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Research Article

Fibrous Long Head of Triceps and Adduction Contracture of the Shoulder in Children

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Abstract

Objective: To evaluate the clinical and functional outcomes of surgical treatment of the long head of the triceps in children.

Materials and Methods: A retrospective study was conducted. Data were analyzed on 52 patients (60 shoulders) aged over 5 years from August 1995 to December 2014. The adduction-retraction angle, the elbow flexion angle when the scapula was held against the chest wall, and the shoulder-arm angle (Rx) were measured. Surgical techniques were performed to release the long head of the triceps. The triceps longus tenotomy was performed.

Results: There were 36 female and 16 male patients in this study. The shoulders were bilateral in 8 patients and the right shoulder in 13 shoulders, and the left shoulder in 47 shoulders were affected. All 52 patients (60 shoulders) developed adduction contracture after repeated intramuscular injections of antibiotics into the long head of the triceps. 54 shoulders (46 patients) were classified as severe and 6 shoulders (6 patients) were classified as moderate, and there were no mild cases. Overall, we achieved excellent results in 56 shoulders (93.3%), good results in 4 shoulders (6.7%). There have been no fair or poor results or complications to date.

Conclusion: Overall, surgical treatment of frozen shoulder has resulted in good results and improved shoulder function. Release of the long head of the triceps is a simple and safe surgical technique.

Keywords: *Intramuscular Antibiotic Injection; Fibromyalgia; Fibromyalgia and Spasticity; Stiffness; Brachial Plexus Palsy*

Introduction

Fibrous muscle can be congenital or secondary to intramuscular injection or direct trauma [1,2]. In Asian countries, intramuscular injection is commonly used to treat children with infections or even fever. Contractures, identified during surgery, are due to the fibrotic long head of the triceps. This finding has been confirmed histologically. Cosmetic concerns include adduction contracture and lateral displacement of the scapula with the elbow flexed, skin dimpling, and palpable long head of the triceps contracture (cf. figure 1A-1D).

Materials and Methods

A retrospective study was conducted to evaluate the results of surgical techniques, performed from August 1995 to December 2014, on 57 patients (65 shoulders). Five patients (5 shoulders) were excluded from the study due to insufficient follow-up. The remaining 52

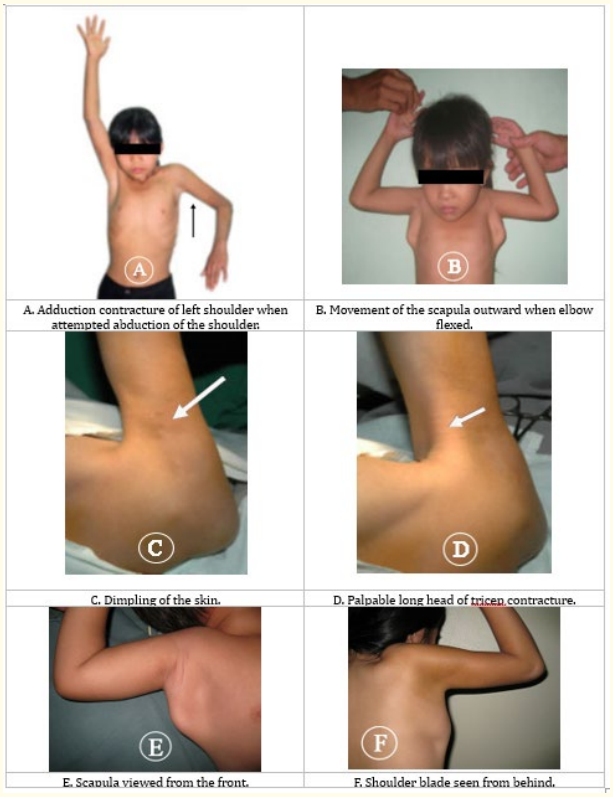

Figure 1A-1F: *Clinical of the adduction contracture of the shoulder.*

patients (60 shoulders) formed the basis for this study. Of the nine patients, fibrosarcoma of the long head of the triceps was associated with fibrotic contractures of the quadriceps, triceps, deltoid and rectus femoris, potentially representing a similar process.

Informed consent was obtained from all participants. The study was approved by the Ethics Review Committee of our Institute and was conducted in accordance with the principles of the Declaration of Helsinki.

Preoperatively, information was collected on the type and amount of medication injected, history of trauma, age at onset of symptoms, duration of symptoms, associated contractures, local skin changes, pain, cosmetic concerns, and changes in functional activities.

We measured adduction-adduction angles, elbow range of motion (ROM) with the scapula held against the chest wall, scapula-humeral angle on radiographs, and range of motion, using a goniometer (cf. figure 2). Anteroposterior radiographs of both shoulders with both arms in maximal abduction were systematically obtained for all patients. Scapular rotation was assessed on anteroposterior radiograph of the chest with both arms in maximal abduction. Ultrasound was performed to detect the long fibrous head of the triceps. Axial radiographs, arthrograms, computed tomography, or magnetic resonance imaging are performed when the long fibular head of the triceps is involved by the deltoid muscle and dislocation or subluxation of the humeral head or rotator cuff disease is suspected.

The severity was classified according to the following criteria.

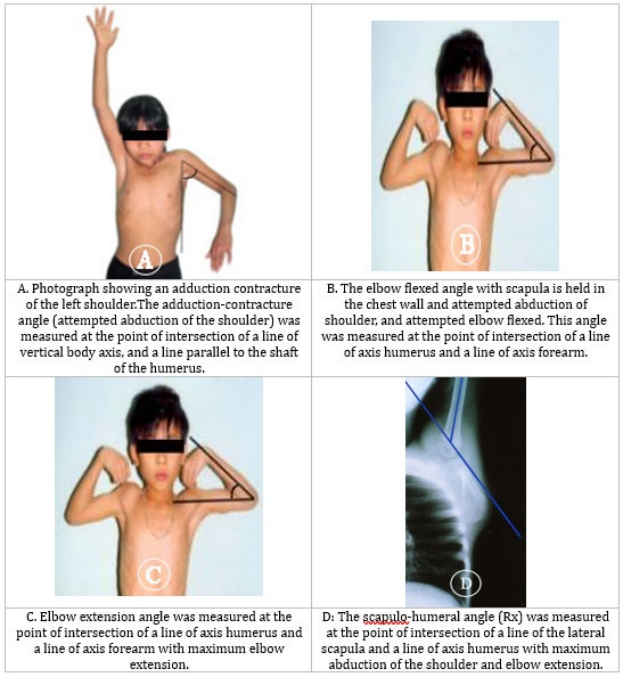

Figure 2A-2D: *Clinical and Xray of adduction contracture of shoulder.*

	Serious	Medium	Mild
Adduction angle (maximum abduction)	≤ 45°	≤ 90° - > 45°	> 90°
Elbow flexed angle (scapula is held in the chest wall)	≤ 60°	≤ 90° - > 60°	> 90°
Scapulo-Humeral angle (Rx)	≤ 60°	≤ 90 ° - > 60°	> 90°
Functional points (QuickDASH)	> 75	> 25° - ≥ 75	≤ 25

Table 1: *Classification of severity.*

Indications for surgical intervention are contractures of at least 60 degrees. Patients must be at least 5 years of age and must have evidence of progressive deformity during growth or change in skeletal anatomy, chronic discomfort, and concern about appearance.

The patient was operated by one surgeon (the author).

Operative procedure

To perform the Henry posterior exposure [3], place the patient prone on the operating table with the upper limb on a hand board, the arm and shoulder free. The lateral decubitus position with the arm supported on pillows is also effective. During general anesthesia, extend the shoulder and elbow to maximum flexion.

Identify the long head of the triceps, which is movable and lies posteromedially. Using this as a landmark, make an incision 4 cm below the scapula, extending distally along the medial edge of the muscle for 6 cm (cf. figure 3A).

Develop the skin and subcutaneous layer to expose the long and lateral heads of the triceps. Develop the proximal gap between these two triceps heads with your fingers. Lift the suture from the underlying tissue and separate it proximally. Identify the contracture and fibrosis of the long head of the triceps with the elbow flexed and extended.

Note the relationship of the radial nerve and its branches to the three triceps heads. While protecting the median nerve, ulnar nerve and brachial artery medially, and the radial nerve and deep artery laterally. Confirm that the branches of the radial nerve are identified and protected before releasing the long head of the triceps at the level of the deltoid tubercle of the humerus and the inferior border of the teres major muscle (cf. figure 3B and 3C).

After completion of the release, complete hemostasis is achieved by coagulation of all sources of bleeding. The skin is closed without leaving any drainage; the arm is placed close to the body with the elbow flexed to 90° with a silk cord.

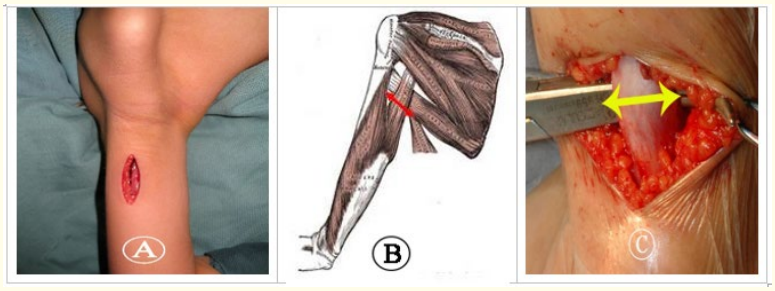

Figure 3A-3C: *A. Incision 3 cm inferior to the acromion, extending distally along the medial edge of long head of triceps for 6cm; B. Release of long head of triceps at level the deltoid tubercle of the humerus and inferior edge of teres major; C. Tenotomy long head of triceps.*

Postoperative rehabilitation

Shoulder exercises were started three days after surgery. During the first two weeks, the scapula was held in the chest wall with the elbow maximally flexed and passive shoulder extension up to 100° was performed by a physical therapist. After two weeks, the range of motion was increased to 130°. After three weeks, the range of motion was increased to normal. Full shoulder extension was allowed between the fourth and sixth weeks after surgery.

Postoperatively, we recorded the correction of skinfolding, range of motion, adduction-retraction, elbow extension angle, elbow flexion angle with the scapula held in the chest wall; the level of functional use of the upper limb for grooming and the scapula-humeral angle on X-ray; the results of manual muscle testing according to Jones classification and complications.

We evaluated patients independently at one week, three weeks, six weeks, three months and every six months thereafter. Anteroposterior and scapular X-rays, as well as anteroposterior X-rays of the chest including both shoulder joints, are performed one week and six weeks after surgery and every six months thereafter if there are any changes in the shoulder joint.

The criteria used for assessing the results of operation.

Results	Adduction-contracture angle (maximum abduction)	Elbow flexed angle (scapula held in the chest wall)	Scapulo-humeral angle (Rx)
Excellent	≥ 150°	≥ 130°	≥ 150°
Good	≥ 120° - < 150°	≥ 110° - < 130°	≥ 120° - < 150°
Fair	≥ 90° - < 120°	≥ 90° - < 110°	≥ 90° - < 120°
Poor	< 90°	< 90°	< 90°
	Or if complications had led to decreased muscle power or functional activity (less than 3 points according to Jones's classification).		

Table 2: *The criteria used for assessing the results of operation.*

Results

From August 1995 to December 2014, 52 patients (60 shoulders) underwent surgery. In all patients, the long fibrous head of the triceps developed after repeated intramuscular injections of antibiotics into the postero-proximal arm. Most of these injections were given in the first 24 months of life. The medical agents injected were all antibiotics: penicillin in 31 cases (59.6%), penicillin and gentamycin in 12 cases (23.1%), other agents such as lincomycin, streptomycin, cloxacillin… in 9 surgeries (17.3%). In 30 patients (35 shoulders), the long fibrous head of the triceps developed between the ages of four and nine. In 17 patients (19 shoulders), the long fibrous head of the triceps developed between the ages of 10 and 14 years. In 5 patients (6 shoulders), the long fibrous head of the triceps developed between the ages of 15 and 19 years. All patients had no history of birth trauma or other congenital anomalies.

The mean age at the time of surgery was 7 years 2 months (range, 6 years 4 months to 19 years 3 months). There were 38 females and 14 males; 8 patients had bilateral shoulders and 9 patients had right shoulders, 52 patients had left shoulders.

The mean follow-up period was 14 years 8 months (range, 10 years 4 months to 19 years 2 months).

Preoperatively, hand strength was tested with the shoulder in flexion and extension and was normal in all patients. Three months after the procedure, there was no decline in hand strength. Postoperatively, all patients recovered muscle strength equal to or better than 4 points according to the Jones classification.

54 shoulders (46 patients) were classified as severe and 6 shoulders (6 patients) were classified as moderate, and there were no mild cases.

Long-term follow-up showed excellent results in 52 shoulders (86.7% [45 patients]), good results in 8 shoulders (13.3% [7 patients]). There were no outcomes or complications in any shoulder.

We assessed the functional recovery of the shoulder and elbow by measuring the angle of motion (range of motion-ROM).

Preoperative, if the scapula was held in the chest wall and the shoulder could not extend beyond 90 degrees (cf. figure 1A).

Preoperative adduction-retraction angle (mean, 42 degrees; range, 35 to 60 degrees) (cf. figure 2A).

Postoperative adduction angle (maximum adduction angle of the shoulder) (compare figure 4C) was greater than 150 degrees in 52 shoulders [86.7% (45 patients)]; with 140 degrees in 8 shoulders [13.3% (7 patients)].

Preoperative elbow flexion angle with the scapula held against the chest wall (mean, 39 degrees; range, 25 to 55 degrees) (cf. figure 2B).

Postoperative elbow flexion angle with the scapula held against the chest wall (compare figure 4C) with angles greater than 130 degrees in 56 shoulders [93.3% (48 patients)]; with angles between 120 and 125 degrees in 4 shoulders [6.7% (4 patients)].

Postoperative elbow extension angle was normal in all patients

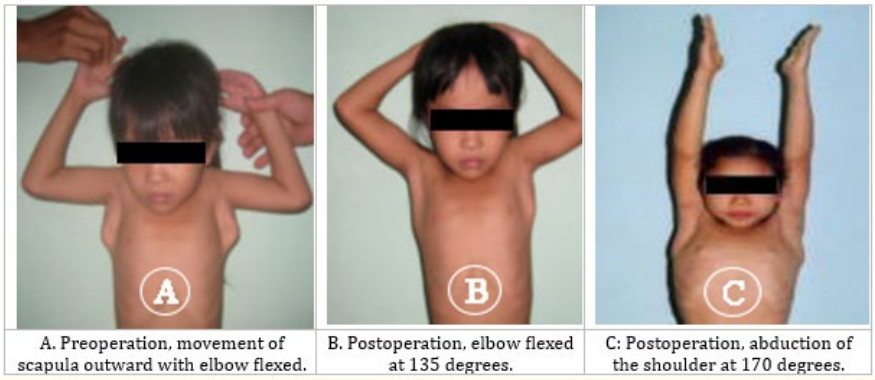

Figure 4A-4C: *Pre-Postoperative fibrous long head of preoperative the scapulo-humeral angle - Rx (average, 61 degrees; range, 40 to 72 degrees) (cf. figure 5A).*

The postoperative scapulo-humeral angle in radiographs (cf. figure 5B) with greater than 150 degrees in 57 shoulders [95.0% (49 patients)]; with 145 degrees in 3 shoulder [5.0% (3 patient)].

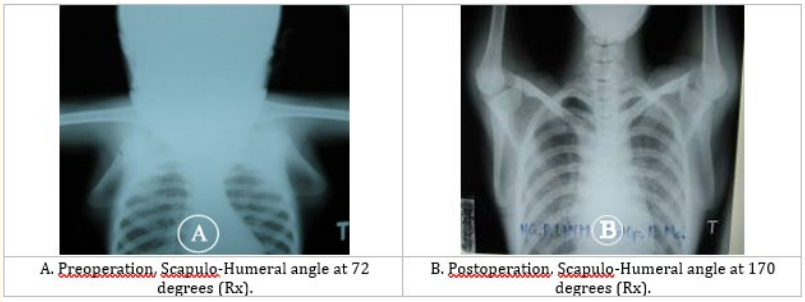

Figure 5A and 5B: *Scapulo-Humeral angle in radiographs.*

Ultrasound seen fibrous long head of triceps in all patients (cf. figure 6A and 6B).

Intraoperative muscle biopsy showed marked fibrosis of the long head of the triceps (cf figure 7A and 7B). All of these findings were also seen in the fibrosis of the quadriceps, deltoid, triceps, rectus femoris, and gluteus muscles after intramuscular antibiotic injection.

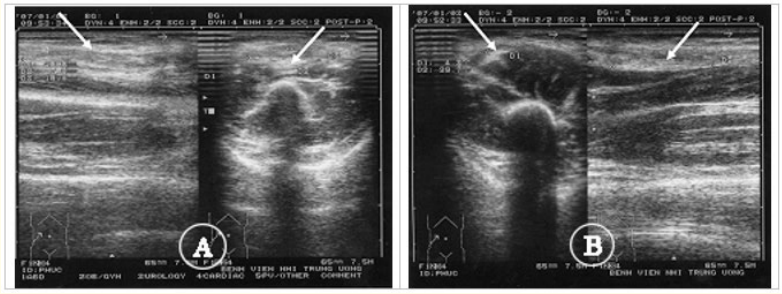

Figure 6A and 6B: *Ultrasound seen fibrous long head of triceps.*

A. Fibrous long head of triceps was seen intraoperation.

B. Muscle biopsy showed marked fibrous tissue of long head of triceps.

Figure 7: *Muscular biopsy intraoperatively.*

Preoperatively, the morphology was characterized by a skin dimple in the proximal middle-lateral third of the arm that was clearly visible with the elbow flexed (cf. figure 1C) and a palpable long head of the triceps contracture (cf. figure 1D) in 60 shoulders (100%).

Postoperatively, the morphology was characterized by no skin dimple, no palpable long head of the triceps contracture in all shoulders, and complete resolution of scapular lateral movement with the elbow flexed (compare figure 2C) in 60 shoulders (100% [52 patients]).

Complication:

- Wound infections: No.
- Neuromuscular injury: No.

Discussion

Hnévkovský 1961 [4], Miki 1962 were the first authors to present muscle fibrosis after intramuscular antibiotic injection in children [5]. Since then, most authors have published muscle spasticity that seems to be related to injection in children such as: quadriceps fibrosis with knee stiffness [4,6-11], triceps fibrosis with elbow stiffness [12,13], deltoid fibrosis with shoulder abduction contracture [14-18], rectus femoris fibrosis with limited hip and knee mobility [19], gluteus maximus fibrosis with hip abduction contracture [20,21], and knee stiffness with patellar luxation due to quadriceps fibrosis [22,23]. Hung NN, Vietnam (2009) was the first author to publish Stiff shoulder due to long head of triceps in children [24].

In Vietnam, from October 1984 to December 2004, we recorded 278 cases of quadriceps contracture, 106 cases of rectus femoris contracture, 191 cases of deltoid contracture, 34 cases of triceps contracture, 104 cases of knee stiffness with patellar dislocation and 12 cases of gluteus maximus contracture (Hung NN, these documents have been published in the Article in Vietnam).

We believe that the injection site is also related to the development of the disease, such as injection into the lateral thigh causes fibrosis of the quadriceps, anterior thigh causes fibrosis of the rectus femoris, lateral shoulder causes fibrosis of the deltoid, lateral buttock causes fibrosis of the gluteus maximus, distal or slight posterior third of the arm causes fibrosis of the triceps, and injection into the proximal posterior third of the arm can cause fibrosis of the long head of the triceps.

The literature mainly consists of case reports (before 1980) [25-30]. The most common cause of fibrosis is related to muscle changes after injection. Similar to quadriceps fibrosis, many drugs have been identified as causes of contractures, including dramamine, iron, tetramycin, penicillin, lincomycin, streptomycin, pentazocine, vitamins, and antipyretics [30-37]. In a study of 9,845 healthy children, Sun X [38] found 122 cases of gluteal contractures (1.36%) that were probably due to repeated injections of penicillin diluted with 1.5–2% Benzyl alcohol. In another series, Babhulkar [12] reported 11 cases of triceps contractures after intramuscular injection of oxytetracycline. In our patients, antibiotics were injected with penicillin in 21 cases (65.6%), penicillin and gentamycin in 8 cases (25.0%), other types such as lincomycin, streptomycin, cloxacillin… in 3 cases (9.4%). Intramuscular injection can cause local necrosis and local chemical myositis, which can lead to muscle fibrosis. Repeated needle punctures and local trauma into the muscle can cause hemorrhage, necrosis, phagocytosis of muscle fibers, accumulation of mononuclear cells and cellular infiltration even when no substance is injected [39]. Contractures often develop after repeated injections into the muscle. Furthermore, the chemical composition of some drugs or the nonphysiological pH of the carrier medium can produce varying degrees of tissue toxicity and can stimulate the formation of fibrotic tissue. This property and the rapid injection of large amounts of drugs can lead to muscle fibrosis. These drugs included pentazocine, pethidine, dimenhydrinate, vitamin preparations, antibiotics, and antipyretics [2,40,41]. (Most of our patients did not remember the name of the drug they had injected, but they may determine the reason for the injection.) Electromyography showed no electrical activity in the affected muscle, while nerve conduction velocity findings were normal [39,42,43]. Frasch W. 1976 [32] and McCloskey JR. 1977 [44] suggested that if long-term antibiotic therapy is planned in children, intramuscular injections of antibiotics should be avoided and the intravenous route used if possible, and we agree with their opinion.

Spastic shoulder adduction and lateral displacement of the scapula due to spastic triceps longus must be differentiated from spastic shoulder adduction due to other causes. Brachial plexus palsy in the newborn results from injury to one or more cervical and thoracic nerve roots (C5-T1) occurring before, during, or after birth. In general, about half resolve completely within the first year. Most improvements occur within the first 3 months. Brachial plexus palsy also results in spastic adduction of the scapula; however, this usually involves the infraspinatus and teres minor muscles, and dyskinesia (abnormal involuntary movement) is a prominent feature [45]. Brachial plexus palsy does not result in skin depression or a palpable long head of the triceps contracture. Long thoracic nerve palsy results in loss of function of the serratus anterior muscle; this allows the trapezius muscle to function unimpeded, with a tendency to move the scapula laterally when the arm is raised, and there is no skin depression or a palpable long head of the triceps contracture. Fibrosarcoma of the deltoid muscle with spastic excision of the shoulder and wing of the scapula. Osteochondritis of the scapula, when located on the anterior surface, causes a marked lateral movement of the scapula and resolves spontaneously after excision [46]. According to Gray [47], the triceps arises anatomically from the dorsal arm and is composed of three heads forming a trifurcated structure. The long head arises from the infraglenoid tubercle of the scapula, the lateral head from the superior half of the posterior surface of the humeral shaft above the spiral groove, and the medial head from the posterior surface of the inferior half of the humeral shaft below the spiral groove. The common tendon, a two-layer fascial structure that originates in the middle of the muscle, attaches to the superior surface of the olecranon with a small fibrous band that continues distally and above the anconeus to join the deep fascia. The functional elbow is the extension of the elbow, and the position of the scapula varies depending on whether the long head of the triceps is contracted [48]. The shoulder is adducted when the triceps is pulled with the long head of the triceps contracted, especially when attempting to flex the elbow. Thus,

shoulder abduction does not exceed 90 degrees if the scapula is held against the chest wall and the scapula is moved outward with the elbow flexed in 38 shoulders [100% (32 patients)]. The triceps consists of three heads forming a tripennate structure, releasing the long hesd of the triceps did not affect elbow extension in 38 shoulders [100% (32 patients)], and postoperative elbow flexion and extension function was normal in all patients.

Cosmetic concerns included adduct contracture and lateral movement of the scapula, especially during attempted elbow flexion. Long-term fibrotic long head of the triceps caused a skin dimple, a palpable long head dimple of the triceps, which we found in all patients. The only functional complaint presented was limited shoulder abduction with adduct contracture. Surgical intervention reduced adduct contracture, lateral movement of the scapula, and chronic discomfort. The morphological results after surgery with skin dimpling, palpable long head of the triceps were completely resolved in all patients, and lateral scapular motion with elbow flexion was completely resolved in 38 shoulders (100% [32 patients]).

Indications for surgical treatment are cases with adduction contracture at rest of less than or equal to 60 degrees. We agree with Gammie's opinion that patients must be at least 5 years old and must have evidence of deformity progression during growth or change in skeletal anatomy. Children under 5 years of age are not aware of the cosmetic problems and cannot cooperate with the physician in terms of postoperative physical therapy. The deformity can be corrected by surgical treatment focusing on releasing the long head of the triceps contracture. Postoperative results with complete resolution of the closed angle were obtained in 37 shoulders (97.4% [thirty-one patients]), elbow flexion angle was greater than 130 degrees in 36 shoulders (94.7% [30 patients]), and the radiographic shoulder-humeral angle was greater than 150 degrees in 37 shoulders (97.4% [31 patients]).

Normal muscle fibers were preserved to avoid loss of strength in shoulder abduction, flexion and extension, and elbow flexion and extension. In the present study, with excellent results in 36 shoulders (94.7% [30 patients]), good results in 2 shoulders (5.3% [2 patients]). Shoulder function was improved, elbow extension was not affected, and there were no fair or poor results and complications in any patient.

Conclusion

1. Adduction contracture is a rare upper limb deformity caused by intramuscular antibiotic injection. The main signs are the inability of the shoulder to abduct more than 90 degrees if the scapula is held tight against the chest wall, the scapula moves outward when the elbow is flexed, muscle biopsy shows marked fibrous tissue in the long head of the triceps, and ultrasound shows fibrotic long head of the triceps. In children, those who develop contracture after injection may have a tendency to develop fibrosis, contracture seems to be related to the injection in children. The injection is usually an antibiotic such as penicillin, gentamycin, lincomycin, etc. The injection site is directly related to the subsequent disease area and therefore the proportion of affected muscles depends on the usual injection site in each country. Finally, once again, we strongly warn against intramuscular antibiotic injection in children.
2. Surgical procedure for long head triceps release is simple, safe, and significantly improves shoulder function.

Limitation of the Study

This is the second article in 14 years that we have published surgical results for this pathology. The limitation of the article is that there are no other authors who have published this pathology to compare the results after surgery.

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