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ORIGINAL ARTICLE

Arthroscopic Treatment of Shoulder Internal Rotation Contracture In Children Secondary To Obstetric Brachial Plexus Birth Palsy

Ahmed Mostafa El-Feky[1], Omar Abd-Elwahab Kelany[1], Mohammed Mahmoud Mansour[1] and Amr Shihata El Hady[1*]

[1] Orthopedic Surgery Department, Faculty of Medicine, Zagazig University, Egypt

Corresponding author*
Amr Shihata El Hady

Email:
Moodata91@gmail.com

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ABSTRACT

Background: Children who had been delivered with brachial plexus injury often presented with debilitating condition when their shoulder becomes stuck in an inwardly rotated position. Instances of inadequate recuperation following physiotherapy necessitate several surgical alternatives, such as soft tissue interventions like muscle releases and/or transfers, which can rectify this deformity.The current study aimed to present the clinical and radiological outcome after arthroscopic release of shoulder internal rotation contracture in cases of brachial plexus injury during birth.**Methods:** The current study was done in Zagazig University hospitals and had been included thirty-five participants presented by brachial plexus injury since delivery associated with shoulder internal rotation contracture with subluxation of the humeral head.**Results:** Mallet score; improved as the median of pre-operative Mallet score was 11 (2) and significantly increased to 16 (3) at the post-operative follow up, external rotation; improved as the median of pre-operative external rotation was 2 (1) and increased to 4 (1) post-operatively (P<0.001). Increase in elevation; as median of pre-operative elevation was 3 (1) and increased to 4 (1) post-operatively (P=0.003).**Conclusion:** The optimal time to do the arthroscopic release is before the child reaches two years old in order to achieve the greatest range of motion improvement of shoulder and to prevent additional bone alterations such as glenoid retroversion or displacement of the humeral head posteriorly, according to our perspective.

Keywords: Children, Arthroscopic repair, glenohumeral, brachial plexus, contracture

INTRODUCTION

Birth-related traction injuries to the brachial plexus lead to lasting orthopedic issues, primarily impacting the shoulder [1].

The internal rotation posture occurs when there is an disconcordance of the active contraction of internal rotation muscles (including: latissimus dorsi, teres major, subscapularis and pectoralis major) and the paralysis of shoulder external rotators muscles (including: teres minor, serratus posterior and infraspinatus,) [2] [3].

The posture of internal rotation causes deformities in the glenohumeral joint, specifically humeral head subluxation posteriorly and dysplasia of glenohumeral [4].

Management of internal rotation contractures is necessary to address the deformities of the glenohumeral joint. Several surgical techniques have been proven to be clinically

successful in restoring the balance between exterior and internal rotation power. At now, clinical trials do not unequivocally support one therapy over another. However, current research suggests that it is beneficial to cure the contractures of shoulder internal rotation and reduce the glenohumeral joint early using arthroscopic methods, even though this involves releasing the anterior capsule [5].

Shoulder arthroscopy is a surgical procedure that involves releasing the shoulder joint anterior capsule and ligaments and performing a subscapularis tenotomy. This procedure helps to relieve contracture and reconstruct the glenohumeral joint with less risk of complications [6].

The main aim of this study was to demonstrate the clinical and radiological outcomes and results following surgical release of shoulder internal rotation contracture in patients with brachial plexus injury during birth trauma.

METHODS

The current research was conducted at Zagazig University hospitals. This study comprised thirty-five individuals who had brachial plexus trauma during delivery and were experiencing internal rotation contracture of the shoulder along with moderate to severe glenohumeral dysplasia. The Research Ethics Committee at the Faculty of Medicine, Zagazig University granted approval for this study from 2020 to 2022, with reference number 5669.

Follow-up: Patients received prospective routine follow-up at four weeks, , three months, six months, 1 year and up to 3 years after the surgery.

Inclusion criteria:

Patients with internal rotation contracture deformity of the shoulder due to OBPP with:

- glenohumeral dysplasia.
- subluxation.
- From one to three years old.

Exclusion criteria:

- Shoulder dislocation.
- Less than one year or above 3 years old.
- Previous Surgical intervention in the shoulder.

Preoperative evaluation involved conducting clinical tests to evaluate the range of motion in all patients. The presence of positive trumpet signals and the difficulty to raise the hand to the level of the mouth were observed and documented in all cases (figure 1).

Patients underwent preoperative and postoperative evaluations utilizing the Mallet categorization score system (table 1) [7].

Axial plane imaging (CT) was utilized to perform a radiological assessment of both shoulders.

This assessment aimed to evaluate the glenoid version (Glenoid Retroversion GRV) and the degree of subluxation (percent humeral head anterior to the middle of the glenoid fossa PHHA) (figure 2).

Surgical technique:

The arthroscopy procedure is conducted with the patient in a seated position like a beach chair, utilizing a 2.7-mm arthroscope. A posterior port is created by accessing the posterior soft area and introducing saline to inflate the joint. A frontal entrance is created with direct observation by inserting an 18-gauge spinal needle via the rotator interval, positioned below the biceps tendon. The rotator interval, anterior capsule, anterior ligaments, and subscapularis tendon are recognized. An electrocautery device is inserted via the anterior portal. The release begins at the upper part of the rotator interval, where the thicker superior glenohumeral ligament is located, and then continues to reach the middle glenohumeral ligament. The superior, intra-articular segment of the

subscapularis tendon is then freed while maintaining the integrity of the inferior and lateral muscle segments of the subscapularis. The electrocautery instrument is taken out and replaced with an arthroscopic punch. Next, the inferior glenohumeral ligament is freed.

The axillary nerve is shielded by employing the punch. The arthroscopic equipment is extracted from the glenohumeral joint and maneuvered into external rotation, both with the arm in a resting position and with the arm elevated to a 90-degree angle. Significant enhancement in external rotation is observed, frequently accompanied by a noticeable clicking sound related to the decrease of the glenohumeral joint. Achieving external rotation of 45 degrees or greater with the arm held close to the body is considered a favorable outcome.

Following the closure of the skin incisions, a shoulder Spica cast was given to all patients with the shoulder positioned in maximal external rotation and 90° abduction. After a duration of 4 weeks, the cast was taken off and a course of physical therapy was initiated, which including gentle stretching and the use of night bracing for a further 4 weeks. Each patient received regular postoperative follow-ups at specific intervals: 4 weeks, 3 months, 6 months, 1 year and up to 3 years after the surgery. During these follow-ups, the patients reported their ranges of motion, shoulder function, and shoulder strength using the Mallet grading system.

Postoperative protocol:

• A Shoulder Spica will be applied in external rotation and abduction for a duration of six weeks.

• Physical therapy will be commenced, which will include stretching exercises and the use of a brace in external rotation at night for an additional four weeks.

• Clinical and radiological examination was conducted at the third and sixth months, as well as every 6 months thereafter.

Outcomes:

Functional data before and after surgery were recorded in a planned and systematic manner. The revised Mallet shoulder function score was documented, along with measurements of active and passive shoulder movement. Incidents of surgical complications were recorded. Measurements of radiographic characteristics were taken on the axial CT view of both glenohumeral joints for each patient. The recorded parameters comprised the extent of glenoid retroversion and the proportion of the humeral head positioned anterior to the mid-scapular line.

Statistical analysis:

The patients' data were collected and presented in excel sheet, then analysed using a data base software program, IBM SPSS 23.0 for windows (SPSS Inc., Chicago, IL, USA). The qualitative categorical data were presented in the form of number (n.) and percentages (%) while the quantitative data were presented according to the normality of distribution either mean in addition to standard deviation (SD) in normally distributed data or median with interquartile range (IQR) in non-normally distributed parameters. At the level of P-value significance when less than or equal 0.05 it will be significant and when P-value more than 0.05 it will be non-significant. On comparing between paired data as pre-operative and post-operative data we used paired t-test when the data analysis shows normal distribution and used Wilcoxon rank-sum test when the data analysis was not distributed normally.

RESULTS:

In the current prospective research the follow-up duration was ranged from 24

months to 36 months average 31.1 months. It included 35 patients. Their ages ranged from 1.5 to 3 years and mean ± SD of 2.5 ± 0.48, (62.9%) were males and (37.1%) were females (table 2).About (48.6%) of the patients had right-sided affected and (51.4%) had left side affected.

Statistically significant increase in PHHA; as a mean of pre-operative PHHA 25.5 ± 11.23 and increased to 40 ± 6.7 post-operatively (P<0.001). Significant reduction in retroversion; as mean of pre-operative retroversion 33.3 ± 16.4 and reduced to 14.8 ± 11 post-operatively (P<0.001).

Increase in external rotation; as median of pre-operative external rotation 2 (1) and increased to 4 (1) post-operatively (P<0.001). Increase in elevation; as median of pre-operative elevation 3 (1) and improving to 4 (1) post-operatively (P=0.003). Mallet score; improved. as median preoperatively from 11 (2) to 16 (3) post-operatively (P<0.001). (Table 2).

Table (1): Mallet score for shoulder function

Mallet grading	Description
I	Flail shoulder
II	Active abduction < 30
	Zero degrees of external rotation
	Hand to back of neck impossible
	Hand to back impossible
	Hand to mouth with marked trumpet sign
III	Active abduction of 30 -90
	External rotation up to 20
	Hand to back of neck difficult
	Hand to back with difficulty
	Hand to mouth possible with partial trumpet sign
IV	Active abduction over 90
	External rotation over 20
	Hand to back of neck easy
	Hand to back easy
	Hand to mouth easy with less than 40 of shoulder abduction
V	Normal shoulder

Table (2): Demographic data among studied patients

Variables		All patients (n=35)
Side affected*(n. %)*	Right	17 (48.6%)
	Left	18 (51.4%)
Follow up duration *(months)*	*Range*	(24-36)

Variables		All patients (n=35)
Age (years)	Mean + SD	2.5 +0.48
	Range	(1.5 -3)
Sex (n. %)	Male	22 (62.9%)
	Female	13 (37.1%)

Variables		Pre-operative	Post- operative	P Value
External Rotation	Median (IQR)	2 (1)	4 (1)	<0.001
	Range	(1 - 3)	(2 – 4)	

* Wilcoxon signal – rank test, Non – significant : P>0.05, Significant: P ≤0.05

Variables		Pre-operative	Post- operative	P Value
PHHA	Mean ± SD	25.5 ±11.23	40±6.7	<0.001
	Range	(0 – 42.3)	(22.3 – 48.7)	

* Paired – T rest, Non – significant : P>0.05, Significant: P≤0.05)

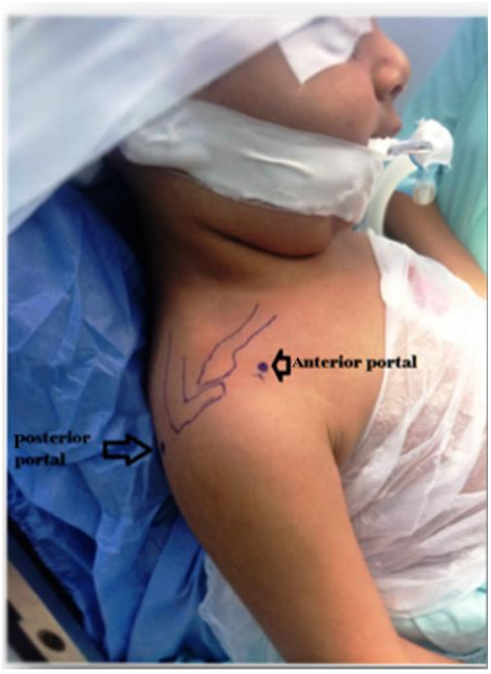
* PHHA = Percentage of humeral head anterior to glanoid fossa

Variables		Pre-operative	Post- operative	P Value
Retroversion	Mean ± SD	33.3 ±16.4	14.8±11	<0.001
	Range	(5.5 – 64.3)	(0.2 – 50.4)	

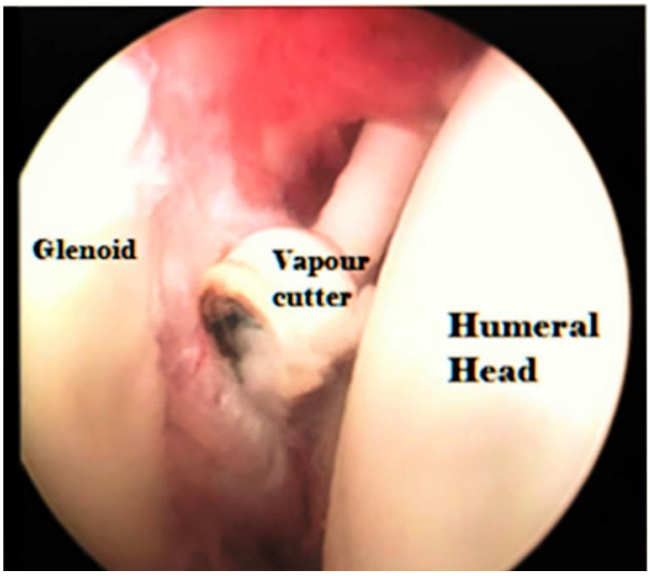
* Paired-T test, Non – significant: P> 0.05, Significant: P≤0.05

Variables		Pre-operative	Post- operative	P Value
MALLET score	Median (IQR)	11 (2)	16 (3)	<0.001
	Range	(5 – 15)	(11 – 20)	

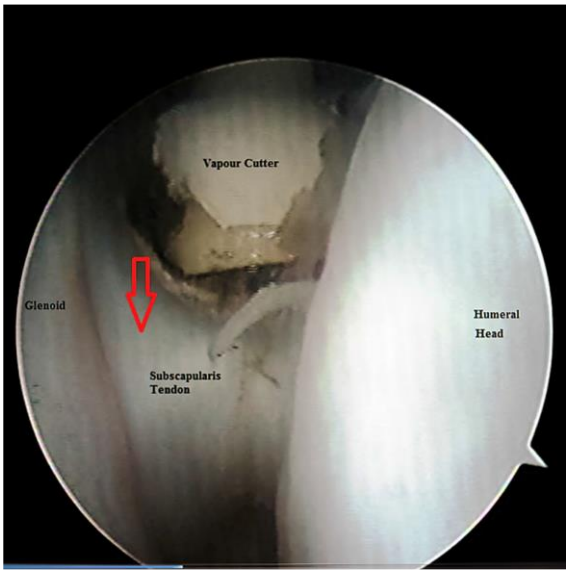
* Wilcoxon signed –rank test, Non – significant: P> 0.05, Significant: P <0.05



1 Anatomical landmarks with anterior and posterior portal identification; clav clavicle, Acr acromion.



2 An electrocautery vapor was introduced through the anterior portal; VC vapor cutter.



. 3 The subscapularis tendon to its muscular portion was identified, and release was continued solely to the capsule, taking care to preserve the inferior and lateral portions of the subscapularis tendon

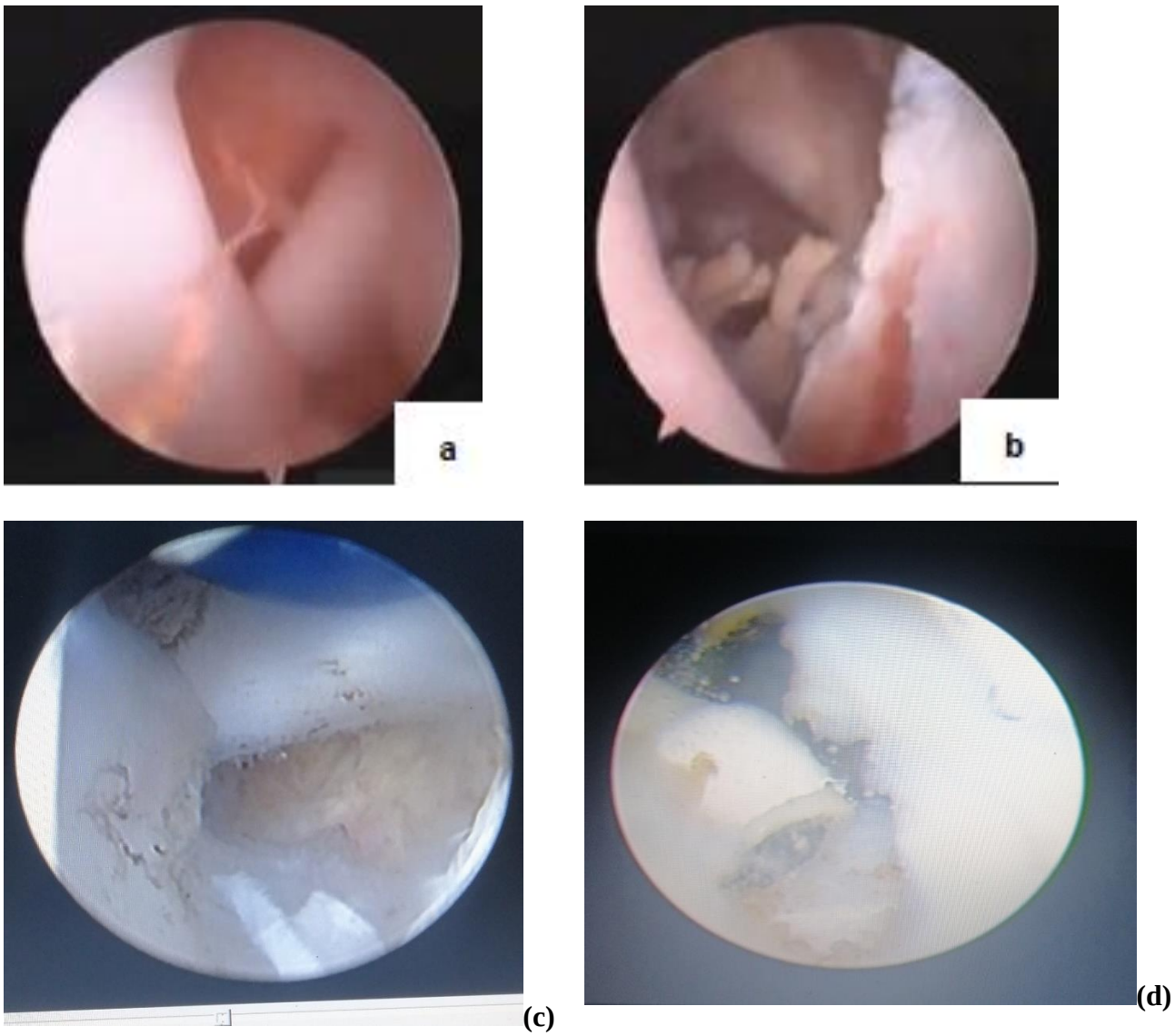


Figure (4): Subscapularis tendon before (a) and after release (b , c , d) .

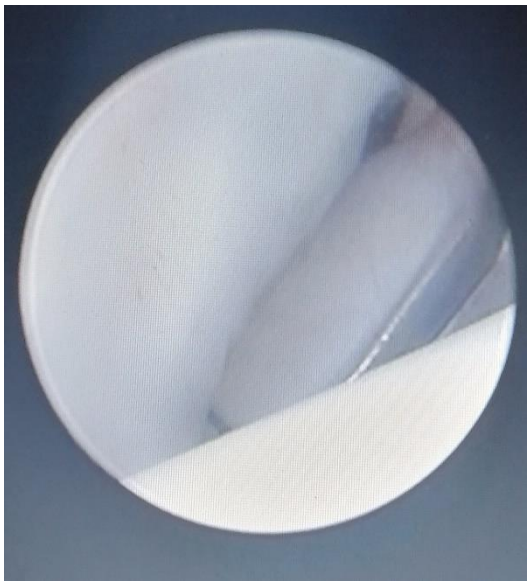


Figure (5): Arthroscopic punch in the axillary pouch .

Several publications have documented that arthroscopic subscapularis release leads to relief in shoulder internal rotation contracture. In their study, Elzohairy and Salama examined fifteen children with brachial plexus lesions during delivery and managed these children with an arthroscopic release of subscapularis tendon procedure. In their study they observed that this treatment resulted in enhanced improvement in shoulder motion range and overall functionality.

Ali et al. [9] conducted a study at Al-Azhar University Hospitals involving 10 patients with OBPP. They treated these patients with an arthroscopic release of subscapularis tendon alone and reported that this operation was straightforward, effective, and secure for young children.

It enhanced abduction and external rotation, but it did not have a statistically significant impact on internal rotation.

In our study, we preferred arthroscopic subscapularis release for restoring external shoulder rotation and remodelling of the glenohumeral joint. Morover, the procedure is minimally invasive allows more precise subscapularis release with enhanced visualizing of the intra-articular distortions and providing better cosmetics for the affected patient. Unlike, open procedures which may had a potential risk of giving a way for extensive scarring in tissues.

Our prospective study included thirty-five patients with passive external rotation <20° secondary to obstetric palsy with ages ranging from 1.5 to 3 years and average follow-up ranging from 24 to 36 months.

Zayed [10] found a significantly statistically negative correlation of age with postoperative range of motion (ROM) and modified Mallet score. There was significant improvement of shoulder function can be reached in children by subscapularis muscle release which is performed before the glenohumeral deformities occur.

This study demonstrates encouraging outcomes in terms of enhanced Mallet score and expanded passive range of shoulder motion, particularly in external rotation and abduction, following surgical subscapularis release .

According to Hassan et al. [11], the average passive external rotation (ER) was 70°, ranging from 40 degrees to 90 degrees. The average active ER was 60 degrees, ranging from 20 degrees to 90 degrees, at the most recent follow-up .

In their study, Naoum et al. [12] demonstrated that active abduction increased by 21° (from 15° to 45°) after six months and keeping on improvement until the final follow-up, resulting in an overall improvement of 31° (from 20° to 50°). Active external rotation demonstrated an initial improvement of 52° (with a range of 40–60°) at 6 months. However, over time, there was a progressive decline in this improvement, resulting in an overall improvement of 35° (with a range of 25–45°) at the final follow-up .

In this study, the overall Mallet score increased from an average of 11± 1.07 standard deviation (ranging from 5 to 15) before the operation to an average of 16± 2.22 standard deviation (ranging from 11 to 20) after the operation.

The efficacy of this method relied solely on prompt diagnosis (after passive shoulder external rotation reaches 10 degrees with the upper limb adjacent to the body) also on timely intervention, hence reducing invasiveness of the process. It has the potential to avert irreversible glenohumeral distortion, which may not always be recoverable.

This study has several limitations, including the absence of a control group, the extended learning process required for the surgical intervention due to the rarity of arthroscopy cases of shoulder lesions in pediatrics, and the increased potential of axillary nerve trauma due to its close relation to the subscapularis.

lastly , we recommend arthroscopic subscapularis release in patients with internal rotation contracture in the early stages of development for better life quality ,better mobility and performance .

CONCLUSION:

The operation is successful to enhance the range of motion, external rotation, elevation and better be performed under the age of two years to prevent secondary bony alterations in the form of glenoid retroversion and subluxation posteriorly in the humeral head in our opinion.

After the age of 3 years, the improvement in the shoulder range of movement was not significant and the operation did not prevent the evolution of significant secondary bony changes.

CT is mandatory for the diagnosis of glenohumeral deformities and improvement postoperatively.

Early reduction and correction of the deformities happened, making a high possibility for remodeling to take place.

Postoperative monitoring is essential for children following successful shoulder reduction due to the potential hazards of future deformity or delayed development of stiffness resulting from fibrosis of the capsule and ligaments, as well as incomplete remodeling of the head of the humerus and glenoid tissue.

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