Surgical correction of unilateral and bilateral facial palsy

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Unilateral and bilateral facial palsies are debilitating and depressing conditions for the patient. For the past 30 years attempts have been made to improve the reanimation of these patients. The ability to transfer axons over significant distances with nerve grafts and the transfer of muscle that can be revascularised by microvascular surgery greatly improves results of this surgery. The revascularisation of muscle has been the important step forward but the re-focusing of interest in this condition has brought about a number of peripheral advances.

UNILATERAL FACIAL PALSY

Unilateral facial palsy is a depressing condition for the sufferer. The appearance is classic to any medical practitioner, with paralysis of the involved frontalis with consequent depression of the eyebrow, inability to close the eyelids, with risk to the cornea that becomes dry and if not corrected, opaque. The lower face is inactive and has no response to emotion. The degree to which this paralysis is apparent relates to age, in a child loss of function of the frontalis is not obvious and the eyebrow is not depressed. Closure of the eyelids is usually satisfactory; they rarely have a dry cornea and the lower eyelid only drops towards the late teens and early 20s. The static position of their face is symmetrical but on smiling the distortion of their face becomes clearly apparent and causes a high degree of distress because they are not the same as their peers. They are therefore vulnerable to being teased between the ages of 7 and 13. Some movement in congenital facial palsies can be seen on the paralysed side in response to command but in uninhibited laughter becomes lost or completely swamped. The latter group may be just as distressed as the total paralysis. A unilateral facial palsy, in the elderly group, is usually referred 18 months after the development of the facial palsy. As will be seen from table 1, describing the aetiology, the most common referrals relate to congenital onset or acoustic neuromas. The commonest cause of unilateral facial palsy is a Bell’s, which recovers in over 85% of cases. An acoustic neuroma that in the course of excision requires the removal of the facial nerve may have the gap replaced with a nerve graft or alternatively an immediate hypoglossal facial anastomosis may be carried out. In circumstances where the facial nerve is in continuity at the end of extirpation of a cerebellar pontine angle tumour, but the patient wakes with a unilateral facial palsy there may be a neuropaaxia of the nerve that could take a year to recover. Parotid tumours, which require removal of branches or even the whole of the facial nerve, are usually nerve grafted immediately with good results. Congenital facial palsies are at the present state of our knowledge, unexplained. In a series of 61 patients we sought for the recognised risk factors for birth trauma, maternal primaparity, birth weight over 3500 grams and forceps assisted. It was found, however, that when the study group was compared with the UK national data for these criteria, there was no demonstrable difference. It would therefore seem that these factors might be assumed to lead to compression of the facial nerve at birth but do not show a statistical relation. We do not routinely carry out MRI scans on these children to assess brain stem damage, as it would require anaesthesia and treatment is not influenced by the result. However, some young patients have been referred having already had an MRI scan and in the 21 patients examined eight had abnormal scans. Three had evidence of absence of the facial nerve nuclei, two had lesions in relation to the facial nerve nucleus, one had partial agenesis of the corpus colosum, one had cerebellar hypoplasia, and one had a prominent circle of Willis. Clearly further investigation into the causes of congenital facial nerve palsy would be of real interest.

In congenital cases our preference would be to proceed to surgical correction at the age of 5 years. The child is at that time becoming aware...
Surgical correction of unilateral and bilateral facial palsy

**Table 1** Aetiology of the causes of unilateral facial palsy in 260 cases

<table>
<thead>
<tr>
<th>Aetiology</th>
<th>Total (%)</th>
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<tbody>
<tr>
<td>Congenital</td>
<td></td>
</tr>
<tr>
<td>Acoustic</td>
<td></td>
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<tr>
<td>Mastoid/ear infection</td>
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<tr>
<td>Cerebral infection</td>
<td></td>
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<tr>
<td>Cerebral tumour</td>
<td></td>
</tr>
<tr>
<td>Parotid tumour</td>
<td></td>
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<tr>
<td>Nerve tumour</td>
<td></td>
</tr>
<tr>
<td>Bell's</td>
<td></td>
</tr>
<tr>
<td>Trauma</td>
<td></td>
</tr>
<tr>
<td>Other syndrome</td>
<td></td>
</tr>
<tr>
<td>Haemangioma/lymphatic malformation</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
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of their disability and is more prepared to allow surgery to proceed without interference. We would also hope that function would be restored by the age of 7 years when they proceed to their primary school. The period for teasing is usually between the ages of 7 to 13 and if the face can be brought to normality before this time, much of the discomfiture caused by this can be avoided.

**Forehead**

Paralysis of the forehead is evident by the loss of forehead creases on one side, with or without depression of the eyebrow. At present there is no satisfactory means by which the forehead can be animated and the crease lines restored. If this is causing grave concern to the patient then paralysis or weakening of the contralateral side is required. The latter can be achieved either by the use of botulinum toxin injected every four to six months, or alternatively the frontal branch of the facial nerve on that side can be divided as it crosses the zygomatic arch in its mid-position. If the latter course is followed then it must be explained that the eyebrows are likely to drop bilaterally in years to come.

To elevate the eyebrow a number of alternatives are available. Possibly the most effective is an excision of about one centimetre of skin immediately above the eyebrow and either closed by direct suture or by using a dermosest. Elderly people are more likely to require this correction and are similarly less likely to form a poor scar. If a scar in this region is to be avoided then excisions of skin just below the hairline, box suturing, or an endoscopic brow lift are alternatives. The endoscopic brow lift, although highly successful in aesthetic surgery, seems to work less well where there is muscle paralysis. If elevation of the eyebrow is to be undertaken, it will affect the closure of the upper eyelid and if this is on the borderline for correction, it is most likely this will have to be addressed. Improving the symmetry of eyebrows can make a pleasing improvement in appearance, particularly in the elderly patient.

**The eye**

Eye closure is critical to protection of the cornea and the avoidance of corneal opacity and blindness. In any circumstance where a facial palsy has developed, even if transitory, it is of importance that methods be used to protect the moisture of the cornea, particularly at night. Children very often do not require surgical intervention as they seem to adapt successfully. The author has only seen one child with a corneal opacity and this from the Middle East. Concern can develop at the age of 2 or 3 as the child may rub the eye and in consequence make it red, giving the appearance of conjunctivits. Commonly this habit tends to spontaneously rectified with advancing years. Rarely intervention is required and then would be corrected much as for an adult.

Usually, however, children proceed through to the ages of early 20s, at which time the lower eyelid tends to descend, giving more scleral show. A McLaughlin’s lateral tarsorrhaphy will often correct this for a while, improving symmetry and comfort. A gold weight in a child’s eyelid is not generally well tolerated, as it tends to lower the eyelid, reducing their vision and sometimes being unaesthetic.

In the mature onset facial palsy, we would generally opt for a gold weight inserted into the upper eyelid and fixed to the tarsal plate with sutures. These gold weights are carefully made with their edges smoothed off and made as slim as possible. The weight required to lower the upper eyelid is checked before surgery by application to the upper eyelid with a steristrip and the lightest weight to achieve this is used.

In our experience, the weight required is usually around one gram. It is important that the gold weight is shaped to the contour of the cornea as if it is too concave or too convex, as the gold weight descends over the cornea it may change its shape and therefore its optical refraction and cause blurring of vision. Clearly the larger the weight the more likely is the latter to occur. If the gold weight is fixed to the tarsal plate, it is much less likely to migrate or be extruded. If the gold weight has to be removed or is unsuitable, then methods can be used to permit the descent of the upper eyelid. Our favoured choice is under local anaesthetic to divide the levator and insert a small section of temporalis fascia. Descent of the lower eyelid, even by a millimetre, can sometimes cause a surprising degree of discomfort and its correction brings relief effectively. There are a number of means by which the lower eyelid can be elevated but a McLaughlin’s lateral tarsorrhaphy is a simple procedure quickly performed and gives a high degree of aesthetic improvement. It should not be extended beyond 5 mm. Medial tarsorrhaphies are unattractive and veiling of the caruncle is immediately obvious. If a lateral tarsorrhaphy is inadequate to elevate the medial part of the lower eyelid, then one would proceed to a fascial sling extending from the medial canthal ligament along the lower eyelid and fixed to the supraorbital margin. Again this gives an aesthetic result and elevates the whole of the eyelid. It is clearly the object of these procedures to ensure that the lower lachrymal canaliculus is in correct association with the orbit. However carefully the lower eyelid is positioned in relation to the orbit, it does not necessarily correct epiphora. Muscle contracture opening and closing the lachrymal sac will certainly act as a siphon sucking fluid along the lachrymal canaliculus into the sac itself. However, there is evidence to believe that the facial nerve via the greater superficial petrosal acts as an inhibitor to the lachrymal gland and that when this inhibition is
CORRECTION OF UNILATERAL FACIAL PALSY

Lower face: over 55 age group

The principle of lower facial support is that any sling procedure must have a fixation in the midline of the upper and lower lip. If the fixation point is made in the area of the nasolabial fold then the philtrum and the central part of the lower lip will nevertheless drift towards the animated side. The other aesthetic factor is to use a broad fascial sling, as narrow bands such as palmaris tend to cause a groove in the cheek, which is unattractive. Slings in the face are devascularised and therefore vulnerable to infection. Preoperatively, therefore, it is essential to ensure that the patient has clean teeth and if not, should undergo oral hygiene. We prefer a broad strip of tensor fascia lata, 3–4 cm wide and at least 15 cm long. The latter is passed through the cheek via incisions in the nasolabial fold and in the preauricular region. Pulley is then fashioned in the upper and lower lip and at the modiolus. There will inevitably be creep towards the animated side and this should be taken into consideration. The more active the smile on the animated side, the more likely is the sling to relax. Transfer of the masseter into the sling has not been found particularly helpful as there tends to be hollowing at the angle of the mandible, fullness in the central cheek, with no demonstrable benefit, certainly in response to emotion. The transfer of the temporal muscle has been, and still is, a popular means of facial reanimation. There are numerous ways by which the temporal muscle can be extended to the nasolabial fold area. The temporalis muscle, however, is powered by the 5th cranial nerve and therefore does not respond to emotion. Conversion from mastication to emotion can be achieved in children under the age of 7 years or by long periods of retraining. In general, however, a good smile can be achieved on command but not to uninhibited emotion.

The treatment of facial palsy: younger age group: 5–55 years

Young people, both children and adult, often have good static position of their face in repose. Their facial paralysis becomes evident when one side of their face animates, producing a pronounced distortion of facial appearance. Many of these sufferers will inhibit themselves from smiling or alternatively camouflage it, whether with their hand or with their hair that they allow to hang over their face. Many are gravely distressed and do not involve themselves in public activity. Since the early 1970s we have been trying to achieve movement of the face in response to emotion.

**First stage: facial reanimation by muscle grafts**

In the first operation, surgery is carried out to the upper and lower eyelids and then a crossed facial nerve graft is used to extend the buccal branch of the animated facial nerve and is passed across the upper lip just below the alar base with its distal end fixed to the tragus of the ear on the paralysed side. A 20 cm sural nerve graft is harvested via small transverse incisions on the back of the leg. A small area of loss of sensation is to be expected on the lateral side of the foot but in children this rapidly recovers. The functioning animated side of the face is opened via a parotidectomy incision and the buccal branch of the facial nerve comparatively easily found just beneath the parotid duct. The nerve graft is then threaded across the face, fixed at the tragus of the contralateral ear, and the nerve graft is then repaired to the buccal branch of the facial nerve under the microscope. Three months postoperatively the passage of the Tinel sign across the nerve graft is assessed by gentle tapping. A good Tinel at the tragus of the ear or just short of it is reassuring for the surgeon, enabling them to proceed to the second stage at six months.

**Second stage (Fig 1)**

Attention is turned to the paralysed side of the face where again a parotidectomy incision is used to explore the cheek. The distal end of the nerve graft is found and it is dissected along its course medially towards the alar base to achieve good fixation of the muscle in these areas. Next the facial artery and vein are defined as they cross the mid-part of the mandibular border. The artery separates from the vein passing medially towards the angle of the mouth. The vein passes up in a more vertical direction in line with the medial canthus of the eye. A sufficient length for both the artery and vein to be taken onto the superficial surface of any muscle is carried out. The bed is therefore prepared and interest can then be diverted to a suitable muscle for transfer. The gracilis was first used by Harii with good result. The muscle, however, is unidirectional and tends to produce a grimace by elevating the upper lip and angle of the mouth rather than elevate the upper lip and angle of the mouth rather as would be expected if zygomaticus alone was functioning. In the early 1980s we sought a muscle that had a more triangular shape providing a wider origin to emulate the muscles of the face. We have therefore used pectoralis minor in most of this series, occasionally using a cut down latissimus dorsi in circumstances where nerves or vasculature are unfavourable.

**Harvesting the pectoralis minor**

An incision is made along the anterior axillary fold and deepened to expose the pectoralis major. Just below the pectoralis major can be found the minor. The pectoralis minor can then be explored along its anterior surface as far as the coracoid process. The insertion into the coracoid process is then divided and fixed with a suture. By lifting the muscle and drawing it downwards, the hilar structures can be defined. The nerve can be marked and divided. The hilar vessel to the pectoralis minor usually emanates directly from the axillary artery but in a certain proportion comes from the acromiothoracic trunk at the point where it separates from the axillary artery. The venous drainage of the pectoralis minor lies beneath the artery and enters the axillary vein. The muscle can then be removed from the chest and inserted into the face. The hilar structures...
are placed superficial and the insertion is split into three. Whereas fascial slings are set in as tight as possible, the muscle in contrast is set up loosely so that it does not distort the angle of the mouth. The previously divided facial artery and vein are then transferred to the superficial part of the muscle, as is the crossed facial nerve graft. These structures are then repaired to their corresponding hilar vessels under magnification. The success of the vascular anastomosis can be observed immediately by change in colour of the muscle and bleeding from its surface.

Monitoring muscle viability
Assessing blood flow through a structure placed subcutaneously can clearly not be achieved by direct observation. The medical physics department at Mount Vernon Hospital has developed an impedance monitor that assesses pulsatile blood flow. An array of four wires is placed beneath the muscle graft (fig 2). The outer two wires carry a current, which passes through the muscle. With pulsatile blood flow into the muscle there is a small voltage change that can be appreciated by the two inner wires. This small change can then be visualised onto a monitor screen as a waveform.

We would not expect to see movement in the muscle graft for six months as it takes this time for the axons to traverse the nerve repair and enter the motor end plates of the muscle itself. Children animate at 3–4 months because of more rapid migration of the axons.

The latissimus dorsi muscle can be used in a similar manner. It fortunately has a longer pedicle and therefore in circumstances where previous surgery may have damaged the facial vessels or a longer nerve is required, it may be the muscle of choice.

RESULTS (FIG 3A, B, C, FIG 4A, B, C)
The House-Brackman assessment of facial palsy is excellent but is particularly applicable to Bell’s palsy and the sequelae of late recovery. With muscle grafts such as that described, the complications and results are a little different. We have therefore graded the results as: 0 no change, + good static position but no movement of the muscle, ++ as being good static position, good smile with the lips closed but not exposing the teeth, +++ is good static position, good smile with the lips closed and with the lips open. +++ is clearly the most desirable, as exposure of the teeth on smiling is the accolade. If we examine the results of 252 muscle grafts completed and 30 latissimus dorsi (fig 5A, B), it will be seen that 90% fall into the ++ and +++ category and 10% into the + and 0 category. If, however, we compare age against outcome (fig 6) it will be seen that more +++ occur in the first two decades of life, decline in the next two decades, and again further in the next two decades. The less good ++ results, however, increase with advancing decades. The latter may reflect the speed of axon migration.

COMPLICATIONS AND IMPROVEMENTS IN SYMMETRY
Weakness of the lower lip depressor
Paralysis of the lower lip depressor is sometimes described as “asymmetric crying facies”, as it is commonly noticed in children when trying to roll the lower lip down in crying rather than in the act of smiling. The aetiologies are congenital and acquired. Congenital can be solitary or associated with a first arch syndrome, associated with abnormalities of the lower part of the ear.
Acquired can be (1) damage to the marginal mandibular nerve or (2) block dissection of the neck.

The two muscles that draw the lower lip downwards are the depressor anguli oris and the depressor labii inferioris. The latter muscle is the most important in function and more relevant if lost. In attempting to produce symmetry by paralysis or function by muscle transfers it is this muscle that has to be considered.

Available treatments
- Botulinus toxin—the simplest means of providing symmetry for the lower lip is by the injection of botulinus toxin into the contralateral functioning depressor. This is a very simple procedure and paralysis that lasts four to six months. No scars are involved and it is a popular method of correction.
- Permanent paralysis of the contralateral depressor can be achieved by dividing the marginal mandibular branch on the animated side. The nerve can be found as it runs superficial to the facial artery in the mid-part of the mandibular border and divided. The depressor labii inferioris can be formally excised, care being taken to avoid the mental nerve.
- Anterior belly of digastic transfer. In young people who wish a permanent correction of the lower lip depressor, then the anterior belly of the digastic can be transferred as described by Conley and Baker in 1982. The surgery takes about an hour and is comparatively simple. It has an 80% success rate.

In cases where the aetiology is probably related to the first arch syndrome, it is not advisable to carry out an anterior belly of digastic transfer as it commonly absent.

MOÖBIUS SYNDROME

In 1888 Möbius1 described a combined sixth and seventh cranial nerve palsy. Clinically they often have a rather thin upper lip and inability to show emotion. The platysma muscle is usually functioning and therefore attempts at lip movement produce a curling down of the lower lip. Static position is symmetrical but the inability to show emotion is a real concern for these patients. Oral incontinence and drooling can occur in some patients. Low self esteem and limitations to social integration are common.

There is no functioning seventh nerve and it is therefore impossible to provide true movement responsive to emotion. Function can be converted if the surgery is carried out before the age of 7 years. Every succeeding year after this it becomes more difficult to convert function and re-training is required.

Transfer of the temporalis muscle to the angle of the mouth has been used. It commonly causes hollowing in the temporal fossae and also the excursion of the angle of the mouth on smiling is comparatively limited. The ability to transfer muscle, revascularise it and reinnervate it has provided hope for these patients. In two cases we have used the accessory nerve to provide the motor power. The motor nerve of choice, however, is the masseteric branch of the fifth. Before using this motor nerve, however, function of the temporalis muscle should be confirmed to avoid damaging the ability to masticate. The nerve to the masseter is deeply placed and therefore a muscle with a long hilar nerve is required. The latissimus dorsi muscle has a triangular shape suitable for inserting around the mouth and can provide a broad origin from the zygomatic arch to the sternomastoid. The surgery is comparatively lengthy and therefore it is advisable to carry it out in two stages, separated by three months.

Results
- Of the 16 cases treated, 14 have had a good result (see fig 7). Despite potential variabilities such as the quality of nerve repair, thickness of muscle and possible inequalities of muscle revascularisation, symmetry has been surprisingly good. Some skin fixation has produced skin creasing on smiling but in general has not been a major problem.
- The treatment of Möbius syndrome, by providing reinnervated and revascularised muscle, has made a real contribution to these patients quality of life. Children before the age of 7 years do particularly well but considerable improvement can be achieved in older age groups, providing re-training is entered upon on enthusiastically.

CONCLUSION

The treatment of unilateral, bilateral, and partial facial palsies relates to trying to provide movement of the lower face symmetrically in response to emotion. Production of smile in response to command is insufficient as in uninhibited mirth it will not function. The advent of microvascular transfers has made some of these goals possible with varying degrees of success. We have a better understanding of which groups give the better results but as with all surgery, successes can

Figure 5 (A) Results of 252 pectoralis minor transfers. (B) Results of 30 latissimus dorsi muscle transfers.

Figure 6 Outcome scores related to age of patients at time of surgery.

Figure 7 Möbius syndrome. Results of 16 cases all using the latissimus dorsi muscle as the motor. Motor nerve was masseteric branch of fifth in all but two cases that were powered by the accessory nerve.
occur against the “run of play”. It is perhaps the latter that above all else makes one continue to strive to improve these people’s facial deformity and their self respect.

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