MODIFICATION OF THE L'EPISCOPO PROCEDURE FOR
BRACHIAL PLEXUS BIRTH PALSY

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We reviewed 19 children who had undergone a new modification of the L'Episcopo procedure for obstetric brachial plexus palsy. Through an axillary approach the latissimus dorsi tendon was re-routed anteriorly to the humerus and then anastomosed to the teres major tendon routed posteriorly. At an average follow-up of four years two months, the mean increase in shoulder abduction was 26° and the mean increase in external rotation was 29°. No neurovascular injury or postoperative infection occurred. Two patients had complications, and five did not gain from the procedure. The modified operation was relatively easier to perform and provided excellent cosmesis.

Smellie (1764) first described birth injuries of the brachial plexus and numerous reports have discussed the pathological anatomy and management of these lesions (Erb 1874; Duchenne 1883; Klumpke 1885; Wickstrom, Haslam and Hutchinson 1955; Wickstrom 1962; Hoffer, Wickenden and Roper 1978; Meyer 1986). Although the severity as well as the incidence of birth-related brachial plexus injuries has decreased with refinements in obstetric care (Specht 1975; Hardy 1981; Zancolli 1981), restoration of good function to the severely affected upper arm still poses problems. The main aim of surgery is to increase shoulder motion to allow the hand to reach the head (Zancolli 1981). Most procedures seek to increase abduction and external rotation of the shoulder (Riordan and Bayne 1986).

The operations devised by Sever (1918) and L'Episcopo (1934) have been used for more than 50 years. Sever recommended cutting the subscapularis and pectoralis major muscles to release the adduction contracture. The L'Episcopo technique involves detaching the latissimus dorsi and teres major muscles from their insertions and transferring them posteriorly and laterally so that they become external rotators. The original procedure utilised anterior and posterior incisions and the tendons were sutured in their new position under an osteoperiosteal flap. The disadvantages are the need for the two incisions with the risk of hypertrophic scarring of the anterior incision, and the difficulty of attaching the transferred tendon directly to bone. A modification of the procedure was developed by one of us (DCR) to simplify it and to improve the strength of the muscle transfer. We report the results in 19 patients.

PATIENTS AND METHODS

During the period 1977 to 1987, 21 children underwent the modified L'Episcopo procedure at the Shriners Hospital for Crippled Children, Shreveport; 19 were available for follow-up (12 girls and seven boys). Their mean age at first evaluation was four years four months (three months to nine years three months). The mean age at operation was five years 11 months (two years to ten years five months). Eighteen patients had Erb's palsy (involvement of C5 and C6 nerve roots), and one (case 19) had whole plexus palsy (involvement of C5 through to T1 nerve roots).

Those patients who were first seen in infancy or early childhood were treated by passive and active range-of-motion exercises to prevent contracture and maintain muscle function. Serial muscle examinations showed that many developed improved muscle function with increasing age. When the improvement in function ceased, and if there was good sensory and motor function in the hand, they were considered for reconstructive surgery. Four patients (cases 4, 13, 15 and 17) initially presented at eight years of age or later and another (case 11), who was
first seen at the age of one year three months, was subsequently lost to follow-up for eight years. These older children were considered to be candidates for surgery by the criteria outlined above.

Each patient was evaluated by the surgeon and the occupational therapist before operation. We recorded active and passive shoulder motion, grip strength, and hand co-ordination and sensation. The average active shoulder abduction was 49° (0 to 90), and the mean active external rotation was 3° (−45 to 30). Anteroposterior, lateral and axillary radiographs of the shoulder were obtained to ascertain the shape and position of the humeral head (Fig. 1). There were no cases of shoulder dislocation, but two patients (cases 2 and 12) had superior displacement of the humeral head. Student's t-test was used to determine statistical significance between pre-operative and postoperative shoulder motion.

**Operative technique.** The patient is positioned supine on the operating table with a small sandbag beneath the shoulder. The paralysed limb is draped free, and the axillary skin along the intended line of incision is infiltrated with 1% lidocaine with adrenaline, diluted 1:3 with normal saline. An axillary incision, 5 to 6 cm in length, is made transversely from the anterior to the posterior axillary fold. By blunt dissection, taking care to preserve the intercostobrachial nerves in the subcutaneous tissue, the neurovascular bundle is identified and retracted anteriorly. The latissimus dorsi and teres major muscles are identified and cleaned of connective tissue from their musculotendinous junctions to their insertions on the proximal humerus (Fig. 2). The tendon of latissimus dorsi is dissected free from the tendon of the teres major and then transected at its musculotendinous

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**Table 1.** Clinical details and results in 19 patients who had the modified L'Episcopo procedure

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<tr>
<th>Case</th>
<th>Sex</th>
<th>Age at operation (yr mth)</th>
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<th>Active external rotation (degrees)</th>
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The latissimus muscle belly is sutured to the teres major muscle (Fig. 3) which is then detached at its bony insertion. Tag sutures of O-Ethibond (Ethicon Inc, Somerville, New Jersey) are placed in the free ends of the teres major and latissimus dorsi tendons (the tendon of the latissimus dorsi remains attached to the humerus through its normal insertion). Using blunt finger-tip dissection, a circumferential tunnel adjacent to bone is created proximal to the pectoralis major insertion. With the fingertip as a reference, a 3 cm incision is made over the proximal lateral deltoid ending approximately 5 cm distal to the acromion, and thus proximal to the axillary nerve. Blunt dissection is carried down to the fingertip. Using the tag suture, the latissimus dorsi tendon is now passed anteriorly to the humerus through the previously created tunnel and into the lateral deltoid incision (Fig. 4). The teres major muscle, now conjoined with the latissimus dorsi is routed posteriorly to the humerus through the tunnel and also brought into the lateral incision (Fig. 4). The tag sutures of the latissimus dorsi tendon and teres major are tied together to bring these structures into continuity (Fig. 5). Two additional figure-of-eight sutures are then placed and the fibres of the deltoid muscle are allowed to re-approximate over this anastomosis.

**Postoperative management.** Postoperatively, the shoulder was immobilised in a shoulder spica cast in 70° abduction and 45° external rotation for eight weeks. The patients were then readmitted to hospital for supervised physiotherapy. On the day after removal of the cast the range of active and passive movements was recorded and the strength of the humeral external rotators and shoulder abductors assessed. Gentle passive range-of-motion exercises were started including active humeral external rotation and shoulder abduction against resistance. Thera-Band rubber strips (Fred Sammons Inc, Burr...

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**Figures:**

Figure 2 – Identification of the latissimus dorsi and teres major muscles from their musculotendinous junctions to the humeral insertion of the conjoined tendon. Figure 3 – The latissimus dorsi is divided at its musculotendinous junction, and its muscle belly is sutured to that of the teres major. Tag sutures are placed in the free ends of the latissimus dorsi and teres major tendons. Figure 4 – The tendon of the now conjoined latissimus dorsi and teres major muscles is routed posteriorly to the lateral incision. The latissimus dorsi tendon, still attached at its insertion, is passed anteriorly to the lateral incision. Figure 5 – The tag sutures are tied together to bring the tendons into continuity. The inset shows a cross-section of the completed anastomosis.
Ridge, Illinois) were used in reaching manoeuvres to promote bicipital abduction and external rotation of the shoulder and the occupational therapist instructed the patient in activities such as dressing and personal hygiene. After one week the patients were discharged with a prescription to continue passive and active exercises. They were seen at three months, six months, and thereafter, every 12 months.

RESULTS

Patients were evaluated by the surgeons, the physiotherapists and the occupational therapists. The mean follow-up was four years and two months.

The average postoperative external rotation was 32° (range 60 to 90), an increase of 29° (p < 0.05; Table I). Postoperative active abduction averaged 74° (range 25 to 170), an increase of 26° (p < 0.005; Table I).

Five patients did not gain any improvement from the procedure (cases 4, 8, 9, 11 and 19). One of these (case 19) had a whole plexus palsy and three (cases 4, 9 and 11) were older than six years at the time of surgery. Flattening of the humeral head and glenohumeral incongruity were seen on the pre-operative radiographs of these four relatively older patients. There was no humeral head deformity pre-operatively in the fifth patient (case 8) who was operated on at the age of two years. Two of these five patients (cases 8 and 9) subsequently underwent derotational osteotomy of the humerus for persistent internal rotational deformity.

Complications. Two of the 19 patients had complications. One (case 3) required subscapularis tenolysis two years later, resulting in active external rotation of 85° and abduction of 115°. The other patient (case 15) had partial rupture or attenuation of the tendon anastomosis but nevertheless had significant gains in active abduction (25°) and external rotation (20°). No patient required blood transfusion, and there were no cases of postoperative infection or of neurovascular injury.

DISCUSSION

The modified technique for converting the latissimus dorsi and teres major muscles into external rotators of the shoulder provides significant improvements in abduction and external rotation. The axillary approach makes the identification and dissection of latissimus dorsi and teres major relatively easy. The brachial artery and plexus can be readily identified and retracted anteriorly away from the area of dissection. The axillary incision also gives an excellent cosmetic result and avoids the risk of ugly scarring which can occur with the anterior approach.

The new technique of tendon transfer allows direct tendon-to-tendon anastomosis instead of suturing of the tendons either to an osteoperiosteal flap (L'Episcopo 1934), through drill holes to the humerus (Zachary 1947), or to the rotator cuff (Hoffer et al 1978). The anastomotic technique proved easy to do, and in only one case did the repair partially rupture.

Strecker et al (1988) recently reported their results with a combined Sever–L'Episcopo transfer in 18 patients followed up for an average of three years three months. There was a small average decrease in abduction postoperatively and an average gain of 56° of external rotation, but there was a 20% incidence of transient or permanent axillary nerve palsy. Hoffer et al (1978) using a modification of the Sever–L'Episcopo technique in which the latissimus dorsi and teres major tendons were transferred posteriorly to the rotator cuff, reported an average gain of 45° of active external rotation, and 64° of active abduction. Two of their 11 patients had less movement after surgery than before, but there were no serious complications.

The prognosis for neonatal brachial plexus palsy is much better than has been previously thought; most patients progress to complete recovery within one to two years (Jackson, Hoffer and Parrish 1988). In those with residual paralysis, several factors need to be considered before operating.

First, surgery should be undertaken before serious deformity has developed in the humerus. Persistent internal rotation causes torsion of the humerus, flattening of the humeral head and sometimes flattening of the glenoid (Riordan and Bayne 1986). Glenohumeral incongruity limits the potential gain of motion postoperatively. Secondly, surgery should take place when the child is old enough to co-operate with the physiotherapist. The youngest child in our series (two years old) was also the most unco-operative and did not benefit from the surgical procedure. Three to four years old is the best age. Thirdly, the lack of improvement in the one patient in this series who had whole plexus palsy, suggests that operative intervention is not indicated in such cases.

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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.

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