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The posterior triangle and the painful shoulder: spinal accessory nerve injury

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Forty-three cases of accessory nerve injury referred to the Peripheral Nerve Injury Unit have been reviewed. Accessory nerve injury results in a characteristic group of symptoms and signs. Referral for treatment is usually delayed, the average time being 11.3 months. Surgical treatment resulted in improvement of symptoms in almost all cases.

Accidental injury to the spinal accessory nerve from surgical procedures in the neck has been recognised for many years *(1–3)*. The consequences of accessory nerve injury are usually profound for the patient but, despite this, referral for nerve repair is usually delayed.

The experience of the Peripheral Nerve Injury Unit (PNI) at The Royal National Orthopaedic Hospital, Stanmore, is presented. We endeavour to explain our findings in the light of current knowledge of the anatomy and physiology of the nerve.

Patients and treatment

All cases of accessory nerve injury referred to the PNI Unit were reviewed. The mode of injury, symptomatology, time to referral, treatment and outcome were recorded from the clinical records and review in outpatients.

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Between 1984 and 1994 inclusive, 43 patients with accessory nerve injury were referred to the PNI Unit. Twenty-five cases were the result of cervical lymph node biopsy or cervical lump excision and 16 cases were due to assault or closed traction lesions. One of the remaining two cases was secondary to radiotherapy and the other secondary to a soft tissue release for neck pain. Two of the injuries from closed traction lesions were associated with a brachial plexus injury.

The average age of the patients was 34 years (range 19–71 years). The mean age of the patients in the lymph node biopsy group was 39 years and in the assault group 27 years. Their symptoms and signs are shown in Table I.

Treatment in 39 patients was either by nerve graft or neurolysis. The decision to graft was made if there was no conduction across the injured nerve on stimulation at surgical exploration of the neck. Neurolysis was carried out if there was conduction across the lesion. Twenty-seven patients underwent nerve grafting and 12 patients neurolysis.

Four patients did not undergo surgery, owing to an excessive delay in referral (7 years) in one patient, improving symptoms in one, no pain or disability in one, even though there was paralysis of the trapezius muscle, and one patient where surgery would have been extremely hazardous owing to dense scar tissue at the site of injury in the anterior triangle of the neck.

Table I. Symptoms and signs after nerve injury in 43 patients

	Symptoms	*Number of patients*
1	Facial numbness/paraesthesia	7
2	Reduced shoulder abduction	43
3	Pain	37
4	Drooped shoulder	43

Results

The average time from injury to surgery was 11.3 months (range 1 day to 42 months). The median time to surgery was 6–8 months (Fig. 1). Of the 39 patients who underwent surgery, the outcome is known in 36 who had full follow-up, the minimum follow-up period being 6 months. Three patients have been lost to follow-up. Recovery has been classified as shown in Table II. There was no relationship between the grade of outcome and time between injury and surgery for nerve grafts (Fig. 2), nor between grade of outcome and length of follow-up (Fig. 3).

The four patients who did not undergo surgery had a variable outcome. The two patients whose time to referral was too long, were both symptomatic with pain and reduced shoulder movement, but had learnt to cope with their disability. The other two patients had minimal symptoms.

The outcome of surgical intervention improved symptoms in all but seven patients. Two of these patients had associated brachial plexus injuries which contributed to the poor outcome. However, only 4 (9%) had normal pain free shoulders.

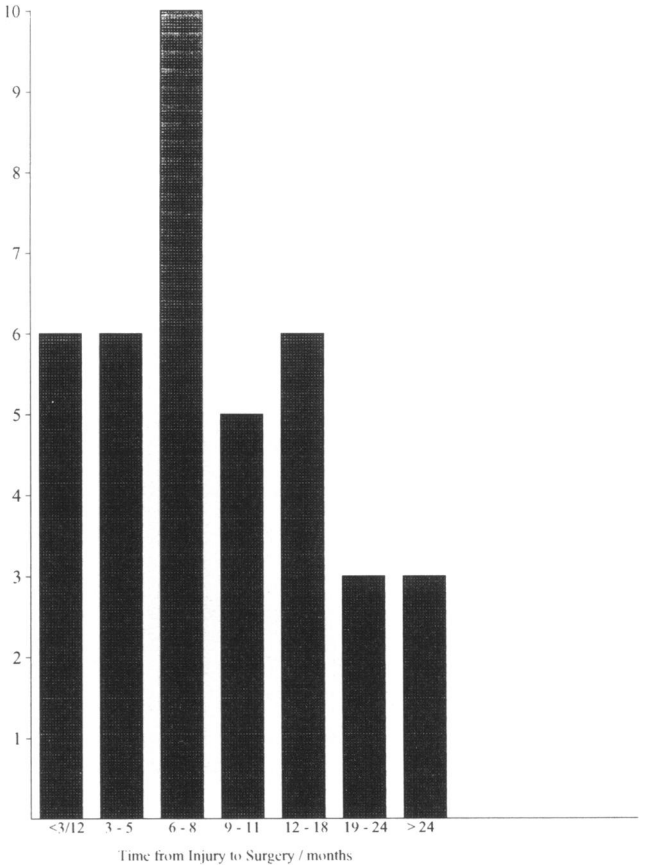

Figure 1. Time from injury to surgery.

Discussion

Knowledge of the anatomy of the spinal accessory nerve readily explains its frequent injury.

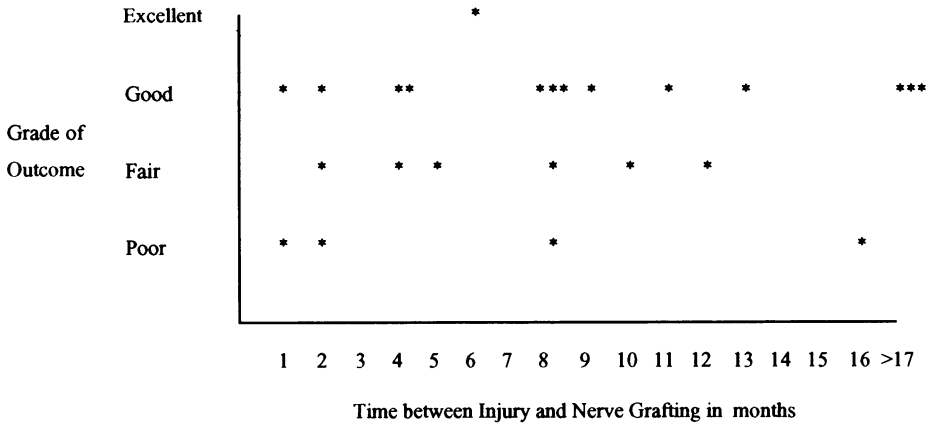

Figure 2. Time between injury and nerve grafting.

Table II. Classification of recovery

	Outcome	*Grade*	*Number*	*Treatment*
A	No change	Poor	7	Graft 4, neurolysis 3
B	Pain improved Movement improved	Fair	10	Graft 6, neurolysis 4
C	Almost normal (difficulty with overhead work)	Good	15	Graft 13, neurolysis 2
D	Normal (from patient's point of view)	Excellent	4	Graft 1, neurolysis 3

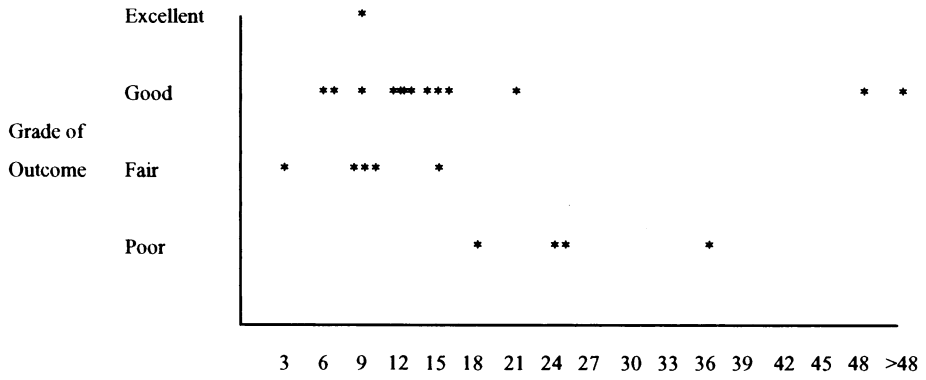

Figure 3. Length of follow-up for nerve grafts.

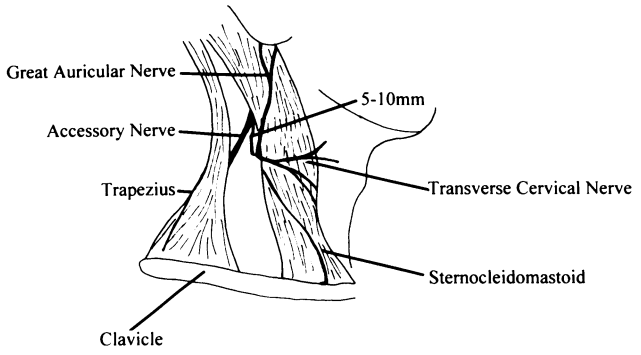

Figure 4. Relationship of the spinal accessory nerve to the great auricular and transverse cervical nerves.

Anatomy

The nerve is small, being only 2 mm in diameter *(4)*, superficial and intimately related to the lymph nodes in the posterior triangle of the neck.

It is composed of a cranial root and a spinal root *(5)*. The spinal root is the part injured in the neck and after separating from the cranial root passes backwards and laterally, anterior to the internal jugular vein in 90% of cases and posteriorly in 10% *(6)*. It then crosses the transverse process of the atlas and descends obliquely to reach the upper part of the sternocleidomastoid muscle (SCM). Here it enters the muscle to run between the cleidomastoid and cleidooccipital bellies of the SCM. Occasionally it runs deep to the SCM, and very occasionally terminated in the SCM, ie trapezius muscle is then solely innervated by the cervical plexus.

The nerve enters the anterior part of the SCM between the junction of the upper third and lower two-thirds and the junction of the upper quarter and lower three-quarters. It emerges from the posterior border of the SCM just above the midpoint of the muscle or 4–6 cm below the tip of the mastoid process. Here it is very superficial, lying just deep to the deep cervical fascia, embedded in fibroadipose tissue and lymph nodes. At this point there is a consistent relation to the sensory branches of the cervical plexus; the transverse cervical and great auricular nerves wind around the posterior border of sternocleidomastoid at its mid part. The accessory nerve emerges into the posterior triangle 5–10 mm cephalad (Fig. 4).

Passing in a downward oblique direction across the posterior triangle, it reaches the anterior border of the trapezius 3–5 cm above the clavicle, but this is variable and may range from 1.5–11 cm. A number of branches to the superior part of the trapezius are given off in the lower part of the posterior triangle and it then passes on to the deep surface of the trapezius where it forms a plexus with C3 and C4.

The accessory nerve receives branches from the cervical plexus in two places. Anterior to SCM it receives branches from C2 and C3 with great variation in the number of branches and anastomoses. Deep to the trapezius it forms a plexus with branches from C3 and C4.

Other studies have pointed out a number of variations. Soo *et al. (7)* noted that the nerve passed anterior to the internal jugular vein in 54% of cases and posterior in 46% of cases. Krause *et al. (8)* noted that in 18 out of 47 dissections the accessory nerve passed deep to the SCM. The relationship of the accessory nerve to the transverse cervical and great auricular nerves is used to locate the accessory nerve when it is buried in scar tissue after injury.

Effect of accessory nerve injury

Surgeons carrying out radical neck surgery for carcinoma, sacrifice the accessory nerve and have coined the term 'shoulder syndrome' *(9)* for the consequences. However, not all patients experience the full syndrome after nerve injury.

Associated numbness

Often, the first symptom noticed is numbness over the angle of the jaw and around the ear, caused by associated injury of the transverse cervical and great auricular nerves. Both are closely related to the accessory nerve.

Paralysis of the trapezius

Paralysis of the trapezius results in an obvious shoulder droop and difficulty with shoulder movement as the function of this muscle is to stabilise and rotate the scapula during arm movement, assisted by the serratus anterior.

In the upright posture the weight of the arm tends to draw the scapula downwards. Suspension is provided passively by the deep cervical fascia, and actively by the levator scapulae and the upper fibres of the trapezius *(10)*. EMG studies have shown low level activity in the trapezius at rest *(11)*, although this can be eliminated with voluntary relaxation. Nerve injury will result in loss of this active suspension and the shoulder droops.

An essential component of arm elevation is external rotation of the scapula. The muscles responsible are the serratus anterior and the trapezius *(10)*. Trapezius paralysis prevents this occurring and normal elevation cannot be obtained. The loss of shoulder elevation, in particular of abduction, varies. The majority of our patients were only able to abduct to 80–90°, but some patients had almost normal abduction. The explanation for this lies in the variation of the trapezius innervation. Fahrer *et al. (12)* and Soo *et al. (13)* have shown normal EMG activity in the trapezius in some patients who have complete accessory nerve lesions. They conclude that there must be some motor activity derived from the cervical plexus alone.

Krause *et al. (8)* have identified nerve fibres derived from the cervical nerves which run deep to the prevertebral fascia colli and which pierce this layer at the anterior border of the trapezius. They believe that these nerves contribute to the innervation of the middle and inferior parts of the trapezius.

Pain

This is the most debilitating consequence of injury and is experienced by most patients. The onset is variable, being from immediately after the injury to several days or weeks *(1)*. The pain is localised to the shoulder girdle, and may radiate into the arm, rarely the hand. It is usually described as an ache or dragging sensation. Six of our patients had no pain, whereas 28 (67%) experienced rest pain, often disturbing sleep. The other nine had pain only when the arm was used.

The cause of the pain is often thought to be due to the unsupported shoulder producing traction on the brachial plexus *(1)*. However, after reconstructive surgery patients often notice a reduction in their pain but still have a drooped shoulder. Also, experimental work on mixed nerves has shown that stimulation of muscle nerve fascicles produces a distinct cramp-like pain projected over the muscle belly and sometimes to remote parts *(14)*. Whetmore and Elde *(15)* in rat studies suggest that the nerve contains sensory fibres with nocioceptive properties, but the sensory and motor composition of the accessory nerve in humans is not known. The myelinated fibre count within the posterior triangle has been calculated to ~1700 *(4,16)*.

Winging of the scapula and altered scapulohumeral angle

Winging of the scapula occurs because the trapezius paralysis allows the medial border of the scapula to lift off the chest wall *(17)*. The scapulohumeral angle is measured between the lateral border of the scapula and the longitudinal axis of the humerus, with the apex at the humeral head. Normally this measures 35°. In accessory nerve palsy this angle increases to 40° *(18)*.

Division of any motor nerve, either under local anaesthesia or general anaesthesia without paralysis, produces an obvious twitch in the muscle supplied. In addition, during a local anaesthetic procedure, the patient usually experiences a sharp painful electric shock pain at the time of injury *(19)*. This may allow the surgeon to recognise that a nerve injury has occurred at the time of injury with the possibility of immediate repair.

Injury to the accessory nerve results in a characteristic group of symptoms and signs—reduced shoulder abduction, drooped shoulder and pain. Repair of the nerve improves symptoms in most cases. A sound grasp of the surgical anatomy, together with the use of a nerve stimulator ought to prevent this serious complication of surgery in the neck.

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