



FUNCTIONAL OUTCOME OF MODIFIED PUTTI PLATT PROCEDURE IN RECURRENT DISLOCATION OF SHOULDER – A RETROSPECTIVE ANALYSIS

Orthopaedics

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ABSTRACT

Hand, which is considered to be an extension of brain and a tool for the execution of human intellect and will, owes much to the versatility of the movement of the shoulder for its placement on the desired spot of action. The shoulder, by virtue of its anatomy and biomechanics, is one of the most unstable and frequently dislocated joints, accounting for nearly 50% of all dislocations. Most of the recurrent dislocations of shoulder (96%) follow an initial significant traumatic dislocation. There are two basic types of surgical approaches for shoulders with anterior instability: "anatomic" and "non-anatomic" repairs. With anatomic repairs, the goals are to restore the labrum to its normal position and to reestablish the appropriate tension in the shoulder capsule and ligaments. The goal of non-anatomic surgical procedures is to stabilize the shoulder by compensating for the capsulolabral and osseous injury with an osseous or soft-tissue checkrein that blocks excessive translation and restores stability. In Modified Putti Platt procedure, as done in our institute, after proper positioning and adequate exposure, the subscapularis muscle and capsule is incised at the musculotendinous junction. A quadrangular uncortical graft, harvested from the iliac crest, is inserted fully into the trough made in the anterior glenoid, resulting in deepening of the glenoid articular surface. Subscapularis and the capsule are closed by double breasting, keeping the arm in external rotation. We did a retrospective analysis to assess the outcome of this procedure done in our institute. 102 patients were assessed and the required data were collected using hospital medical records, telephonic interview and direct clinicoradiological assessment. All the patients had positive apprehension test, pre-operatively. The mean Rowe score was 30.98 (standard deviation 5.846). The mean follow up duration was 44.52 months. 91 patients (89.2%) had no pain at last follow up duration and the rest had slight and occasional pain. All the patients were able to work above shoulder. The mean external rotation at 6 months follow up was 37.89° (SD 9.239), which increased to 65.88° (SD 8.967) at last follow up. The mean internal rotation at 6 months follow up was 61.18° (SD 4.623), which increased to 77.16° (SD 6.234) at last follow up. There was significant improvement of Rowe's score post-operatively when compared to pre-operative Rowe's score. There was a significant mean increase of 49.216 points post operatively with a correlation coefficient of +0.513. ($p < 0.05$). All patients, at last follow up had a UCLA score of more than 27, with 96 patients (94.1%) had good clinical outcome (according to UCLA grading system). 6 patients had fair clinical outcome. 77 patients (75.5%), according to Rowe score had good clinical outcome. 12 patients (11.8%) had excellent outcome. 13 patients had fair clinical outcome. None of the patients who were operated in our institute had recurrence of dislocation. None of them were reoperated. 91 patients (89.2%) had negative apprehension with no evidence of subluxation. 10 patients (9.8%) had negative apprehension, but slight discomfort in abduction and external rotation. One person had positive apprehension test, but he was able to continue his activities of daily living and continued to engage in professional non contact sports, though at one level below; and he did not choose to undergo a reoperation. 6 patients, all aged more than 45 years, had clinicoradiological evidence of mild arthrosis of the shoulder joint. They are being treated conservatively with physical therapy and analgesics. Mild donor site pain was there in 6 patients in the first yr of surgery. This subsided with time with analgesics. None had evidence of donor site infection, and none had evidence of visceral injuries.

KEYWORDS

INTRODUCTION

"Hand, which is considered to be an extension of brain and a tool for the execution of human intellect and will, owes much to the versatility of the movement of the shoulder for its placement on the desired spot of action. The main function of the shoulder is to put the hand into a position where it is best able to fulfill its many purposes. It may be above the head, in front of the head, or by the side of the body. This has been made possible by the nature by providing excellent mobility-but only at the cost of stability."⁽¹⁾

The shoulder, by virtue of its anatomy and biomechanics, is one of the most unstable and frequently dislocated joints, accounting for nearly 50% of all dislocations. (2) Most of the recurrent dislocations of shoulder (96%) follow an initial significant traumatic dislocation. (3,4) Failure to immobilize the shoulder for 3 to 4 weeks after reduction of an initial dislocation was once thought to be the chief cause of recurrence, but the studies of **McLaughlin** and **Cavallaro**, **McLaughlin** and **MacLellan**, **Rowe**, and **Rowe** and **Sakellarides** demonstrated that other factors are more important (2, 5).

Atraumatic and multidirectional glenohumeral instability constitutes only 4 % of all glenohumeral instabilities. (3, 4) It may be anterior, posterior, inferior or in all directions. It may be associated with congenital abnormalities such as Ehlers Danlos syndrome, aplasia of the shoulder joint, after a nerve injury to the shoulder, or after a stroke (stroke with a flail shoulder) or glenoid hypoplasia.

There are two basic types of surgical approaches for shoulders with anterior instability: "anatomic" and "non-anatomic" repairs. (6) With anatomic repairs, the goals are to restore the labrum to its normal position and to reestablish the appropriate tension in the shoulder capsule and ligaments. The goal of non-anatomic surgical procedures is to stabilize the shoulder by compensating for the capsulolabral and osseous injury with an osseous or soft-tissue checkrein that blocks excessive translation and restores stability.

Modified Putti Platt procedure was started in East India around 50 years back for recurrent anterior dislocation of shoulder by **Dr. Sailendra Bhattacharyya**, Chairman and Chief Orthopaedic Surgeon of our institute, BORRC.

AIMS AND OBJECTIVES

The purpose of this study is:

1. To analyse the outcome of the procedure-Modified Putti-Platt in patients who have undergone this procedure.
2. To establish our guidelines for future regarding selection of patients.

REVIEW OF LITERATURE

ANATOMICAL CONSIDERATIONS

Before we go into anatomical details of shoulder joint, it will be of interest to have some historical background. Dissection of the human body was not permitted in the early days. (1) Even then, people had some idea of the shoulder anatomy. **Sushruta**, in 6th B.C., correctly described that in shoulder, articulation takes part between two bones. **Hippocrates** who never liked dissection, and always referred to it as "unpleasant, if not cruel task", gave an explicit account of the shoulder. Galen later made the clinical study of the shoulder. It was only in 1348, that the necropsy was allowed to find out the cause of death in plague. Since then, more clear concepts about the shoulder started coming. But the greatest leap came, when the renaissance painters, in order to paint very accurately, quietly started dissecting human bodies. Leonardo da Vinci's drawings from his note book proved this point. In 1543, Vesalius published his book "de Fabrica corporis humani". Duchenne was probably the first, who studied the function of individual muscles of shoulder by electrical stimulation. But the most scientific study has been made by Inman, Saunders and Abbott in 1944. All subsequent papers either support or contradict their work. With the advances in the other fields of science, the advances in medicines also took place. Newer radiological modalities, arthroscopy, electron microscopy and

biochemistry have all contributed to a better understanding of human shoulder.

An understanding of the normal functional anatomy of the shoulder is necessary to understand the factors influencing the stability of the joint. The bony anatomy of the shoulder joint does not provide the inherent stability.

The glenoid is a flattened dishlike piriform structure, narrower superiorly. (2, 7) Only one fourth of the large humeral head articulates with the glenoid at any given time. In anatomical position of the limb, the glenoid looks upwards and forwards but when its orientation is considered in relation to the scapular plane, it is retro tilted by $7^\circ \pm 5^\circ$. The scapular plane subtends an angle of $30^\circ - 45^\circ$ to the coronal plane. Surface area of glenoid measures 41 mm by 25 mm. The area is somewhat increased by the glenoid labrum. **Howell et al** suggested that the glenoid is deepened by around 50% by the presence of glenoid labrum. (8) The labrum increases the humeral contact to 75%. The addition of labrum renders the socket to be elastic and flexible permitting greater range of movement.

Hiroyuki Sugaya et al (9) studied the morphology of glenoid and labrum with the help of three-dimensionally reconstructed computed tomography with elimination of the humeral head. The configuration of the glenoid rim was evaluated on both en face and oblique views. 100 shoulders with glenohumeral instability were compared with 75 normal shoulders. Investigation of the normal glenoids revealed no side-to-side differences. Fifty percent of the shoulders with recurrent anterior glenohumeral instability had an osseous Bankart lesion; 40% did not have an osseous fragment but demonstrated loss of the normal circular configuration on the en face view and an obtuse contour on the oblique view, suggesting erosion or compression of the glenoid rim.

The humeral head is mounted at the upper end of the shaft with some inclination medially. (7) The head neck axis subtends an angle of $125^\circ \pm 5^\circ$ with the long axis of the shaft. It is retroverted relative the lower condyles of the humerus. The angle of retroversion varies between 20° to 40° degree. The average vertical diameter of the surface is 48mm and the average horizontal diameter is 45 mm. Radius of curvature of the void varies from place to place in the same specimen and the surface is highly irregular. (7, 10)

Based on a surface contact study, **Prof. A.K. Saha (12)** had classified shoulder into three types as follows:

Type A: Radius of curvature of the head is smaller than that of glenoid. At any given position, the contact area is very small.

Type B: Radius of the curvature of the head and that of glenoid is same. The contact area between two surfaces is almost total.

Type C: Radius of curvature of humeral head is larger than that of glenoid. The surface contact is maintained only by the labrum and the adjacent margin of the glenoid only.

Prof A K Saha had worked extensively on biomechanics of shoulder. He in 1950, described about the **Zero position of the shoulder joint**. (12) During elevation of the shoulder in any plane, there comes a particular position when the mechanical axis coincides with the anatomical axis of the humeral shaft. In this position, all the muscles having rotator function on the glenohumeral joint align themselves along the surface of an imaginary cone (**The cone of Milch**). The anatomical- mechanical common axis also acts as the axis of the cone at this position and hence all the rotator muscles lose their rotatory functions as their lines of pull become collinear with the axis of the cone. The entire amount of force exerted by the muscles is utilised to exert a co-axial compressive force to stabilize the humeral head on the glenoid. This particular position of the shoulder during elevation has been defined as "zero position" of the shoulder.

This position can be utilized with the advantage to knock out the detrimental rotatory force exerted by the short rotators, during reduction of unimpacted fracture of the surgical neck, all fractures above the deltoid insertion and the anterior dislocation of the shoulder.

The exact position has wide individual variations, but usually lies in a position when the shoulder is elevated to $150^\circ \pm 15^\circ$ and the scapula realigns 45° forwards to the coronal plane. When an individual elevates his shoulder keeping his elbow flexed, to an extend when the radial styloid can be placed on the midline of the forehead at the

hairline by some amount of forward flexion, his "zero position" is approximately assumed.

BIOMECHANICS: Factors in glenohumeral stability

Although there is inadequate coverage of humeral head by glenoid, the normal shoulder constraints the humeral head to within 1 mm of the centre of glenoid cavity through its arc of movement (3).

The following passive and active mechanisms are responsible for joint stability (3, 13).

Passive mechanisms

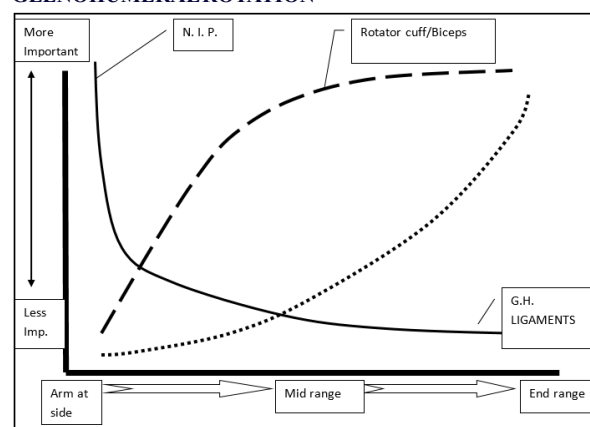
Joint conformity, Finite joint volume, Adhesion/ cohesion, Scapular inclination, Ligamentous and capsular restraints

Active mechanisms

Dynamic glenohumeral stability is provided by the long head of biceps and muscles of rotator cuff (Subscapularis, supraspinatus, infraspinatus, teres minor)

The following chart depicts the relative importance of the dynamic and static factors for shoulder stability (13).

GLENOHUMERAL ROTATION



Recurrent dislocation of shoulder

The first report of shoulder dislocation is found in the Edwin Smith Papyrus (3000-2500 B.C.), but the most detailed early description of anterior dislocation came from the father of medicine, Hippocrates (3). Glenohumeral instability presents in many ways, ranging from vague sense of shoulder dysfunction to an obvious fixed dislocation. Glenohumeral instability may be classified according to the degree of instability (subluxation or dislocation), the chronology of instability (acute or chronic), initial force (traumatic or atraumatic), voluntary or involuntary and the direction in which the translation occurs (anterior or posterior). (3) Most of the recurrent dislocations of shoulder (96%) follow an initial significant traumatic dislocation. Anterior dislocation usually follows with the arm in extension, abduction and external rotation. Posterior dislocation usually follows electric shock, seizures, or a fall on flexed and adducted arm. The amount of initial trauma that initiated the instability as well as force required to produce subsequent episodes is important. The reported incidence of humeral head deficit in the recurrent dislocation of shoulder varies from 38% to 67 %. Most common in the anterior dislocation of the shoulder is the subcoracoid type; other types are subglenoid, subclavicular, intrathoracic, and retroperitoneal. Posterior dislocation may be either subacromial, subglenoid or subspinous.

Atraumatic and multidirectional glenohumeral instability constitutes only 4 % of all glenohumeral instabilities. It may be anterior, posterior, inferior or in all directions. It may be associated with congenital abnormalities such as Ehlers Danlos syndrome, aplasia of the shoulder joint, after a nerve injury to the shoulder, or after a stroke (stroke with a flail shoulder) or glenoid hypoplasia.

OPERATIVE TREATMENT OF ANTERIOR SHOULDER INSTABILITY

There are two basic types of surgical approaches for shoulders with anterior instability: "anatomic" and "non-anatomic" repairs (3). With anatomic repairs, the goals are to restore the labrum to its normal

position and to reestablish the appropriate tension in the shoulder capsule and ligaments. The goal of non-anatomic surgical procedures is to stabilize the shoulder by compensating for the capsulolabral and osseous injury with an osseous or soft-tissue checkrein that blocks excessive translation and restores stability.

Many surgical procedures have been prescribed for the recurrent anterior glenohumeral instability:

PRINCIPLES OF SURGERY	NAMED PROCEDURES DESCRIBED
Tightening, realigning the subscapularis tendon and partially eliminating external rotation	Magnusson Stack procedure, Putti Platt procedure
Reattachment of capsule and glenoid labrum to glenoid tip	Bankart's repair, Du Toit staple, capsuloraphy, Eyre Brook capsuloraphy
Augmentation of bony anterior glenoid block	Eden Hybbinette procedure
Transfer of tip of coracoid process with its muscle attachment and creation of musculotendinous sling across the anteroinferior capsule	Bristow procedure
Anterior glenoid buttress with coracoid process prolongation	Ondard procedure, Trillat procedure
Other methods : Filling the defect with infraspinatus tendon, performing rotational plasty	

Te Slaa et al. in 2004(14) studied 105 patients with 107 acute, primary dislocation of glenohumeral joint seen between January 1, 1991 and July 1, 1994 with the mean time of follow-up of 71 months. In 34% of the patients, the injury occurred during a sports activity and in 28% at home. The overall probability of recurrence within four years was 26%. Age was the most significant prognostic factor in recurrence which took place in 64% of patients less than 20 years of age and in 6% of those older than 40 years.

Robinson et al (15) in 2004 did a three-year, prospective, observational cohort study of 538 consecutive patients with a first-time anterior dislocation of the shoulder and enlisted the risk factors for recurrent dislocation of the shoulder. Seventeen (3.2%) of the 538 patients sustained an early redislocation within the first week after the original dislocation. Patients at increased risk of early redislocation included those who sustained the original dislocation as the result of a **high-energy injury** (relative risk = 13.7), those who had a **neurological deficit** (relative risk = 2.0), those in whom a **large rotator cuff tear** occurred in conjunction with the dislocation (relative risk = 29.8), those in whom the original dislocation was associated with a **fracture of the glenoid rim** (relative risk = 7.0), and those who had a **fracture of both the glenoid rim and the greater tuberosity** (relative risk = 33.5).

There are enough literatures available which describe the various treatments and surgical procedures for glenohumeral instabilities.

McAuliffe et al (16) in 1998 reviewed 36 patients who had recurrent anterior dislocation of the shoulder after a previous anterior repair and analysed the various causes of failure. It was found that failure could have been avoided in virtually all of the patients by correct pre-operative diagnosis, selection of the appropriate operation and its proper execution.

Hutchinson et al (17) in 1995 reported their experience in 14 patients with grand-mal epilepsy and recurrent anterior dislocation of the shoulder. After the bone buttress operation there were no further dislocations and all patients were satisfied despite a small restriction in their range of movement. They recommended this to be the operation of choice for patients with this difficult problem.

Singer et al (18) reported 20-year results of Bonnin's modification of the Bristow-Latarjet procedure in 14 patients operated on by one surgeon. All but one patient had traumatic dislocations. At review, the Rowe scores were excellent in five, good in eight and fair in one. The functional outcome was satisfactory, with a mean Constant-Murley score of 80 points (68 to 95), but 12 patients had restriction of external rotation (86%). There were radiological degenerative changes in ten

shoulders(71%).

Ahmada A. M (19) in 1987, in a follow up study of 38 patients with recurrent anterior dislocation of the shoulder reported that Bankart and Hill-Sachs lesions were not a constant finding but **subscapularis laxity** was detected in almost every case, an observation that helps to confirm its central role as a cause of recurrence. They used modified Magnusson-Stack procedure of lateral and distal transfer of the insertion of the subscapularis muscle in these patients, all of whom have been followed-up for a minimum of three years. There was only one failure; the other 37 patients had an excellent or satisfactory result with an adequate range of movement.

Collins et al (20) in 1986 reported the results of 107 shoulder reconstructions by one surgeon, of which 59 were Putti-Platt procedures, and 48 were combined Putti-Platt/Bankart procedures. They concluded that the Putti-Platt procedure provides excellent shoulder stability for active sportsmen without significant loss of performance, though they reported nine redislocations among these patients.

Leach et al (21) in 1982 reported only one redislocation after 78 consecutive cases of a Modified Putti-Platt operation for recurrent anterior dislocations of shoulder. Though it limited the external rotation by 12 to 19 degrees (at 90 degrees of abduction), it had not been a functional problem in any of their patients.

RJ Hawkins and RL Angelo (22) in 1990 reported disabling pain due to osteoarthritis in the shoulder (ten patients, eleven shoulders) at an average of 13.2 years after a Putti-Platt repair, resulting in substantial limitation of motion. Seven shoulders were successfully treated non-operatively, and a technique of anterior release was successful in four shoulders.

Fredriksson et al (23) in 1991, analysed 101 patients who had undergone a Putti Platt procedure in a follow up study of 8 ± 2 years (range of 5-14 years). 89 of them were followed up and 43 underwent a clinical examination, 23 being assessed with the Cybex dynamometer. The 46 who did not attend were interviewed by telephone. Redislocation occurred in 18 patients (20%), but this was twice as high in patients who were aged less than 26 years at the time of operation compared with those who were older (29% versus 13%). The time of recurrence was between 1 and 11 years after operation. A decrease in strength and power of abduction, internal and external rotation, was found in the affected shoulder. Restriction of all measured movements, particularly external rotation, was also found in all patients. Nevertheless most had a high functional score and relatively few symptoms.

Kim Seung-Ho et al (24) studied the surgical outcomes of arthroscopic Bankart repair of anterior capsulolabral lesions with use of suture anchors in 167 patients with traumatic recurrent anterior instability of the shoulder. They found that arthroscopic capsulolabral repair with use of suture anchors can provide satisfactory outcomes in terms of recurrence rate, activity, and range of motion.

Gartsman et al (25), in a study on 53 patients, reported that the technique of arthroscopic treatment of anterior-inferior glenohumeral instability was better than previous arthroscopic techniques and is equivalent to open repair. They opined that the improved rate of success demonstrated in the study was the result of repair not only of the anterior-inferior (Bankart) lesion but also (where necessary) of inferior and superior labral tears. Additionally, soft-tissue tension within the capsule and ligaments was corrected with use of a suture technique but was supplemented by laser thermal capsulorrhaphy in forty-eight of the fifty-three shoulders. Rotator interval repair was considered a critical factor in fourteen of the fifty-three shoulders.

Brian Cole J. et al (26) did a comparative study of arthroscopic and open shoulder stabilization in a two to six year follow up study. The decision to select either arthroscopic Bankart repair or open capsular shift was based on the findings of an examination under anesthesia and the findings at the time of arthroscopy. Thirty-nine patients with only anterior translation on examination under anesthesia and a discrete Bankart lesion underwent arthroscopic Bankart repair with use of absorbable transfixing implants. Twenty-four patients with inferior translation in addition to anterior translation on examination under anesthesia and capsular laxity or injury on arthroscopy underwent an

open capsular shift. There were no significant differences between the two groups with regard to the prevalence of failure or any of the other measured parameters of outcome. An unsatisfactory outcome occurred after nine (24 percent) of thirty-seven arthroscopic repairs and after four (18 percent) of twenty-two open reconstructions. All cases of recurrent instability resulted from a reinjury in a contact sport or a fall less than two years postoperatively.

MATERIALS AND METHODS

This is a retrospective analysis of the outcome of Modified Putti Platt surgery in the recurrent anterior dislocation of shoulder. All the patients who underwent Modified Putti Platt procedure in this institute during the year 1985 to 2005 were included in this study. The collection of data were from Hospital record, telephonic interview: (This was essential, where the patients had stopped follow up after 2-3 years, because they did not have any significant complaints related to shoulder or the procedure.) and clinical examination: All patients who were telephoned were encouraged to come to the hospital for a follow up check up. Many people turned up to fill up the questionnaire on their own, and for clinical examination and radiological evaluation.

Some patients were excluded from the study to remove the confounding factors. These **exclusion criteria** were:

1. evidence of generalized laxity of ligaments
2. initial polytrauma involving ipsilateral elbow, hand injuries
3. associated spinal cord injury and neurodeficits

MODIFIED PUTTI PLATT PROCEDURE done at our hospital: an overview

Operative procedure:

The surgery is done under general anesthesia. The patient lies supine with the head turned to the opposite side and shoulder over a sand bag; the shoulder and the ipsilateral arm, being draped free. Modified deltopectoral incision is given. Subcutaneous tissue and the deep fascia are incised in the line of skin incision. Coracoid process is identified, and osteotomised. Subscapularis and the capsule are incised at the musculotendinous junction. A quadrangular uncortical graft is harvested from the iliac crest and is inserted fully into the trough made in the anterior glenoid, resulting in deepening of the glenoid articular surface. The arm is kept externally rotated in around 20° to 30° and then the subscapularis and the capsule is closed by double breasting. Care is taken not to put tension on the suture line. Coracoid process is reattached. The wound is closed over a drain and an arm to chest bandage is applied. Post operatively, sutures are removed on the 12th post operative day, and also the strapping, and shoulder mobilization is started. Shoulder muscle strengthening is advocated. Arm is kept in arm pouch sling for two more weeks.

In the original Putti Platt procedure, which was described by Osmond-Clark in 1948, (which was used by Sir Harry Platt of England and Vittorio Putti of Italy), the subscapularis tendon is divided 2.5 cm from its insertion. The anterior shoulder joint capsule, which adheres to the posterior surface of the subscapularis tendon, may be opened in the same plane as the tendon is divided so the joint can be inspected. The lateral stump of tendon is attached to the most convenient soft-tissue structure along the anterior rim of glenoid cavity. If the capsule and the labrum have been stripped from the anterior glenoid and the neck of the scapula, the tendon is sutured to the deep surface of the capsule, and "it is advisable to raw the anterior surface of the neck of the scapula, so that the sutured tendo-capsule will adhere to it." After the lateral stump is secured, the medial stump is lapped over the lateral stump, producing a substantial shortening of the capsule and the subscapularis muscle. (27)

In those instances when the medial capsule can be separated from the medial muscle tendon unit, the capsule is sutured on the top of the secured lateral tendon and medial muscle tendon unit is then secured over the capsule laterally in the area of the greater tuberosity of the humerus. The exact placement of the lateral stump into the anterior soft tissue and of the medial stump into the greater tuberosity of the humerus is determined so that after the procedure, so that after the procedure, the arm should externally rotate to the neutral position. The pre-operative details were collected from the medical record. Post-operatively the details were collected at six months, one year, two years, and at last follow up.

STATISTICAL ANALYSIS

Assessment of shoulder function is crucial to effective outcome

research for shoulder conditions. Various methods and tools have been proposed for functional assessment of the shoulder. Many of the tools are designed as scoring scales, attempting to represent multiparametric shoulder function in terms of an overall score. Other assessment tools focus on standardizing data collection without development of a scoring system. The use of multiple instruments impairs comparative analysis among investigators, an important method of advanced clinical research. (28)

All the scoring systems attempt to give comparable weightage to both the subjective characteristics as well as objective characteristics. The **UCLA** (University of California at Los Angeles) scale includes pain (10 points), motion (10 points), function (10 points), and patient satisfaction (5 points). (29) **ROWE** score includes assessment of function (50 points), pain (10 points), stability (30 points), and motion (10 points). (30) The American shoulder and elbow surgeons (**ASES**) shoulder evaluation form includes assessment of pain, motion, strength, stability and function. (31) **Lysholm** assessment score includes assessment of pain, function, stability and motion. (32) **Constant and Murley** score use a specialized instrument for the assessment of strength. (33)

OBSERVATIONS

We were able to locate and fully evaluate 102 patients at a mean of forty four months (range 28 to 133 months) after the procedure. The patients were interviewed by telephone and the assessment score completed in given format by me. They were encouraged to come to hospital for assessment. 57 patients (58.14%) had come in person for assessment. The questionnaires that fulfilled the requirements of grading system of Rowe et al and that of UCLA were given to the patients for them to complete. We assessed them clinicoradiologically for range of motion, presence of any arthrosis, instability, stiffness, infection or distal neuro-vascular deficits.

CT scan of the shoulder could not be done for any of the patients as none of them could afford them. CT scans were not done either as a routine pre-operative assessment.

The rating system of Rowe et al. was used to evaluate the clinical outcome of the procedure. This 100-point system assigns 50 points for function, 30 points for stability, 10 points for motion, and 10 points for pain. The UCLA Score (University of California at Los Angeles) scale includes pain (10 points), motion (10 points), function (10 points), and patient satisfaction (5 points).

The data were analysed using SPSS for WINDOWS (Statistical Package for Social Sciences, SPSS Inc, Chicago, Illinois) software after the data were entered.

1. THE FOLLOW UP DURATION: The mean follow up duration of the group was 44.52 months (range from 28 months to 133 months). The median follow up duration was 37 months

2. AGE GROUP: Most of the patients (87.25) were in the age group of 20-40 years. The age-wise distribution of the patients is shown in table

Age group	N	Percentage
20-30	56	54.90%
31-40	33	32.35%
41-50	10	9.80%
51-60	01	0.98%
61-70	02	1.96%
Total	102	~100%

3. SEX: There was male predominance in the sample group. Around 94% were male; 6% were female.

4. PRE-OPERATIVE OCCUPATION: Most of the patients (70%) had sedentary life style in our sample group. 28% were manual labourers. Two were professional players, though many were non professional players. 47% of these patients used to engage in contact sporting activities; the rest in non contact sporting activities.

5. AGE AT FIRST DISLOCATION: The mean age at first dislocation was 23 years, ranging from 15 years to 54 years; the standard deviation being 6.94.

6. MECHANISM OF INITIAL INJURY: Most of the patients

(63.7%) gave history of fall as the initial mechanism of injury. Other modes of initial dislocation were while sudden abduction and external rotation movement of the shoulder, contact sports, and road traffic accidents and seizures.

Mechanism of injury	Frequency	Percent
Fall	65	63.7
Contact sports	12	11.8
Road traffic accident	3	2.9
Seizures	3	2.9
Spontaneous, while abduction/ER	19	18.6
Total	102	100.0

7. SIDE OF INJURY: 54 patients had complaints on their dominant shoulder, while the rest on their non dominant shoulder.

8. FREQUENCY OF DISLOCATION BEFORE SURGERY: 58 patients had history of dislocation at the rate of 1-2 per year; while 35 patients had 3-5 per year; another 9 patients had more than 6 dislocations per year

9. PREVIOUS SURGERY: Only 4 patients had undergone surgery before initial evaluation at our institute for recurrent dislocation of shoulder.

10. PRE OPERATIVE INSTABILITY: All the patients who were assessed pre-operatively had evidence of instability, with apprehension test positive for all of them.

POST OPERATIVE ASSESSMENT

The post operative outcome of the patients who had undergone surgery were recorded and entered at 6 months, one year, and two years. The final outcome at last follow up was also recorded and entered.

1. PAIN: The pain reduced for all the patients with time. While 48 patients had occasional or slight pain at 6 months follow up, 91 patients had no pain at last follow up, which in every case was more than two years.

2. FUNCTIONAL LEVEL: All the patients were able to perform activities of daily living at 6 months follow up study. At last follow up, all the patients were able to work above shoulder level, with slight restriction of activities.

3. RANGE OF MOTION: All the patients were able to work above shoulder at last follow up. 58 patients had active abduction of more than 150 degrees. 89 patients had active forward flexion of more than 120 degrees. The mean external rotation at 6 months follow up was 37.89° (SD 9.239), which increased to 65.88° (SD 8.967) at last follow up. The mean internal rotation at 6 months follow up was 61.18° (SD 4.623), which increased to 77.16° (SD 6.234) at last follow up.

4. STRENGTH OF FORWARD FLEXION: The strength of forward flexion was good or normal for all the patients at last follow up.

5. OUTCOME

i) UCLA score

All patients, at last follow up had a UCLA score of more than 27, with 96 patients (94.1%) had good clinical outcome (according to UCLA grading system). 6 patients had fair clinical outcome.

Outcome at last FU, according to UCLA score		N	Percent
Valid	28-33 good	96	94.1
	27-21 fair	6	5.9
	Total	102	100.0

ii) Rowe Score

77 patients (75.5 %), according to Rowe score had good clinical outcome. 12 patients (11.8%) had excellent outcome. 13 patients had fair clinical outcome (40-69).

Outcome at last FU, according to Rowe score		N	Percent
Valid	90-100 excellent	12	11.8
	70-89 good	77	75.5
	40-69 fair	13	12.7
	Total	102	100.0

6. POST OPERATIVE INSTABILITY/RECURRENCE: None of the patients who were operated in our institute had recurrence

of dislocation. None of them were reoperated. 91 patients (89.2%) had negative apprehension with no evidence of subluxation. 10 patients (9.8%) had negative apprehension, but slight discomfort in abduction and external rotation. One person had positive apprehension test, but he was able to continue his activities of daily living and continued to engage in professional non contact sports, though at one level below; and he did not choose to undergo a reoperation.

7. INFECTION: 7 patients had evidence of early infection. All of them had superficial wound infection. None of them required additional operative procedure, and it subsided with non operative methods.

8. ARTHROSIS: 6 patients had clinicoradiological evidence of mild arthrosis of the shoulder joint. All patients who had arthrosis were of age 45 years or more. They are being treated conservatively with physical therapy and analgesics.

9. DONOR SITE MORBIDITY: Mild donor site pain was there in 6 patients in the first yr of surgery. This subsided with time with analgesics. None had evidence of donor site infection, and none had evidence of visceral injuries. (Table 22)

10. RETURN TO SPORTING ACTIVITIES: Very few of our sample size were engaged in the professional sporting activities. On statistical analysis of all patients who used to engage in sporting activities (amateur or professional), 56 percent returned to the same level of sporting activities, and 2 percent played at 1-2 levels below. The rest of the patients (all non professional players) had stopped sporting activities. On cross tabulation between the pre-operative sporting activities and post operative sporting activities according to their levels, one of the professional players had returned to the same level, while the other had returned to one level below.

The patients with traumatic dislocation had a better outcome with a significant difference, when compared to non-traumatic etiology. 30% of the patients of non-traumatic etiology had slight pain at last follow up, while only 6.1% of group of traumatic dislocation had slight pain. ($p=0.002$). (The patients with traumatic dislocation had better clinical outcome than non traumatic origin. All 12 patients who had excellent outcome (ROWE score) were from the traumatic dislocation group. 76.8% of the patient from traumatic dislocation had good outcome, while 70% of non-traumatic had good outcome. 30% percent of the non-traumatic group had fair outcome, while 8.5% of the traumatic dislocation had fair outcome ($p=.012$). Similarly all patients of traumatic dislocation had a good clinical outcome (UCLA), while 70% of the patients of non-traumatic group had good outcome, the rest 30% a fair outcome. ($p<.005$))

PRE AND POST OPERATIVE COMPARATIVE ANALYSIS

On assessing the paired t-test between pre-operative and post operative analysis of ROWE's score, there was significant improvement of Rowe's score post-operatively when compared to pre-operative Rowe's score. There was a mean increase of 49.216 points post operatively (with 95% confidence interval of 47.547 to 50.884) ($p<0.05$). The Pearson correlation was +0.513. ($p<0.05$)

DISCUSSION

The mean age at first dislocation in our study was 23.16 with a standard deviation of 6.954. The mean age at first dislocation in the study of Te Slaa et al was 26 years with a standard deviation of 13. The mean age at first dislocation for the study group of arthroscopic repair in the work of Cole et al was 28 years; while the mean age of open repair was 27 years. The mean age in the study of Gartsman was 32 years (range: 15 to 58 years). The mean follow up period in our study was 44.52 months. The mean follow up period in the study of Gartsman was 33 months. The mean follow up duration in the study of Cole et al was 52 months for arthroscopic repair and 55 months for open repair. The mean follow up period in the study of Te Slaa et al was 71 months. The population of our sample group was predominantly male (96 patients, 94.1%), the rest 6 patients were female. In the study of Te Slaa, there were 69 male and 38 female patients (ratio 1.8:1). In the study of Kim et al, there were 149 male patients and 18 female patients. In our study, 63.7% of the total patients gave history of fall as the initial injury; 11.8% had following contact sporting activities. 18.6% had spontaneous dislocation during abduction and external rotation of the limb. Other modes were after seizures and road traffic accident. In the study of Te Slaa, in 34% of the patients, the initial injury occurred during a sports

activity and in 28% at home. Dowdy (34) reported non-traumatic dislocation in 22% of the patients. In our study, at last follow up, 11 patients (10.8%) had slight pain, 91 patients (89.2%) had no pain. The pain was graded according to UCLA scoring system. In the study of Te Slaa, the mean visual analogue scale was 8 (range 2 to 10 SD 1.86). In our study the mean external rotation was 65.88° (SD 8.967) at last follow up. The mean internal rotation was 77.16° (SD 6.234) at last follow up. In the study of Jens Ivar Brox (35), in 2003 where the recurrent dislocation were treated with Eden Hybinette procedure, the mean external rotation of the operated shoulder was 62° (SD 18°) in patients with no arthrosis, 52° (12°) in incipient arthrosis and 40° (19°) in moderate arthrosis. Brian Cole et al in the comparative study of open and arthroscopy repair for recurrent shoulder dislocation, showed that both groups had loss of external rotation with the arm at the side; the loss was 9 ± 12.0 degrees (mean and standard deviation) in the arthroscopy group and 11 ± 10.0 degrees in the open-repair group. The mean increase in Rowe's score post operatively was 49.216, in our study. The mean post operative Rowe score was 80.20. In the study of Te Slaa, the mean Rowe score for the whole group was 87 (15 to 100; SD 15.95). The mean Rowe score in the recurrence group was 71.9 (55 to 75; SD 4.6) and was significantly lower compared with those who did not redislocate and had a mean Rowe score of 92.4 (15 to 100 SD; 15.1). Jens Ivar Brox reported in 2003, the results of Eden-Hybinette-Alvik operation for recurrent anterior dislocation of the shoulder. The Carter-Rowe score was excellent in 32 patients, good in 8, fair in 4 and poor in 1. The mean Carter-Rowe score was 90.

Only two patients engaged in the professional sporting activities in our group. Both of them returned to their respective sporting fields, though one of them played at one level below. In the study of Michael J. Pagnani (36) who in 2002 reported analysis of surgical repair of traumatic anterior shoulder instability in 58 American football players, fifty-two of the fifty-eight patients returned to full participation in American football for at least one year. Forty-one participated for at least two years, and twenty-four of them participated for three or more years. Eleven high-school athletes went on to play at least one year of collegiate football. In the study of Jens Ivar Brox, some of the patients had retired from competitive sports at the time of the operation. 6 patients competed at a national or international level in cross-country skiing, European handball, ice hockey and ski jumping before surgery. All these returned to the same level after the Eden-Hybinette-Alvik operation. 2 other patients reported severe limitations in sports, 2 had moderate and 10 occasional limitations. 6 patients had a mild or moderately positive apprehension test, which was associated with limitations in sports. In our study, there was no history of re-dislocation of shoulder after the Modified Putti Platt procedure. 91 patients (89.2%) had negative apprehension with no evidence of subluxation. 10 patients (9.8%) had negative apprehension, but slight discomfort in abduction and external rotation. One person had positive apprehension test. In the study of Jens Ivar Brox, 2 of our 52 patients had redislocations, after the Eden-Hybinette-Alvik operation. McAuliffe, in his work on failed surgery for recurrent anterior dislocation of shoulder, found that most patients (38 of 49) had undergone a previous simple Putti Platt procedure. In our study, 6 patients had clinicoradiological evidence of mild arthrosis of the shoulder joint. All patients who had arthrosis were of age 45 years or more. In the study of Jens Ivar Brox, incipient and moderate arthrosis was observed in 24/45 of the operated shoulders.

DEMERITS OF THE STUDY

1. This was a retrospective analysis; and therefore there was little control over patient selection.
2. The pre-operative clinical and radiological analysis was not uniform.
3. Patients who did not come for clinical examination, were subjected to telephonic interview, such reports were subjective and may be biased.
4. Due to financial constraints, CT scans of the shoulder joint and three dimensional CT reconstructions could not be done to quantify and delineate the anatomical change of the joint, post-procedure.
5. MRI could not be done to assess the status of dynamic stabilizers of the shoulder joints.
6. Very few patients of the study group were professional athletes or sportsperson; hence the recommendation of doing the procedure on the whole population cannot be done with certainty.

CONCLUSION

1. The etiology for recurrent dislocation of shoulder is multifactorial.
2. Most of the recurrent dislocation is traumatic in origin.

3. There are two basic types of surgical approaches for shoulders with anterior instability: "anatomic" and "non-anatomic" repairs.
4. **Modified Putti Platt procedure** done in our institute consists of double breasting of subscapularis tendon and capsule, with the arm kept in mild external rotation; along with application of unicortical thin bone graft in the trough made in anterior Glenoid.
5. This procedure gives a good clinical outcome on long term follow up in Indian population.
6. The loss of external rotation is minimal, since the double breasting of subscapularis is done in external rotation.
7. Further studies are required to assess the clinical outcome of this procedure in professional athletes and contact and non contact sportspersons
8. Further radiological studies are required to assess the change in anatomy and biomechanics of shoulder joint post procedure.

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