Levator scapulae and rhomboid transfer for paralysis of trapezius

THE EDEN-LANGE PROCEDURE

J. Romero, C. Gerber

From the University of Zurich, Balgrist, Switzerland

Spinal accessory nerve palsy leads to painful disability of the shoulder, carrying an uncertain prognosis. We reviewed the long-term outcome in 16 patients who were treated for pain, weakness of active elevation and asymmetry of the shoulder and the neck due to chronic paralysis of the trapezius muscle, as a result of nerve palsy. Of four patients who were treated conservatively, none regained satisfactory function, although two became pain-free. The other 12 patients were treated operatively with transfer of the levator scapulae to the acromion and the rhomboid muscles to the infraspinatus fossa (the Eden-Lange procedure). At a mean follow-up of 32 years, the clinical outcome of the operatively treated patients was excellent in nine, fair in two, and poor in one patient, as determined by the Constant score. Pain was adequately relieved in 11 and overhead function was restored in nine patients. Pre-operative electromyography had been carried out in four patients. In two, who eventually had a poor outcome, a concomitant long thoracic and dorsal scapular nerve lesion had been present.

The Eden-Lange procedure gives very satisfactory long-term results for the treatment of isolated paralysis of trapezius. In the presence of an additional serratus anterior palsy or weak rhomboid muscles, the procedure is less successful in restoring shoulder function.

J Bone Joint Surg [Br] 2003;85-B:1141-5.

Received 17 January 2003; Accepted after revision 9 July 2003

Non-operative treatment for paralysis of the trapezius muscle, including strengthening of the remaining thoracoscapular muscles, does not satisfactorily compensate for the

missing muscle function and gives unsatisfactory overall clinical results.^{1,2} In 1924, Eden³ described the clinical syndrome of paralysis of the trapezius muscle resulting from surgical injury to the spinal accessory nerve and proposed a reconstruction by levator scapulae and rhomboid tendon transfer. He described two patients who suffered from pain in the shoulder, radiating into the arm, after excision of cervical lymph nodes. Both patients had pain, initially on carrying weights but later also at rest. They were unable to abduct their arm more than 45° and felt weakness upon turning the head towards the unaffected side. Physical examination revealed a drooping arm with asymmetry of the neck and shoulder contour, and winging and lateral displacement of the scapula. He treated these patients by transferring the tendon of the levator scapulae to the acromion and the tendon of both rhomboids to the central part of the body of the scapula. Both patients had relief of pain and were able to abduct their arm above the horizontal. Later Lange⁴ and Francillon⁵ reported encouraging short-term results with this procedure and, more recently, Bigliani et al⁶ reported favourable results using a modified Eden-Lange procedure.

As paralysis of the trapezius muscle is rare and long-term results of treatment are scarce in the medical literature, we have reviewed our experience of trapezius paralysis and report the final results of 16 patients at a mean follow-up of 29 years.

Patients and Methods

Complete paralysis of the trapezius muscle was identified in 16 patients. Data on the aetiology of the spinal accessory nerve palsy and the complaints of the patients were obtained from a retrospective review of the medical records.

Paralysis developed after biopsy of lymph nodes behind the sternocleidomastoid muscle in 13 patients, after surgical excision of a dermoid cyst of the neck in one, blunt trauma to the neck in one, and after a viral infection in one. Most patients complained of a dull pain reaching from the scapula to the forearm and a feeling of a heavy weight in the arm, which was cumbersome to control (13 of 16). Pain radiating to the hand was noted by 11 patients, but three were pain-free. None had a markedly stiff shoulder, but passive shoulder movement was slightly reduced in two. Every patient had drooping of the shoulder girdle, winging of the medial

J. Romero, MD, Orthopaedic Surgeon
C. Gerber, MD, Professor and Chairman
Department of Orthopaedic Surgery, University of Zurich, Balgrist, Forchstrasse 340, CH-8008 Zurich, Switzerland.

Correspondence should be sent to Dr J. Romero.

©2003 British Editorial Society of Bone and Joint Surgery
doi:10.1302/0301-620X.85B8.14179 \$2.00

Table I. Details of 12 patients who underwent levator scapulae and rhomboid transfer for paralysis of trapezius

Case	Gender	Age (yrs)	Pre-operative EMG	Age at surgery (yrs)	Follow-up (yrs)	Data source at follow-up
1	F	45	No	12	32	Examination
2	F	67	Paralysis of the trapezius, serratus and rhomboid muscles	29	38	Examination
3	F	39	Paralysis of the trapezius, serratus and rhomboid muscles	26	13	Telephone interview
4	F	75	No	41	34	Examination
5	F	72	Isolated paralysis of the trapezius muscle	43	29	Examination
6	M	59	No	26	33	Telephone interview
7	F	54	No	19	35	Examination
8	F	53	No	19	34	Examination
9	M	56	No	21	35	Examination
10	F	64	Isolated paralysis of the trapezius muscle	27	37	Examination
11	M	45	No	11	34	Interview with relatives
12	F	50	No	17	34	Examination

Outcome data							
Pain	Overhead activities	Constant score		Scapular rotation (degrees)		Additional operation	Final result
		Index	Contralateral	Index	Contralateral		
None	Yes	80°	84°	-	-	No	Excellent
None	No	27°	42°	-	-	No	Fair
Moderate	No	-	-	-	-	Fascial sling	Poor
None	No	64.5°	78°	40°	31.5°	No	Fair
None	Yes	73.5°	79°	44°	64°	No	Excellent
None	Yes	-	-	-	-	No	Excellent
None	Yes	87°	88°	48°	48.5°	No	Excellent
None	Yes	73.5°	82°	40.5°	49.5°	No	Excellent
None	Yes	70.5°	92°	53°	63°	No	Excellent
None	Yes	82°	83°	44°	40°	No	Excellent
None	Yes	-	-	-	-	No	Excellent
None	Yes	81.5°	89°	47.6°	62.5°	No	Excellent

border of the scapula, a prominence of the inferior pole and rotation of the scapula when seen from behind. All were unable to elevate and abduct their arm more than 90° or carry out overhead activities, and shrugging of the shoulder was impossible.

The diagnosis was not made initially in 14 patients who were referred after more than a year of unsuccessful physiotherapy. Electromyography was undertaken on four patients in whom there was a suspicion of other nerve injury, two patients had additional deficits in the serratus and rhomboid muscles. None of the 16 patients had been operated on for trapezius paralysis. Surgical treatment was proposed to all patients; 12 accepted (Table I) and were operated upon at a mean age of 25 years (11 to 43). The dominant shoulder was affected in eight of these 12 patients. Four patients with a mean age of 23 years (18 to 34) declined surgical treatment.

The surgical procedure was that described by Eden³ and Lange⁴ in which the levator scapulae and rhomboid muscles are transposed laterally. The ends of the tendons of the levator scapulae and rhomboid muscles are detached, with a thin bone chip, from their insertion into the medial border of the scapula. Transosseous sutures are used to secure the tendon of the levator scapulae to the lateral aspect of the spine of

the scapula and of the rhomboid muscles to the infraspinatus fossa, having elevated the infraspinatus from its fossa. Post-operatively, the arm is supported in an abduction splint for six weeks, followed by passive and active exercises for the shoulder.

The outcome of the operatively treated patients was assessed by personal interview and physical examination in nine patients after a mean interval of 34 years (29 to 38). A telephone interview took place with two further patients, at 13 (case 3) and 33 years (case 6) after the operation. An interview with relatives yielded information for the last operatively treated patient (case 11), who lives overseas, 34 years after the operation.

For the patients who underwent examination, shoulder function of the affected and unaffected sides was scored according to Constant, and the Mann-Whitney U test was used for comparison. Anteroposterior radiographs were taken of the shoulder with the arm at the side and again in maximum active abduction. We determined the angle between a line connecting the cranial and caudal ends of the glenoid, and a vertical axial line. The difference between the angles measured on the two films was calculated. The opposite shoulder was examined in the same way and served as a control. The Mann-Whitney U test was used to compare

Fig. 1

Photograph of a 64-year-old woman (case 10) who is able to abduct her arm above the horizontal. She underwent the Eden-Lange procedure of the right shoulder 37 years before, at the age of 27 years, for paralysis of the trapezius muscle after cervical lymph node biopsy.

scapular rotation of the affected with the contralateral healthy shoulder.

Of the four patients who were treated non-operatively, outcome data were obtained from a review of the records of three patients, recorded at two, five and 19 years. One patient was interviewed over the phone, 33 years after diagnosis.

Results

Of the patients who were treated non-operatively, two had become pain-free, but neither could use his arm above the horizontal. The results of the operative treatment are summarised in Table I. One woman (case 3) who had been operated on at the age of 26 years, refused examination 13 years later because she was disappointed with the outcome. She had complained of excessive scapular winging and had undergone further surgery involving a fascial sling procedure, seven years after the index operation; she was still in pain and was unable to use her arm overhead at the final follow-up. Another woman (case 6), who had been operated upon 33 years before, was too busy professionally to attend for review, but reported subjectively an excellent outcome. She was free of pain and enjoyed unrestricted overhead movement of the arm. The parents of the surgically treated patient (case 11), who had left the country, reported that they had visited their son often and that he had no pain or restriction of shoulder function, 34 years after the operation.

No intra-operative or early post-operative complications were recorded or remembered. None of the 12 patients com-

plained of stiffness after removal of the splint; nine patients had an excellent overall result. They were able to abduct their arm above the horizontal (Fig. 1) and experienced no limitation of activities of daily living. The adult patients returned to the same profession or employment as before the accessory nerve palsy. They were able to participate in recreational sporting activities without restriction. There were no professional athletes in the series. The two patients who had been operated upon as children, at the ages of 11 (case 11) and 12 years (case 1), were satisfied with the long-term result, 34 and 32 years, respectively, after the procedure.

The median Constant score for the nine surgically treated patients, who were examined personally, was 73.5 points for the operated arm compared with 83.0 for the opposite arm. There was no significant difference between the treated and the contralateral, healthy arm ($p = 0.07$). All, except the patient who had undergone an additional operation (case 3), were pain-free. The patient who had undergone further surgery and two other patients complained of impairment of overhead activities. In two (cases 2 and 3), pre-operative electromyography (EMG) revealed additional injury to the long thoracic and dorsal scapular nerve. At final follow-up the rhomboids and the serratus anterior muscles were weak.

The radiographs revealed no degenerative changes in any of the seven patients who underwent radiological examination at follow-up; two patients had declined radiological examination. The radiologically measured scapular rotation was 44.0° (median) for the operated shoulder, compared with 49.5° for the opposite shoulder. This difference was not statistically significant ($p = 0.259$).

Discussion

The trapezius muscle contributes greatly to the dynamic equilibrium about the shoulder. It consists of a cranial portion with descending fibres, a middle portion with transverse and a caudal portion with ascending fibres. The descending part has its origin from the occiput and the spinous processes of C1 to C6, and its insertion into the clavicle. The trapezius and subclavius muscles are the only muscles of the shoulder girdle which have no direct contact with the scapula itself. The upper portion of trapezius pulls the clavicle cranially in an oblique direction toward the midline. Due to the firm acromioclavicular and coracoclavicular connections, the scapula is rotated, carrying the glenoid into an external and forward orientation which facilitates elevation of the arm.

Motor innervation of trapezius is from the spinal accessory nerve.⁷ Proprioceptive fibres arise from branches of the third and fourth cervical roots. The accessory nerve is susceptible to injury since it lies superficially in the subcutaneous tissue of the posterior triangle. Although efforts are made to preserve the nerve during surgical procedures in this region, it may occasionally be sacrificed intentionally during radical neck dissection for cancer.⁸⁻¹⁵ Most com-

monly, however, even minor surgical procedures such as lymph node biopsies or excision of benign tumours, are associated with accidental damage to the spinal accessory nerve.^{1,16-24} External trauma may cause nerve injury and, in some patients, a palsy may occur without any known aetiology.²⁵⁻²⁷ Scapulothoracic muscle imbalance, as a result of a paralysis of trapezius, affects movement of the glenohumeral joint and function of the arm. In addition, the arm becomes painful, probably because of traction on the brachial plexus. Function does not improve or recover over time, although pain may subside.

The diagnosis is often delayed. In our series, incorrect initial diagnosis was the rule rather than the exception. If, however, the complex function of the different parts of the muscle is understood, clinical diagnosis of paralysis is easy. Drooping of the shoulder, asymmetry of the neckline, winging of the scapula and weakness of flexion and abduction are pathognomonic signs. The patient should be examined from behind, and comparison made between the two sides. Electromyography is not essential to establish the diagnosis, but may be valuable if additional nerve lesions are suspected. In this series, the two patients who had had additional nerve injuries, as documented by EMG, had poor results. It is felt that the diagnosis of additional nerve lesions is, therefore, relevant.

Lateral transfer of the levator scapulae and rhomboid muscles, as described by Lange²⁸ in his textbook of 1951 has provided excellent long-term results in this series of patients comprising two paediatric and seven adult patients. This is achieved by compensating for the isolated paralysis of trapezius, and demonstrated by clinical and radiological measurement of scapular rotation during abduction. Bigliani et al,⁶ proposed a modification of the original Eden-Lange procedure, consisting of a transfer of rhomboid minor cephalad to the scapular spine, and closing the gap between it and levator scapulae. They believe that placement of the transfer in this position substitutes more efficiently for the middle part of trapezius, which has a different function from the ascending caudal part. Indeed, the transverse portion of the muscle runs horizontally from its origin at the upper thoracic vertebrae to the scapular spine and the acromion. It adducts the scapula and stabilises the medial border of the scapula. The ascending caudal part originates from the third to the 11th thoracic vertebrae, and inserts into the medial aspect of the spine of the scapula, depressing it, and pulling it medially and downward. This function would be replaced by the transferred rhomboid major. The theoretical concerns addressed by this modification were not identified as a clinical problem in the patients in this series, and the functional results obtained would not suggest a necessity to modify the original technique. We have not, however, specifically compared the original with the modified technique.

Bigliani et al,⁶ reported poorer results in patients with concomitant weakness of serratus anterior. They believed that it was caused by traction on the long thoracic nerve by the unsupported limb. This may also apply for the dorsal

scapular nerve which originates from the fifth cervical root, as does the long thoracic nerve. Both the levator scapulae and rhomboid muscles are supplied by the dorsal scapular nerve. It is, therefore, possible that the long thoracic and dorsal scapular nerves may be damaged in the same manner. Our findings confirm much less favourable results in the presence of dysfunction of the dorsal scapular and/or long thoracic nerve, so that the transfer should probably only be recommended and used with great caution in the presence of such additional pathology.

All but one of the patients in the present report sustained either an operative or external trauma to the neck which was responsible for the disabling pain and weakness of the shoulder and the arm. If the diagnosis is made within 12 months of injury, repair or grafting of the nerve may have its role, although results have shown variable success.^{1,12,13,16,19,29} None of the patients in this series underwent nerve repair, grafting or had been previously operated on for the same condition.

The Eden-Lange procedure has proved to be a rewarding operation for adults and children with impaired arm function as a consequence of irreparable damage to the spinal accessory nerve. Functional recovery and substantial relief of pain for more than 30 years can be achieved if there is no additional nerve palsy.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References

1. Dunn AW. Trapezius paralysis after minor surgical procedures in the posterior cervical triangle. *South Med J* 1974;67:312-5.
2. Bigliani LU, Perez-Sanz JR, Wolfe IN. Treatment of trapezius paralysis. *J Bone Joint Surg [Am]* 1985;67-A:871-7.
3. Eden R. Zur Behandlung der Trapeziuslähmung mittelst Muselpplastik. *Deutsche Zeitschr Chir* 1924;184:387-397.
4. Lange M. Die Behandlung der irreparablen Trapeziuslähmung. *Langenbecks Arch Klin Chir* 1951;270:437-439.
5. Francillon MR. Zur Behandlung der Accessoriuslähmung. *Schweiz Med Wochenschr* 1955;33:787-788.
6. Bigliani LU, Compito CA, Duralde XA, Wolfe IN. Transfer of the levator scapulae, rhomboid major, and rhomboid minor for paralysis of the trapezius. *J Bone Joint Surg [Am]* 1996;78:1534-40.
7. Green RF, Brien M. Accessory nerve latency to the middle and lower trapezius. *Arch Phys Med Rehabil* 1985;66:23-4.
8. Bocca E, Pignataro O. A conservation technique in radical neck dissection. *Ann Otol Rhinol Laryngol* 1967;76:975-87.
9. Skolnik EM, Yee KF, Friedman M, Golden TA. The posterior triangle in radical neck surgery. *Arch Otolaryngol* 1976;102:1-4.
10. Roy PH, Bearhs OH. Spinal accessory nerve in radical neck dissections. *Am J Surg* 1969;118:800-4.
11. Williams WW, Twyman RS, Donell ST, Burch R. The posterior triangle and the painful shoulder: spinal accessory nerve injury. *Ann Roy Coll Surg* 1996;78:521-5.
12. Anderson R, Flowers RS. Free grafts of the spinal accessory nerve during radical neck dissection. *Am J Surg* 1969;118:796-9.
13. Harris HH, Dickey JR. Nerve grafting to restore function of trapezius muscle after radical neck dissection: a preliminary report. *Ann Otol Rhinol Laryngol* 1965;74:880-6.
14. Hoaglund FT, Duthie RB. Surgical reconstruction for shoulder pain after radical neck dissection. *Am J Surg* 1996;112:522-6.
15. Carenfelt C, Eliasson K. Occurrence, duration and prognosis of unexpected accessory nerve paresis in radical neck dissection. *Acta Otolaryngol* 1980;90:470-3.

16. **Woodhall B.** Trapezius paralysis following minor surgical procedures in the posterior cervical triangle: results following cranial nerve suture. *Ann Surg* 1952;136:375-80.
17. **Battista AF.** Complications of biopsy of the cervical lymph node. *Surg Gynec Obstet.* 1991;173:142-6.
18. **Hoffmann JC.** Permanent paralysis of the accessory nerve after cannulation of the jugular vein (letter). *Anaesthesiology* 1983;58:583-4.
19. **Olarte M, Adams D.** Accessory nerve palsy. *J Neurol Neurosurg Psychiat* 1977;40:1113-6.
20. **Tucker JA, Gee W, Nicholas GG, McDonald KM, Goodreau JJ.** Accessory nerve injury during carotid endarterectomy. *J Vasc Surg* 1987;5:440-4.
21. **Wright TA.** Accessory spinal nerve injury. *Clin Orthop* 1975;108:15-8.
22. **Autran JM, Hazan A, Senechaut JP, Peytral C.** Postoperative iatrogenic lesions of the external branch of the accessory spinal nerve. *Ann Otolaryngol Chir Cervicofac* 1988;105:339-42.
23. **Mead S.** Posterior triangle operations and trapezius paralysis. *Ann Arch Surg* 1952;64:752-5.
24. **Woodhall B.** Operative injury to the accessory nerve in the posterior cervical triangle. *Arch Surg* 1957;74:122-7.
25. **Bateman JE.** Nerve injuries about the shoulder in sports. *J Bone Joint Surg [Am]* 1967;49-A:785-92.
26. **Logigian EL, McInnes JM, Berger AR, et al.** Stretch-induced spinal accessory nerve palsy. *Muscle Nerve* 1988;11:146-50.
27. **Eisen A, Bertrand G.** Isolated accessory nerve palsy of spontaneous origin: a clinical and electromyographic study. *Arch Neurol* 1972;27:496-502.
28. **Lange M.** Orthopädisch-chirurgische Operationslehre. *Verlag J F Bergmann, München*, 1951.
29. **Vastamäki M, Solonern KA.** Accessory nerve injury. *Acta Orthop Scand* 1984;55:296-9.