

## Brachial Plexus Birth Palsies

### RESULTS OF TENDON TRANSFERS TO THE ROTATOR CUFF

BY M. MARK HOFFER, M.D.\*, ROGER WICKENDEN, M.D.\*, AND BRYAN ROPER, M.D.\*, DOWNEY, CALIFORNIA

*From the Children's Orthopedic Service, Rancho Los Amigos Hospital, Downey*

There have been numerous reports on brachial plexus palsies secondary to birth injury<sup>1-3,5,7,9</sup> and several specific approaches to the treatment of the paralyzed shoulder have been suggested<sup>4,6,8,10,12,13,14,15</sup>. A new surgical procedure to improve these paralyzed shoulders was suggested to us by Roper, and in the present paper we describe the results of this operation in eleven children with Erb's palsy.

#### Clinical Material

Over the last ten years, we have followed thirty-nine children with birth-related brachial plexus palsies at Rancho Los Amigos Hospital. Their ages at first evaluation ranged from two weeks to ten years. Twenty-seven had so-called Erb's palsies (involvement of the fifth and sixth cervical nerve roots); four, posterior cord palsies; and eight, mixed and so-called Klumpke's palsies (involvement of the seventh and eighth cervical and first thoracic nerve roots).

elbow flexorplasties of the Steindler type, and eleven tendon transfers to the rotator cuff of the shoulder to strengthen external rotation. This paper is concerned with the eleven transfers to the cuff.

#### Treatment

##### *Preoperative Evaluation*

The ages of the eleven patients who had this procedure ranged from three to eight years and all eleven were evaluated preoperatively by the senior author (M. M. H.) and by occupational therapists. Anteroposterior and axillary view roentgenograms of the shoulder showed no dislocations. Physical examination revealed excellent sensibility and muscle function in the hand, an adduction-internal rotation contracture of the glenohumeral joint, and passive abduction of the arm from the body that averaged 74 degrees (range, 15 to 130 degrees). The deltoid was graded 3 or 4. The average passive external rotation of the shoulder was graded 0 (range, 20 to -25 degrees) and the

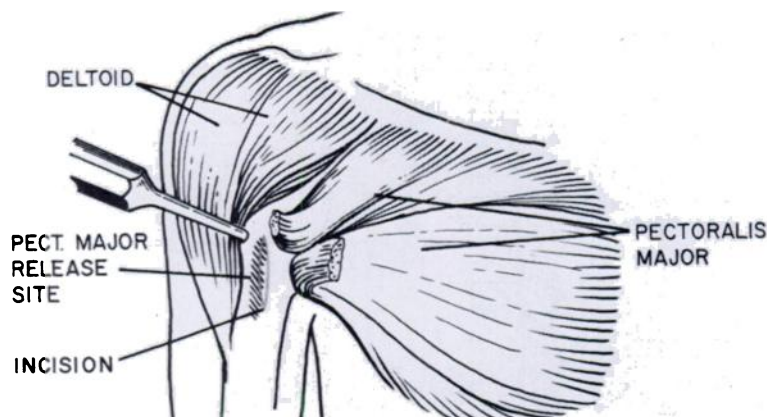


FIG. 1

Release of the pectoralis major through a small anterior axillary incision. The subscapularis is left intact.

For the first three to four years after onset of their palsy these children were treated with passive and active exercises, and with dynamic orthoses that substituted for weak muscles and encouraged use of the limb<sup>7</sup>. Serial muscle examinations showed that additional muscle function developed throughout this period. If at the end of this time there was good sensibility and muscle function in the hand, reconstructive surgery was considered. To date, in the group with Erb's palsy, we have performed four flexor carpi ulnaris transfers for weak wrist extension, three

external rotators were graded 1 or 0, while the latissimus dorsi and teres major were graded 4 or 5 in all eleven patients.

Contraindications to this procedure were considered to be impaired sensation and muscle function in the hand, a deltoid muscle of grade 2 or less, and a latissimus dorsi and teres minor graded less than 4.

##### *Surgical Treatment*

Prior to operation an attempt was made to correct the internal rotation-adduction contracture by applying a series of corrective shoulder spicas. In all but one case we

\* Rancho Los Amigos Hospital, 7601 East Imperial Highway, Downey, California 90242.

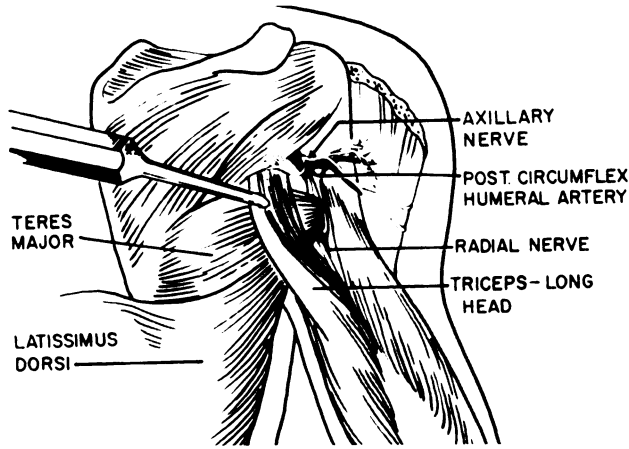


FIG. 2

Exposure of the latissimus dorsi and teres major through a second posterior axillary incision. Note the proximity of the radial nerve and the structures within the quadrilateral space to the insertions of these muscles.

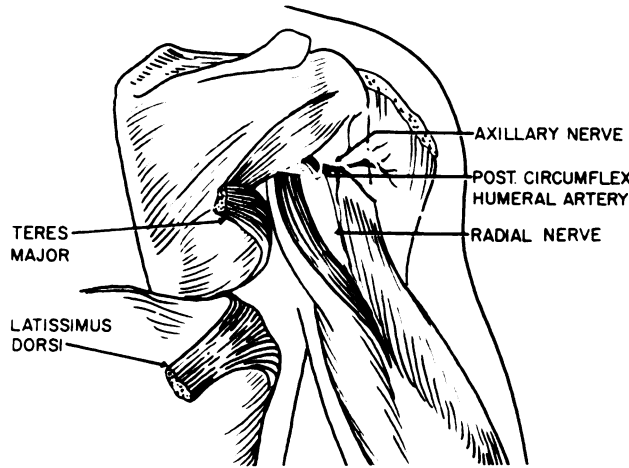


FIG. 3

Release of the latissimus dorsi and teres major, which are then re-routed posterior to the long head of the triceps.

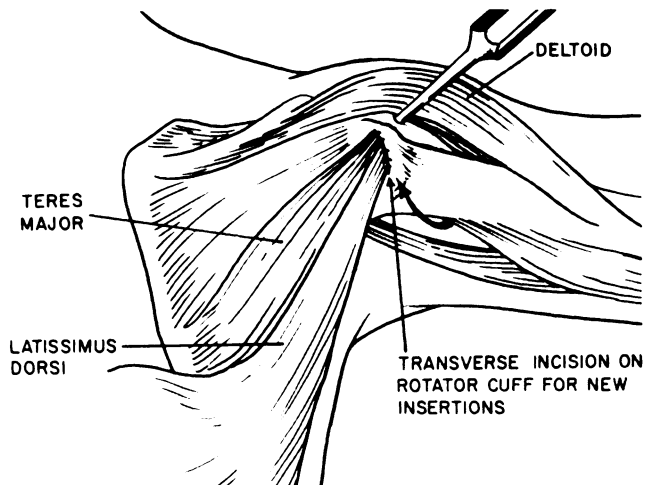


FIG. 4

Tendons of the teres major and latissimus dorsi sutured into a transverse incision near the attachment of the rotator cuff to the humerus. The site of the new insertion of these muscles should be placed as far superiorly and anteriorly as possible.

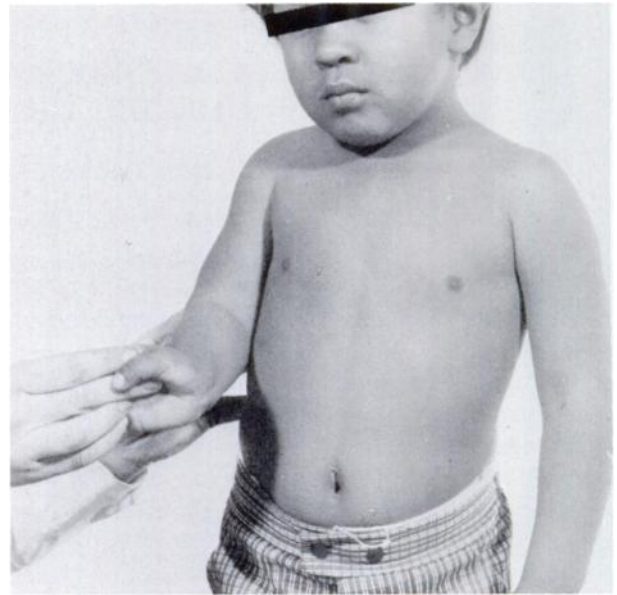


FIG. 5

Case 6. Preoperative external rotation and abduction.

were able to gain some external rotation beyond the neutral position. The final plaster spica was bivalved and used for postoperative immobilization.

At operation, with the patient side-lying and the paralyzed extremity draped free, a short anterior axillary incision was made and the tendinous insertion of the pectoralis major was released, allowing increased abduction and external rotation passively (Fig. 1). In none of our patients did we release the subscapularis muscle. Through a second posterior axillary incision the insertions of the latissimus dorsi and teres major were identified and released, permitting still more glenohumeral abduction. During this part of the procedure care was taken not to injure the radial nerve and the contents of the quadrilateral space (Figs. 2 and 3). The interval between the posteroinferior margin of the deltoid process and rotator cuff then



FIG. 6-A



FIG. 6-B

Figs. 6-A and 6-B: Case 6. Postoperative external rotation and abduction.

was developed, and the arm was maximally abducted and externally rotated. The released latissimus dorsi and teres major tendons then were transferred posterior to the long head of the triceps and sutured to the rotator cuff as high as possible. Usually the transfer was brought through two incisions in the cuff and sutured to itself (Fig. 4). By this

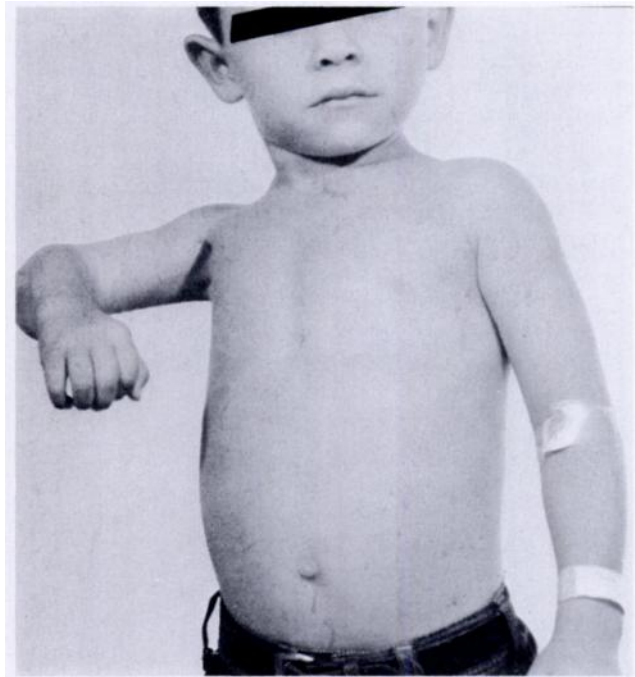


FIG. 7

Case 11. Attempted abduction and external rotation before operation.

maneuver the latissimus dorsi and teres major were converted to external rotators of the shoulder.

Postoperatively the shoulder was maintained in the abducted, externally rotated position in the spica cast for four weeks. The cast then was bivalved to allow the therapist to train the transfer. The abducted and externally rotated position was maintained until the transfer had grade-3 strength or better. Thereafter the arm was gradually brought down to the side. For at least six months postoperatively the patient wore a night-positioning airplane splint holding the shoulder in abduction and external rotation.

### Results

All patients were re-evaluated in February 1978. The



TABLE I

Case	Sex	Age at Operation (Yrs. + Mos.)	Length of Follow-up (Yrs. + Mos.)	Preoperative				Postoperative			
				External Passive Motion (Deg.)	Rotation Muscle Grade	Abduction Active Motion (Deg.)	Muscle Grade	External Active Motion (Deg.)	Rotation Muscle Grade	Abduction Active Motion (Deg.)	Muscle Grade
1	F	5 + 1	3 + 7	-20	0	70	3	20	3	150	4
2	M	4 + 9	6 + 8	-25	0	90	3	-10	4	160	4
3	M	8 + 4	5 + 1	20	1	80	3	70	3	180	4
4	M	7 + 7	5 + 7	0	0	130	3	50	4	120	3
5	M	5 + 4	3 + 11	20	1	30	2	60	3	130	3
6	M	3 + 6	2 + 3	0	0	75	3	80	4	120	3
7	M	5 + 4	4 + 8	0	0	15	2	80	4	90	3
8	F	4 + 0	3 + 3	5	0	75	3	35	3	140	3
9	F	5 + 0	3 + 0	0	0	90	3	40	3	150	4
10	M	3 + 0	2 + 4	-15	0	40	2	45	3	120	3
11	M	4 + 3	2 + 0	-20	0	120	3	25	4	160	4



FIG. 8

Case 11. Postoperative abduction and external rotation holding a weight of 450 grams.

follow-up ranged from two years to six years and eight months postoperatively. At follow-up, all patients had improved external rotation, the average postoperative active external rotation being 45 degrees (range, -10 to 80 degrees). The strength of the external rotators at this time

was grade 3 or better in all patients. Postoperative active abduction improved in ten of the eleven patients, the average abduction being 138 degrees, an over-all average gain of 64 degrees. The strength of abduction was grade 3 or better in all eleven patients (Table I).

Preoperatively these children had used their involved extremities as assisting hands generally on a table top and function was limited by lack of abduction and external rotation. Postoperatively those with grade-3 external rotator-abductor strength had improved placement and reaching function of their extremity (Figs. 5, 6-A, and 6-B) and those with grade-4 external rotator-adductor strength began lifting heavier objects overhead (Figs. 7 and 8).

There were no serious complications as a result of these eleven operative procedures, and no postoperative infections or other wound complications. One patient (Case 2) failed to gain external rotation beyond neutral. Perhaps subscapularis release in that patient would have produced a better result. Another patient (Case 4) had a relatively minor loss of abduction range, but good external rotator motion and power.

### Discussion

Transfer of the teres major and latissimus dorsi to the rotator cuff is a modification of previously devised procedures<sup>7,11,13</sup>. It has the advantage of being easily performed and it increases active external rotation. As a bonus, it enhances the stabilizing effect of the rotator cuff and increases glenohumeral abduction because it enables the deltoid to be more effective. Thus, the average gain in active abduction was 64 degrees and in external rotation, 45 degrees in these eleven patients. All transfers functioned at a level of grade 3 or better two years or more after operation.

NOTE: The authors would like to thank M. Mitani, O.T.R., and her staff for their assistance in the preparation of this manuscript.

### References

- ADLER, J. B., and PATTERSON, R. L., JR.: Erb's Palsy. Long-Term Results of Treatment in Eighty-eight Cases. *J. Bone and Joint Surg.*, **49-A**: 1052-1064, Sept. 1967.
- AITKEN, JOHN: Deformity of the Elbow Joint as a Sequel to Erb's Obstetrical Paralysis. *J. Bone and Joint Surg.*, **34-B**: 352-365, Aug. 1952.
- CHUNG, S. M. K., and NISSENBAUM, M. M.: Obstetrical Paralysis. *Orthop. Clin. North America*, **6**: 393-399, 1975.
- DiPALMA, A. F.: *Surgery of the Shoulder*, Ed. 2, pp. 523-533. Philadelphia, J. B. Lippincott, 1973.
- ESQ, G. D.: Brachial Plexus Palsy in Newborn Infants. *Pediatrics*, **48**: 18-28, 1971.

6. FAIRBANK, H. A. T.: Birth Palsy: Subluxation of the Shoulder-Joint in Infants and Young Children. *Lancet*, **1**: 1217-1223, 1913.
7. HSU, J. D.; PERRY, J.; and BARBER, L.: The Use of Orthoses in Patients with Brachial Plexus Lesions [abstract]. *Arch. Phys. Med. Rehab.*, **53**: 583, 1972.
8. L'EPISCOPO, J. B.: Tendon Transplantation in Obstetrical Paralysis. *Am. J. Surg.*, **25**: 122-125, 1934.
9. LEFFERT, R. D.: Brachial-Plexus Injuries. *New England J. Med.*, **291**: 1059-1067, 1974.
10. LIEBOLT, F. L., and FUREY, J. G.: Obstetrical Paralysis with Dislocation of the Shoulder. A Case Report. *J. Bone and Joint Surg.*, **35-A**: 227-230, Jan. 1953.
11. ROPER, B.: A New Operation to Improve Weakness of the Abductors and External Rotators of the Shoulder. *In Orthopedic Seminars, Rancho Los Amigos Hospital, Downey, California. Vol. IV, pp. 347-353, 1971.*
12. SEVER, J. W.: Obstetric Paralysis. Report of Eleven Hundred Cases. *J. Am. Med. Assn.*, **85**: 1862-1865, 1925.
13. WICKSTROM, JACK: Birth Injuries of the Brachial Plexus. Treatment of Defects in the Shoulder. *Clin. Orthop.*, **23**: 187-196, 1962.
14. WICKSTROM, JACK; HASLAM, E. T.; and HUTCHINSON, R. H.: The Surgical Management of Residual Deformities of the Shoulder following Birth Injuries of the Brachial Plexus. *J. Bone and Joint Surg.*, **37-A**: 27-36, Jan. 1955.
15. ZACHARY, R. B.: Transplantation of Teres Major and Latissimus Dorsi for Loss of External Rotation at Shoulder. *Lancet*, **2**: 757-758, 1947.