Pectoralis Minor: A Unique Muscle for Correction of Facial Palsy

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The author introduced this muscle for the first time almost a decade ago, and this is the first extensive description of the intricate microanatomy of this complex but unique microneurovascular muscle unit. Advantages and disadvantages and indications and contraindications for its use in facial paralysis are presented in detail from an extensive clinical experience of almost 50 such microneurovascular transfers. Pitfalls that the reconstructive microsurgeon should beware and strengths in using this muscle for facial palsy are highlighted. The detailed operative approach is presented, with promise of undetectable scars and minimal functional loss. The strategies for how to inset this muscle unit in the new recipient site are given, along with the thought processes involved in selecting the actual sites of anchoring the muscle to reproduce a mirror image of the contralateral normal face. Finally, an exemplary clinical case demonstrating the use of the pectoralis minor muscle for both eye and lower face reanimation is presented in detail, demonstrating the dual nerve supply and the resulting independent eye and smile movements with total lack of mass action and/or synkinesis. Restorations of eye blink and of a symmetrical and coordinated smile are the frequent rewards of using this unique muscle for the correction of facial palsy.

In 1978, the idea of using the pectoralis minor muscle to address the needs of the chronically paralyzed face presented itself during the exploration of an infraclavicular brachial plexus. Our 4-year experimental work on the functional recovery of microsurgically transplanted free muscle had just been published,[1] and I was on the lookout for a muscle unit that could adequately substitute for the missing facial musculature. Microdissections of the pectoralis minor muscle in fresh cadavers showed that it was a feasible transfer, and in 1979 we proceeded with microreconstruction of our first clinical case of developmental facial paralysis. This was subsequently presented at the 1981 meeting of the International Society of Reconstructive Microsurgery in Guaruja, Brazil. In 1982, a brief report on this new anatomic unit was published with Manktelow as coauthor.[2] Up to that time, the gracilis[3] and the extensor digitorum brevis[4] were the reported muscle units under consideration for facial reanimation. The gracilis, when used as a whole unit, far exceeded the needs of the recipient site. Possibilities were there for its use only as a "minitransfer" based on specific vascular and neural territories. Despite this possibility and the easiness of its harvesting, the anatomic composition of the muscle, the direction and length of its muscle fibers, its bulk, and the sparcity of its innervation made it a second choice for facial reanimation work.

The second muscle under consideration was the extensor digitorum brevis, which had the ideal shape but lacked the bulk to produce adequate excursion subsequent to microneurovascular transfer.[5]

In contrast, the pectoralis minor seemed to have the best of both muscles, since it had an ideal shape, adequate bulk, and a dual nerve supply that allowed for independent movements of its upper and lower portions. These characteristics made this muscle a much more intelligent choice for substitution of the atrophied facial musculature.

Indications and Contraindications

The best indication for use of the pectoralis minor muscle flap is in developmental facial paralysis in young children. In a 4- or 5-year-old child, the dimensions of the muscle are ideal, i.e., 6 to 10 cm in length and 0.4 to 0.6 cm in width. In these patients, the muscle can be used in toto

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without thinning or shortening. The muscle also can be an ideal choice for adults, especially patients who are not athletic and have not built up the muscles of the upper torso through sports or exercise. Its use is not recommended in well-developed patients, especially weight lifters or swimmers, because of excessive bulk. In these patients, its use is not favored unless one is willing to proceed with substantial debulking.

A disadvantage of the pectoralis minor flap is that because of its deep position underneath the pectoralis major, debulking cannot be done easily while in situ. Thus one has to proceed with debulking after the muscle is harvested and prior to reestablishment of its blood supply through microvascular anastomoses with recipient vessels. This substantially increases the ischemic time, which can have functional repercussions. Another disadvantage is its short and complex neurovascular pedicle, which necessitates familiarity with the vascular and inaccessible neural networks of the infraclavicular region if one is to use this flap with safety.

A third disadvantage is the apparent variability in the dominant vascular supply. The vascular supply of the muscle can vary, and the surgeon should be prepared to make judgment calls intraoperatively on whether the lateral thoracic artery is of sufficient caliber to carry the whole muscle. If, for instance, the contributing branch from the thoracoacromial trunk is of large caliber, its severance may lead to duskiness of the upper portion of the pectoralis minor. In contrast, the nerve supply to the pectoralis minor is subject to minimal variations. The majority of the muscle (four-fifths) receives innervation from the medial pectoral nerve, while the most superior part of the muscle receives a tiny branch from the lateral pectoral nerve. Furthermore, another substantial branch of the lateral pectoral nerve destined to innervate the pectoralis major uses the pectoralis minor only as a throughway. Thus harvesting of the pectoralis minor necessitates taking that nerve (see Fig. 2, *left*). However, one does not need to lose these axons, and if one takes the time to redirect these fibers back to the pectoralis minor muscle, one can obtain additional innervation of the pectoralis minor through the process of direct neurotization.

Advantages include the following:

1. The donor-site morbidity is minimal and includes a small incision over the anterior axillary fold, an imperceptible loss of pectoralis major bulk, which, incidentally, is never appreciated by the patient but only by careful inspection of the upper thoracic area, and no reportable functional loss.
2. The muscle has an ideal form and shape; it is a flat muscle and is comprised of several slips that can be separated in a distoproximal fashion to appreciable length without fear of vascular and neural compromise.
3. The muscle has sufficient bulk to substitute for the lower face and can yield adequate excursion in the needed directions of pull.
4. If the hilus of the muscle is placed over the zygomatic arch, its slips of origin can be separated and fashioned to substitute not only for the zygomaticus major muscle but also for the elevators of the upper lip, as well as for the retractors of the commissure. Thus one can obtain a multidirectional pull that is ideal if the patient has a "canine" type of smile in the contralateral normal face.
5. Probably, the most important advantage is its dual innervation, which is a proof of the muscle's segmental origin during development. The upper third of the muscle is innervated by a branch of the lateral pectoral nerve, while the lower two-thirds receives its nerve supply from the medial pectoral nerve, which is an offshoot from the medial cord of the brachial plexus. This dual innervation allows for independent movements of the upper part quite separately from the lower part of the muscle. These separately moving muscle subunits can be used to advantage to address the separate needs of animation of the eye and the mouth, a quality not present in previously described muscle units.

Anatomy

The pectoralis minor is a flat, thin, triangular muscle situated beneath the pectoralis major. The muscle arises from the outer surfaces of the third, fourth, and fifth ribs near their costochondral junctions and from the fasciae covering the intercostal muscles. The fibers ascend upward and laterally and converge to form a flat tendon that inserts in the upper surface of the coracoid process of the scapula. Frequently there is an additional slip that originates from the second rib (Fig. 1).

The normal action of the muscle pulls the scapula forward and downward, assisting simul-

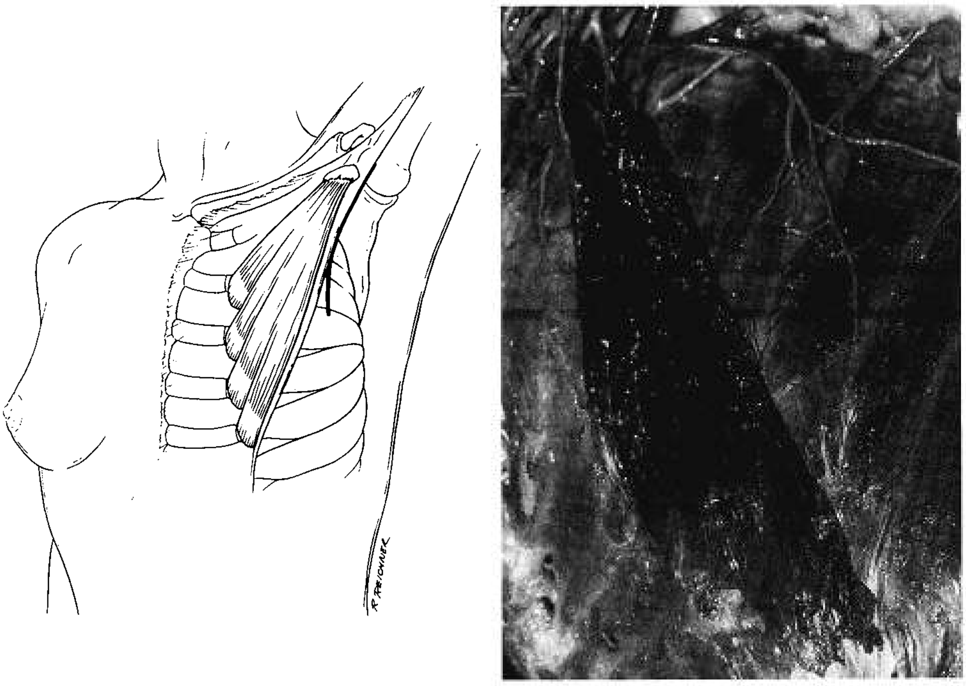

FIG. 1. (*Left*) Diagrammatic depiction of the location of the pectoralis minor on the anterior thorax showing the four slips of origin near the costal cartilages and the coracoid tendinous insertion. Note the heavy line over the anterior axillary fold, which signifies the incision for microsurgical harvesting of this muscle. (*Right*) Corresponding fresh dissection specimen showing the pectoralis minor exposed after removal of the pectoralis major muscle.

taneously in adduction of the arm by rotating the scapula. If the scapula is maintained in a fixed position by the levator scapulae, the pectoralis minor muscle raises the corresponding ribs in forced inspiration.

Blood Supply

There is great variability in the arterial supply of the pectoralis minor, with contributions received from three main sources: the lateral thoracic artery, the thoracoacromial artery, or directly from a branch of the axillary artery. The latter, infrequently encountered arterial source occurs when the contributions to the muscle from the other two arterial trunks are minimal. I have named this direct artery also the *lateral thoracic artery* because in the few clinical patients in whom I encountered a direct artery from the axillary to the pectoralis minor there was no visible contribution to the muscle by other arterial sources more inferiorly. As a matter of fact, in our original 10 dissections,[2] a separate branch from the axillary artery was never encountered.

However, by far the predominant vascular pattern is from branches of the lateral thoracic and/or the thoracoacromial arteries; the former passes around the lateral margin of the muscle after it has supplied it with a branch, while the latter passes around the medial margin of the muscle after it has sent an arterial branch usually to the superior part of the muscle (Fig. 2). One or the other branch is dominant, but in my clinical series far more frequently the dominant branch comes from the lateral thoracic artery (Fig. 3). When the two branches share the blood supply to the pectoralis minor, I have chosen to harvest the muscle on the lateral thoracic contribution. However, in these cases, the superior portion of the muscle was not as well perfused and appeared duskier.

There is also extensive variability in the venous drainage of this muscle. More often than not there is a separate vein that will drain the muscle adequately. However, in many cases one has to resort to one or the other venae comitantes because the direct vein is missing. If one is in doubt as to the dominant venous drainage, it is best to harvest all the available veins and observe under magnification which one best drains the muscle unit after the microvascular transfer.

Nerve Supply

The nerve supply to the pectoralis minor is multisegmental, receiving contributions from all

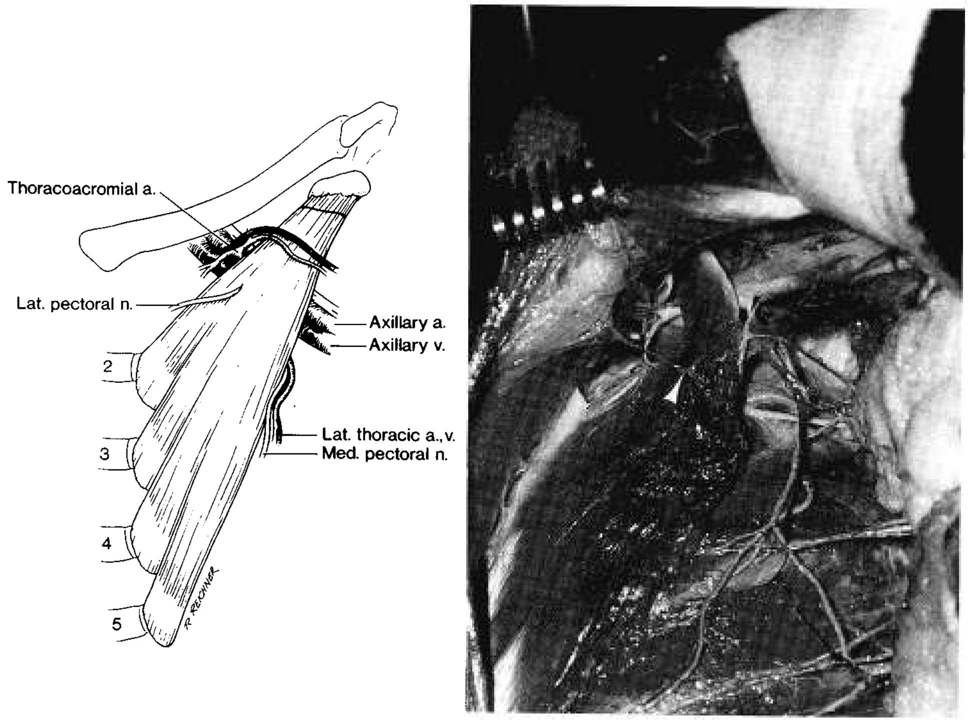

FIG. 2. (*Left*) Diagrammatic illustration of the left pectoralis minor in situ showing the two vascular pedicles, namely, the thoracoacromial and the lateral thoracic, as they emerge around the muscle medially and laterally after they have contributed their branches. Note the lateral pectoral branch that uses the pectoralis minor as a passageway in its journey to the undersurface of the pectoralis major. (*Right*) Fresh specimen showing the left pectoralis minor in situ. The pectoralis major is elevated with the retractor. Note the two arterial branches (*black arrows*), one emerging medially and one laterally, which contribute to the blood supply of this muscle. Note that the superior branch from the trunk is a small arterial twig. In this case, as in the majority of cases, one has to transfer the muscle on the branch from the lateral thoracic artery. Note also the branch from the lateral pectoral nerve (*white arrow*) as it pierces through the pectoralis minor to reach the undersurface of the pectoralis major.

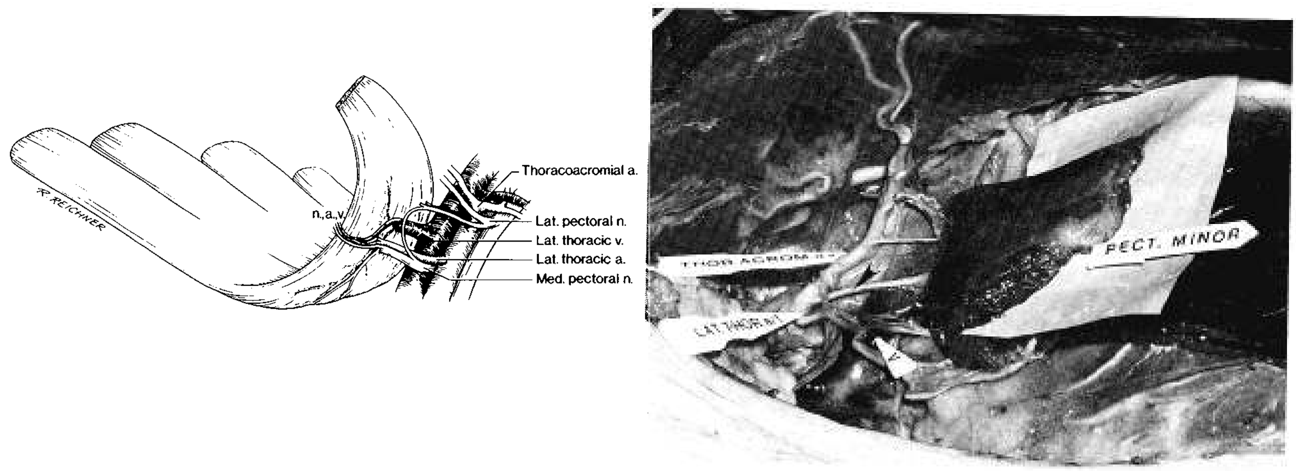

FIG. 3. (*Left*) Diagrammatic illustration of the exemplary vascular and neural patterns that supply the pectoralis minor muscle. Note that the arterial branch from the lateral thoracic artery is larger and enters the muscle more centrally. This artery is closely accompanied by the medial pectoral nerve, which is in all cases the predominant nerve supply to this muscle. The superior portion of the muscle, however, more frequently than not receives its innervation from contributions of the lateral pectoral nerve. Note the communicating loop between the medial and the lateral pectoral nerves that is a common occurrence. (*Right*) The right pectoralis minor is reflected toward its origin showing the hilar structures. Note the extensive vascular variability. In this specimen, the thoracoacromial and lateral thoracic arteries contribute two branches each to the pectoralis minor, a small and larger branch, for a total of four. Two are tiny twigs that enter the muscle at its margins. The other two branches are of larger caliber. Clinically, this muscle would have been transferred on the dominant artery (*arrow*) which in this case is a branch of the thoracoacromial trunk.

the five spinal nerves contributing to the brachial plexus, namely, C5, C6, C7, C8, and T1. Motor fibers from these spinal nerves reach the pectoralis minor through branches of two nerves: the lateral and medial pectoral nerves. By far the dominant innervation to the pectoralis minor is through the medial pectoral nerve, with contributions from C8 and T1 (Fig. 3, *left*). A major branch from this nerve is responsible in all cases for three-fourths or two-thirds of this muscle, depending on whether the muscle has three or four slips. Also constant is the innervation of the superior part of the pectoralis minor, which in all cases comes through a tiny branch from the lateral pectoral nerve. A larger lateral pectoral branch also penetrates the pectoralis minor, but it usually does not supply the muscle. Instead, it courses through it on its way to the pectoralis major (Figs. 2, *left*, and 3, *left*).

Contrary to the reported variability in the nerve supply of the pectoralis major,[6] the innervation of the pectoralis minor is relatively constant. Variations are limited to the presence or absence of the communicating loop with fiber exchange between the medial and lateral pectoral nerves.

In addition, it is worth mentioning that in two clinical cases of severe brachial plexus plexopathy with documented neuroradiologic and electrical findings of C8 and T1 avulsion, the inferior segment of the pectoralis minor responded to intraoperative electric stimulation, raising the possibility that perhaps some motor fibers from T2 may contribute to the innervation of this muscle.

The muscle's dual innervation makes the pectoralis minor a unique muscle for facial reanimation procedures because one can motor the upper leaves separately from the lower portion of the muscle. This unique characteristic allows for independent eye and mouth movements, which makes it one of the greatest advantages of using this muscle for facial muscle substitution.

Flap Design and Dimensions

In the adult, the individual slips of the pectoralis minor measure 10 to 14 cm in length. The upper leaves are shorter (Fig. 1, *left*), while the lower leaves are of longer length (12 to 14 cm). In contrast, in a baby or child, the pectoralis minor leaflets are only 6 to 10 cm in length, which make it ideal for facial reanimation procedures because one can use the muscle in toto without requiring any trimming. The width of the muscle is less than 0.5 cm in very young patients but can be up to 2 or 3 cm in athletic adults. This is why I prefer not to use this muscle in weight lifters or swimmers, since it would require extensive debulking.

The design of the flap is carried out by precise preoperative measurements of the face of the patient in repose and during extremes of facial movement. A mold is made of the exact shape needed for a particular reanimation procedure. Prior to harvesting the pectoralis minor muscle, the tension of the muscle is measured and 6-0 silk sutures are placed 1 to 2 cm apart over its inferior margin. Once the muscle is harvested from the anterior thorax, it is placed in a wet sponge. There is 30 to 50 percent shrinkage of the muscle following harvest owing to the elastic recoil of its fibers. By placing holding sutures along its origins and insertion, an attempt is made to reexpand the muscle to its previous dimensions. Then the mold is placed on the stretched muscle, and appropriate trimming and debulking are carried out. It is important to allow for more muscle length than the length-width measurements of the facial mold. This notion is supported by my experience in facial reanimation procedures, since in contrast to extremity free-muscle transplantation, it did not always prove a good idea in the face to reproduce the in situ length. In a few patients in whom the muscle was placed under too much tension, the force generated was too great for the requirements of the recipient site. In these patients I had to weaken the muscle subsequently. Thus during the revisional stage I loosened the transplanted muscle by advancing it medially. This invariably corrected the deformity.

In young children (4 to 5 years old), no trimming or debulking is necessary because the muscle usually fits perfectly the facial dimensions required in the child.

Operative Technique

The patient is placed on his or her back, and the face and neck area as well as the contralateral upper extremity and upper thorax are prepped and draped. One surgical team prepares the recipient site. The following tasks need to be addressed: (1) face lift incision, (2) undermining of a cheek flap extending from the preauricular area to the upper and lower lip up to the philtrum (the superior margin of the cheek flap is the infraorbital rim, and the inferior margin is the submandibular area), (3) identification of the facial artery and facial vein and the microsurgical isolation of this vascular pedicle from 2 cm below the mandible to the level of the alar base, and (4) identification and microsurgical isolation of the distal ends of the cross-facial nerve grafts up to the region of the upper lip.

A separate team harvests the pectoralis minor muscle simultaneously by working on the opposite side of the operating table. This lessens the operative time appreciably. The following steps are followed:

1. Placement of the incision over the posterior border of the anterior axillary fold so that it is not easily visualized (Fig. 1, *left*)
2. Identification of the inferior margin of the pectoralis major muscle
3. Identification and isolation of the lateral thoracic vascular pedicle as it enters the inferior margin of the pectoralis major (Fig. 4)
4. Microsurgical pursuit of the lateral thoracic pedicle to the undersurface of the pectoralis minor muscle and invariably to the isolation of the dominant arterial trunk that supplies the pectoralis minor
5. Identification of the inferior margin of the pectoralis minor muscle and demarcation of the outer surface over the thorax by blunt dissection
6. Distal dissection freeing the undersurface of the pectoralis minor muscle from the intercostals, investing fasciae, and outer costal surfaces
7. Proximal exploration clearly defining the outer and inner surface of the origin of the muscle up to the coracoid process
8. Placement of two holding sutures over the inferior margin of the pectoralis minor and everting the muscle so that the hilar structures become apparent
9. Identification of the medial and lateral pectoral nerves and communicating loop, tracing of the pectoral nerves to gain as much length as possible, and marking with 8-0 microsutures and subsequent severance of the nerves
10. Identification and clarification of the dominant arterial supply and dominant venous drainage
11. Marking of the muscle tension in situ by placing black 6-0 sutures every centimeter along its inferior margin
12. Separation of the origin of the muscle from the thoracic wall and complete freeing of it (an attempt is made to incorporate as much fascia as possible in the terminal portion of the individual slips)
13. Severance of the coracoid insertion
14. Keeping the muscle warm until the recipient site in the face is completely prepared to receive the transfer.

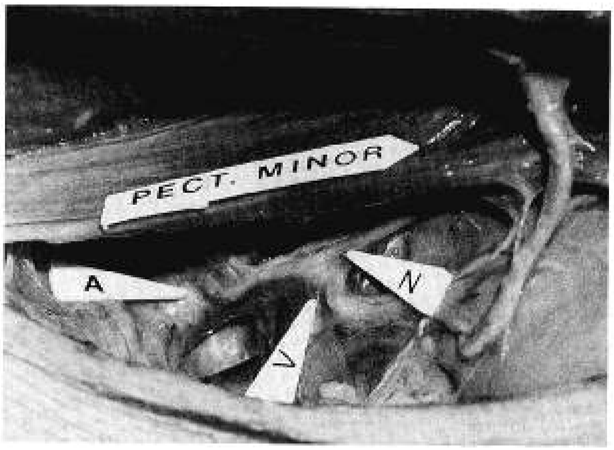

FIG. 4. The inferior margin of the pectoralis major is visualized superiorly. Note the lateral thoracic artery as it ascends from the axillary artery and after supplying the pectoralis minor passes over the lateral margin of the pectoralis minor to enter the inferior margin of the pectoralis major. This is an important surgical landmark, since identification of the lateral thoracic vessels at the lower border of the pectoralis major allows easy isolation by following these vessels in a distoproximal fashion. This invariably leads to the branch of the lateral thoracic artery to the pectoralis minor muscle.

When everything is ready and prior to microsurgical transfer, the previously prepared facial mold is brought onto the face and the measurements are checked again. Then with the preoperative video showing the patient talking or smiling, playing on a TV monitor in the operating room, 4-0 and 5-0 Mercilene sutures are placed to the alar base, upper lip, nasolabial fold, oral commissure, and lower lip. Every suture is tested to see if pulling on the suture reproduces the exact pull that we need to match the animation of the contralateral normal face. Once the surgeon is satisfied that the sutures reproduce the contralateral directional pulls of the desired facial movements, the vascular pedicle of the muscle is severed and the muscle is photographed as a free unit. Then it is brought to the face after appropriate trimming and/or debulking. Both surgical teams are working together at this critical point to inset the muscle in the cheek using the previously placed sutures in a methodical fashion with minimal ischemia time. This task usually takes from 20 to 40 minutes. Then the operating microscope is brought over the field, and the artery and vein anastomoses are executed. The diameter of the branch of the lateral thoracic artery that supplies the pectoralis minor ranges from 0.5 to 0.9 mm depending on the age and vascular variability that may be present in that patient. This caliber is not very dissimilar from the distal end of the facial artery. If there is a question of the venous drainage, the arterial clamps are released and the hilar structures are observed carefully. The vein that bleeds the most is the one that is chosen for microvascular reconnection with the facial vein. Once the vascular anastomoses have been completed, the insetting of the muscle is checked and final tension is adjusted. If additional sutures are needed, these are carried out at this stage. Depending on the preoperative videos and the facial mold measurements, the facial tension is adjusted so that it never exceeds the tension in situ. In most cases, I try for 60 to 70 percent of the in situ tension depending on the strength of the pull that I am trying to get (Fig. 5).

At completion of muscle placement, the microscope is brought back to the operating field and the microneural coaptations are carried out. Usually I place two cross-facial nerve grafts for smile substitution. The upper graft is coapted with the lateral pectoral nerve, and the lower graft is sutured to the medial pectoral nerve.

At completion of the microneural repairs, the medial and lateral pectoral nerves are stimulated and intraoperative videos are obtained of the resulting facial movements. Finally, the cheek flap is closed and a tiny stitch is placed as a marking over the cheek to facilitate postoperative Doppler monitoring of the arterial pulse. Usually no dressings or drains are necessary. The face lift incision is covered with antibiotic ointment, and the face is left open for direct inspection. Extubation of the patient is carried out very carefully to make sure that no structures are disrupted.

CASE REPORT

A 6-year-old Canadian boy presented at my office in 1981 with unexplained left facial palsy since birth. He was previously extensively investigated for space-occupying lesions, but all the neuroradiologic tests were negative. No forceps were used during delivery, and the pregnancy was reported as uneventful. Repeated electrical testing did not yield any evidence of further reinnervation. On examination, when asked to animate his face, there was a minimal "puckering" of the left commissure, indicating that some residual function had escaped the developmental mishap. There was also lagophthalmos (4 mm) when the patient attempted to close his left eye. I diagnosed the condition as developmental facial paralysis on the basis of history, signs and symptoms, and lack of trauma during delivery.

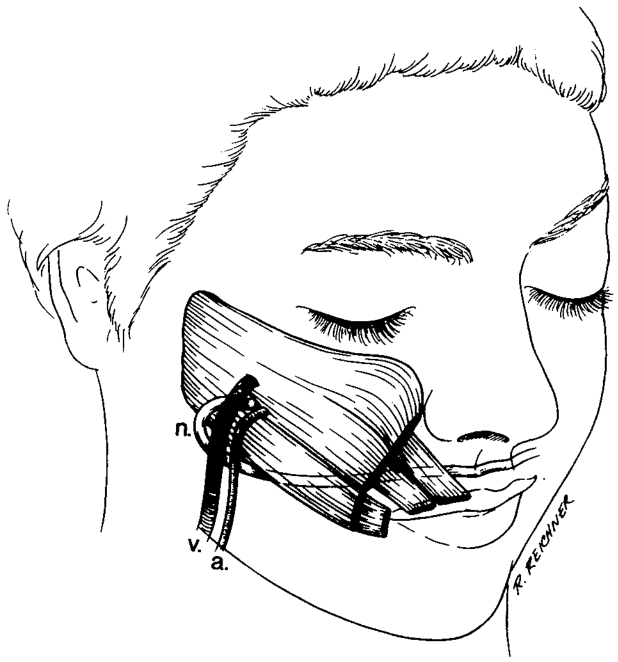

FIG. 5. The pectoralis minor after it has been transferred to the face. The placement of the muscle is such that the coracoid insertion is anchored at the zygomatic arch and preauricular area. The lower slip of the muscle is directed to the commissure or lower lip depending on the preoperative measurements. The central slips are dedicated for the upper lip and nasolabial folds. The upper slip usually ends at the alar base and is also anchored in the medial region of the infraorbital rim about 1 cm below the medial canthus. This slip is placed for nasalis substitution if the patient has a strong nasalis function in the contralateral normal face. The microneurovascular repairs are always done on the external surface of the muscle to facilitate their execution.

On April 16, 1981, both sural nerves were harvested and a cross-facial nerve grafting procedure was carried out using two nerve grafts for the lower face and one for eye reanimation. In toto, three interpositional grafts were placed carrying motor fibers from the right to the left paralyzed face. On April 28, 1982, the patient had a right free pectoralis minor microneurovascular transfer to the left face for facial muscle substitution (Fig. 6). In this patient, the pectoralis minor muscle was used for both eye and oral sphincter substitution. The upper leaflet of the muscle was split with fascia extension and tunneled from lateral to medial in a preseptal position. The terminal portion of the two fascia strips were anchored behind the medial canthal ligament. The lateral pectoral nerve, when stimulated intraoperatively, led to muscle contraction resulting in eye closure. The cross-facial nerve graft that was dedicated for eye reanimation was coapted to the lateral pectoral branch that innervated the upper slip of the pectoralis minor. Thus the left eye was able to be synchronized with the contralateral eye sphincter by means of the upper zygomatic fibers of the right face that elongated through the cross-facial nerve graft and were now guided to the lateral pectoral nerve. The other two cross-facial nerve grafts that were placed for smile

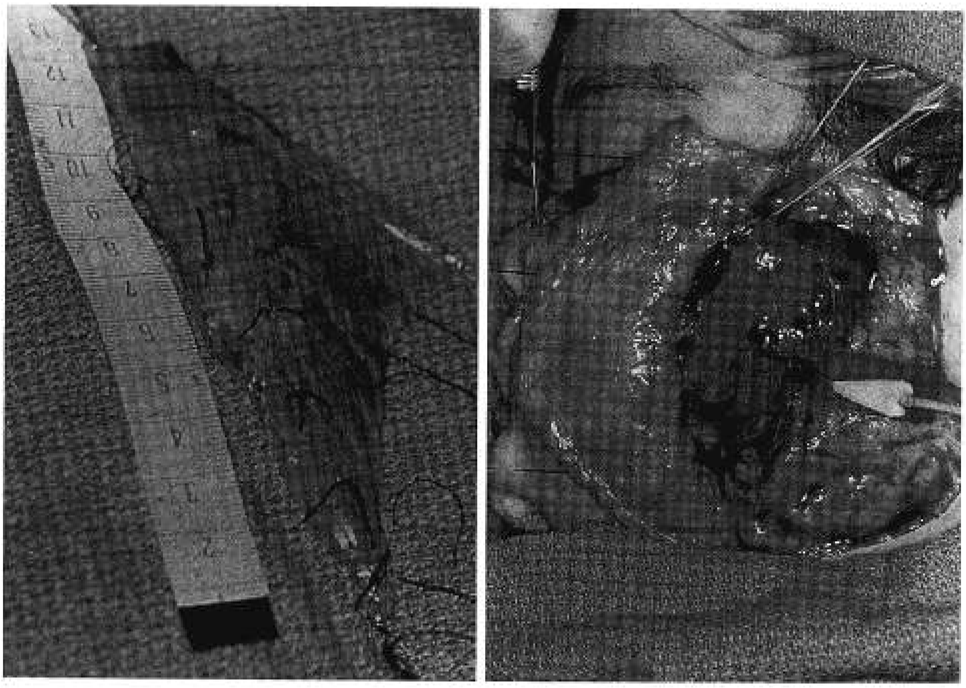

FIG. 6. (*Left*) The right pectoralis minor muscle was harvested using the technique described in the text. The outer surface of the muscle is shown. Note the sutures placed every 2 cm to mark the tension of the muscle in situ. (*Right*) The right pectoralis minor muscle has been transferred to the left cheek. The microvascular anastomoses have been completed (*white arrow*). The final tension of the muscle will be adjusted prior to execution of the microneural coaptations.

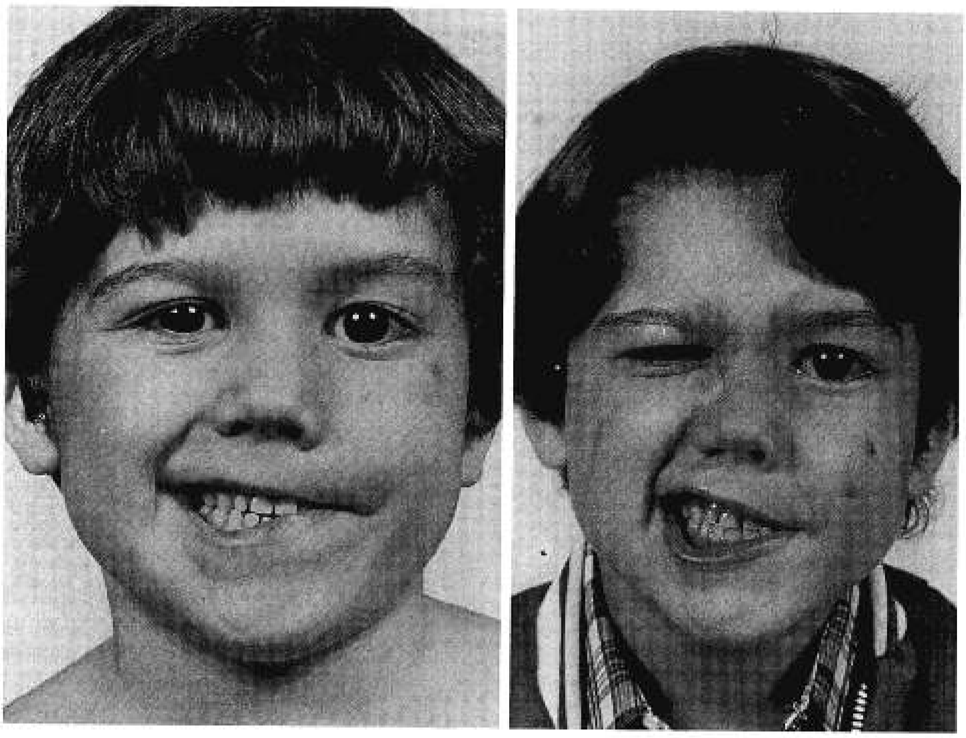

FIG. 7. (*Left*) A 6-year-old white boy with developmental left facial paralysis. Note absence of left nasolabial fold, lowering of the left alar base, lack of left lower lip depressor, and weak buccinator. He also was unable to completely close the left eye and presented with 4 mm of scleral show. Note the small degree of puckering around the left commissure, implying a partial paralysis. (*Right*) Patient is shown here 1 year after three cross-facial nerve grafts were placed in his face and just prior to the free pectoralis minor transfer to the left face. Direct neurotization through the cross-facial nerves accounts for the increased animation present in the left face. However, this is never enough to restore symmetry.

restoration were carefully coapted to the medial pectoral nerve. The lower two-thirds of the muscle was placed in the left cheek according to the technique described previously. In 1982, I used to make a nasolabial fold incision to facilitate the placement of the muscle transfer. In the past 4 years, I have stopped using this incision because the resulting nasolabial scar was not acceptable to me. This has made preparation of the recipient site somewhat more difficult and lengthy, but I think it has paid off, since now there are no visible scars in the anterior face. Figure 7 shows the patient at 6 years of age (Fig. 7, *left*) and 1 year following the cross-facial nerve grafting procedure (Fig. 7, *right*). Figures 8, 9,

FIG. 8. Patient is seen here at 10 years of age and 3 years after microneurovascular transfer of the right pectoralis minor to the left cheek. As is the case in developmental facial paralysis patients, he has completely synchronous and coordinated animation of the left paralyzed face with the right normal face (*center*). In addition, he is demonstrating a phenomenon that depicts an intriguing degree of plasticity, since he is able to voluntarily move the right (*left*) or the left side of his face independently (*right*) despite the fact that both sides of his face are controlled by his right cerebral cortex; i.e., peripheral fibers of the right facial nucleus innervate the right facial musculature as well as cross through the cross-facial nerve grafts to supply innervation to the free pectoralis minor transplanted to the left face.

FIG. 9. Patient is shown here in 1988, at age 13, that is, 6 years following the microneurovascular transfer of the right pectoralis minor to the left face. In repose (*left*); showing a small grin (*center*); and with a broader smile (*right*).

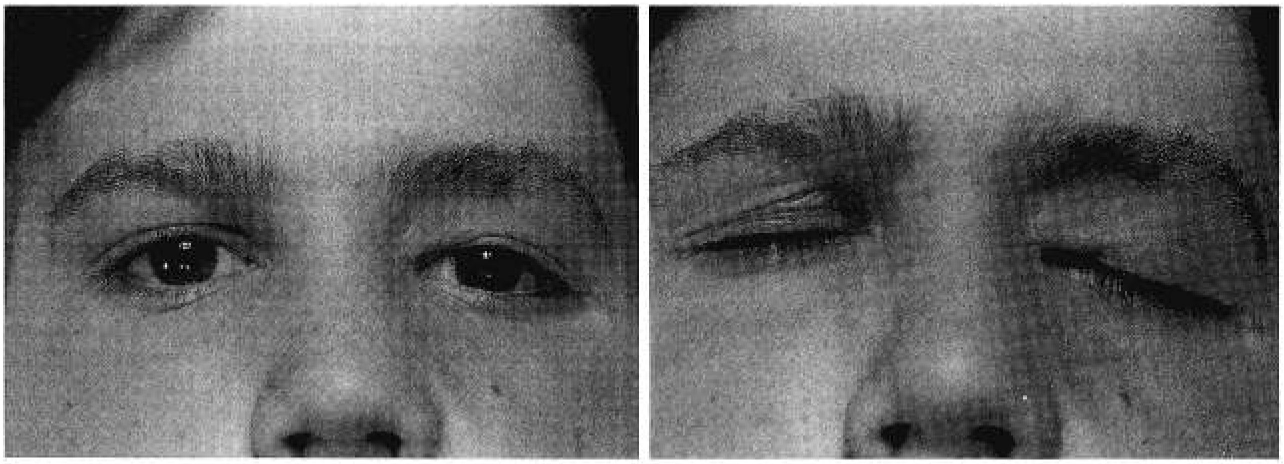

FIG. 10. The upper slip of the pectoralis minor, which was elongated with incorporation of fascia from its costal origin, was split and placed in a preseptal position to substitute for the paralyzed left eye sphincter. This segment of the muscle was innervated by a separate cross-facial nerve graft to the lateral pectoral nerve. The patient has independent eye movements which are synchronized only with his contralateral eye as well as restoration of his blink reflex in the left eye, which was previously delayed and incomplete. There is no evidence of synkinesis with the left lower face. Patient is shown here in close-up with the eyes open (*left*) and closed (*right*). Minimal revisions are planned to correct the excess skin in the medial aspect of the left upper eyelid.

and 10 show the clinical results that can be accomplished with this technique.

CONCLUSIONS

The pectoralis minor is a highly versatile muscle that should be included in the armamentarium of surgeons who treat patients with developmental or late acquired facial paralysis. It is not a substitute for the highly intelligent and densely innervated normal facial musculature, but its dual innervation, its multileaf origin, and its flat and thin shape make it a second-best target to use in our plight for restoration of facial symmetry and coordinated function in cases of chronic and/or developmental facial paralysis.

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