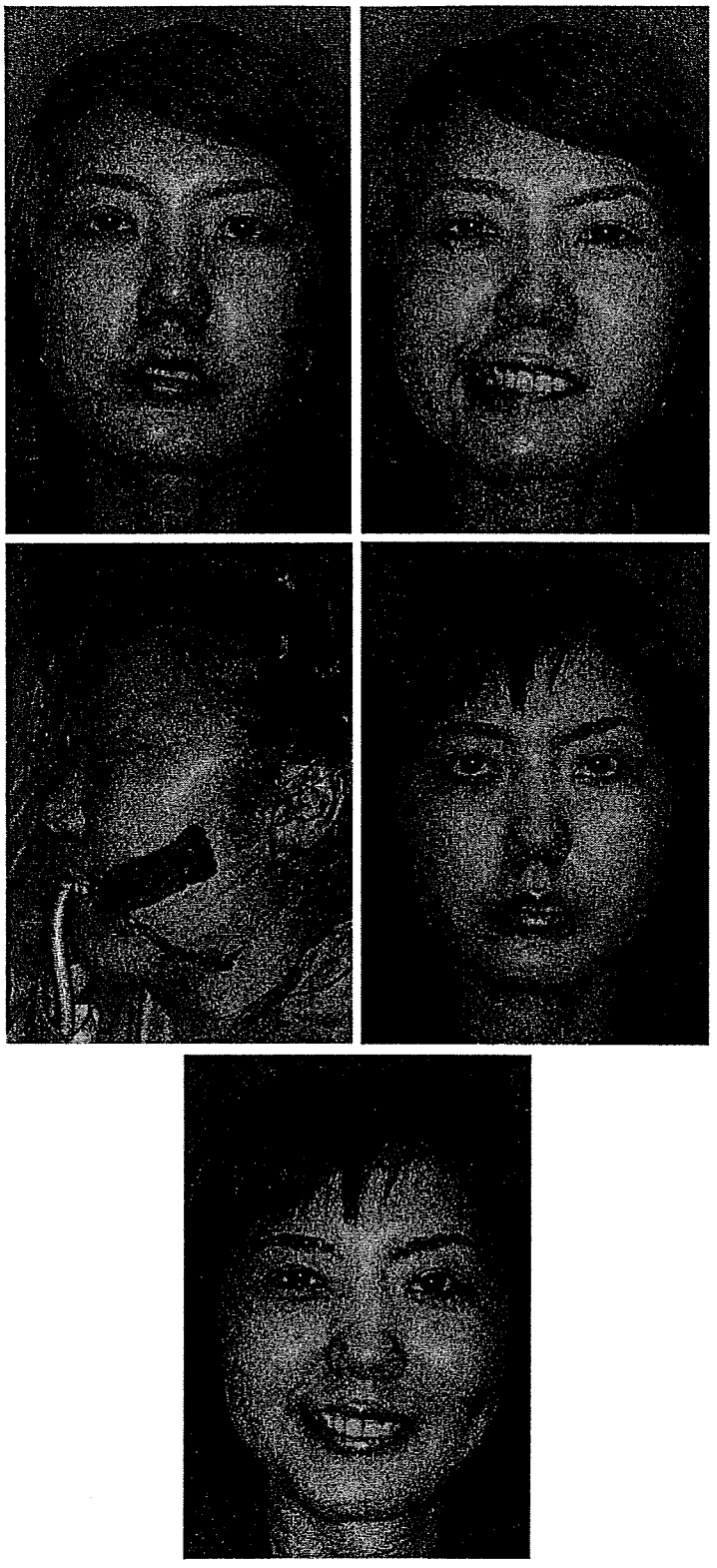

Fig. 2. (*Above, left*) Photograph of the patient in case 1, a 27-year-old woman with left incomplete paralysis following removal of an acoustic neurinoma seen preoperatively at rest. (*Above, right*) Photograph of the same patient smiling, with slight asymmetry of the cheeks. (*Center, left*) A mini–latissimus dorsi is transferred. The thickness of the mini–latissimus

Gore & Associates, Flagstaff, Ariz.)[12] and percutaneous sutures[13] offers a relatively easy method of treatment. Muscle shortening or plication is another way to reposition tissues that have fallen downward. Rubin et al. described shortening by partial excision of the weakened zygomatic major and lateral aspect of the levator labii superioris muscle.[1] Horlock et al. reported five patients who underwent subperiosteal midfacial suspension.[2] Although Rubin et al. suggested that muscle shortening contributes to increased muscle contraction, Horlock et al. disagreed with this concept. The idea that the already contracted and atrophied facial muscles might be strengthened by shortening or repositioning is difficult to believe.

Unlike these methods, Frey et al. recently reported seven patients treated by an original method for both static and dynamic improvement.[10] In their method, cross-face nerve is grafted between the paralyzed and nonparalyzed facial nerve branches. An innovative technique is that the distal end of the nerve graft is sutured end-to-side to the facial nerve branch on the incompletely paralyzed side to avoid damage to partially recovered facial nerves. Improvements in facial movement are well demonstrated on three-dimensional video analysis. However, obtaining facial symmetry may not be easy when the patient shows a big smile, because reinforcing sufficient power to the already atrophied muscle is difficult. In this situation, the authors noted that the neurovascular free muscle should also be transferred using the grafted nerve as the recipient nerve. These procedures are reasonable when a two-stage method combining muscle transfer with cross-face nerve grafting is the only method and no one-stage neurovascular free muscle transfer enabled by harvesting a long nerve has been developed. In fact, some surgeons have reported cases of incomplete paralysis treated by two-stage methods combining muscle transfer with cross-face nerve grafting.[14–16] They concluded that the combination of cross-face nerve grafting and muscle transfer improved dynamic movement of the cheek. However, one-stage transfer using the various muscles is developing and becoming the first choice, especially among Asian surgeons.[3,4,17–19] Muscle transfer is more time consuming and labor intensive than cross-face nerve grafting but offers an assured method with which to obtain sufficient power in the cheek to achieve a symmetrical smile. We thus believe that one-stage muscle transfer is better than cross-face nerve graft with or without muscle transfer.

In the first stage of this series, we were worried about causing damage to the incompletely recovered facial nerve by subcutaneous dissection for the muscle pocket. Some thin facial nerve branches can be seen subcutaneously during dissection, particularly proximal to the nasolabial fold. However, experience has taught us that careful dissection can avoid deterioration of incomplete paralysis. Slight deterioration of facial movement in the cheek was temporarily recognized in three cases but did not last more than a few months. This deterioration was probably not caused by damage to the facial nerve but more likely was attributable to swelling in the cheek.

In previous reports, 183 of 468 patients (39.1 percent) who underwent neurovascular muscle transfer have received revisional operations, including attachment revision in the nasolabial fold line, debulking of the cheek, and fascia graft.[20] Conversely, only five patients required debulking of the transferred muscle and one patient had fascial graft to the lower lip for lip elevation in this series. No patients so far have required revision of the nasolabial fold line. This is because the nasolabial fold is almost natural or rather deep among patients with incomplete paralysis. Patients can thus expect improvement from a one-time operation. This is advantageous to other surgical procedures for the treatment of incomplete facial paralysis.

The lack of a generally accepted grading system for facial paralysis has been problematic. The best known and most widely used system is the House-Brackmann system.[21] However, these systems, including the Sydney[22] and Sunnybrook[23] systems, evaluate total facial function and cannot be precisely applied to evaluate neurovascular muscle transfer. Reconstructive surgeons thus use originally developed grading systems.[15,16] We have been using our own grading system since around the first development of neurovascular muscle transfer.[6,24] Almost all of these systems are rather objective analytical methods, at least in the evaluation of complete paralysis but not in quantitative assessments, particularly in the evalua-

Fig. 2. (*Continued*) dorsi is approximately 7 mm. (*Center, right*) Photograph obtained 1 year after the mini–latissimus dorsi transfer at rest. (*Below*) Good results (grade 5) are obtained. The synchronized ratio of the vertical flow and the symmetrical ratio of the horizontal flow between the cheeks improved from 49.9 percent to 92.8 percent and from 25.0 percent to 59.5 percent, respectively. The synchronized ratio of the vertical flow and the symmetrical ratio of the horizontal flow between the lower lips improved from 47.9 percent to 76.5 percent and from −9.3 percent to 4.6 percent, respectively.

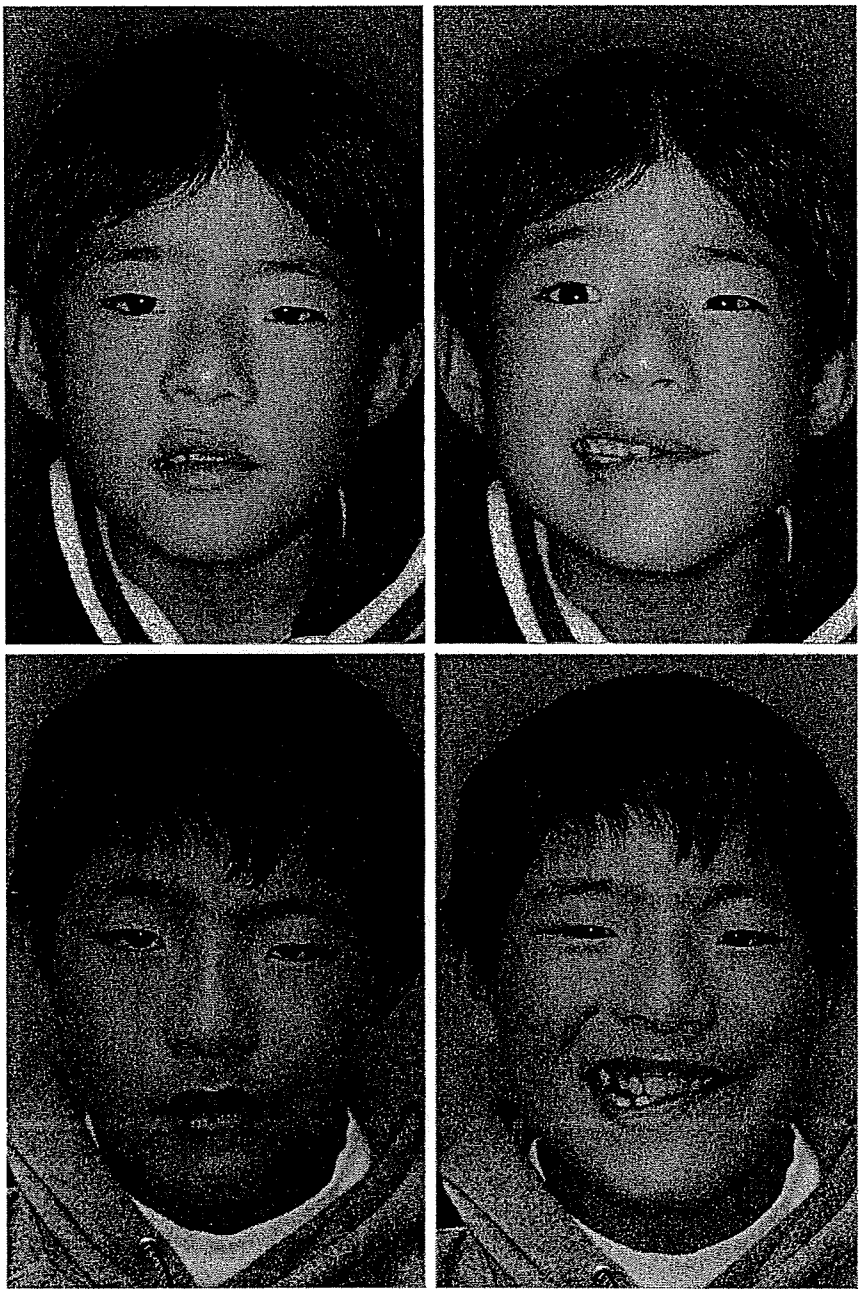

Fig. 3. (*Above, left*) Photograph of patient 2, a 7-year-old boy with a congenital left incomplete facial paralysis seen preoperatively at rest. (*Above, right*) The same patient smiling preoperatively with diminished movement of the cheek. (*Below, left*) Photograph obtained 3 years after a mini–latissimus dorsi transfer seen at rest. (*Below, right*) Good results (grade 5) were obtained. The synchronized ratio of the vertical flow and the symmetrical ratio of the horizontal flow between the cheeks improved from 36.8 percent to 69.2 percent and from 5.3 percent to 48.2 percent, respectively. The synchronized ratio of the vertical flow and the symmetrical ratio of the horizontal flow between the lower lips improved from −2.0 percent to 41.3 percent and from −75.8 percent to 0 percent, respectively.

Fig. 4. (*Above, left*) Photograph of patient 3, a 20-year-old woman with right incomplete paralysis caused by ablative surgery in the parotid area seen preoperatively at rest. (*Above, right*) Photograph of the same patient smiling, with an impaired elevation of the right nasolabial fold. (*Below, left*) Photograph obtained 4 years after a mini–latissimus dorsi transfer at rest. (*Below, right*) The patient was graded as 5. The synchronized ratio of the vertical flow and the symmetrical ratio of the horizontal flow between the cheeks improved from 20.4 percent to 92.3 percent and from 0 percent to 97.2 percent, respectively. The synchronized ratio of the vertical flow and the symmetrical ratio of the horizontal flow between the lower lips improved from 42.9 percent to 68.3 percent and from 12.0 percent to 67.4 percent, respectively.

tion of incomplete facial paralysis. To overcome this problem, new techniques using videotapes for quantitative analysis have been developed. Although various methods have been reported,[25–27] many require placement of marking dots and identification of marker positions in multiple frames of video sequences.[9,10,28] These methods are thus not widely accepted. Conversely, Wachtman et al. reported a

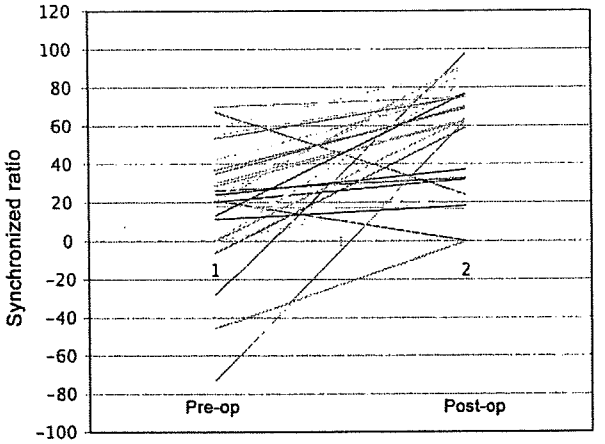

Fig. 5. The preoperative synchronized ratio of the vertical flow between the healthy cheek and the paralyzed cheek ranged from −72.9 to 58.9, with an average ±SD of 18.1 ± 31.2. The postoperative ratio ranged from 0 to 97.7, with an average ±SD of 57.2 ± 28.4. A significant improvement ($p < 0.001$) by the mini–latissimus dorsi graft was observed.

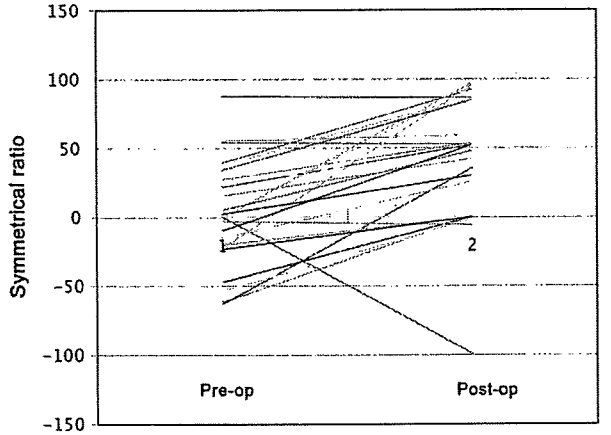

Fig. 6. The preoperative symmetrical ratio of the horizontal flow between the healthy cheek and the paralyzed cheek ranged from −62.7 to 87.7, with an average ±SD of 5.3 ± 37.2. The postoperative ratio ranged from −99.5 to 95.6, with an average ±SD of 40.4 ± 45.6. A significant improvement ($p < 0.001$) by the mini–latissimus dorsi graft was observed.

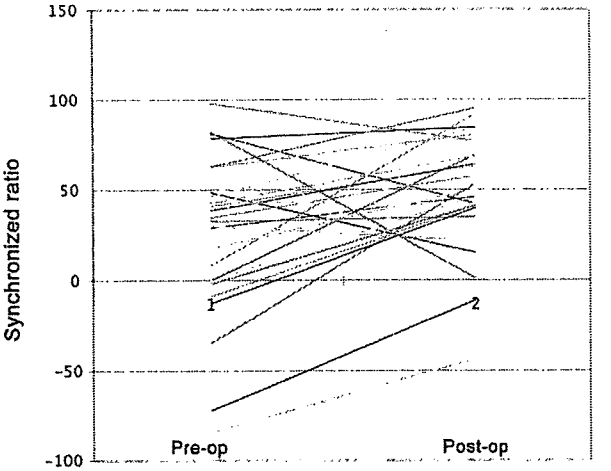

Fig. 7. The preoperative synchronized ratio of the vertical flow between the healthy lip and the paralyzed lower lip ranged from −84.4 to 97.8, with an average ±SD of 24.2 ± 43.8. The postoperative ratio ranged from −43.6 to 95.1, with an average ±SD of 41.9 ± 36.6. A significant improvement ($p < 0.05$) by the mini–latissimus dorsi graft was observed.

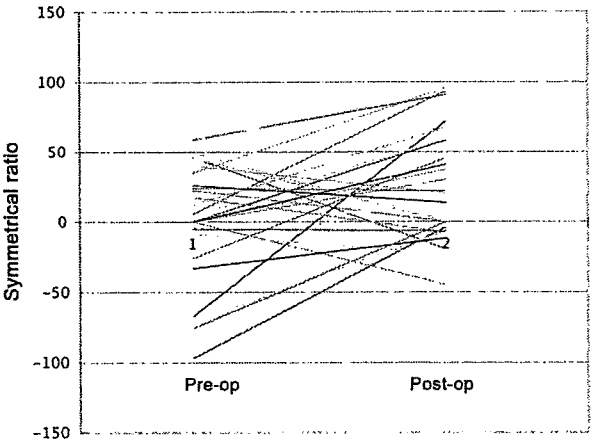

Fig. 8. The preoperative symmetrical ratio of the horizontal flow between the healthy lip and the paralyzed lower lip ranged from −96.9 to 63.8, with an average ±SD of 37.2 ± 42.5. The postoperative ratio ranged from −23.2 to 95.6, with an average ±SD of 45.6 ± 39.9. A significant improvement ($p < 0.05$) by the mini–latissimus dorsi graft was observed.

new method of automated face analysis, in which the magnitude and direction of facial motion can be tracked automatically by dense flow extraction.[29] They demonstrated the efficacy and validity of this analysis system by comparison with established manual marking methods. The FEMAS-1 software used in this series can quantitatively analyze facial movement by the optical flow method, similar to automated face analysis.[8] Because markings are not required, existing videotapes can be used for retrospective assessment. Furthermore, calibration for absolute measurement of facial movement is not necessary, as FEMAS-1 can obtain a symmetry index of facial movements using the right-to-left ratio. Dynamic symmetry is more important for smile reconstruction than absolute amplitude of the cheek as some surgeons have indicated.[9,10] FEMAS-1 was easy to use and very efficient for the evaluation of muscle transfer. Recently, three-dimensional objective methods using a complex mirror system have been developed to ac-

quire three different views of the face on a single video.[30] Future cases should be analyzed using this new system.

Improvements in synchronized and symmetric ratios in the cheek and lower lip area after muscle transfer were verified by statistical analysis. There were two patients whose results of vertical and horizontal movements of the cheek became worse postoperatively. Although the reason is unknown, one was the youngest patient (7 years old) and the other was the oldest patient (69 years old) in this video analysis series. Correct videos may not be able to be recorded for these patients, probably because of unstable head position. Cheek movement could be easily expected to improve, as the muscle was transferred into the cheek. However, contrary to our expectation, improvement of lower lip movement was also recognized. Although the accurate reason is unknown, our speculations are as follows. The direction of lower lip movement varied in each patient. In some patients, the lower lip on the healthy side moves superolaterally accompanied by cheek movement. Neurovascular muscle transfer may be effective in such patients. Conversely, muscle transfer may be ineffective for patients in whom the lower lip moves downward on smiling. Although improvement in the lower lip was recognized, individual data in Figures 7 and 8 were more variant than those in Figures 5 and 6. The results may show the difference of lower lip movement in the healthy side on smiling. In the future, patients in whom the lower lip moves downward on smiling may need another approach in addition to neurovascular muscle transfer into the cheek.

CONCLUSIONS

Problems associated with incompletely recovered facial paralysis are often poor static position of the mouth and weak cheek movements on smiling. We have been using one-stage mini–latissimus dorsi transfer for such patients. Statistical analysis by FEMAS-1 revealed that a more symmetrical smile can be achieved by muscle transfer.

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CODING PERSPECTIVE

This information prepared by Dr. Raymond Janevicius is intended to provide coding guidance.

15842 Graft for facial nerve paralysis; free muscle flap by microsurgical technique

- The procedure described is a one-stage reconstruction: The muscle flap is transferred, microvascular anastomoses are performed, and the throracodorsal nerve is connected to a contralateral facial nerve branch.
- CPT code 15842 is global and describes this entire procedure.
- Suture of the facial nerve (64864) is not separately reportable, as this is included in the global code 15842.
- Use of the operating microscope is included, so code 69990 is not separately reported.
- Although the CPT book descriptor indicates "Graft," code 15842 describes a free **flap.**
- Bilateral procedures are reported with modifier "-50." Some payers (including Medicare) require a one line entry:
  15842-50.
  Others require two lines:
  15842
  15842-50.

REFERENCES

1. Rubin LR, Lee GW, Simpson RL. Reanimation of the long-standing partial facial paralysis. *Plast Reconstr Surg.* 1986;77: 41–49.
2. Horlock N, Sanders R, Harrison D. The SOOF lift: Its role in correcting midfacial and lower facial asymmetry in patients with partial facial palsy. *Plast Reconstr Surg.* 2002;109:839–854.
3. Wang W, Chang T, Yang C, et al. Cross-face neurovascular latissimus dorsi for facial reanimating in one stage. *Chin J Microsurg.* 1989;12:155.
4. Wang W, Chang T, Yang C, et al. Ultra-long neurovascular pedicle segmental muscle flap transfer for facial reanimation in one stage. *Chin J Med.* 1992;72:681.
5. Harii K, Asato H, Yoshimura K, Sugawara K, Nakatsuka T, Ueda K. One-stage transfer of the latissimus dorsi muscle for reanimation of a paralyzed face: A new alternative. *Plast Reconstr Surg.* 1998;102:941–951.
6. Harii K. Microneurovascular free muscle transplantation for reanimation of facial paralysis. *Clin Plast Surg.* 1979;6:361–375.
7. Minamitani H, Hoshino Y, Hashimoto H, et al. Computerized diagnosis of facial nerve palsy based on optical flow analysis of facial expressions. In *Proceedings of the 25th Annual*

International Conference of the IEEE Engineering of Medicine and Biology Society, Cancun, Mexico; September 17–21, 2003:663.
8. Minamitani H, Iijima A, Kunihiro T. Diagnosis system for the quantitative assessment of facial nerve palsy based on the image analysis of facial movements. *J Jpn Soc Med Biol Eng.* 2003;41:87.
9. Bajaj-Luthra A, Mueller T, Johnson P. Quantitative analysis of facial motion components: Anatomic and nonanatomic motion in normal persons and in patients with complete facial paralysis. *Plast Reconstr Surg.* 1997;99:1894–1904.
10. Frey M, Giovanoli P, Michaelidou M. Functional upgrading of partially recovered facial palsy by cross-face nerve grafting with distal end-to-side neurorrhaphy. *Plast Reconstr Surg.* 2006;117:597–608.
11. Rose EH. Autogenous fascia lata grafts: Clinical applications in reanimation of the totally or partially paralyzed face. *Plast Reconstr Surg.* 2005;116:20–35.
12. Skourtis ME, Weber SM, Kriet JD, Girod DA, Tsue TT, Wax MK. Immediate Gore-Tex sling suspension for management of facial paralysis in head and neck extirpative surgery. *Otolaryngol Head Neck Surg.* 2007;137:228–232.
13. Alam D. Rehabilitation of long-standing facial nerve paralysis with percutaneous suture-based slings. *Arch Facial Plast Surg.* 2007;9:205–209.
14. Manktelow RT. Free-muscle transplantation for facial paralysis. *Clin Plast Surg.* 1984;11:215–220.
15. O'Brien BM, Pederson WC, Khazanchi RK, Morrison WA, MacLeod AM, Kumar V. Results of management of facial palsy with microvascular free-muscle transfer. *Plast Reconstr Surg.* 1990;86:12–24.
16. Terzis J, Noah M. Analysis of 100 cases of free-muscle transplantation for facial paralysis. *Plast Reconstr Surg.* 1997;99: 1905–1921.
17. Koshima I, Moriguchi T, Soeda S, Hamanaka T, Tanaka H, Ohta S. Free rectus femoris muscle transfer for one-stage reconstruction of established facial paralysis. *Plast Reconstr Surg.* 1994;94:421–430.
18. Kumar PA. Cross-face reanimation of the paralysed face, with a single stage microneurovascular gracilis transfer without nerve graft: A preliminary report. *Br J Plast Surg.* 1995;48:83–88.
19. Hayashi A, Maruyama Y. Neurovascularized free short head of the biceps femoris muscle transfer for one-stage reanimation of facial paralysis. *Plast Reconstr Surg.* 2005;115:394–405.
20. Takushima A, Harii K, Asato H, Momosawa A. Revisional operations improve results of neurovascular free muscle transfer for treatment of facial paralysis. *Plast Reconstr Surg.* 2005;116:371–380.
21. House J, Brackmann D. Facial nerve grading system. *Otolaryngol Head Neck Surg.* 1983;93:146–147.
22. Coulson S, Croxson G. Assessing physiotherapy rehabilitation outcomes following facial nerve paralysis. *Aust J Otolaryngol.* 1995;2:20–24.
23. Ross B, Fradet G, Nedzelski J. Development of a sensitive clinical facial grading system. *Otolaryngol Head Neck Surg.* 1996;114:380–386.
24. Ueda K, Harii K, Yamada A. Free neurovascular muscle transplantation for the treatment of facial paralysis using the hypoglossal nerve as a recipient motor source. *Plast Reconstr Surg.* 1994;94:808–817.
25. Neely JG, Cheung JY, Wood M, Byers J, Rogerson A. Computerized quantitative dynamic analysis of facial motion in the paralyzed and synkinetic face. *Am J Otol.* 1992;13:97–107.
26. Johnson P, Brown H, Kuzon WJ Jr, Balliet R, Garrison JL, Campbell J. Simultaneous quantitation of facial movements: The maximal static response assay of facial nerve function. *Plast Reconstr Surg.* 1994;32:171–179.
27. Frey M, Giovanoli P, Gerber H, Slameczka M, Stüssi E. Three-dimensional video analysis of facial movements: A new method to assess the quantity and quality of the smile. *Plast Reconstr Surg.* 1999;104:2032–2039.
28. Johnson PJ, Bajaj-Luthra A, Llull R, Johnson PC. Quantitative facial motion analysis after functional free muscle reanimation procedures. *Plast Reconstr Surg.* 1997;100:1710–1722.
29. Wachtman GS, Cohn JF, VanSwearingen JM, Manders EK. Automated tracking of facial features in patients with facial neuromuscular dysfunction. *Plast Reconstr Surg.* 2001; 107:1124–1133.
30. Tanaka I, Minamitani H. Three-dimensional video analysis of facial movements using optical flow. *Facial Nerve Res Jpn.* 2005;25:64.

JOHNS
特集○耳の奇形○

治　療

先天性顔面神経麻痺の外科的治療

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Key Words 顔面神経麻痺，第1・第2鰓弓症候群，マイクロサージャリー

はじめに

耳介は胎生5～6週に現れてくる第1鰓弓と第2鰓弓，ならびにその間に存在する第1鰓溝より発生する。したがって，先天的な耳介の変形が見られる際には，耳介以外の第1・第2鰓弓由来組織の異常を伴うことがしばしばある[1]。顔面神経は第2鰓弓由来の末梢神経であり，顔面神経の運動神経線維が分布する表情筋もまた，第2鰓弓由来の組織である[2]。このため，特に小耳症など重度の耳介変形が存在する場合には，先天性顔面神経麻痺（以後，先天性麻痺と略す）を合併していることがまれではない。特に，第1・第2鰓弓由来組織の器質的な異常を本態とする先天性疾患として知られているHemifacial microsomia（以下，HFMとする）は，顔面神経麻痺を25%[3]，あるいは45%[4]に合併するとの報告が見られる。一方，先天性麻痺としては，HFMのほかに，下顎縁枝の麻痺による下口唇麻痺だけが見られるものや，周産期の麻痺に至るまで種々の麻痺がある。

一般的に小児期の顔面神経麻痺は，安静時には麻痺が比較的目立たず，兎眼など大きな機能障害をもたらす可能性がある症状も軽度であるため，積極的な治療が行われない場合が多い。また，他の顔面奇形を伴う場合はそれらの治療が優先され，顔面神経麻痺の治療は後回しにされることが多い。しかし，先天性麻痺では頬部，あるいは下口唇の動きに乏しいことが多く，笑いの表情を作ることができないことが多い。また，患児が笑うことにより顔の歪みが目立つことを嫌がり，自ら"笑わなくなること"で表情の乏しい印象を与えることも多い。したがって，患児の社会性を発達させる上でも顔面神経麻痺の治療，特に笑いの再建は重要であると考えられる。

われわれは陳旧性顔面神経麻痺の患者に対して，神経血管柄付き遊離筋肉移植術（以後，単に遊離筋肉移植術）による笑いの再建を中心とした手術を行っているが，1990年半ばまでは主として交差神経移植と薄筋を組み合わせた二期的手術法を小児期の患者に対しても施行し，その有効性を報告してきた[5]。しかし，1995年，広背筋を用いた一期的再建術を開発し，それ以後は，小児に対しても同法を用いた再建を行ってきたので紹介する。

Ⅰ．手術適応および手術時期

先天性麻痺の患者は，思春期を過ぎるまで未治療である場合，笑うという感情表現をあまり行わず，いつも下を向いている傾向が見られる。これは完全麻痺の患者だけでなく，不全麻痺や部分麻痺の患者にも見られることであり，遊離筋肉移植術を行うことによって表情の改善が望めると判断されれば，積極的に手術を施行するべきとわれわれは考えている。このような無表情さは，多感な青少年期を顔面神経麻痺の状態で過ごした結果であると思われるため，この点からはできるだけ複雑な感情が発達する以前の早期の手術が望まれる。しかし，遊離筋肉移植術を小児期に行うに当たっては，いくつかの注意点に配慮する必要がある。

まず，広背筋を用いた一期的再建術を行う場合，大人であれば患側から移植床神経である健側

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図 1　遊離広背筋移植術
a：採取した広背筋を示す。健側の頬部にまで届く，長い神経が同時に採取されている。
b：健側の頬部においた切開から顔面神経分枝を露出したところを示す。
c：移植筋を頬部に置いたところ。この症例では小耳症を合併している（矢印）。

の顔面神経分枝にまで交差するのに十分な長さの胸背神経が採取できる[6]。しかし，小児は大人と比較して，顔面が体幹に対して大きいため，小児では移植神経の長さが不足することが考えられる。われわれは経験的に6歳以降であれば，十分な長さの神経を確保することができると考えており，他の合併異常がない場合には，小学校の低学年から積極的に筋肉移植を行っている。

他の合併異常を伴う場合，例えばHFMでは小耳症に対する肋軟骨移植術を行う時期は8歳以降まで待機することが多いが[7]，遊離筋肉移植術を先に行っても何ら問題はないと考えている[8]。ただし，顎変形に対する骨延長などによる硬組織の形成術を要する場合はこれを優先すべきであろう。

II．神経・血管柄付き遊離広背筋移植術（図1）

広背筋を用いた一期的再建の方法に関してはすでに詳述しているので[6,9]，先天性麻痺の患者に対する手術の注意点を中心に述べる。まず，先天性麻痺の患者においては顔面動静脈が低形成，ないしは欠損している可能性を考えておくべきである。特にHFMでは実際に顔面動脈の欠損により遊離皮弁移植の際に移植床血管を変更した報告[10]もある。また，われわれの経験では8例のHFMのうち，5症例において顔面静脈の低形成が見られ，2症例において選択血管の変更を余儀なくされた[8]。

顔面動静脈が使用できない場合は上甲状腺動脈と総顔面静脈，ないしは外・内頸静脈を使用することを考慮する。したがって，手術はまず移植床血管の確保を行うことから始める。これには，まず，患側下顎縁で下顎切痕を中心に約2 cmの切開より顔面動脈と静脈を露出するが，この両者あるいはいずれかが欠損しているか吻合に適さないほど未発達な場合には，前後に皮膚切開を延長して，先に述べた血管を移植床血管として確保する。

次に，耳前部の皮膚切開より広背筋弁を挿入するための皮下ポケットを頬部の皮下ポケットを作成する。さらに，健側の頬部耳下腺前縁の小切開より顔面神経分枝を剝離露出する。

顔面の準備と同時に，同側の側胸部より約3×8 cmの広背筋を採取する。広背筋の支配神経であ

図 2　症例（7歳，男性）
a：先天性麻痺（不全）による顔面非対称が見られる。
b：移植筋を置く位置のデザインを示す。
c：術後2年の状態を示す。

る胸背神経をできるだけ長く採取するために，近位側で腕神経叢の中にできるだけ胸背神経を剝離して行く。この操作で胸背神経は6歳以上であれば13から14 cmの長さ，すなわち対側の顔面神経分枝にまで届く距離を確保できる。両方の準備が整ったところで移植を行う。まず，胸背神経を患側の皮下ポケットから健側頬部の小切開まで通しながら，筋体の片方の断端を鼻唇溝部分の皮下に固定する。そして，神経と血管は顕微鏡下で縫合するが，どちらを先に行っても良い。最後に，筋体のもう片方の断端を頬骨弓部の皮下組織に固定し，ペンローズ・ドレーンを挿入して閉創する。一方のチームは，同時に胸部の皮膚切開部を閉創するが，ここには吸引ドレーンを入れておく。

Ⅲ．症例の提示

〔症例〕 7歳，男性（図2）。

先天性麻痺により，笑うと頬部の動きが悪いため顔面の非対称が目立っていた。7歳時に神経・血管柄付き遊離広背筋移植術を施行した。移植床血管は顔面動静脈を選択した。9歳時の状態では，笑った時に下口唇の軽度非対称は残っているが，鼻唇溝の動き（笑い表情）は良い。

Ⅳ．考　察

先天性麻痺の患者は，学童期に患児は顔面神経麻痺によって“笑えない”ことを意識し始め，下を向いたまま他者とのコミュニケーションを取るようになり，ついには笑うという動作を拒否するようになる[11]。われわれの経験した範囲では，早期に遊離筋肉移植術を行った場合，患児が他の正常児と同様に表情豊かに成長して行くことが確認され，また，移植筋の動きは成長に伴いより自然になる印象を受けた。したがって笑いの再建に関しては，早期の手術がよりよい結果を生じると考えている。

一方，“笑い表情”の再建術に関しては古くより種々の報告があるが，咀嚼筋を用いる方法は顔面骨の成長を阻害する可能性があり，さらに得られる表情も自然ではないという欠点があるため行うべきではないと考えられる[12]。成人と同様にやはり遊離筋肉移植術が第1選択となると思われるが，年齢の下限には制約がある。

まず，顕微鏡下で安全に血管吻合，神経縫合ができる年齢であるが，Freyら[12]は，4歳以上であれば遊離筋肉移植術が可能であるとしており，われわれも4歳の患者に薄筋を用いた二期的再建術を報告している[13]。Harrison[11]や，Zukerら[14]も，心理社会的には早期に笑いを獲得すべきであるため，就学前に遊離筋肉移植術をすべきであるとしている。しかし，広背筋を用いた一期的再建術を幼児期に行った場合，胸背神経が対側の顔面神経分枝にまで届かない可能性がある。

われわれは，小児に対する顔面交差神経移植と広背筋移植による二期的再建手術を比較し，6歳以降であれば採取できる胸背神経が対側にまで十分に届くことを確認している。6歳であれば就学期に相当するので，心理社会的にも麻痺が小児に

与える影響を最小限にすることができる。これらのことから，神経採取部である下腿に瘢痕や知覚麻痺を残すことになる二期的手術よりも，就学期以降に広背筋を用いた一期的手術を行う方がより良い選択であると考える。

小児に対して外科的手術を行う場合，手術部の成長が阻害される可能性が常に問題となる。Sinselらは家兎を用いた顔面への筋肉移植の実験で，移植後顔面骨の成長が阻害されたと報告している[15]。しかし，その論文に対してFreyは，成長障害は血管柄付きでない筋肉移植による瘢痕のためであって，臨床的に顔面骨の成長障害を経験したことはないと述べている。われわれ[13]も，移植筋が成長に伴って拘縮をきたしたり，成長を阻害することはなかったと報告している。したがって，神経・血管柄付き遊離筋肉移植によって顔面の成長障害が出現する可能性は現在のところあまり考慮する必要はないと思われる。

一方，先天性顔面神経麻痺の特徴は，下顎縁枝などの分枝に特化して麻痺が存在することが多い点である。われわれは，下口唇麻痺に対しても筋肉移植術を行ってきたが，まだ，症例数が少なく確実な結果を得るには至っていない。今後はこのような手術方法に対する検討も必要と思われる。

まとめ

先天性麻痺に対する再建術に関して述べた。小児期においては，兎眼など大きな機能障害をもたらす症状が軽度であるため，眉毛下垂，閉瞼不全に対しては，積極的な治療は必要がない場合が多い。しかし，笑った時の顔面の非対称は，両親，本人に精神的苦痛をもたらし，結果として患児はあまり笑うという感情表現をしなくなる傾向が強い。このため，就学期前後に神経・血管柄付き遊離筋肉移植術を用いた笑いの再建術を行うべきである。広背筋を用いた一期的手術を行う場合，採取できる神経の長さなどから，6歳以降であれば手術は可能であると考えられる。

文　献

1) Moore KL（星野一正：訳）：眼と耳．Moore人体発生学，第4版，410-429頁，医歯薬出版，東京，1990.
2) Moore KL（星野一正：訳）：鰓弓器官と頭頸部．Moore人体発生学，第4版，176-212頁，医歯薬出版，東京，1990.
3) Murray JE, Kaban LB, Mulliken JB：Analysis and treatment of hemifacial microsomia. Plast Reconstr Surg 74：186-199, 1984.
4) Vento AR, LaBrie RA, Mulliken JB：The O. M. E. N. S. classification of hemifacial microsomia. Cleft Palate Craniofac J 28：68-76, 1991.
5) Ueda K, Harii K, Asato H, et al：Neurovascular free muscle transfer combined with cross-face nerve grafting for the treatment of facial paralysis in children. Plast Reconstr Surg 101：1765-1773, 1998.
6) Harii K, Asato H, Yoshimura K, et al：One-stage transfer of the latissimus dorsi muscle for reanimation of a paralyzed face；A new alternative. Plast Reconstr Surg 102：941-951, 1998.
7) Nagata S：A new method of total reconstruction of the auricle for microtia. Plast Reconstr Surg 92：187-201, 1993.
8) Takushima A, Harii K, Asato H, et al：Neurovascular free-muscle transfer to treat facial paralysis associated with hemifacial microsomia. Plast Reconstr Surg 109：1219-1227, 2002.
9) 波利井清紀，朝戸裕貴，多久嶋亮彦：顔面神経麻痺の形成外科的治療．JOHNS 16（3）：444-449，2000.
10) Huntsman WT, Lineaweaver W, Ousterhout DK, et al：Recipient vessels for microvascular transplants in patients with hemifacial microsomia. J Craniofac Surg 3：187-189, 1992.
11) Harrison DH：Treatment of infants with facial palsy. Arch Dis Child 71：277-280, 1994.
12) Frey M, Giovanoli P, Tzou CH, et al：Dynamic reconstruction of eye closure by muscle transposition or functional muscle transplantation in facial palsy. Plast Reconstr Surg 114：865-875, 2004.
13) Ueda K, Harii K, Asato H, et al：Neurovascular free muscle transfer combined with cross-face nerve grafting for the treatment of facial paralysis in children. Plast Reconstr Surg 101：1765-1773, 1998.
14) Zuker RM, Goldberg CS, Manktelow RT：Facial animation in children with Mobius syndrome after segmental gracilis muscle transplant. Plast Reconstr Surg 106：1-8, 2000.
15) Sinsel NK, Guelinckx PJ, Opdebeeck H：The effect of muscle transplantation after unilateral partial facial paralysis on craniofacial growth and development；relationship between muscle and nerve histomorphometric findings. Plast Reconstr Surg 105：111-127, 2000.

5. 顔面軟部組織欠損の再建法

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The Japanese Journal of Plastic Surgery, Vol. 52, 増刊号, 2009
形成外科
第52巻 増刊号 別刷
克誠堂出版株式会社