



Research Article

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Treatment of Posterior Shoulder Dislocation in Obstetric Brachial Plexus Palsy Using Subscapularis Release and Tendon Transfer

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Abstract

Background: The muscle imbalance of the shoulder results in weak external rotation and abduction. Active internal rotation and adduction can cause glenohumeral joint deformity with late posterior dislocation.

Patients and Methods: In this prospective study from 2004 to 2009, thirty four patients, 18 females and 16 males with mean age of 4 years (1-7 years). The right side was affected in 19 cases while the left side was affected in 15 cases. All patients were suffering from obstetrical brachial plexus palsy (OBPP) with internal rotation contracture and defective shoulder abduction plus posterior dislocation or subluxation of the humeral head. These patients were treated with soft tissue release (subscapularis slide and anterior soft tissues release) with or without tendon transfer (latissimus dorsi & teres major to infraspinatus).

Conclusion: The subscapularis release can provide objective functional benefit, but this degraded over time. The transfer of teres major and latissimus dorsi to infraspinatus is a useful procedure for correction of defective shoulder abduction and external rotation in (OBPP) as it increases the stabilizing action of the rotator cuff allowing the deltoid muscle to act with maximal force.

INTRODUCTION

The incidence of obstetric brachial plexus palsy (OBPP) is 1 to 4 /1000 live births, and about 50% of these cases have good recovery without late deformity. Partial recovery of the C5, C6, C7 roots gives muscle imbalance, and delay of recovery causes biceps muscle contracture ¹⁻³. The residual muscle imbalance of the shoulder in the form of weak external rotation and abduction with active internal rotation and adduction can cause glenohumeral joint deformity with late dislocation posteriorly ⁴⁻⁶. The advances in microvascular surgery and early reconstruction of the brachial plexus reduced the need for palliative treatment as rehabilitation by physiotherapy, orthosis, and braces which are difficult to apply in this young age and failure occurs in severe cases ⁷.

For treatment of this deformity there were many surgical options, such as anterior release of contractures in internal rotators and adductors of the shoulder as in Sever operation ⁸. Enhancing this technique tendon transfer of the latissimus dorsi and teres major to the lateral aspect of the humerus was added by L'Episcopo ⁹. Later, the technique of transferring the latissimus dorsi and teres major to the rotator cuff was suggested by Hoffer et al ¹⁰. Bone procedures as derotation osteotomy of the proximal humerus are available to correct these deformities. Pedicle and free muscle transfers in cases of paralytic shoulder are other options. The criteria of selection of the specific procedure were based on the age of the patient and the degree of glenohumeral deformity on the preoperative computed CT or MRI. As long as the glenohumeral joint is congruent, tendon and muscle transfer can be performed at a later date, but they should be considered at earlier times to maximize functional recovery ¹¹. Shoulder reconstruction expected to improve both arm appearance and some of the hand functions as reaching the head or mouth and raising the hand above the shoulder³.

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The aim of this prospective study is to evaluate the results of 34 patients with OBPP treated surgically with anterior release and tendon transfer of teres major and latissimus dorsi.

PATIENTS AND METHODS

In a prospective study from 2004 to 2009, thirty four patients, 18 females and 16 males with mean age of 4 years (1-7years). The right side was affected in 19 cases while the left side was affected in 15 cases. All patients were suffering from obstetrical brachial plexus palsy (OBPP) with internal rotation contracture and defective shoulder abduction with posterior dislocation or subluxation of the humeral head. These patients were treated with soft tissue release (subscapularis slide and anterior soft tissues release) with or without tendon transfer (latissimus dorsi & teres major to infraspinatus).

Sixteen cases (47 %) were delivered at hospital while eighteen cases (53 %) were delivered at home. fifteen cases (44 %) had definite history of difficult labor ,and five cases (14.7 %) were breech delivery. Two cases (5.9%) had associated fracture clavicle. In 9 cases (26.5%) the baby was the first child of his/her parents. Birth weight in 17 cases (50%) was over 4kg (3.6 to 4.5 kg) which appear to be the most important risk factor. 32 cases (94.1%) had no previous surgery and were treated by physiotherapy, only 2 cases (5.9%) had primary microsurgical repair of the plexus. We found complete paralysis (C_5 , C_6 , C_7 , C_8 , T_1 roots affected) in 21 cases (61.8%) at the time of birth and 13cases (38.2 %) were partial (C_5 , C_6 only affected). All cases 34 were suffering from medial rotation contracture, 21 cases (61.8%) were dislocated and 13 cases (38.2%) were subluxated. Standard plain X-ray of the shoulder and computerized tomography (CT) were routinely done for all patients for precise assessment of the deformity (Glenoid retroversion and degree of posterior subluxation of the humeral head). Follow up (CT) of both shoulders were performed for all 34 cases postoperatively. We used mallet ¹² grading and modified Gilbert systems ¹³ for the shoulder function (Fig 1) & (Table 1&2)

Modified Mallet classification (grade I = no function, Grade V = normal function)

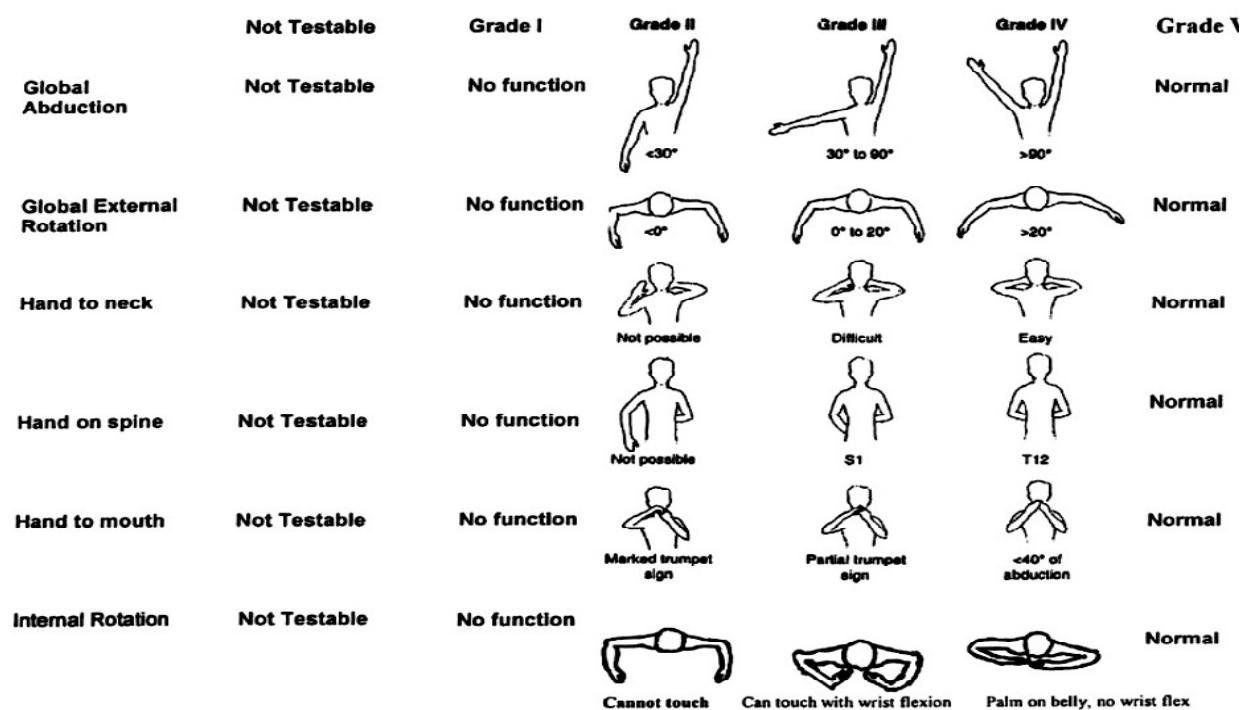


Fig1. Illustration of Mallet classification. A score of one represent no function, and a score of 5 represent full function.

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Table1. *The Mallet grading of function of the shoulder joint.*

Mallet grading	Description
Grade I	Flail shoulder
Grade 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
Grade 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
Grade 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
Grade V	Normal shoulder

**** Grade II gives 1 point, grade III gives 2 points, and grade IV gives 3 points. Excellent function = 15 points, good function = 9-12 points and Poor function < 9 points. (Nicolas et al., 2004)**

Table2. *Modified Gilbert system.*

Stage	Function
Stage 0	Flail shoulder
Stage I	Abduction or flexion to 45 ,no active lateral rotation
Stage II	Abduction <90 ,lateral rotation to neutral
Stage III	Abduction = 90 , weak lateral rotation
Stage IV	Abduction <120 , incomplete lateral rotation
Stage V	Abduction >120 , active lateral rotation
Stage VI	Normal

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Rationale of Treatment

The aim of the operations was to relocate the dislocated glenohumeral joint and to alleviate secondary deformities arising from incomplete recovery following nonsurgical management or residual deformities following primary reconstruction.

All 34 patients underwent subscapularis release. Added tendon transfers were needed in 21 cases. Posterior capsulorraphy was done in three cases for residual glenohumeral subluxation.

Technique for Subscapularis Release

The patients were placed in lateral decubitus. The affected shoulder and torso were prepared to the mid-line anteriorly and posteriorly. A longitudinal incision was made along the lateral border of the scapula, and dissection was carried out down to the latissimus dorsi muscle, which was retracted inferiorly, and the inferior angle of the scapula was identified and stabilized with towel clips. The subscapularis muscle is readily identified and elevated in its entirety from the anterior surface of the scapula with use of electrocautery or a periosteal elevator.

Dissection was then performed in a subperiosteal fashion, progressing from the inferior angle upward. An external rotation force on the humerus was applied gently throughout the release to confirm adequate release of the muscle and elimination of the contracture. Care must be taken to avoid injury of the subscapular artery and nerve running anteromedial to the glenoid neck and anterior to the subscapularis muscle, and over the scapular notch. After complete release of the subscapularis muscle, the wound was closed over a suction drain.

Technique for Tendon Transfer

The patient is lying in lateral decubitus, with the arm is abducted 120° and externally rotated. A curved wide C shaped incision following the lateral border of the scapula and the posterior margin and the deltoid 2-3 cm posterior to the posterior axillary fold to avoid tethering scar. After dissection of the deep fascia, the tendons were identified, and the latissimus dorsi tendon was released at its insertion at the proximal humerus. In our work, the tendon of latissimus dorsi was thin and weak in 3 cases (below 2 years of age) where the transfer of the latissimus dorsi was augmented by teres major muscle transfer as described by Edward et al (2000)¹⁴.

To avoid injury of their neurovascular bundles, care was done to avoid excessive dissection on the under surface of the latissimus dorsi and teres major. The interval between the poster-inferior margins of the deltoid muscle and the rotator cuff was then developed, and with the arm maximally abducted and externally rotated, the released tendons of teres major and latissimus dorsi were sutured as superior as possible to the infraspinatus tendon. We always putted in mind that the tension of the transferred tendons should keep the arm in some abduction and external rotation.

At the completion of the operation, the arm was held in the appropriate position and a plaster body jacket, prepared before the operation, was applied and above elbow cast was applied and attached to the body jacket with the shoulder in 90 of abduction, full external rotation and 20 forward elevation in order to take pressure off the brachial plexus. One month postoperative a splint was applied full-time to maintain the arm in abduction and external rotation position for 1.5 months, removing it only to bathe and for gentle range-of-motion exercises, which are begun at six weeks. The patient then wears the splint only at night for an additional 1.5 months to be discontinued six months postoperatively (Fig 2).

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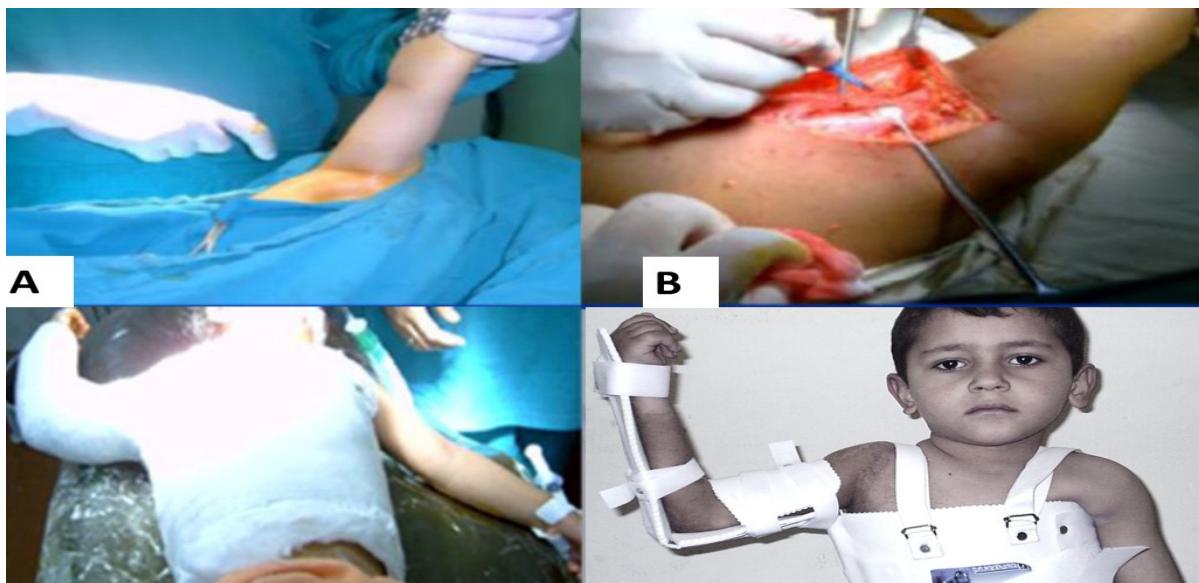


Fig2. Some stages in operative technique: A) position of the patient; B) posterior exposure of the tendons; C) plaster jacket; D) shoulder abduction splint.

Statistics

We used SPSS 17 program for windows: Results were expressed as mean \pm standard deviation for quantitative variables, and as percentages for qualitative variables. Paired T-test was used to determine the effect of surgery on shoulder motion.

RESULTS

The follow up ranged from 24 months to 62 months with an average of 30 months. The mean shoulder abduction in all patients was improved from $(85.9^\circ \pm 18.9 \text{ SD})$ preoperative to $(132.0^\circ \pm 18.7 \text{ SD})$ postoperative. The mean shoulder external rotation in all patients was improved from $(-17.9^\circ \pm 16.6 \text{ SD})$ preoperative to $(66.5^\circ \pm 14.9 \text{ SD})$ postoperative ($P \leq 0.001$). The mean improvement of shoulder external rotation was 84.4 degrees, thus the average gain in shoulder external rotation was 37%. The improvement in both abduction and external rotation was statistically significant (Table 3). With correlation between the age at surgery (in months) and the improvement of shoulder abduction and external rotation postoperatively, we found a highly significant negative correlation ($P \leq 0.001$) between age at surgery and average improvement of shoulder abduction and external rotation (chart 1) (i.e. the older the age at surgery, the less the improvement in shoulder range of abduction and external rotation (Fig 3&4).

Table3. preoperative and postoperative range of motion (abduction and internal rotation)

	Pre operative	Post operative	Paired t	P value
Mean abduction \pm standard D.	85.9 ± 18.9	132.0 ± 18.7	15.3	≤ 0.001
Range	60-130	90-170		
Mean ext. Rot. \pm Standard D.	-17.9 ± 16.6	66.5 ± 14.9	17.14	≤ 0.001
Range	-45 - 20	40 - 90		

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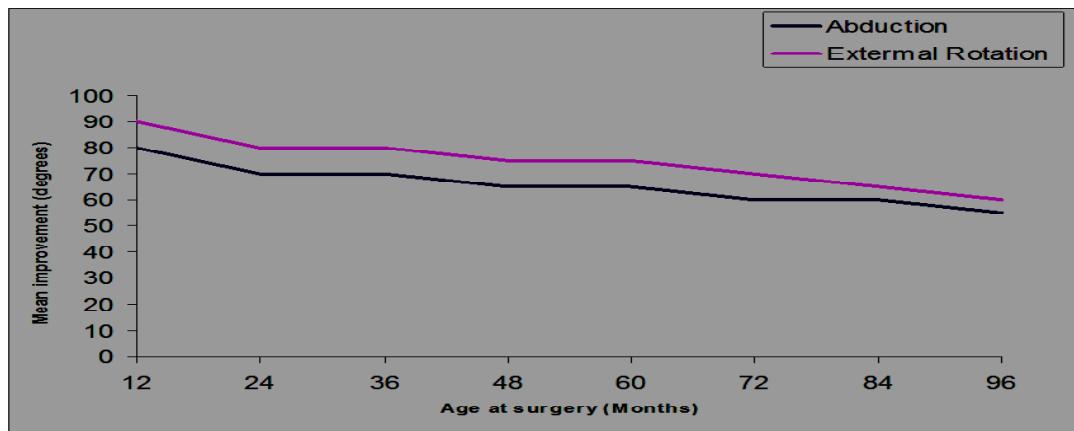


Chart1. *The mean improvement of abduction and external rotation of the shoulder in relation to age*

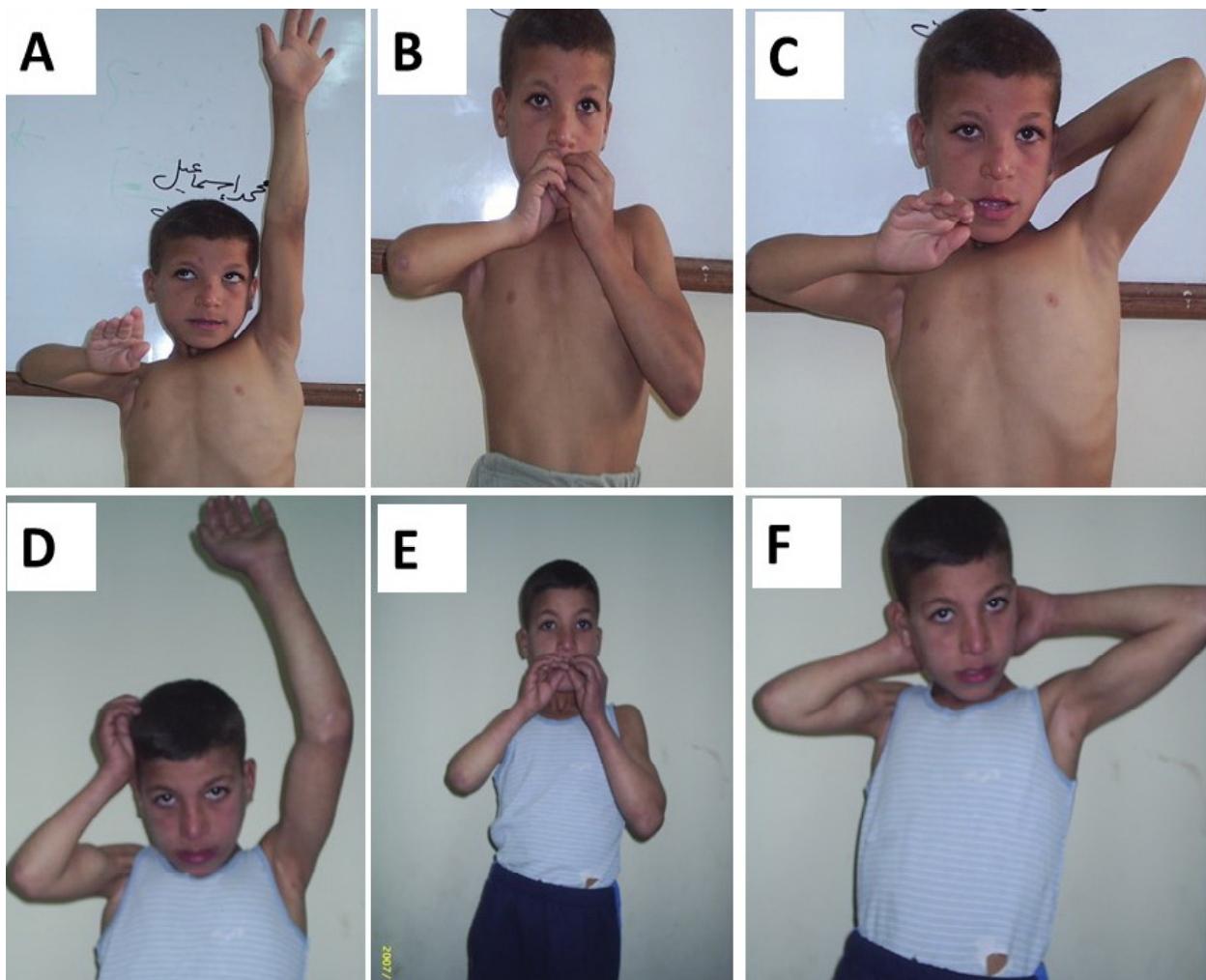


Fig3. *case No. 7: A&B&C) Preoperative range of motion; B&D&F) the movements of the same patient after 2 years follow up.*

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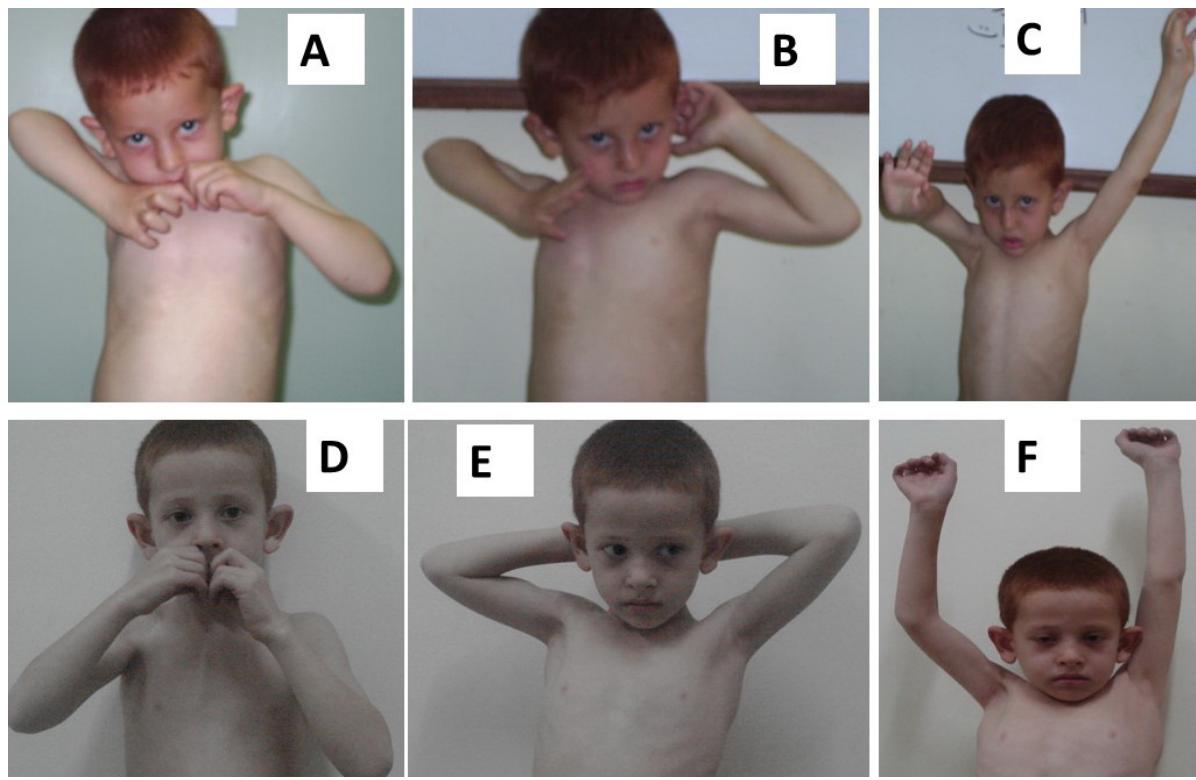


Fig4. Case No. 9: D&E&F) Preoperative range of motion; B&D&F) the movements of the same patient after 2 years follow up.

The mean global Mallet score¹² was improved from 7.1 ± 1.0 SD (range from 6 – 9) points preoperative to 13.2 ± 0.8 SD (range from 11- 15) postoperative. We had 29 cases with excellent score , 5 good, and none with poor score postoperative in comparison to 30 cases with poor score, 4 good, and none with excellent score preoperative (Table 4).

Table4. Global Mallet score changes.

	Pre-operative	Post-operative	Paired t	P
Mean abduction \pm standard D.	85.9 ± 18.9	132.0 ± 18.7	15.3	≤ 0.001
Range	60-130	90-170		
Mean ext. Rot. \pm Standard D.	-17.9 ± 16.6	66.5 ± 14.9	17.14	≤ 0.001
Range	-45 - 20	40 - 90		

Follow up computerized tomography (CT) of both shoulders was done one year postoperatively to measure the glenoid version and degree of subluxation of the humeral head. Statistically when correlating the relationship between age at surgery and CT changes, we found highly significant negative correlation ($P \leq 0.001$) between age at surgery and the glenoid retroversion was found (i.e. the older the age at surgery, the higher is the degree of retroversion of the glenoid) (Fig 5&6), however there was no significant correlation between age at surgery and the degree of posterior subluxation or dislocation of the humeral head.

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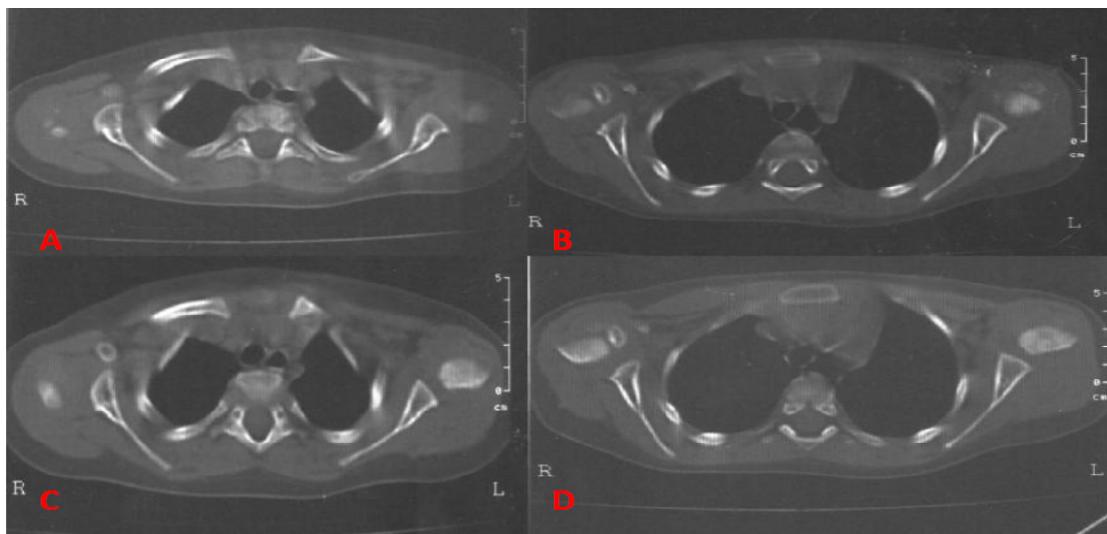


Fig5. CT scan of the patient No. 8 A&C) Preoperative CT; B&D) 1 year postoperative.

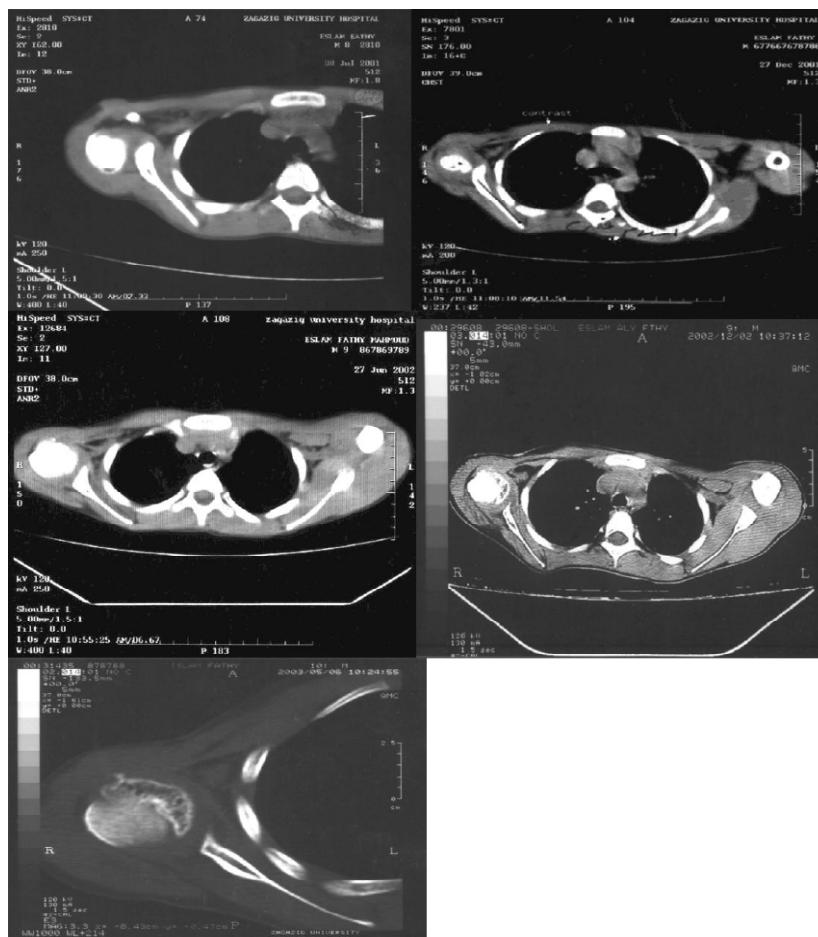


Fig6. Serial CT examination of patient No. 11 : A&B) CT 6 months postoperative ; C&D) 1 year follow up CT; E,F,G) 3 years follow up CT.

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The development of the glenohumeral joint in successive CT was characterized by the amount of glenoid version and the degree of humeral head subluxation in relation to the axis of the scapular spine. Prior to operation, the mean glenoid retroversion of the affected shoulder was $47.8^\circ \pm 8$ (range, -60° to -35°) and the mean humeral head subluxation was $8.82\% \pm 7.7$ (Range, 0% to 25%). At the end of the follow up period, the mean glenoid retroversion of the affected shoulder was $-8.7^\circ \pm 2.5$ (range, -10° to -6°) and the mean humeral head subluxation of the affected shoulder was 46.6 ± 1.3 % (range, 45% to 49%). The mean improvement in glenoid version was 39° (range, -60° to -35°) ($p = 0.012$), and the mean improvement in humeral head subluxation was 37 % ($p = 0.03$).

COMPLICATIONS

Loss of the last degrees of internal rotation occurred in 10 cases (29.4%) which were evident when the patient was asked to put his hand on his abdomen. However this loss was of little functional impairment. One case (0.3%) had keloid and ugly scar. Superficial infection occurred in one case (0.3%) however it was controlled with dressing and antibiotics. One case showed postoperative recurrence of posterior dislocation and was treated with proximal humeral osteotomy.

DISCUSSION

Posterior subluxation and dislocation occurs in about 20% of children with obstetric brachial plexus palsy and in Narakas groups 2 and 3 more than one third are so affected ¹⁵. Internal rotation contracture is the most frequent and important secondary deformity of the shoulder in birth palsy. The problem is sometimes addressed by muscle release procedures such as the posterior subscapular slide or anterior subscapularis tendon lengthening operations. Once passive external rotation is improved, the child is later assessed for muscle transfers to reconstruct active external rotation if necessary ¹⁶.

In this work we found good functional and clinical improvement provided by subscapularis muscle release with latissimus dorsi and teres major transfer. The mean global Mallet score ¹² was improved from 7.1 ± 1.0 SD (range from 6 – 9) points preoperative to 13.2 ± 0.8 SD (range from 11- 15) postoperative. We had 29 cases with excellent score, 5 good, and none with poor score postoperative in comparison to 30 cases with poor score, 4 good, and none with excellent score preoperative.

Some authors reported a decrease in postoperative gain over 10 years' follow-up; the final values were still higher than untreated cases because of the greater loss of external rotation and deterioration in glenohumeral congruence ¹⁷.

Loss of external rotation and internal rotation deformity are indications for surgery releasing the subscapularis muscle first to restore external rotation range ¹⁸. Some authors reported that tendon transfer of the teres major and/or latissimus dorsi insertions onto the proximal humerus or onto the infraspinatus muscle inhibits internal rotation but cannot recover significant active external rotation basically ^{9, 10, 13}. El-Gammal et al and Chuang et al added to this procedure lengthening of pectoralis major muscle to teres major transfer to the rotator cuff, reinserting the two extremities of the clavicular part of the pectoralis major laterally so as to enhance abduction ^{19, 20}. External derotational osteotomy of the humerus is indicated only when glenohumeral incongruence prevents recovery of adequate joint mobility ^{21, 22}.

Newman et al ²³, on a mean 4.7 years' follow-up of 13 patients with isolated subscapularis release, reported results comparable to those obtained with associated tendon transfer. In this study, isolated subscapularis release gave poorer results: six of the eight patients in question showed ER and modified Mallet scores below the mean values of the series as a whole, and two required later surgical correction.

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A great controversy was found in literature about the effect of the age of the patients at surgery on the final outcome. Waters et al¹⁶ believe that tendon transfer surgery slows shoulder joint impairment and corrects glenoid retroversion and posterior subluxation. Van der Sluijs⁴ in MRI study of 17 pathological shoulders found that 70% of patients under 5 months of age had normal shoulders, whereas 80% of those older than 5 months showed radiologic deformity. They concluded that late deformity is due to muscle imbalance. Consequently, early correction of imbalance should usefully postpone the onset of bone abnormality^{19, 21}. In Cohen G et al series³, the patients over the age of 5 years get lower results than the younger patients, in the range of external rotation and modified Mallet score.

We agree with this conclusion as in this study when correlating the relationship between age at surgery and CT changes, we found highly significant negative correlation ($P \leq 0.001$) between age at surgery and the glenoid retroversion (i.e. the older the age at surgery, the higher is the degree of retroversion of the glenoid). We found also a highly significant negative correlation ($P \geq 0.001$) between age at surgery and average improvement of shoulder abduction and external rotation (i.e. the older the age at surgery, the less the improvement in shoulder range of abduction and external rotation). We found also that the various functional, clinical and scan data support the short- to medium-term benefit of this surgical indication.

CONCLUSION

Subscapularis release provided objective functional benefit, but this degraded over time. Teres major and Latissimus Dorsi to infraspinatus transfer is a useful procedure for correction of defective shoulder abduction and external rotation in (OBPP). The basic advantages of this procedure over other tendon transfers are, it increases the stabilizing action of the rotator cuff thus allows the deltoid to act with maximal force, also in this position it increases both shoulder abduction and external rotation and it increases the lever arm of external rotation as the diameter of the head is larger than the diameter of the shaft.

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Citation: Reda H Elkady, MD, Hossam A Fekry, MD. "Treatment of Posterior Shoulder Dislocation in Obstetric Brachial Plexus Palsy Using Subscapularis Release and Tendon Transfer". American Research Journal of Orthopedics and Traumatology. 2017; 2(1): 1-11.

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