Acta Orthop. Belg., 2013, **79**, 355-360

Arthroscopic release of shoulder internal rotation contracture in children with brachial plexus birth palsy

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In children with brachial plexus birth palsy, the unopposed contraction of the shoulder internal rotators and adductors, secondary to weakness of the external rotators and abductors, leads to internal rotation contracture of the shoulder joint. Latissimus dorsi and/or teres major tendon transfers combined with *open* musculotendinous lengthening can improve shoulder function. Arthroscopic release of the anterior glenohumeral ligaments, capsule and upper intra-articular subscapularis tendon, with or without tendon transfer(s), can also be performed in young children to restore external rotation and abduction of the shoulder. Joint alignment, thus obtained, may provide improvement of glenohumeral joint morphology in the long term, although the extent of glenoid remodeling has not been well defined. The authors review and discuss the recent literature on arthroscopic release, with or without tendon transfers, for reduction of the glenohumeral joint subluxation and for restoration of external rotation. Both pathologies respond well to these procedures. According to the literature, arthroscopic release "alone" may be sufficient in children up to 3 years. This minimally invasive procedure restores function successfully, and leads to a centered glenohumeral joint and to glenoid remodeling. A successful arthroscopic release of the shoulder in a 2.5-year-old child is described.

Keywords : brachial plexus birth palsy ; arthroscopic release ; shoulder.

INTRODUCTION

Complicated delivery of an infant may lead to brachial plexus birth palsy. If not resolved spontaneously, severe functional impairment may occur from neuromuscular imbalance between antagonist shoulder muscles (*4,6,13,19*). The weak external rotators and abductors are overpowered by the intact internal rotators and adductors, resulting in shoulder internal rotation contracture and progressive deformity of the glenohumeral joint (*4,6,10,12,15,21*). In children with posterior humeral head subluxation or dislocation, early shoulder joint deformity may be seen by the age of 6 months, and glenoid deformity by the age of 2 years (*10,15,24*). Therefore, careful monitoring of these children during the first several

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No benefits or funds were received in support of this study.
The authors report no conflict of interests.

months of their lives is mandatory for early detection of progression of the deformity.

Surgical intervention is indicated when an internal rotator contracture and joint deformity are established (*1,6,7,13,18,22,24*). Several treatment options have been described including open or arthroscopic soft tissue release, various tendon transfers, and combined techniques (*6,18,24*). In children aged up to 3 years, arthroscopic release alone may restore function successfully, and lead to a centered glenohumeral joint with a beneficial effect on glenoid remodeling, according to Pearl *et al* (*13*).

For older children with advanced glenohumeral joint deformity and a failed soft tissue release procedure, humeral derotational osteotomy remains a valuable option to obtain a more functional arc of motion (*1,22*).

ILLUSTRATIVE CASE

A 2.5-year-old boy was admitted with shoulder internal rotation contracture secondary to brachial plexus birth palsy. He had undergone more than 6 months of intense stretching exercises under physiotherapeutic supervision, without any improvement. Clinical examination showed the typical trumpet sign (Fig. 1). Active external rotation was -30°, active elevation 90°. The Mallet score (*15*) was 12 points. The Mallet score is a reliable instrument to assess upper limb function in children with brachial plexus birth palsy. It assesses five different functions (global abduction, global external rotation, hand to mouth, hand to neck, and hand to spine active range of motion). Every function is rated from 1 (no function) to 5 points (normal function). As to glenohumeral joint deformity, magnetic resonance imaging (MRI) showed a glenoid retroversion (GRV) of -19°, with 25% of the humeral head lying anterior to the middle of the glenoid fossa (PHHA = percentage of the humeral head anterior to the middle of the glenoid fossa). Arthroscopic release was decided. The parents were informed that a second operation (tendon transfer) might be necessary in the future and gave their written informed consent for the data to be included in this study. This study was approved by the Institutional Review Board/Ethics Committee of the authors' institution.

Fig. 1. — The trumpet sign : shoulder abduction to bring the hand to the mouth, as if playing a trumpet, to compensate for loss of external rotation.

Surgical technique

Passive external rotation (with the arm at the side, and at 90° of abduction) and passive abduction of the shoulder were evaluated under general anaesthesia, with the patient in the lateral decubitus position. After identifying the landmarks, arthroscopy was performed with a small joint 2.7 mm arthroscope. The glenohumeral joint was distended with 20 ml of saline, using a 20G spinal needle. The posterior portal was created at the posterolateral corner of the acromion, taking care not going too low, to avoid injury to the articular surface. Because of the contracture, an assistant held the arm in approximately 90° of abduction while applying longitudinal traction, to facilitate entry of the arthroscope

Fig. 2. — Postoperatively : shoulder spica cast in 90° of abduction and 70° of external rotation for 4 weeks.

into the joint through the posterior portal. The anterior portal was placed under arthroscopic visualisation from the posterior portal, with the aid of a spinal needle.

The anterior capsule, anterior glenohumeral ligaments, rotator interval and subscapularis tendon were identified, and an electrocautery was introduced through the anterior portal. The thickened superior and middle glenohumeral ligaments along with the upper intra-articular portion of the subscapularis tendon were released. Then, the transition of the subscapularis tendon to its muscular portion was identified, and release continued solely to the capsule, taking care to preserve the inferior and lateral portions of the subscapularis tendon to maintain active internal rotation. An arthroscopic punch was then used to release the inferior glenohumeral ligament taking care not to injure the axillary nerve. Finally, the arthroscopic instruments were removed, and manipulation of the shoulder joint was done with the arm at the side, and also with the arm at 90° of elevation. An audible click was noted, suggesting joint reduction ; passive external rotation of > 70° was obtained, suggesting that no additional release of the subscapularis tendon or the axillary pouch was necessary.

Postoperatively, the shoulder was immobilised in a shoulder spica cast in 90° of abduction and 70° of external rotation for 4 weeks (Fig. 2). At follow-up after 18 months, external rotation and active elevation of the shoulder were 45° and 130°, respectively (Fig. 3), and the Mallet score reached 17 points. Internal rotation was within normal limits (Fig. 4). The parents were very satisfied with the end result of the operation and the functional improvement of their child. However, they did not agree with a postoperative MRI scan to evaluate the glenoid deformity, because of possible anaesthesia-related problems.

DISCUSSION

Brachial plexus birth palsy is the most common traumatic nerve injury during labor, occurring in 0.87 to 2.5 per 1000 live births (*3,17*). It usually involves the C5 and C6 nerve roots with or without C7 involvement. Global palsies (C5-T1) are infrequent and are associated with a worse prognosis, especially if Horner's syndrome or phrenic nerve palsy are present (*16,22*). Most cases resolve spontaneously during the first few months. During that time period, physical therapy is indicated to prevent shoulder and upper extremity contractures, until normal motor function is restored. Unfortunately, some children experience persistent internal rotation contractures which may lead to posterior humeral head subluxation and glenoid retroversion (*24*). Therefore, prevention of deformity through shoulder joint realignment and restoration of a maximal range of motion are important for long-term joint remodeling (*5*).

Several surgical techniques have been described to achieve shoulder alignment and function, depending on age and degree of glenoid deformity (*2,9,11,14,15,19,24*). Tendon transfers can improve range of motion but do not restore normal glenohumeral joint alignment. This may explain the loss of clinical benefit over time, raising concern about potential long term joint sequelae (*11*). *Open* shoulder joint reduction combined with musculotendinous lengthening and/or tendon transfers have also been described (*5,19,24*). Van der Sluijs *et al* (*24*) reported a significant increase in the Mallet score in 19 patients who underwent open reduction with subscapularis tendon lengthening ; however, 42% of

Fig. 3. — Improved external rotation and elevation at 18-month follow-up.

Fig. 4. — Normal internal rotation at 18-month follow-up

their patients developed an external rotation contracture which did not resolve over time. Hui and Torode (*5*) reported a significant decrease of glenoid retroversion after open reduction with tendon lengthening, and Waters and Bae (*23*) reported improved clinical and radiographic variables with open joint reduction, plus latissimus dorsi and teres major tendon transfer.

Arthroscopic release with or without tendon transfers has also been reported (8,*9,13,14,15*) (Table I). Pearl *et al* (*14*) (Table I) studied 33 children, with a mean age of 3.7 years, who were treated with arthroscopic release with and without latissimus dorsi tendon transfer. Passive external rotation was restored up to 45° in all but one patient, after arthroscopic release ; yet no information concerning the postoperative status of the glenohumeral joint was provided. The same authors reported marked remodeling in 12 of 15 children with a nonconcentric joint at 2-year follow-up, after arthroscopic release with or without tendon transfers. Other authors reported rapid remodeling of the glenoid after arthroscopic shoulder joint reduction (7,*9,15*). Kozin *et al* (*8*) (Table I) showed significant improvement in clinical and radiologic outcome in 44 children treated with arthroscopic release with or without tendon transfer to restore glenohumeral joint alignment. At 1-year follow-up, the GRV (glenoid retroversion) improved from -34° to -19°, while the PHHA (percentage of the humeral head anterior to the middle of the glenoid fossa) improved from 19% to 33%, with significant benefit in shoulder joint function. The patient, presented in the illustrative case, experienced improvement in shoulder range of motion after arthroscopic anterior release without any tendon transfer. Although the authors cannot document any improvement of glenoid deformity, because a final MRI under anesthesia was refused by the parents, the improved shoulder function after the arthroscopic release probably was associated with joint realignment and/or glenoid remodeling.

Table I. — Studies on arthroscopic release of shoulder internal rotation contracture in children with brachial plexus birth palsy

Studies	Patients	Type of surgery	Age (mean, years)	FU (years)	PHHA (%)		Glenoid retroversion (degrees)		Deformity Waters *et al (21-23)*		External rotation (degrees)		Elevation (degrees)		Mallet score (total)	
					Preop.	Postop.	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.	Preop.	Postop.
Kozin *et al* (*8*)	44	Arthroscopic release (n = 28) Arthroscopic release/ tendon transfer (n = 16)	2.7	1	19 ± 12	33 ± 12	-34 ± 15	-19 ± 13	2.9 ± 1.0	1.9 ± 0.4	–26 ± 20	47 ± 17	112 ± 28	130 ± 38	12.7 ± 1.6	17.1 ± 1.4
Mehlman *et al* (*9*)	50	Arthroscopic release (n = 34) Arthroscopic release/ tendon transfer (n = 16)	5.1	2	30.5	38.8	-25	-14.1	2.8	1.9	–	–	–	–	12.6	16.3
Pearl *et al* (*14*)	33	Arthroscopic release only (n = 15)	1.4	2	–	–	–	–	Marked remodeling in 12 of 15 children with a pseudoglenoid deformity		-2	64	94	106	–	–
		Arthroscopic release/ late tendon transfer (n = 4)	1.8		–	–	–	–			-15	62	115	125	–	–
		Arthroscopic release/ tendon transfer (n = 14)	6.7		–	–	–	–			-24	56	121	124	–	–
Pedowitz *et al* (*15*)	22	Arthroscopic release (n = 7) Arthroscopic release/ tendon transfer (n = 15)	3.9	1 month (postop; imaging in spica cast)	15.6 ± 13.5	46.9 ± 11.2	-37 ± 15	-8 ± 8	–	–	–	–	–	–	–	–

FU : follow-up ; PHHA : percentage of the humeral head anterior to the middle of the glenoid fossa ; External rotation : passive external rotation with the arm at the side ; Elevation : active elevation against gravity (approximated by compelling the child to reach for objects overhead).

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