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RESEARCH ARTICLE

THE RESULTS OF ARTHROSCOPIC RELEASE WITH TENDON TRANSFERS IN CASES OF B.P.B.P WITH GLENOHUMERAL DYSPLASIA

Anis E.M. Shiha[1], Hassan H. Noaman[1], Ahmed I. Addosooki[2] and Mohamed R. Abo Al-Ezz[2]

1. Orthopedics and Traumatology Department.
2. Faculty of Medicine, Sohag University.

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Abstract

Background: Internal rotation deformity due to brachial plexus birth palsy frequently lead to glenohumeral deformity . Our surgical approach to treat these contractures relies on arthroscopic release and tendon transfer of latissimus dorsi muscle for young children . We report the results for twenty children followed for a minimum of two years after such treatment

Patients and methods: This study was done in the Orthopedic department, Sohag University Hospitals including all patients with brachial plexus birth palsy with internal rotation contracure of the shoulder. Twenty children with a mean age of 4 years (between 2 and 6 years old) underwent arthroscopic contracture release and tendon transfer of latissimus dorsi muscle as a primary procedure.Passive and active external rotation, internal rotation, and elevation were measured for all patients pre and postoperatively. Modified mallet score and active movement score was measured pre and postoperatively. Magnetic resonance imaging was performed preoperatively and postoperatively to evaluate glenoid version and head sublaxation.

Results: At the time of follow-up, the mean passive external rotation was increased by 67° ($p < 0.005$) in the children with a successful arthroscopic release and tendon transfer. The mean active elevation increased by 12°. Internal rotation was not measured consistently preoperatively, but when it had been it was found to have decreased substantially postoperatively. Mean glenoid version improved from -33° to -7° following soft-tissue releases and The percentage of the humeral head anterior to the middle of the glenoid improved from 8% to 43%. While the average duration of clinical and radiographic follow-up was twenty-four months, improvements in both shoulder motion and glenohumeral joint morphology were seen early and were maintained during the follow up period.

Conclusion: In children with internal rotation contracture, arthroscopic release and tendon transfer effectively restores nearly normal passive external rotation and a centered glenohumeral joint at the time of surgery. In most of these children, external rotation strength is sufficient to maintain this range of motion and to improve glenoid development when preoperative deformity was present. Improvement

Corresponding Author:- Anis E.M. Shiha
Address:- Orthopedics and Traumatology Department.

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Introduction:-

Brachial plexus birth palsy (BPBP) occurs in approximately 1.5 per 1,000 live births[(1)] and is presumed to result from traction to the brachial plexus during delivery. The natural history of BPBP is less favorable than historically believed, with twenty to forty percent of children experiencing incomplete neurological recovery[(2-3)]. In these children with persistent paralysis, secondary contractures can occur, most notably shoulder internal rotation contractures[(4-5)].

These contractures significantly impair function and quality of life and are the most common reason for surgery following BPBP[(5-8)]. Thus, historically, surgery for the so-called "secondary" problems at the shoulder have focused on restoring passive range of motion by releasing contractures and improving active range of motion by way of muscle transfers. These "palliative" interventions were typically performed only after optimal nerve reconstructive surgery had been exhausted or after spontaneous recovery had plateaued.

However, the landscape has changed dramatically in recent years, spurred primarily by two quantum leaps in the understanding of the problem. First, the contracture at the shoulder has been clearly shown to be associated with progressive skeletal dysplasia of the glenohumeral joint[(9)]. This dysplasia begins with increased retroversion of the glenoid and leads to complete posterior dislocation of the glenohumeral joint with humeral head flattening, loss of glenoid concavity, and pseudoglenoid formation. Second, this dysplasia occurs much earlier than previously thought, with nearly ten percent of infants progressing to glenohumeral dislocation in the first year, even as early as 3 months. Thus, it is not unusual to be faced with a dislocated shoulder that needs to be addressed with "secondary" procedures even before the child is old enough to determine if "primary" nerve surgery is necessary[(10,11)].

Recognition of the early development of glenohumeral dysplasia is of critical importance in the management of the shoulder following BPBP, as early treatment of the glenohumeral joint deformity can alter the long-term course of shoulder development and function. Surgical management to address limitation of active external rotation depends on the severity of the problem, and the general functionality of the limb and the age of the child must be taken into consideration. Several series have demonstrated remodeling of the glenohumeral dysplasia following release of the internal rotation contracture with or without muscle transfers to augment external rotation strength[(12-16)].

Even humeral head deformity has been shown to remodel following restoration of appropriate glenohumeral alignment. However, it is still unknown beyond what age remodeling is no longer possible or the severity of glenohumeral deformity that can remodel. Nonetheless, the possibility of restoring normal skeletal structure with early surgery underscores the importance of early detection of glenohumeral dysplasia[(17)].

More recently, open[(18-21)] and arthroscopic[(13,16)] procedures involving joint reduction, with or without tendon transfer, have been shown to be effective at maintaining concentric reduction as well as at reducing and gradually remodeling dysplastic joint. Children less than four years old were treated with an isolated contracture release, with a release of the subscapularis from its origin. Older children and those with a severe contracture and weakness were treated with a latissimus dorsi transfer in addition to a contracture release as the primary operation. According to Pearl et al [(13)] who were become aware of the limitations of subscapularis slide release , as they found that releasing the subscapularis from its origin failed in one of five children. When they reverted to anterior approaches, in small children with severe contractures and advanced deformity, they found exposure to be difficult even after complete release of the pectoralis major and sometimes the conjoined tendon. The subscapularis was often far posterior and severely contracted. Z-plasty lengthening was not always possible as externally rotating the arm distracted the tendon edges beyond a point where they could be sutured together.

In light of these limitations, arthroscopic release of the internal rotation contracture, became our preferred method, with the aim of preserving the same indications as were used with open methods. We hypothesized that (1) release of the internal rotation contracture with an arthroscopic subscapularis tenotomy and capsular release would reliably restore external rotation at the time of surgery and after two years of follow-up, and (2) the restoration and preservation of external rotation achieved by tendon transfer would prevent the development of glenohumeral deformity if one was not yet present or would promote remodeling of any existing deformity. We report on the first twenty children whom we have followed for at least two years following this procedure

Patients And Methods:-

This study was done in Hand and Microsurgery unit, Sohag University Hospitals and was include all patients with brachial plexus birth palsy with internal rotation contracure of the shoulder with mild to moderate glenohumeral dysplasia.

The protocol of the study was be approved by the Scientific and Ethical committee at Sohag Faculty of Medecine. An informed written consent was obtained from all participants.

Twenty children with an internal rotation contracture secondary to brachial plexus birth palsy were treated with an arthroscopic release between September 2019 and September 2021. There were twelve boys and eight girls, and the ages at the time of surgery ranged from two years to six years, with a mean of 4 years old.Sixteen of the children showed involvement of the C5 and C6 nerve roots, and the other four had involvement of the C5, C6, and C7 roots. All of the patient in this series had good hand function.

Surgical release of the contracture was recommended when the patient had not responded to two to three months of continuous stretching exercises supervised by good physiotherapist or passive external rotation was < 20° with the arm at adduction position or was sufficiently restricted to impair the child’s ability to reach overhead activities.

Surgical technique:

Arthroscopy was performed with the patient in a lateral decubitus position and with use of a 2.7-mm arthroscope. A posterior portal was established first. Because of the contracture, and often advanced deformity, it was sometimes necessary to abduct the arm to approximately 90° to pass the scope across the glenohumeral joint. An assistant maintained the arm position while applying longitudinal traction.The posterior portal was made at the posterior glenohumeral joint line about 1 cm below the level of the posterior part of the acromion. Care was taken to avoid making the portal too low. A superior position facili- tates insertion of the arthroscope over the top of the humeral head to avoid damaging the articular surface.

An anterior portal was made from outside in, under direct visualization through the posterior portal. To visualize the entire subscapularis tendon, it is necessary to release the anterior capsular ligaments, including the middle glenohumeral ligament and the anterior portion of the inferior glenohumeral ligament, at their attachment to the glenoid labrum. An electrocautery device set on 20 W was the most useful instrument to perform the release. Basket forceps were also helpful, especially for releasing the capsular ligaments.The muscular portion of the subscapularis was not released.

In most instances, the contracture can be adequately re- leased by tenotomy of the subscapularis tendon at its insertion and the overlying joint capsule. In younger children, this release typically resulted in full external rotation (70° to 90°) with the arm at the side.

A curved incision measuring approximately 6 to 8 cm was made in the skin lines, coursing just medial to the posterior axillary crease toward the midline of the axilla. latissimus dorsi tendon was then meticulously isolated from the teres major (which was left in situ), released directly from the humerus, and transferred under the posterior aspect of the deltoid to the greater tuberosity just adjacent to the infraspinatus tendon insertion with Number-2 Ethibond sutures .

A shoulder spica was applied to hold the arm in 30 degree abduction and full external rotation for six weeks following all procedures. This spica was then modified and used as a night splint for an additional six weeks.

Preoperative and postoperative assessment:

1. Clinical evaluation was done using the modified Mallet score and as well as passive and active shoulder range of motion.

2. Radiological evaluation will be done by using axial plane imaging MRI of both shoulders to measure glenoid version, the degree of subluxation, and Waters type.

Outcomes:
Preoperative and postoperative functional data were recorded prospectively. The modified Mallet shoulder function score were recorded, as was active and passive shoulder motion. Surgical complications were documented. Radiographic parameters were measured on axial MRI views of both glenohumeral joints of each patient. Recorded parameters included the degree of glenoid retroversion, the percentage of the humeral head anterior to the midscapular line, and the Waters type.

Statistical analysis:
The Student t test was used to compare the preoperative and postoperative ranges of motion. Two-tailed p values were reported. The Wilcoxon signed-rank test was used to compare the preoperative Mallet scores with the postoperative scores. Paired t test analyses were performed to compare preoperative and postoperative radiographic continuous variables. As a result of the large number of comparisons that were performed, a false discovery rate adjustment was used to reduce the likelihood of a significant finding being due to chance alone. On the basis of the false discovery rate adjustment, all p values of <0.004 were considered significant.

Results:-
Twenty patients were followed postoperatively for a minimum of 24 months. The median age at the time of surgical intervention was 4 years (range, 2 to 6 years). Twelve patients (60%) were female, and fifteen (75%) of the twenty injuries affected the right upper extremity (table.1).

Table (2) compared between preoperative and postoperative shoulder function parameters. The mean aggregate Mallet score improved by 4 points (95% confidence interval [CI], 3 to 4.9) from 13.4 to 17.3 points ($p < 0.001$).

There were considerable changes in all segments of the Mallet score (figure 1).
1. On average, the Mallet abduction score improved by 1 point (95% CI, 0.8 to 1.2), from 3.1 to 4.1 points ($p < 0.001$).
2. The Mallet external rotation score improved by 1.6 points (95%CI, 1.4 to 1.8), from 2.5 to 4.1 points ($p<0.001$).
3. The Mallet hand to neck score improved by .85 points (95%CI, 0.6 to 1.1), from 2.75 to 3.6 points ($p<0.001$).
4. The Mallet hand to mouth score improved by 0.9 point (95%CI, 0.7 to 1.1), from 2.75 to 3.7 points ($p< 0.001$).
5. The Mallet hand-to-back score decreased by 0.7 point (95% CI, 0.5 to 0.9), from 2.3 to 1.6 points ($p<0.001$).

AMS contains three parameters for shoulder function (figure.2). External rotation improved by a mean of 4 points (95%CI, 3.1-4.8), from a mean of 0.8 to 4.8 ($p<0.001$). No differences in AMS abduction or internal rotation were identified, although this study was not powered to detect small magnitudes of change on the AMS scale.

Some planes of passive and active shoulder motion were significantly changed following surgery (figure. 3).

Radiographic parameters improved significantly following surgery. As demonstrated by axial imaging, glenoid retroversion improved by a mean of 26° (95% CI, 20° to 32°), from -33° preoperatively to -7° two years postoperatively ($p<0.001$) (figure. 4).

All patients had improvement by at least one Waters type, as seen in the preoperative and postoperative distributions of the severity of this parameter (figure.5).

Table (1):- Patient demographics.

	No	**%**
Total no. patients, n (%)	20	100%

Mean age, y	Mean = 4	
Sex, n (%)		
Male	8	40%
Female	12	60%
Side, n (%)		
Right	15	75%
Left	5	25%
Bilateral		0
Gestation, wk		
>37	2	10%
37 to 42	14	70%
>42	4	20%
Presentation, n (%)		
Vertex	16	80%
Breech	4	20%
Birth weight, g		
<4000	14	70%
>4000	6	30%
Assistance, n (%)		
Forceps	1	5%
Suction	2	10%

Table (2):- Preoperative and postoperative scores according to the modified Mallet classification.

Case	**Global Mallet**	**Preoperative Scores (points)**				**Hand to Mouth**	**Global Mallet**	**Postoperative Scores (points)**				**Hand to Mouth**
		Ext. Rot.	**Hand to Neck**	**Hand to Spine**	**Abduct.**			**Ext. Rot.**	**Hand to Neck**	**Hand to Spine**	**Abduct.**	
1	11	3	2	2	2	2	15	4	4	3	1	3
2	13	3	3	2	3	2	17	4	5	3	2	3
3	14	3	3	3	2	3	18	4	5	4	1	4
4	15	3	3	3	2	4	18	4	5	4	1	4
5	12	3	2	3	2	2	18	4	5	4	1	4
6	15	3	2	4	3	3	20	5	5	4	2	4
7	15	4	3	3	2	3	18	5	4	3	1	5
8	16	4	3	3	3	3	20	5	5	4	2	4
9	13	3	2	2	3	3	17	4	4	3	2	4
10	13	3	2	2	3	3	18	4	4	4	2	4
11	15	3	3	4	2	3	20	5	5	4	2	4
12	12	2	2	3	2	3	18	4	4	4	2	4
13	14	3	3	3	2	3	16	4	4	4	1	3
14	13	3	2	3	2	3	17	4	4	4	1	4
15	14	4	2	2	3	3	18	4	5	4	2	3
16	13	3	3	3	2	2	16	4	4	4	1	3
17	11	3	2	2	2	2	13	3	3	2	2	3
18	14	3	3	3	2	3	19	4	5	4	2	4
19	11	3	2	2	2	2	13	3	3	2	2	3
20	14	3	3	3	2	3	18	4	4	4	2	4
Average	13.4						17.3					

Figure(1):- Preoperative and postoperative Mallet scores.

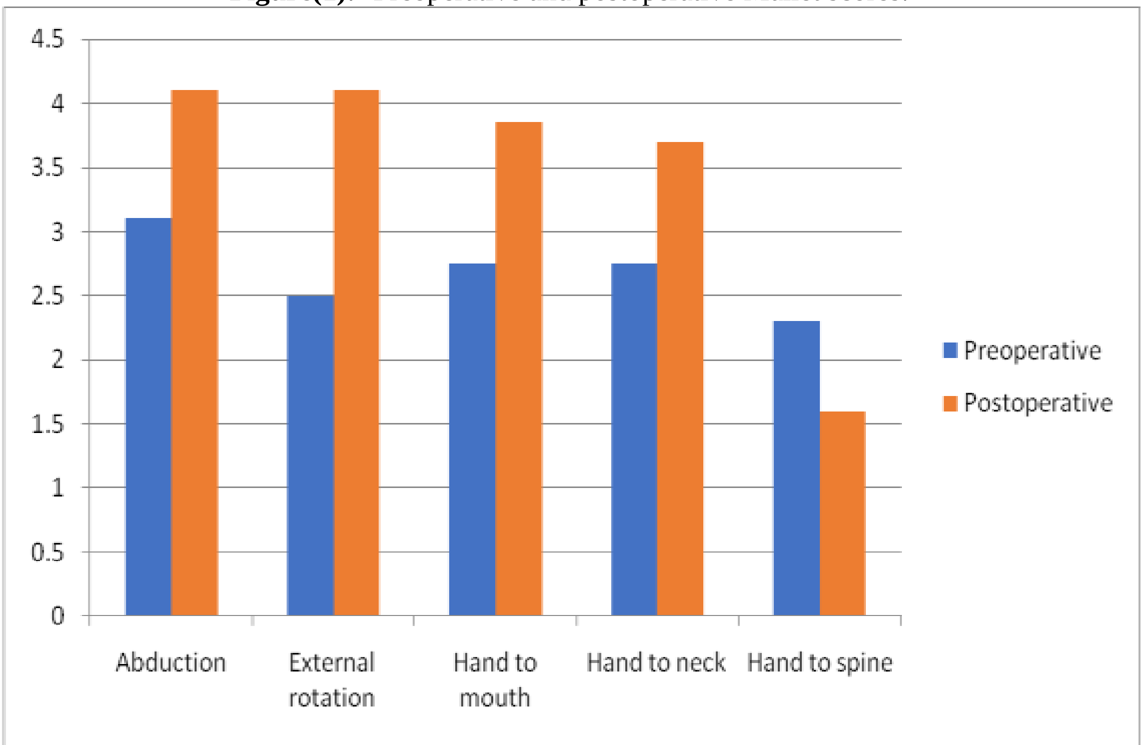


Figure (2):- Preoperative and postoperative active movement scale scores.

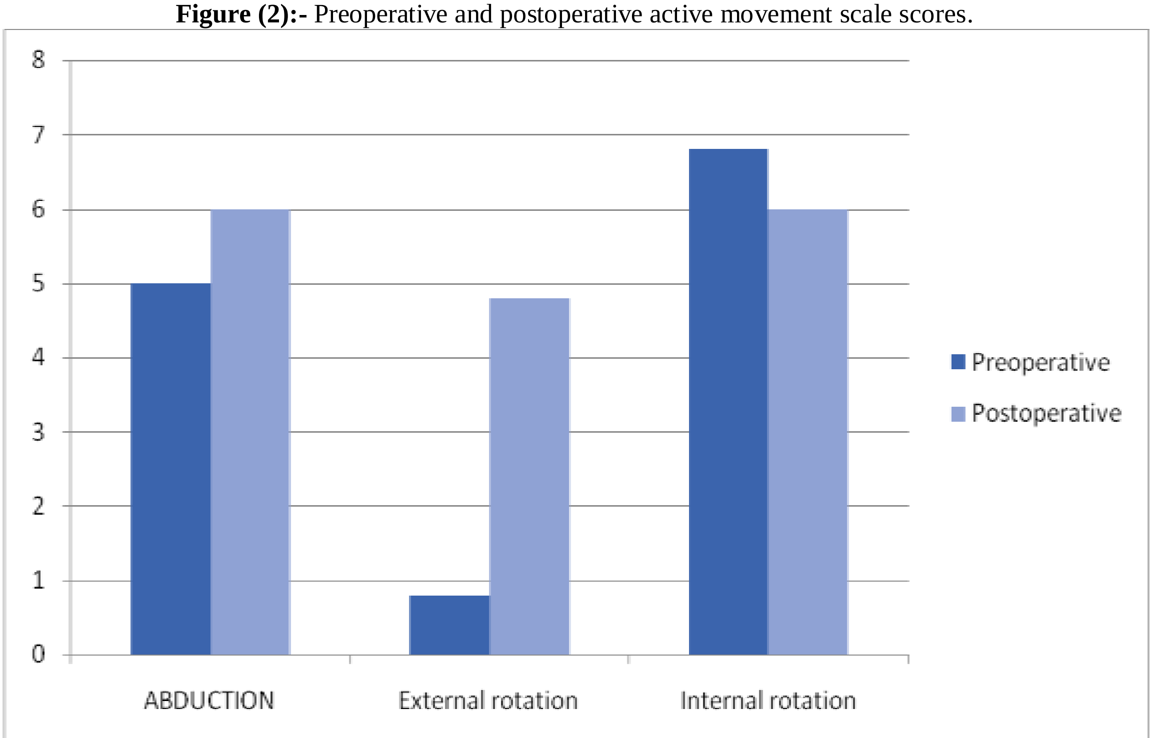


Figure (3):- Preoperative and postoperative active and passive shoulder motion. ABD = abduction, ER = external rotation, and IR = internal rotation.

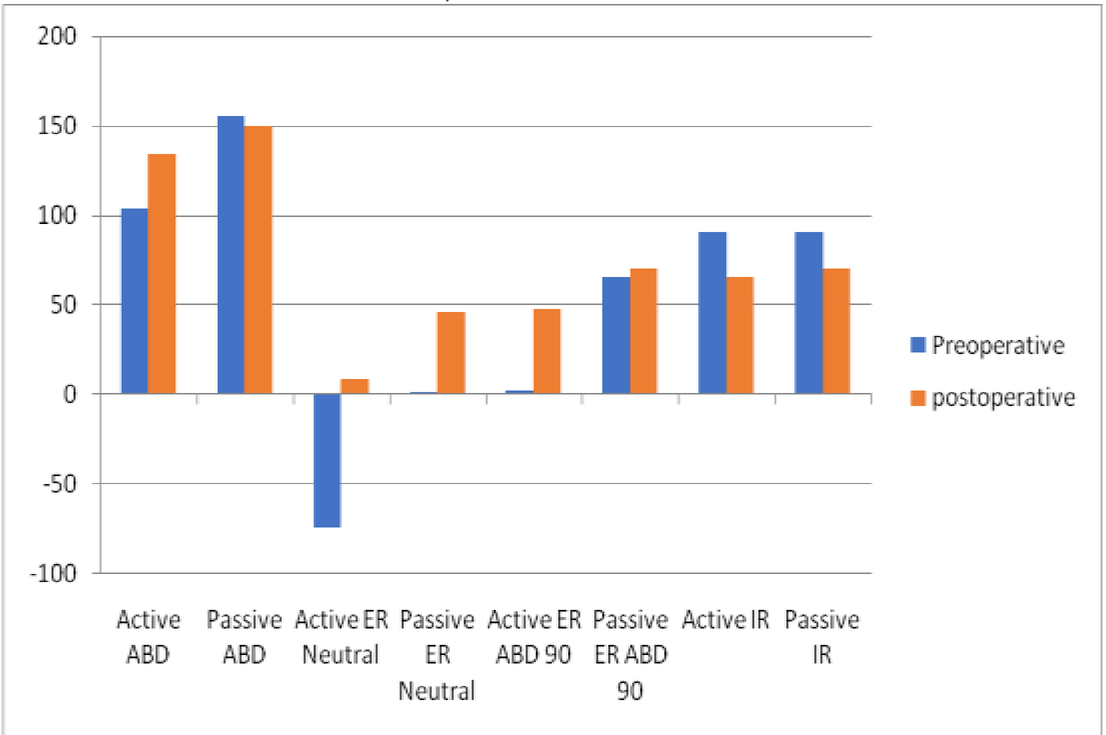


Figure (4):- Preoperative and postoperative percentage of the humeral head anterior to the midscapular line and preoperative and postoperative glenoid retroversion.

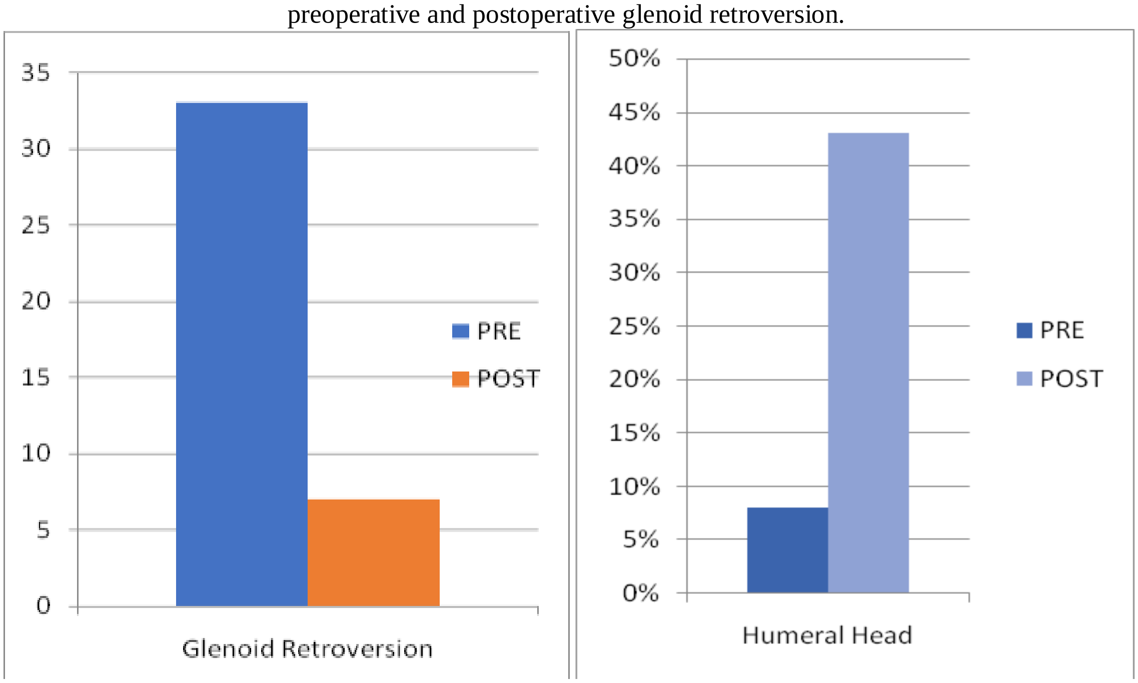
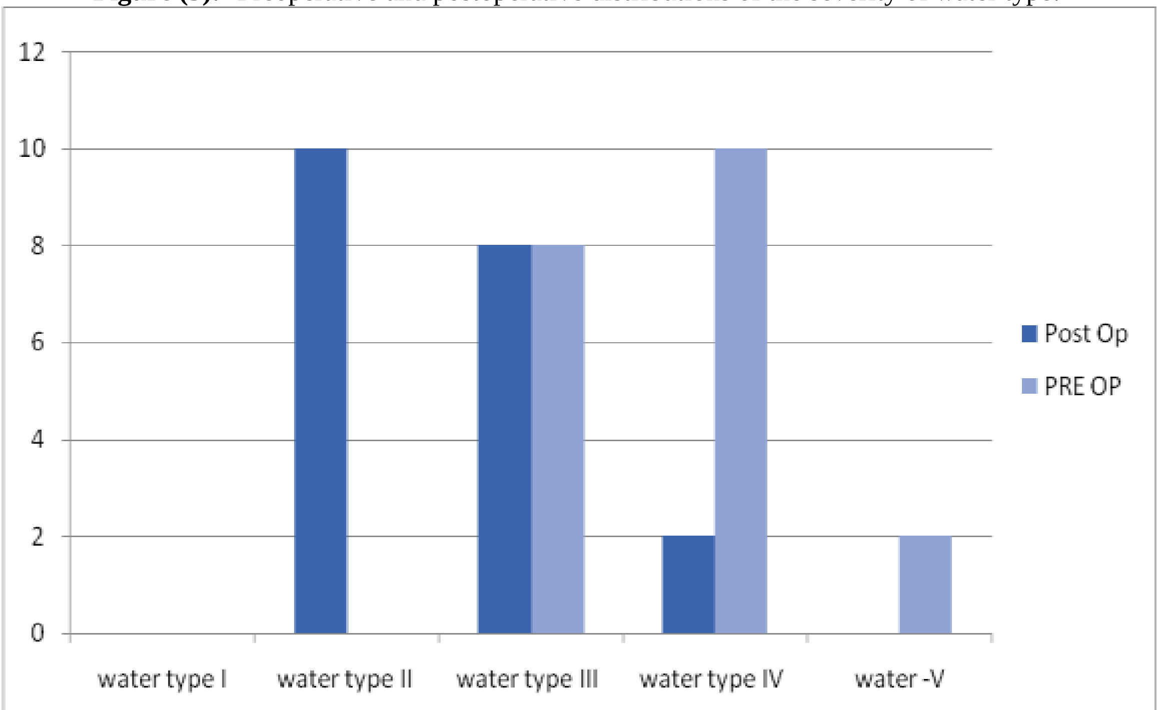


Figure (5):- Preoperative and postoperative distributions of the severity of water type.



Discussion:-

The natural history of BPBP is less favorable than historically believed, with 20–40 % of children experiencing incomplete neurological recovery(2-3). In these children with persistent paralysis, secondary contractures can occur, most notably shoulder internal rotation contractures(4-5).

These contractures significantly impair function and quality of life and are the most common reason for surgery following BPBP(5-8).

Surgical treatment of the secondary shoulder dysfunction following BPBP aims to accomplish three goals: restoration of passive motion by contracture release, realignment of the dysplastic glenohumeral joint, and augmentation of muscle power in the weak domains of shoulder movement. If these goals cannot be accomplished, palliative surgery in the form of humeral osteotomy can improve global shoulder function without addressing the glenohumeral joint deformity and dysfunction.

Reconstructive operations of the shoulder have been used since the early 20th century to palliate the sequelae of brachial plexus palsy at birth. From the early 1900s, Fairbank(22) and Sever(23) addressed the secondary shoulder deformities and attempted contracture releases of the pectoralis major and subscapularis muscles. In 1934, L'Episcopo(24) proposed subscapularis release with transfer of the teres major and later the latissimus dorsi to the posterolateral aspect of the humerus.

Anterior release (release of the subscapularis) combined with latissimus dorsi transfer to the rotator cuff has been the historical standard of care to restore abduction and external rotation in these patients based on small studies with short-term follow-up(19,25). However, there remains a paucity of long-term studies examining the maintenance of these improvements over time.

The increasing awareness of glenohumeral dysplasia over the past decade has created an opportunity to evaluate the effects of these surgical procedures on glenohumeral dysplasia progression. It is for this reason that restoration and preservation of the range of external rotation is the primary objective of our surgical protocol. This objective is further supported by a recent study by Waters and Bae that showed failure of glenohumeral remodeling after latissimus dorsi and teres major muscle transfers when external rotation at the side had not been the primary focus of treatment[26]

Pearl et al.[(13)] reported their experience with arthroscopic release of the subscapularis tendon and/or anterior glenohumeral joint capsule, performed either in isolation or combined with latissimus dorsi and teres major tendon transfers to the rotator cuff. Patients demonstrated improvement in terms of passive external rotation of the shoulder as well as in terms of centering of the humeral head within the glenoid. In addition, twelve of the fifteen patients for whom postoperative magnetic resonance imaging was available at a minimum of two years demonstrated improvement in terms of glenohumeral deformity, suggesting that intra-articular procedures combined with extra-articular soft-tissue rebalancing may lead to glenohumeral joint remodeling.

Similarly, **Kozin et al.**[(16)] adopted the technique of arthroscopic subscapularis release with or without external rotation tendon transfers and reported a series of 44 children with significant remodeling on 1-year follow-up MRI.

These reports draw attention to strategic adaptations in surgical technique that place increased importance on obtaining appropriate glenohumeral articular alignment in addition to extra-articular muscle balance.

Our results demonstrate that, in appropriately selected patients, latissimus dorsi tendon transfers to the rotator cuff combined with arthroscopic release of subscapularis tendon not only improve upper extremity function but also result in remodeling of glenohumeral dysplasia in the majority of patients. In the current investigation, the mean glenoid version improved from -33° preoperatively to -7° postoperatively following muscle rebalancing and soft-tissue releases. The percentage of the humeral head anterior to the middle of the glenoid improved from 8% preoperatively to 43% postoperatively. While the average duration of clinical and radiographic follow-up was twenty-four months, improvements in both shoulder motion and glenohumeral joint morphology were seen early and were maintained during the follow up period.

By employing the AMS outcome score and measuring the active range of motion, we were able to assess improvement in active motion, which is one of the potential benefits of combining arthroscopic release with tendon transfers. All patients in this series exhibited improvement in active external rotation. Preoperatively, no patient had anti-gravity external rotation whereas 53% of the patients achieved anti-gravity external rotation postoperatively (a minimum AMS score of 4).

The clinical relevance of improvements in the functional scores measured in this series is of interest. Although the minimal clinically important difference has not been documented for the Mallet or AMS score, we regard a change of 2 points on the AMS as clinically meaningful because it suggests that either motion is present when it was not present before (e.g., 1 improves to 3) or a previously limited movement is full (e.g., 2 improves to 4)[(43)].

The mean improvement in external rotation from 0.8 to 4.8 points in this series represents a substantial clinical improvement that permits new function such as hand to mouth ability and an improved ability to perform manual tasks directly in front, such as on a table. The clinical relevance of Mallet scores is perhaps less clear. We regard the improvement in the composite modified Mallet score of 4.0 points and in the global external rotation parameter of 1.6 points as being consistent with permitting new function and expanding the range of existing function as noted above. On the other hand, the improvement of 1 point in the Mallet abduction score probably is clinically relevant. Decrease from 2.3 to 1.6 points in the Mallet hand-to-back score correlates with the loss of hand-to-back ability. This outcome was anticipated and was disclosed as likely to occur to all operative candidates. All patients achieved full hand-to-belly ability, although this relatively new parameter[(26)] was not formally recorded .

Many surgical methods have been described for the release of contractures resulting from brachial plexus birth palsy. In our experience, arthroscopic release provided early results comparable with those of open methods and had some distinct advantages. The incisions are more cosmetically ac- ceptable than those used for the extensile open anterior approach through the deltopectoral interval. Although the open approach can be done, by skilled surgeons, through an axillary incision, we have found that severe contractures with poste- rior displacement of the glenohumeral joint have required partial or complete release of additional muscles such as the pectoralis major and conjoined tendons in order to gain adequate exposure. The other open method of subscapularis release (from its origin) does not address contractures within the capsular ligaments, and a second anterior incision may be required to complete the release.

One of the previous concerns about performing a sub- scapularis tenotomy, or any extensive anterior release, relates to the historic problems with iatrogenic external rotation contractures[3,11,27]. Described problems have ranged from loss of functional internal rotation to iatrogenic anterior dislocations. The arthroscopic method and surgical protocol that we described here differ from previously described open techniques in several ways. As stated previously, early open tech- niques often required releasing essentially all structures anterior to the glenohumeral joint, beginning with the skin and multiple surrounding muscles, in order to gain exposure and achieve a release. The arthroscopic procedure releases only the capsule and subscapularis tendon, leaving the muscular portion of the subscapularis intact. Additionally, we transferred only the latissimus dorsi tendon, in contrast to techniques in which both the latissimus dorsi and the teres major are transferred together (with sacrifice of part or all of the pectoralis major). Transferring two powerful internal rotators to a position where they function as external rotators and sacrificing as many or more internal rotators, as part of a surgical procedure that also releases the internal rotation contracture, may excessively tip the balance between external rotation and internal rotation power.

Nonetheless, the surgical procedure described here also resulted in a loss of internal rotation. This was evidenced by the inability of most of the children who were tested to per- form lift-off and belly-press maneuvers postoperatively and by a loss of passive internal rotation with the arm in 90° of abduction. We anticipate a loss of motion in this direction even in the most successful cases. Loss of internal rotation can be expected from any procedure that promotes motion in the opposite direction (i.e., external rotation), especially when the joint is incongruous. In the presence of a pseudoglenoid, an effective surgical release was seen to cause the humeral head to relocate anteriorly on the convex glenoid. This can certainly result in substantial stiffness in external rotation, which sometimes persists. For most patients, the decreased internal rotation is within a functional range and the loss is far outweighed by the benefits of function in the opposite direction and the opportunity for glenohumeral remodeling.

The technical challenges involved in performin arthroscopy on small, contracted, and deformed shoulders are considerable. Inserting the arthroscope, even a small one, risks damaging the articular surfaces. Visualization may be difficult as a result of the limited ability to maneuver in the contracted joint. The proximity of the axillary nerve further complicates the procedure.

The age that constitutes the upper limit at which remodeling of a glenohumeral deformity can occur is unknown. We observed remodeling of the glenohumeral joint at all ages, but the most impressive reorganization of the glenohumeral anatomy occurred in the younger children (less than four years old). We still favor a soft-tissue release of the contracture until the age of eight years, but in the future we may give greater consideration to external rotation osteotomies for children who are older than eight, particularly when they have a pseudoglenoid deformity.

This study and our treatment protocol have limitations, most of which we believe are common to previously described methods. Clinical examination of infants and young children is difficult. The child's fear of the examination, inability to comprehend instructions, and lack of coordination due to un- developed motor function are all challenges faced by the ex- aminer. A realistic assessment of full active motor function is rarely possible before the age of four years and is consistently possible only after the age of six years. Thus, the examination only approximates a complete motor examination, depending on the child's age and the above-mentioned factors. Young children, especially infants, can often be compelled to reach for objects in certain directions, but this is certainly not the same as directing a coordinated patient who can follow commands to move the arm maximally in a specific direction. For example, it would be nearly impossible for the majority of two-year-olds to carry out a command to reach maximally in external rotation while the elbow is held at the side. Yet this is the function of the infraspinatus, the most commonly com- promised muscle in patients with this condition.

On the basis of **Noaman**[(5)] literature, it is difficult to compare different surgical approaches. Outcome variables differ between studies; there is also a variation in indications of surgery, as well as operative techniques between centers, and a high likelihood of observer bias due to lack of blinded assessments in most of the research to date, which is mostly retrospective. Also, a deterioration of shoulder function was observed at follow-up at 12 years, this phenomenon is not specifically associated with anterior compartment releases. This was possibly due to a lack of compliance with physiotherapy programs, especially in teenagers who generally preferred to use their healthy arm.

Furthermore, patients in the present study demonstrated improvement in global shoulder function and improvement in glenohumeral dysplasia following combined joint reduction and muscle-rebalancing procedures. The relative effect of each of these procedures on joint remodeling and ultimate shoulder function is unknown up to date, raising the question of whether joint reduction alone would lead to similar improvements in glenohumeral morphology and active shoulder motion[4,13,22]. Future study will be directed at addressing this clinically important question.

Despite advances in the understanding of and treatments for the shoulder dysfunction following BPBP, surgical treatment of the internal rotation contracture is not without complications, especially with regard to achieving optimal balance between internal and external rotation. Several recent series of a variety of open and arthroscopic techniques have called attention to the postoperative loss of active internal rotation function[13, 25]. The resulting "severe, functionally disturbing" external rotation contracture can require internal rotation humeral osteotomy to restore midline function[26].

For this reason, consideration should be given to only partial release of the subscapularis tendon or to less aggressive musculotendinous lengthening. Conversely, the internal rotation contracture may recur following release and tendon transfers.

Conclusion:-

In children with internal rotation contracture, arthroscopic release and tendon transfer effectively restores nearly normal passive external rotation and a centered glenohumeral joint at the time of surgery. In most of these children, external rotation strength is sufficient to maintain this range of motion and to improve glenoid development when preoperative deformity was present. Improvement in active elevation was minimal. All children have a loss of internal rotation, which is moderate in most of them

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