The Unstable shoulder

The basic science of Instability

The stability of the shoulder is maintained by a complex interplay of static and dynamic factors. The joint is inherently unstable with a head that is 2/3 larger than the glenoid.

Static

Bony anatomy

Ligaments

Labrum and cartilage

The static stabilisers include the bony anatomy and the ligaments. The glenoid is shallow and slightly concave and on its own cannot afford stability to the spherical humeral head. The glenoid is pear shaped being wider inferiorly. It is about 25 mm at its widest compared to the humeral head's 45-48mm. The glenoid is retroverted by about 3 – 7 degrees in 75% and natreverted mildly in others but with a superior tilt of 3 degrees in most. The humeral head is retroverted at 20 to 30 degrees in most.

The articular cartilage is thicker at the edge and increase the concavity and the glenoid labrum increases (by 5 – 9 mm) this concavity further. This increases the congreuency of the joint. The superior labrum and Biceps attachment also contributes to the stability and conformity of the joint as lesions of the superior labrum increase the antero posterior translation

Ligaments These include the superior , middle and inferior glenohumeral ligaments. These ligaments are in tension in different ranges of motion and act to centre the humeral head in extremes of motion. In the normal arc they do not contribute much. (elaborate)

the superior glenohumeral ligament is a thin structure running antero-superiorly from the glenoid to the lesser tuberosity. It is augmented by the coracohumeral ligament running from lateral coracoid to the leser and greater tuberosity. The SGHL is useful in preventing inferior ranslation of the adducted arm The rotator interval is a capsular interval between the superior edge of subscapularis and the anterior edge of the suprspinatus tendon and can be stretched and enlarged in a lax shoulder or as part of multidirectional instability. The SGHL and CHL lie in the interval.

Harryman DT, Sidles JA, Harris SL, Matsen FA. The role of the rotator interval capsule in passive motion and stability of the shoulder. J Bone Joint Surg Am 1992;74:53–66

The MGHL is a much stronger condensation of the capsule which runs from the anterosuperior glenoid and labrum to the humerus at the lesser tuberosity. It is a prime stabiliser aginst anterior dislocation in abduction and external rotation.

IGHL I sthe inferior capsular pouch that has an anterior and posterior condensations as bands. The anterior band runs form the anteroinferior labrum to the humeral neck just below the MGHL attachment. It prevents inferior translation of the arm both in adduction and abduction and being a hammock under the head in abduction moves reciprocally and prevents anterior or poasterior translation of the humeral head.

O'Brien SJ, Neves MC, Arnoczky SP, et al. The anatomy and histology of the inferior glenohumeral ligament complex of the shoulder. Am J Sports Med 1990;18:449–456.

The physical properties of the joint including

1. the negative suction effect,
2. surface tension effect of the fluid film on smooth surfaces and
3. vacuum effect to a distracting force

all help keep the joint in place.

Dynamic Stabilisers

Rotator cuff

Scapular stabilisers

Biceps long head

Dynamic stabilisers include both the rotator cuff muscles and the scapular stabilisers. The prime amongst these are the deltoid, trapezius, Pectoralis major, Serratus anterior and Lattisimus dorsi.. these act differentially to centre the head and give rise to the concavity compression (i.e.. the ball is compressed and thus centred into the concavity by the muscle action.) Proprioceptive feedback from capsular stretching is vital in this muscle action and control of stability. Neural pathways that facilitate this have to be intact.

Instability of the shoulder is difficult to assess and the tests are difficult to reproduce and elicit. There are situations of occult instability when the tests yield no definite answers but in the young patient the pain cannot be attributed to anything else. Equally diagnosis of SLAP lesion is difficult and there is the dilemma of whether the laxity contributes to it. Laxity itself is a normal characteristic of the shoulder joint and as to when it contributes to instability is often difficult to determine. Instability by definition is symptomatic glenoid to humeral translation.

Classification

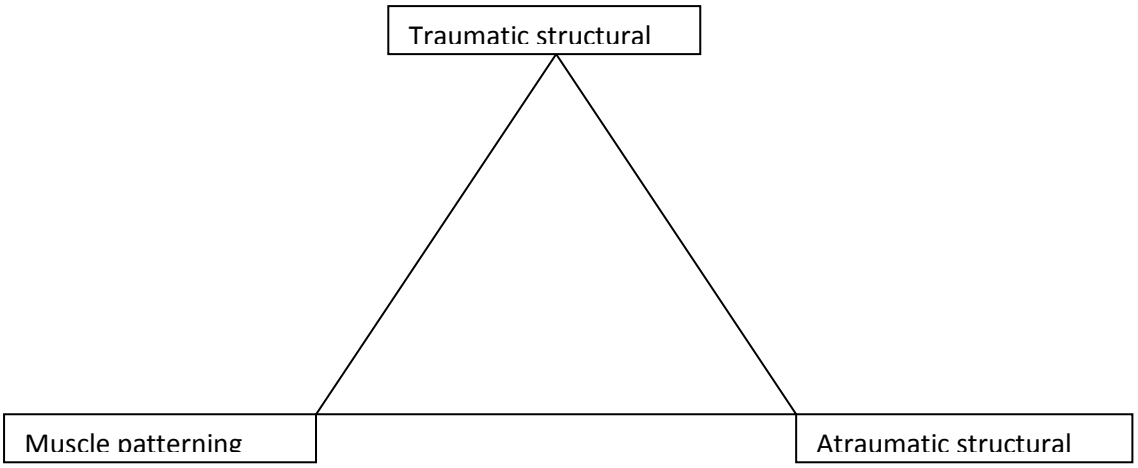
Traumatic
- Anterior
  - Acute or Recurrent
- Posterior
  - Acute or chronic
- Inferior
  - Luxatio erecta

Atraumatic
- Multidirectional instability
  - Voluntary - asymptomatic
  - Involuntary
- Acquired
  - Structural – Antero inferior capsular stretch

The one proposed by Matsen is TUBS and AMBRI and is useful reminder as to the pathogenesis and management.

TUBS is instability that is Traumatic, Unidirectional, with a Bankart lesion that is treated by Surgery. Whereas AMBRI is instability that is **A**traumatic, **M**ultidirectional, often **B**ilateral and the mainstay of treatment is physiotherapy and **R**ehabilitation and rarely may need surgery in the form of **I**nferior capsular shift. The reason why this is no longer used is because the problem is more complex than what the acronym suggests as the discussion below shows.

The Stanmore group have emphasied the instability at presentation is a spectrum. There are specific polar groups and these are organised at the apices of a triangle with many patients falling on the slope between polar groups. The polar groups include traumatic structural as in an anterior dislocation with perthe's –bankart lesion, atraumatic structural in patients that stretch their capsule in overhead sport with wide rotator interval, and last polar group are one with a muscle patterning . These patients have an over acting scapular stabiliser which destabilises the shoulder articulation due asynchronous contraction.



Scapular dyskinesias

The glenoid can be positioned in space depending on the arm position by the scapula and this contributes to the large excursions of the arm in space as compared to any other body part. Scapular dyskinesia is abnormal position or movement of the scapula in movement of the shoulder and occurs in upto 100% of patients with instability or impingement.. the effects include

a. loss of protraction and retraction,

Protraction is necessary for decelerating in throwing, and retraction for cocking in abduction and external rotation.

b. loss of elevation

Elevation of scapula is by serratus anterior through the inferior angle of scapula and with lower fibres of trapezius. This loss of elevation of scapula causes the acromion to impinge on the rotator cuff a common pathway for rotator cuff tendinitis to cause pain or in secondary impingement in instability.

c. loss of kinetic chain

Here the dyskinesis prevents the transmission forces from trunk and lower extremity leading to abnormal glenohumeral stresses.

Kibler described three abnormaities of the medial border of scapula indicative of dykinesis.

Treatment of dyskinesias should include correcting abnormalities of the lower extremity and trunk, as correcting posture and strengthening the trunk is the first to be addressed in the kinetic chain followed by the scapula and the shoulder musculature.

It is also imperative that treating correctable pathology in the shoulder like labral tears should precede addressing scapular stabilisers at times.

The classification can be summarised as follows

I. Degree
    A. Dislocation
    B. Subluxation
    C. Subtle
II. Frequency
    A. Acute (primary)
    B. Chronic
        1. Recurrent
        2. Fixed
III. Etiology
    A. Traumatic (macrotrauma)

B. Atraumatic
    1. Voluntary (muscular)
    2. Involuntary (positional)
C. Acquired (microtrauma)
D. Congenital
E. Neuromuscular (Erb's palsy, cerebral palsy, seizures)

IV. Direction
A. Unidirectional
    1. Anterior
    2. Posterior
    3. Inferior
B. Bidirectional
    1. Anteroinferior
    2. Posteroinferior
C. Multidirectional

Anterior Dislocation

Pathoanatomy

This is the most common of the instability and at presentation there is a history of trauma and the shoulder usually needs relocating by the patient or more commonly by the physician. The mechanism of injury usually involves external rotation and abduction. Usually seen as a sporting injury in the young adult it can occur with falls.

The risk with dislocations in the young adult is the recurrence. Patients younger than 20 have a almost a 100% recurrence rate reflecting level of activity as well as severity of structural lesions like large bony Bankart's, capsular tears, and rotator cuff tears .

Wheler JH, Ryan JB, Arciero RA, et al. Arthroscopic versus nonoperative treatment of acute shoulder dislocations in young athletes. Arthroscopy 1989;5:213–217

Immobilisation is widely felt to best done in external rotation.

Itoi E, Hatakeyama Y, Sato T, et al. Immobilization in external rotation after shoulder dislocation reduces the risk of recurrence: a randomized controlled trial. *J Bone Joint Surg [Am]* 2007;89-A:2124–31.

This has not been borne out in other studies and this position has a low compliance rate (J Bone Joint Surg Br, Jul 2009; 91-B: 918 – 921) . And immobilisation in a position of comfort for 3 - 4 weeks to offset acute pain and mobilisation is the best treatment option.

With recurrent disocations there accrues a substantial amount of damage to the shoulder. The most important of these would be the Perthe's – Bankart lesion which is antero inferior labral tear. This lesion is found in 95% of patients with first time traumatic anterior dislocation. The bankart lesion is in 40 % of cases associated with a bony avulsion of fragment of glenoid which in more severe cases can lead to glenoid deficiency. Yet a few of these bankart lesions take a periosteal sleeve with them from the anterior glenoid face (ALPSA) .

The other consistent lesion is the Hill-Sach's lesion on the postero superior humeral head due to indentation of same on the antero inferior glenoid. Large Hill sachs lesion above 30 % of the humeral head will cause a recurrence in spite of anterior repair (engaging hill sachs) and need addressing to prevent recurrence.

More severe and recurrent injuries leave a antero inferior capsular redundancy, Humeral avulsion of the glenohumeral ligament (HAGL), and SLAP Lesions (Superior labral avulsion of biceps from anterior to posterior.) In fact for recurrent dislocation to occur there is usually demonstrable capsular deficiency.

There is a subset of athletes especially the overhead athletes, or climbers who develop subtle or occult instability and it is proposed repetitive microtrauma produce s IGHL stretch leading to instability, and these patients have at presentation a secondary impingement.

Tibone J, Jobe F, Kerlan R, et al. Shoulder impingement syndrome in athletes treated by anterior acromioplasty. Clin Orthop 1985;198:134–140

In the older (above 40) dislocators there is propensity to damage the rotator cuff proportional to age and to have neurologic sequelae. This is usually is axillary nerve damage but can also be a brachial plexus damage.

Neviaser RJ, Neviaser TJ, Neviaser JS. Anterior dislocation of the shoulder and rotator cuff rupture. Clin Orthop 1993;291:103–106

Clinical Examination

Clinical examination in the acute setting may be impossible due to pain. The arm is adducted and internally rotated arm and it may be unable to externally rotate or fully abduct the extremity. The humeral head can often be palpated along the anterior aspect of the shoulder. Acute reduction is performed in the accident and emergency unless there is a fracture dislocation. A simple tuberosity fracture may still be amenable to a careful manipulation under sedation.

In patients with recurrent dislocation a thorough history eliciting initial and subsequent trauma history, position of arm when dislocating, need for and ease of relocation in the accident and emergency and activity level and motivation of the patient. ,

With time and in patients presenting late after reduction the classic examination reveals an apprehension sign, where the patient feels a discomfort and apprehension of dislocation when the shoulder is taken into a position of abduction and external rotation. This is relieved when a posteriorly directed force is applied to the head of the humerus (Jobe's relocation test). The examination should follow a normal protocol of inspection, palpation, movement and special tests. Scapulothoracic dyskinesia and secondary impingement is evident at times. Laxity should be looked for and accounted (sulcus sign, beighton score). In patient with inferior capsular insufficiency the shoulder hyperabducts beyond 105 degrees on a fixed scapula and is useful to evaluate to plan treatment (Gage sign)

EUA

The examination of patient under anesthesia improves the diagnostic accuracy of the direction of instability and here again as with all awake tests it has to be compared to the normal side.

Hawkins graded the degree of translation into Grade 0 – no translation to grade 3 –as frankly dislocatable. Most often the maximum is grade 2 when it just goes over the rim but relocates spontaneously. Grade 3 in EUA is rare and indicates severe damage.

Management

The initial treatment is immobilisation in a sling for 3 to 6 weeks and a period of physical therapy and rehabilitation before normal function.

In the young patient early surgery would prevent redislocations. Surgical treatment is the mainstay of treatment and can be done both by open or arthroscopic procedures.

Investigations should include radiographs (True AP and axillary lateral) as a bare minimum. Further investigation are done depending on the history and in chronic recurrent dislocator a MRI arthrogram or a CT arthrogram (bony glenoid defects) are helpful in planning treatment. Xray imaging may reveal posterior Hill Sachs defects or rarely glenoid defects. MRI arthrogram is best used to delineate the soft tissue pathology.

Open Surgery

This is the gold standard with the procedure involving a bankart repair and in most instances some form of imbricating and reducing anteroinferior capsular volume. The results of such treatment is good. Latarjet or the modified Bristow- helfet procedure is bony transfer of the coracoid with the attached conjoint tendon to the face of the antero inferior glenoid. This is useful when there is a bony deficiency in the glenoid.

Arthroscopic surgery

This has the added advantage of less soft tissue damage and earlier rehabilitation but in the long term is comparable to open Bankart repair. Its advantage lies in the ability to treat concomitant lesions like cuff tears and especially of SLAP and HAGL lesions.

Surgery involves repairing the labral lesion (Bankart, Alpsa) to the face of the glenoid (not to the anterior neck)

Recurrent Posterior instability

The incidence is between 2 – 5 % of all dislocations. Trauma is discrete after which symptoms start and there is usually no relocation history. It usually occurs in a young individual between 20 to 30 years of age. The presentation is one of recurrent subluxation with mostly the individual perceiving a pain at relocation. The position of discomfort is often flexion, adduction and internal rotation. Activities most likely to be uncomfortable are in this position like opening heavy doors. But in 10% of posterior dislocations there is significant trauma. . Rarely patients present with recurrent dislocations especially after a previous dislocation in epileptics.

The history should exclude

1. voluntary dislocators who may have secondary psychological gain,

2. also patients who present as part of multidirectional instability.

The lesions encountered at arthroscopic surgery include, posterior labral tear, Kim lesion (an incomplete and concealed avulsion of the posteroinferior aspect of the labrum), posterior humeral kissing lesions, postero inferior capsular redundancy, large rotator intervals, and bony pathologies including glenoid defects posteriorly, anterior reverse hill sachs defects. Patient with multi directional instability have a global capsular insufficiency.

Kim SH, Ha KI, Yoo JC, Noh KC. Kim's lesion: an incomplete and concealed avulsion of the posteroinferior labrum in posterior or multidirectional posteroinferior instability of the shoulder.Arthroscopy. 2004;20:712 -20

Clinical examination

Examination reveals usually some generalised joint laxity.The posterior instability is tested with arm in flexion and internal rotation with posterior directed force through the arm(posterior stress test) . The palpating hand at the shoulder perceives the posterior translation but more commonly the clunk of relocation is felt when shoulder is moved into extension from the flexed position. Scapulothoracic dyskinesia is apparent at subluxation most probably as a compensation to the instability. A sulcus sign on pulling the arm down when it is at the side is indicative of a insufficient cuff or inferior capsule. Drawer test is performed with the shoulder abducted at 30 degrees applying a posterior or anterior directed force to the head of humerus and the translation is palpable. This indicates laxity and it should be borne in mind that some young athletes have posterior laxity as spectrum of the normal and also have asymmetrical laxity from the opposite shoulder.

Xray imaging may reveal anterior reverse Hill Sachs defects or rarely posterior glenoid defects. MRI arthrogram is best used to delineate the soft tissue pathology.

Treatment

Initial treatment should involve physical therapy, posture and proprioceptive feedback exercises and to exclude habitual dislocators. Activity modification,seizure control, pain relief and cuff and scapulothoracic muscle rehabilitation should be the mainstay.

Surgery is increasingly recognised to be able to address the structural defects early to better rehabilitate the patient subsequently. This is especially true with an antecedent history of trauma. The most commonly performed procedure involves treatment of the posterior capsulolabral lesion either through open or arthroscopic surgery.

In locked posterior dislocations open surgery include a McLaughlin procedure where the anterior humeral head defect is filled by moving the subscapularis attachment to the defect.

McLaughlin HL. Posterior dislocation of the shoulder. J Bone Joint Surg Am.1952; 34:584 -90

But if seen early within 2 weeks humeroplasty to elevate the defect and bone graft the resultant hole in the head yields better result. Also bone graft to the chronic defect or grafting and resurfacing are more recent treatment options.

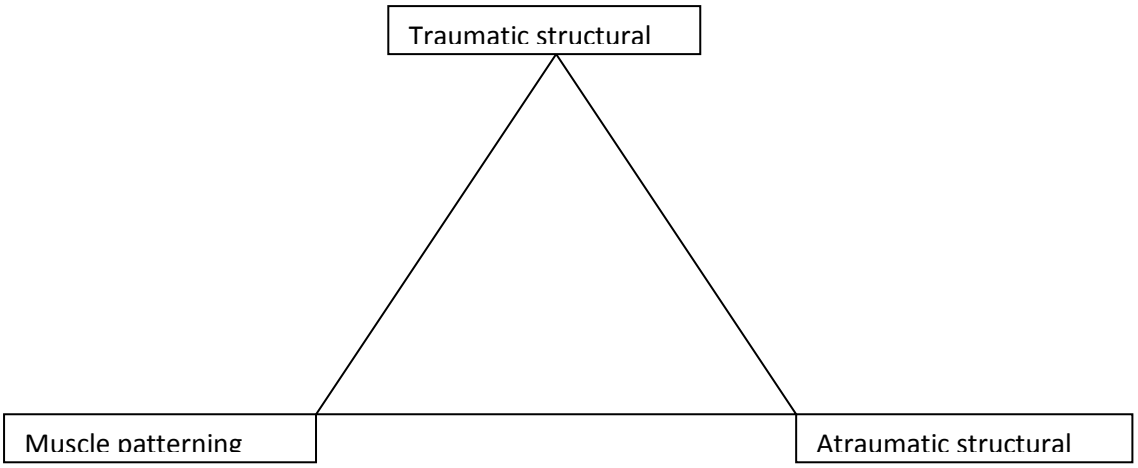
Best results are achieved when all pathological lesions are addressed and in the unidirectional posterior instability. Arthroscopic reapir will involve

1. repairing posterior bankart
2. addressing capsular redundancy wherever they may be including the rotator interval
3. completing a Kim's lesion and repair
4. rarely bony procedures especially for reverse Hill sach's in the form of Bone grafting

Atrumatic and Multidirectional instability

This can either symptomatic (instability) or asymptomatic (laxity) In patients with symptoms it is experienced in the midrange positions of glenohumeral motion, such

as during activities of daily living. Most of the patients tend to avoid the extremes of movement due to discomfort. Also it is possible to demonstrate an ability to translate the humeral head in three directions of anterior, posterior and inferior with the reproduction of discomfort or pain. But there is a wide spectrum at presentation and the Stanmore triangle is helpful in placing a patient on a particular treatment plan.



1 The subgroup of MDI patients with laxity the symptoms are subtle and a history of significant trauma is usually absent. The pathology is one of lax capsule with sulcus sign and laxity in anterior and posterior direction.
2 But there are a much less common subgroup of patients who have had a traumatic injury and also have signs of laxity. In this subgroup there are traumatic lesions that are repairable including labral tears and humeral head impression defects.
3 There is also a subgroup of athletes who do not have such macrotrauma and who with repetitive microtrauma and stretching develop symptomatic instability (throwers, butterfly and backstroke swimmers, climbers, overhead sport especially badminton, gymnasts). This is sometimes alluded to as acquired instability with pathologic findings of anteroinferior capsular stretch and coexisting lesions of internal impingement and peel back

4 Lastly are a subgroup of patients where surgery is contraindicated as in the voluntary dislocator with a secondary gain, or the asymptomatic habitual dislocator with or without a neuromuscular imbalance

McFarland EG, Kim TK, Park HB, et al. The effect of variation in definition on the diagnosis of multidirectional instability of the shoulder. J Bone Joint Surg Am 2003;85-A(11):2138–2144.

Arthroscopic treatment of multidirectional instability Stephen H Treacy, Felix H Savoie, Larry D Field Journal of Shoulder and Elbow Surgery July 1999

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Clinical presentation

This is in itself myriad and a patient and thorough clinical examination is essential. There may or may not be an episode of dislocation and rarely be even traumatic. It is important to distinguish the symptomatic patient from the voluntary dislocator without symptoms.

Traction paresthesias and dead arm after activity or carrying weights indicates a n inferior laxity. The position of dislocation can give an idea of the direction of instability. In fact positional dislocators can reproduce their dislocation reliably when taking the shoulder into such positions. These patients are usually symptomatic and make a conscious effort to avoid the postion of discomfort.

Laxity is measured by the beighton score and include a point each for ability to touch floor bending forward without knee bend, right and left knee and elbow hyperextension (4 points), thumb hyperabduction with volar flexion of the wrist and hyperextension of right and left little finger at the MCP joint. A score of 9 indicates severe hyperlax tissues

The drawer tests and the sulcus sign are indicators of laxity.

The drawer test is performed with patient sitting or supine with arm in 30 degree of abduction with one hand of the examiner stabilising the scapula and shoulder girdle and the other hand holding the head of humerus and translating it forward and backward relative to the fixed glenoid. Sulcus sign is demonstrable in a similar fashion but with patients arm neutral and examiner exerting longitudinal traction on the arm at the elbow. Inferior laxity is the most common accompaniment of most MDI patients. It is important to see if these tests produce any pain or discomfort in addition to the translation.

Tests for other directions of instability including the anterior apprehension and posterior stress test and the relocations tests are performed. It is useful to examine the contralateral normal shoulder as well. This often reveals a similar laxity in the normal shoulder. The reason why one shoulder becomes symptomatic is ill understood but could include repeated micro trauma or a single macrotrauma. It must be said that at times the physical exam can be difficult and the diagnosis is made by a careful history, repeated examination and appropriate investigations (to exclude other causes). There is a propensity to develop secondary impingement with the altered shoulder biomechanics. It is often this that causes pain in these shoulders. Scapulothoracic dyskinesia is often present and should be looked for.

Management

Investigations should include radiographs (True AP and axillary lateral) as for all instability. Xray imaging may reveal posterior or anterior humeral defects. Further investigation are done depending on the history and in chronic recurrent dislocator a MRI arthrogram is helpful in planning treatment. MRI arthrogram is best used to delineate the soft tissue pathology.

Once a diagnosis is established treatment should aim to address the symptoms through rehabilitation and exercise therapy. Exercise should address the whole kinetic chain with emphasis on posture, and control of shoulder movements. Muscles of deltoid, cuff and the scapular stabilisers are addressed for strength and synchrony. Any abnormal muscle patterning (an abnormal activity) should be corrected with a proper course of physiotherapy with muscle retraining and biofeedback.Proprioceptive feed back is poor in these shoulders and exercises and therapy should address the same. At this stage the patients motivation and any evidence of secondary gain should be explored. Patient education is paramount in treating the problem successfully. The non operative program should be offered for 6 months at least and as majority should respond to the same a maintenance program is then taught for the patient to work with at home. Results of treatment is not apparent for at least 3 months and patients should be made aware of the same.

Surgical treatment is reserved for the symptomatic MDI patient who does not respond to the above treatment. It is important not to offer surgery to the voluntary and habitual dislocators.

A common denominator is the inferior laxity of the capsule and any treatment should address this.

Neer CS II, Foster CR. Inferior capsular shift for inferior and multidirectional instability of the shoulder: a preliminary report. J Bone Joint Surg Am 1980;62:897–908

The inferior capsular shift addresses the capsular redundancy both inferiorly and posteriorly. This can usually be done through the anterior approach and rarely the posterior approach alone is used. In shoulders that dislocate both posteriorly and anteriorly it is easier to address the both directions of instability through the anterior approach than through the posterior approach. In patients with posterior labral tears and posterior glenoid defects a posterior approach may be necessary. The anterior approach is usually done through the delto pectoral interval in the beach chair position and the posterior approach through the interval between infraspinatus and teres minor.

The approach can be arthroscopic as well for the inferior capsular shift with equal ability to repair anterior and posterior labral lesions, SLAP lesions and rotator interval closure. It helps visualisation of the laxity of the capsule and helps in a dynamic assessment.

Rehabilitation after inferior capsular shift should be progressed slowly with care to avoid excessive rotations for 6 weeks. No passive stretching is allowed for at least 3 months and even upto 6 months. An abduction brace can be given in neutral rotation for 3 to 4 weeks and exercises started at 4 weeks.

The results of treatment depends on a thorough understanding of the individual patients condition, multiple clinical examinations, patient education, appropriate treatment with exercise and rehabilitation and in those needing surgery a proper follow up rehabilitation protocol.