Includes Clinical Examination Videos
Redeem by scanning the QR Code inside

Musculoskeletal Examination

3rd Edition

Vivek Pandey
Hitesh Shah

Foreword
Parag Sancheti

JAYPEE

Contents

CHAPTER 4

Clinical Evaluation of the Shoulder Joint

RELEVANT SURGICAL ANATOMY AND ITS CLINICAL SIGNIFICANCE

1. **Introduction**

- The shoulder joint [glenohumeral joint (GHJ)] is formed by the articulation of the humeral head and the glenoid cavity. However, functionally, it is a combination of four joints, namely:
  1. Glenohumeral (GH) joint
  2. Acromioclavicular joint (ACJ)
  3. Sternoclavicular joint (SCJ)
  4. Scapulothoracic joint (STJ)

Note: A disease or affection at any of the four joints would affect the function of the entire shoulder girdle, as there is an interplay between the movements of all four joints. Additionally, the STJ is a physiological joint, rather than an anatomical joint, as it lacks a synovial cavity.

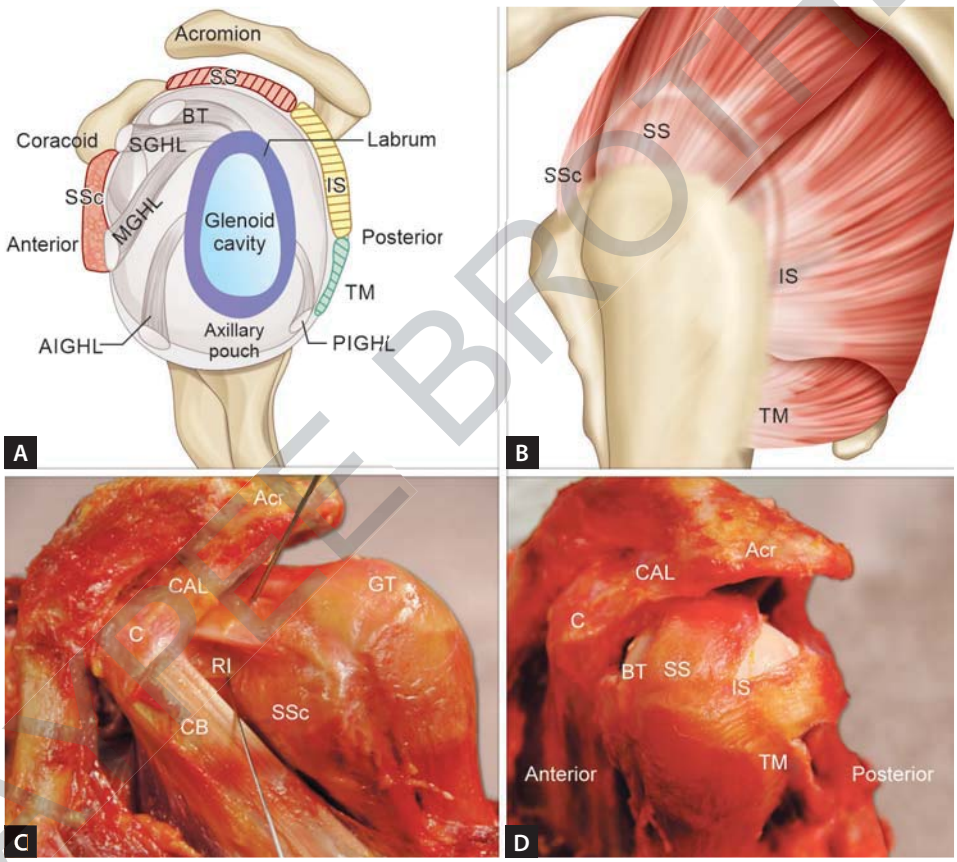
2. **Relevant anatomy of the glenohumeral joint**

The GHJ features a large humeral head and shallow glenoid, which allows a wide range of motion in all directions. However, this anatomy—with a large head articulating in a small and shallow cavity—renders the joint inherently unstable. To prevent instability during extremes of movement, the joint requires strong, intact capsuloligamentous and musculotendinous support. Various ligaments, labrum, capsule, and rotator cuff and other periarticular muscles provide adequate support during shoulder movement.

- ***Ligaments*:** Three important GH ligaments stabilize the shoulder: Superior, middle, and inferior **(Fig. 4.1A)**. These three GH ligaments provide anteroinferior stability to the GHJ in different shoulder positions. The superior GH ligament provides stability to the GHJ in 0° adduction; the middle GH ligament stabilizes GHJ in 45° abduction, and the inferior GH ligament (IGHL) stabilizes GHJ in 90° abduction. Among the three, IGHL is the most important for anteroinferior stability of the shoulder. IGHL has two bands, anterior and posterior that act as a hammock supporting the head of the humerus inferiorly during abduction beyond 90°.

  Clinical significance: During primary or recurrent anterior shoulder dislocation, the IGHL undergoes plastic deformation (stretching) along with the tear in anteroinferior labrum (Bankart lesion). Therefore, Arthroscopic Bankart repair involves repair of anteroinferior labral tear and tensioning the anterior band of the IGHL to shorten the stretched ligament. Occasionally, the posterior band of the IGHL is also plicated to restore hammock balance and reduce the joint volume, helping to decrease instability.

- ***Labrum*:** It is a circumferential fibrocartilaginous structure that surrounds the glenoid cavity **(Fig. 4.1A)**. It deepens the glenoid cavity and creates a *chock-block effect*, thereby enhancing joint stability. A labral tear occurring during shoulder dislocation disrupts this stability.
- ***Capsule*:** The shoulder capsule is a primary stabilizer of the joint. It extends from the *anatomical neck* of the humerus to the border or "rim" of the glenoid fossa. Excess laxity of the capsule can result in multidirectional instability of the shoulder.
- ***Rotator cuff and other surrounding muscles*:** The rotator cuff comprises the subscapularis, supraspinatus, infraspinatus, and teres minor muscles. The subscapularis is attached to the lesser tuberosity, whereas the other three are attached to the greater tuberosity **(Figs. 4.1B to D; Table 4.1)**. Apart from enabling shoulder movement in



Figs. 4.1A to D: Anatomy of the shoulder joint: (A) Illustrative sagittal figure of the left shoulder joint showing muscles and ligaments; (B) Rotator cuff insertion on the humeral tuberosity; (C and D) Cadaveric pictures of left shoulder joint [(C) anterior view of left shoulder; (D) lateral view of left shoulder)] showing important structures.

(Acr: acromion; AIGHL: anterior inferior glenohumeral ligament; BT: biceps tendon; CAL: coracoacromial ligament; CB: coracobrachialis; GT: greater tuberosity; IS: infraspinatus; MGHL: middle glenohumeral ligament; PIGHL: posterior inferior glenohumeral ligament; RI: rotator interval; SGHL: superior glenohumeral ligament; SS: supraspinatus; SSc: subscapularis; TM: teres minor)

Courtesy: Dr Jaap Willems, Netherlands.

various directions, the rotator cuff muscles play a crucial role in dynamically stabilizing the shoulder joint. For example, a primary shoulder dislocation in patients >45–50 years often results in a rotator cuff tear. This loss of cuff support leads to shoulder instability, which can be restored by repairing the torn rotator cuff.

Important note: The overall function of the rotator cuff (subscapularis, supraspinatus, infraspinatus, and teres minor) is "centralization of the humeral head within the glenoid cavity through a mechanism called concavity compression". A well centralized head enables the deltoid to efficiently elevate and abduct the arm while the head remains centralized in the glenoid during the entire range of motion.

- ***Relevant osteology of glenoid and head of the humerus*:** The glenoid is a pear-shaped part of the scapula that articulates with the head of the humerus. It has approximately 7° of retroversion and 5° of superior tilt. The scapula as a whole, however, is oriented about 30° anteverted relative to the coronal plane, primarily due to the contour of the chest wall. The humeral head itself is oriented with 30° of retroversion relative to the transepicondylar axis and has a neck-shaft angle of 130–140°.

  Any alteration in bony conformity of the joint surface, especially of the glenoid, would compromise stability. For example, an excessively retroverted dysplastic glenoid predisposes to posterior shoulder instability, while significant anterior or posterior glenoid bone loss from primary or recurrent dislocation can result in recurrent instability.

3. **Type of joints:**
- *Glenohumeral joint*: Synovial, ball, and socket joint
- *Acromioclavicular and sternoclavicular joint*: Synovial and plane joint

4. **Movements at the glenohumeral joint:** The movements at GH joint include flexion–extension, abduction–adduction, and external and internal rotation.
5. **Vascularity to the head of the humerus:** The vascular supply to the humeral head is via the anterior and posterior circumflex humeral vessels.
6. **Important facts about acromioclavicular joint stability:** The ACJ is stabilized by the AC joint capsule and coracoclavicular (CC) ligaments (conoid and trapezoid). The AC joint capsule predominantly provides horizontal stability to the AC joint, while the CC ligaments provide vertical stability to the AC joint. Both the AC joint and SC joint have an articular disc.
7. **Important muscles around the shoulder (Table 4.1):**

TABLE 4.1: Important muscles around the shoulder joint; their insertion, nerve supply, and action.

Muscle	*Insertion*	*Nerve supply*	*Principal action at the shoulder joint*
Deltoid	Over the upper one-third of the humerus shaft	Axillary nerve	Abductor, flexor, and extensor
Subscapularis	Lesser tuberosity	Upper and lower subscapularis nerve	Internal rotator
Supraspinatus	Greater tuberosity	Suprascapular nerve	Abductor

Contd...

Contd...

Muscle	*Insertion*	*Nerve supply*	*Principal action at the shoulder joint*
Infraspinatus	Greater tuberosity	Suprascapular nerve	External rotator
Teres minor	Greater tuberosity	Axillary nerve	External rotator
Latissimus dorsi	The floor of the intertubercular groove of the humerus	Thoracodorsal nerve	Extensor, adductor, and internal rotator
Trapezius	The posterior border of the lateral one-third of the clavicle, the acromion process, and the spine of the scapula	Spinal accessory nerve	Elevation, retraction, depression and rotation of the scapula
Serratus anterior	The costal aspect of the medial margin of the scapula	Long thoracic nerve	Protracts and stabilizes the scapula against the chest wall, and assists in upward rotation
Pectoralis major	Lateral lip of the bicipital groove	Lateral and medial pectoral nerve	• Clavicular head—flexion of the humerus • Sternocostal head—adduction of the humerus

Before proceeding with the clinical assessment of the shoulder, it is essential to understand the various pathological conditions affecting the shoulder and the relevance of age in those conditions, as this helps establish a clinical diagnosis. **Boxes 4.1 and 4.2** summarize the common clinical conditions affecting the shoulder and those affecting various age groups, respectively.

BOX 4.1: Common conditions affecting the shoulder.

- **Idiopathic:** Primary frozen shoulder, shoulder-hand syndrome
- **Degenerative:** *Most common category*
  - Rotator cuff tendinopathy/tendinitis
  - Calcific tendinitis
  - Rotator cuff tear
  - Acromioclavicular arthritis
  - Glenohumeral arthritis
  - Rotator cuff arthropathy
- **Traumatic:** Dislocation, fractures, associated brachial plexus injury, and rotator cuff tear
- **Congenital:** Sprengel shoulder, Klippel–Feil syndrome, and cleidocranial dysostosis
- **Infections:** Tuberculosis of the shoulder (caries sicca), septic arthritis
- **Inflammatory:** Rheumatoid arthritis
- **Metabolic:** Gout, pseudogout, and Milwaukee shoulder
- **Neurological:** Charcot's shoulder, brachial plexus palsy, and other nerve injuries causing scapular winging
- **Neoplastic:** Benign/malignant tumors

BOX 4.2: Common shoulder pathologies in various age groups.

- **Infants and young ones:**
  - Sprengel deformity, Klippel–Feil syndrome, and cleidocranial dysostosis
  - Septic arthritis, osteomyelitis (can occur in older patients too!)
- **15–35 years:**
  - Shoulder instability, labral tears (anterior, posterior, inferior, and combined)
  - Superior labrum anterior-posterior (SLAP) tear
  - Internal impingement, glenohumeral internal rotation deficit (GIRD)
  - Primary scapular dyskinesis/dyskinesia
- **35–55 years:**
  - Rotator cuff tendinopathy, partial rotator cuff tears
  - Frozen shoulder
  - Calcific tendinitis
  - Acromioclavicular arthritis
- **>55 years:**
  - Rotator cuff tear
  - Glenohumeral arthritis
  - Rotator cuff arthropathy

HISTORY AND ITS EVALUATION

In patients with upper limb complaints, it is essential to ask about their occupation and hand dominance, as these factors play a significant role in the etiopathogenesis and management of the disease.

Chief Complaints and History of Present Illness

The patients with shoulder pathology often come up with specific complaints such as:

- Pain
- Difficulty in movement/overhead activities/reaching back
- Subluxation or dislocation
- Cannot throw (overhead) the ball/an object with a previous speed
- Catching, locking
- Swelling
- Limitation in activities of daily living

1. **Pain:** It is the most common complaint and is consistently observed in almost all shoulder pathologies. However, the presentation can vary with different types of labral tears. Patients with anterior labral tears typically present more with instability than pain, while posterior labral tears more commonly cause pain than instability.

- ***Onset*:** In most conditions, pain is insidious at the onset. However, a few conditions can cause sudden pain, such as:
  - *Calcific tendinitis:* It is one of the most common causes of sudden-onset pain in the shoulder. Often, the pain is so severe that it may cause pseudoparalysis of the shoulder, and the patient may not allow the clinician to move the shoulder more than a few degrees in either plane.
  - *Traumatic:* The patient gives a history of direct/indirect trauma to the shoulder.

- Acute infection, acute exacerbation of an inflammatory disorder such as rheumatoid arthritis.

- ***Timing of pain or diurnal variation*:** Although pain is often experienced during movements, most shoulder conditions cause significant pain at night, worsening when attempting to sleep on the affected side. Many patients report that they have not slept on the affected side for weeks or months. Except in cases of anterior shoulder instability (anterior labral tear), *nocturnal pain is a sensitive sign of many underlying shoulder pathologies, including* rotator cuff pathology, calcific tendinitis, arthritis, and frozen shoulder.
- ***Radiation*:** The shoulder pain typically radiates to the tip of the deltoid insertion and sometimes extends to the elbow or the mid-forearm. Biceps-related pain often radiates toward the front of the arm, whereas AC joint pain is almost always localized to the top of the shoulder (at the anatomical location of the AC joint). Rarely, pain radiates toward the neck or scapula. *If the pain radiates toward the fingers, then the origin of the pain usually lies in the cervical spine (intervertebral disc prolapse), brachial plexus, or nerves of the upper limb.* Further, it is essential to note that both left shoulder pain and cardiac pain would radiate toward the left arm, and that must prompt the clinician to rule out an underlying cardiac disorder (history of cardiac disease, shortness of breath, and palpitation).
- ***Aggravating factors*:** Pain in most shoulder conditions worsens at night when lying on the affected side or during active shoulder movements. In AC joint arthritis, patient complaints of pain over affected shoulder while they lie on opposite side as the affected shoulder moves in adduction mimicking cross-chest adduction test. Constant pain, however, may indicate infection or a malignant tumor.
- ***Relieving factors*:** In many degenerative shoulder conditions, pain tends to lessen during the day or after taking analgesics.

2. **Difficulty in movements:** The patients may experience difficulty in moving their shoulders due to various causes, such as pain, stiffness, rotator cuff tear, loss of power (nerve paralysis), a dislocated, subluxated/dislocated joint, or a fracture (*refer to Chapter 1 for details on causes limiting the joint movement*).

- ***Pain*:** Any painful shoulder pathology, such as arthritis, tendinopathy, bursitis, synovitis, and fracture) would result in difficulty in shoulder movement.
- ***Stiffness*:** Tightness of the tissues surrounding the shoulder, as seen in conditions like frozen shoulder (primary or secondary), restricts mobility.
- ***Rotator cuff tear*:** Chronic rotator cuff tendinopathy weakens the tendon. This weak frayed tendon often develops partial tears in interstitium or bursal or articular side. Gradually, these smaller tears can progress into larger ones, resulting in a loss of power to move the shoulder. Often, these patients report chronic shoulder pain (months to years). In addition, an acute trauma, such as fall over the tip of the shoulder, outstretched hand, or road traffic accident (RTA) can result in an acute rotator cuff tear, leading to inability or difficulty in moving the shoulder.
- ***Loss of power (nerve paralysis)*:** Shoulder movement can be impaired due to nerve injuries, such as:
  - *Traumatic brachial plexus injury*: This injury can happen following a high-velocity injuries, such as RTAs or a fall from a height resulting in difficulty to move shoulder.

- *Suprascapular nerve (SSN) compressive neuropathy*: Frequently, it occurs in two locations. One, under the transverse suprascapular ligament, resulting in weakness of both supra- and infraspinatus. Two, in the spinoglenoid notch, often due to a ganglion compressing the SSN, resulting in weakness of the infraspinatus.
- *Spinal accessory nerve injury*: SSN injury commonly occurs during the surgeries performed in the posterior triangle of the neck, such as lymph node biopsy or clearanace during tumor surgeries, leading to paralysis of the trapezius muscle.
- *Axillary nerve injury*: It may result from proximal humerus fracture or shoulder dislocation, or surgeries around the shoulder (such as fixation or replacement, especially using deltoid split approach), causing paralysis of the deltoid and/teres minor muscles and leading to weakness in shoulder abduction and external rotation.

- ***Misplaced joint (dislocated/subluxated) or broken levers (fractured bones):*** A dislocation/subluxation of the shoulder or fracture of one of the bones (scapula/proximal humerus/clavicle) forming the shoulder joint would result in inability or difficulty in moving the shoulder. Persistent anterior or posterior shoulder dislocations typically result in loss of internal or external rotation, respectively.

3. **Primary or recurrent dislocation/subluxation of the shoulder:** Apart from primary dislocation, most patients present with a history of repeated dislocation or subluxation. The primary event that caused the dislocation (traumatic vs. atraumatic) should be noted, as the pathology, management and prognosis of these two types of dislocations differ. *Traumatic dislocations* are typically associated with structural lesions (labral tear, glenoid bony avulsion, and Hill–Sachs lesion) and, therefore, may require surgical repair. In contrast, *atraumatic dislocations* are often due to muscle imbalance and capsular laxity, which is primarily treated with structured rehabilitation; surgery is reserved for cases unresponsive to physiotherapy. Furthermore, the clinician must be aware of voluntary or habitual dislocators (individuals who can voluntarily dislocate their shoulder), which are mainly managed with rehabilitation alone.

   Sometimes, patients with subtle anterior instability may describe *"dead arm syndrome"* like features wherein the patient feels that their whole upper limb occasionally becomes lifeless/paralyzed for a few seconds, especially during activities that require abduction-external rotation (ABER) position (throwing, bowling, or smashing) and then returns to normal. However, their efficiency or activities requiring strength in ABER position remain compromised. It occurs due to recurrent transient anterior subluxation of the shoulder, and may occur without overt dislocation history.

4. **Unable to throw an object overhead:** Sometimes, young patients less than 40 years—particularly overhead athletes—report difficulty or an inability to throw an object overhead, such as a cricket ball from the boundary or a javelin, with the same velocity as before. They may also experience difficulty performing a powerful smash while playing badminton or tennis. However, underarm throwing or a net drop (in badminton) is not difficult. The possible causes of such a problem are:

- Superior labral anterior-posterior (SLAP) lesion, posterior labral tear, GIRD with tight posterior capsule, internal impingement, or scapular dyskinesia. Often, these four disorders are associated with each other *(Read the details about these conditions at the end of the chapter* under the *Common Conditions section).*

- Rotator cuff tears
- Weakness in the external or internal rotators of the shoulder
- Weak core muscles *(abdominal muscles, erector spinae, quadratus lumborum, pelvic floor, glutei, trapezius, etc.)*

5. **Catching or locking:** This phenomenon is usually observed in cases of instability, labral tears (with/without flaps), cartilage flaps tear, or loose bodies, where the shoulder becomes temporarily stuck in a particular position and subsequently releases during movement. Notably, patient with anterior instability can have catching-like symptoms in an abducted, externally rotated shoulder position, and a diagnosis of instability can be easily missed.
6. **Swelling:** Swelling is uncommon in degenerative shoulder pathologies. However, it may be observed in acute trauma, infection (septic arthritis, tuberculosis of the shoulder), inflammatory disorders, extensive subacromial bursitis, or rarely in rotator cuff tear arthropathy. Rotator cuff arthropathy may cause a fluctuating swelling over the acromioclavicular (AC) joint, known as the *"geyser sign,"* which can be mistaken for a lipoma over AC joint or AC joint arthritis. Gross painful swelling is characteristics of Milwaukee shoulder syndrome, whereas gross painless swelling is observed in Charcot's arthropathy.
7. **Limitations of activities of daily living:** Patients with shoulder dysfunction may struggle with activities such as reaching behind the back, combing hair, dressing and undressing, accessing overhead objects, and throwing. These limitations can also impact performance in sports and physical activities.
8. **Occupational history:** Occupational demands influence susceptibility to specific shoulder pathologies: For example, workers with overhead activities are more susceptible to rotator cuff pathology; overhead athletes often suffer labral tears (especially posterosuperior), partial articular side rotator cuff tears, internal impingement, and GIRD, whereas weight lifters often suffer from ACJ arthritis; and those who train hard on the bench press may suffer from labral tears.
9. **Hand dominance:** Information regarding hand dominance is essential, as it may influence decision-making in treatment and rehabilitation. It also affects the kinematics of the shoulder.

Pain from Neighboring Areas Mimicking Shoulder Pain

Pathologies in neighboring areas, such as the neck, chest, and heart, can also mimic shoulder pain. Rarely, diseased distant organs such as the gallbladder, liver, and spleen can also add to the conundrum. Among all these neighboring areas, neck pathology most frequently masquerades as shoulder pain or occurs concurrently with it.

History of neck pain: Assessment of shoulder pain is never complete unless the cervical spine is evaluated during history and examination. Therefore, when assessing shoulder pain, the history should always include queries regarding complaints of neck pain, as neck pain with radiation toward the shoulder and scapula is often mistaken with shoulder pain. However, patients typically localize neck pain differently from shoulder pain: those with neck pain due to cervical spine pathology (disc prolapse/spondylosis) usually place their hand over the nape of the neck or along the medial border of the scapula, whereas patients with shoulder pain

commonly hold the area with their hand around the shoulder, top or front of the shoulder, or at the deltoid insertion. Furthermore, neck pain due to disc prolapse impinging upon the cervical roots can radiate to the lateral aspect of the forearm, the thumb, and the lateral three fingers. In contrast, true shoulder pain generally does not radiate below the elbow. These history features help differentiate between neck and shoulder pain. Additionally, the shoulder pain worsens during shoulder movement, whereas it may not increase if there is isolated cervical spine pathology. Nevertheless, it is essential to note that shoulder and neck pathologies often coexist, especially in older age group, and a comprehensive diagnosis and treatment of both are necessary for complete relief.

Cardiac origin pain: It is crucial not to overlook the fact that cardiac origin pain can radiate to the left shoulder, potentially causing confusion in diagnosis. However, cardiac pain is usually exertional, often accompanied by symptoms, such as exertional dyspnea, sweating, and palpitations. The patient may also have a history of preexisting cardiac disease.

Chest pain: Occasionally, chest pain due to conditions like *Tietze's disease* and *costochondritis* can radiate toward the shoulder and arm, causing the patient to perceive it as originating from the shoulder.

Costochondritis is more frequent than Tietze's disease and usually affects individuals older than 40 years. It is common in patients who perform repetitive activities, particularly those with osteoarthritis or seronegative spondyloarthropathy, and is characterized by tenderness over the costochondral junction of the 2nd to 5th ribs. In contrast, Tietze's disease is rare, typically has a sudden onset, and typically affects patients <40 years. It is characterized by swelling and tenderness at the costochondral junction of the 2nd and 3rd ribs.

Subdiaphragmatic pathologies: Although rare, pathologies involving organs below the diaphragm—such as chronic liver disease, gallbladder disease, and splenic conditions—can cause referred pain to the shoulder. This phenomenon is primarily due to irritation of the diaphragm, which shares sensory innervation with the shoulder region via the phrenic nerve (C3–C5). Such referred pain often presents as vague, poorly localized discomfort over the shoulder and may mimic musculoskeletal shoulder pain, complicating diagnosis.

Past History

Apart from other comorbidities, a history of diabetes and thyroid dysfunction is particularly important in evaluating painful shoulder conditions. There is a strong association between frozen shoulder and these two disorders. Additionally, individuals with epilepsy have an increased risk of primary or recurrent shoulder dislocations.

Personal, Treatment, Family, Menstrual, and Allergy History

It should be evaluated as per the standard protocol.

At the end of the history assessment, many common clinical conditions can be reasonably diagnosed based on a combination of age and other key complaints. **Table 4.2** summarizes the important snippets for diagnosing common shoulder pathologies. However, all of them require confirmation with relevant tests.

TABLE 4.2: Shoulder clinical diagnostic snippets.

Think of **dislocations, labral pathologies, and internal impingement in young patients** (15–30 years).
Think of **tendinopathies, frozen shoulder, ACJ arthritis, and partial cuff tears** in middle age (35–55 years).
Think of **rotator cuff tear in older age** (55 years onward).
Think of **glenohumeral osteoarthritis and cuff arthropathies** in the elderly (>65–70 years) with complaints lasting for several years.

Symptoms and signs	***Most likely pathology/diagnosis***
A 52-year-old clerk was referred to orthopedics to evaluate shoulder pain. While talking to the patient, the clinician noticed that the patient kept his hand over the neck, nape, and scapula to describe his pain.	***First, rule out cervical causes of pain!*** *(Spondylitis/intervertebral disc prolapse) Cervical spine pathologies are quite common in middle and older-age individuals and masquerade as shoulder pain.*
The presentation of shoulder instability is most varied and atypical. Three scenarios are mentioned below:	
Most patients with recurrent dislocation report to the clinician that they have been dislocating their shoulders. The clinician must confirm the diagnosis and direction(s) of dislocation during the examination.	***Recurrent dislocation of the shoulder.*** *Beware of a self-dislocator—it is habitual dislocation!*
A 19-year-old college student was injured while playing kabaddi and was dragged by fellow players. Since then, he has felt that his shoulder becomes stuck whenever he hyperabducts his arm, followed by a shock-like sensation in the arm, which makes it almost numb. He does not recollect the history of any frank dislocation/subluxation!	***Anteroinferior labral tear along with dead arm syndrome!*** *Note*: The shoulder might have almost dislocated, which he overlooked!
A 42-year-old male, ex-cricket bowler, sustained an anterior shoulder dislocation at the age of 25 years. Subsequently, he gave up playing cricket after experiencing five episodes of dislocation over 2 years. He stopped dislocating after giving up cricket. Strangely, a year back, he started redislocating when he casually reached out for a packet in the backseat of his car. Since this episode, he has had several episodes of dislocation after a trivial injury.	***Primary instability, progressing to glenoid bone loss.*** *Anterior instability can present bimodally if left untreated!*
A 22-year-old boy, who regularly plays cricket and badminton, complained that he could no longer bowl with the same velocity or smash over the net. He also has shoulder pain during abduction and external rotation combination. Further, he has been unable to do push-ups and bench presses anymore.	***Posterosuperior labral tear, internal impingement, GIRD, or scapular dyskinesia!*** *A leading question like "Can you throw overhead?" is very informative. Patients with the above conditions cannot throw overhead but can throw underarm easily or cannot smash but can do a net drop easily.*
A 28-year-old patient presents with an inability to externally rotate his right shoulder for 3 months following an electric shock.	***Persistent posterior dislocation of the shoulder***

Contd...

Contd...

Symptoms and signs	***Most likely pathology/diagnosis***
A 36-year-old male presents with an inability to elevate his shoulder following a fall from the bike (high-velocity trauma).	***Fracture around the shoulder or brachial plexus injury or both.*** Rotator cuff tears are rare in patients <35–40 years.
A 41-year-old female presents with pain over the right shoulder and an inability to elevate his shoulder following a fall from the bike. The active elevation is not possible. The limb remains neurologically intact, and X-rays look normal.	***Rule out "undisplaced" greater tuberosity fracture.*** *MRI can confirm the diagnosis!*
A 46-year-old male with diabetes/hypothyroidism presents with increasing pain and stiffness in the right shoulder, unable to sleep on the affected side for 8 weeks. There is a restriction in both active and passive movements.	***Frozen shoulder*** *Note that many patients are first-time diagnosed with DM/thyroid dysfunction in orthopedic OPD after they present with a frozen shoulder.*
A 44-year-old male presents with pain over the right shoulder, and he points to the pain over the AC joint with a finger. Additionally, he cannot sleep on his right (due to compression of the right AC joint) or left (mimicking the cross-adduction test) shoulder.	***Acromioclavicular joint arthritis or distal clavicular osteolysis!*** *Note: If the patient lifts his finger and places it on top of the shoulder, it is also known as the finger sign and is very specific for ACJ joint pathology.*
A 42-year-old carpenter complained of right shoulder pain during work and at night while sleeping on the affected side for 6 months. Flexion–abduction ROM is terminally painful, while cuff strength is normal.	***Rotator cuff tendinopathy***
A 48-year-old manual worker complained of right shoulder pain during work and at night while sleeping on the affected side for 4 months. He has not noticed any weakness. Flexion–abduction ROM is terminally painful. The full can test is normal, while the empty can is slightly weak.	***Partial rotator cuff tear/rotator cuff tendinopathy***
A 49-year-old female presented with "atraumatic" acute severe onset of pain in her right shoulder for 2 days, making her shoulder almost paralyzed. She does not allow even the slightest movement.	***Calcific tendinitis*** *is the most painful atraumatic condition in an acute setting. History is usually a few days to a week!* (*Note*: Rule out septic arthritis or acute inflammatory arthritis)
A 55-year-old male presents with the inability to actively elevate his shoulder following a fall (low-velocity injury) or a significant jerk while cutting a tree branch. However, his passive ROM is full.	***Rotator cuff tear*** *Note*: *Rule out brachial plexus injury in high-velocity injury.*
Note: Avoid diagnosing a full-thickness rotator cuff tear in young men and women <40 years and avoid diagnosing a labral tear in patients >55–60 years!	
A 75-year-old male presents with increasing pain and stiffness in his left shoulder for 2–3 years. Both active and passive ROM are limited, and crepitus is felt.	***Glenohumeral arthritis***—if good cuff strength *or* ***Rotator cuff arthropathy***—if poor cuff strength. *Note: Frozen shoulder improves after several months, whereas arthritis of either type will progressively worsen over months to years! Also, crepitus is not a feature of the frozen shoulder.*

Scan this **QR code** for watching videos on Clinical Examination.

EXAMINATION

General and Systemic Examination

A quick general and systemic examination must be performed as per the standard protocol.

Local Examination

After obtaining consent and ensuring privacy, it is necessary to provide a chaperone, especially when examining vulnerable groups such as children and the elderly, and a nurse should be present when examining female patients. The local examination must be performed after exposing the upper half of the body with adequate coverage of private areas in females.

Attitude

The shoulder is examined in a sitting, standing, and sometimes supine position for certain tests. The attitude of the index shoulder and upper limb should be described in a standard fashion. For example, the patient is sitting on a stool with the right shoulder drooped, the arm adducted and internally rotated, the elbow flexed, the forearm in mid-prone position, and the wrist in neutral.

Inspection

General findings: Look for swelling, scar, and sinus and describe them in a standard fashion. Several examples of clinical relevance of these findings are—a scar over the clavicle during clavicle plating may result in loss of infraclavicular sensation due to injured supraclavicular nerves, while a scar over the deltoid may explain damage to the axillary nerve or deltoid dehiscence.

Specific Findings

a. **From front:** Observe the shoulder contour and level, swelling, and the presence of a Popeye sign.

- ***Shoulder contour:*** The normal contour of the shoulder is maintained by the bulk of the deltoid muscle and underlying head of the humerus **(Fig. 4.2)**. Loss of this contour may occur with a dislocated humeral head or deltoid muscle wasting, which can result from axillary nerve palsy, multiple surgeries causing muscle wasting or deltoid dehiscence **(Fig. 4.3)**.

Fig. 4.2: A patient with well-maintained normal right shoulder contour (green arrows) noted from the front. Left shoulder shows loss of contour (Turquoise arrows) due to anterior shoulder dislocation.

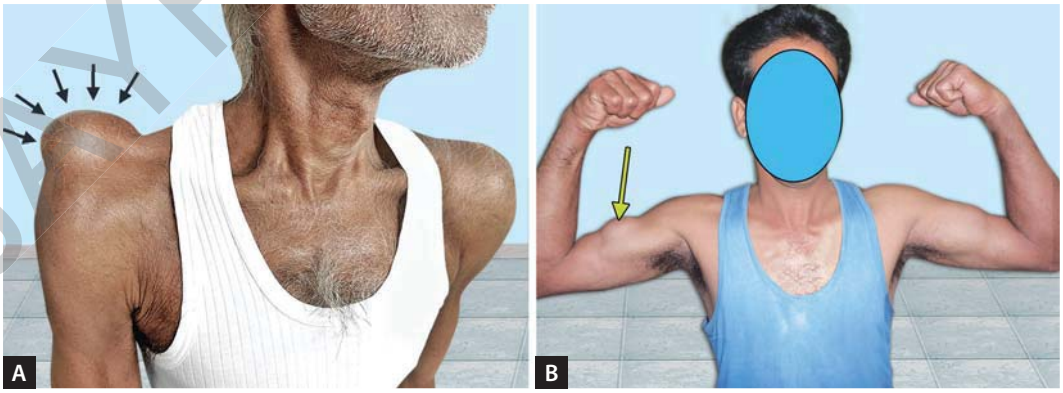
- ***Level of shoulder:*** Compared to the normal shoulder, note whether the affected shoulder is dropped, elevated, or at the same level.
- ***Swelling:*** Inspect for swelling or prominence over the sternoclavicular joint (SCJ), acromioclavicular joint (ACJ), and clavicle. Any bony deformity on the clavicle may indicate malunion or nonunion. A prominent medial or lateral end of the clavicle could suggest a fracture, while prominence over the ACJ or SCJ may be due to dislocation, infection, or degenerative arthritis. Geyser sign (fluctuant swelling over the AC joint due to intraarticular synovial fluid collection over AC joint due to massive rotator cuff tear) may be present in Chronic rotator cuff arthropathy **(Fig. 4.4A)**. Also, inspect the neck and areas around the clavicle.

Fig. 4.3: Loss of left shoulder contour due to deltoid wasting.

- ***Popeye sign:*** Look for a bulge on the mid or lower third of the arm that becomes more prominent when the elbow is flexed. Popeye sign indicates rupture of the long head of the biceps tendon and is often associated with rotator cuff tears, especially subscapularis tears **(Fig. 4.4B)**. Note that the *reverse Popeye sign is seen in distal biceps tendon rupture.*

b. **From the side (Fig. 4.5)** typically look for shoulder contour, any abnormal bulge in front or back of the shoulder, clavicle, AC joint, lateral aspect of the neck and dorsal spine curvature.

- ***Inspect the shoulder*** and look for contour, swelling, scars, or any bulges (anterior, posterior signifying a dislocated head of humerus) or any sulcus appearing below the acromion signifying inferiorly subluxated head. Also observe the ***lateral aspect of neck***, and especially for a surgical scar in a posterior triangle which may explain injury to spinal accessory nerve (during lymph node biopsy or removal for clearance for malignancy) leading to weakness in mid abduction.



Figs. 4.4A and B: (A) Geyser sign—Fluctuant swelling over the AC joint (due to intraarticular synovial fluid collection over AC joint due to massive rotator cuff tear); (B) Popeye sign over the right arm (green arrow).

- ***Dorsal spine curvature:*** Observe whether it is normal or shows exaggerated kyphosis. An increased kyphosis can alter the scapular biomechanics resulting in scapular dyskinesis and pain.

c. **From the back (Fig. 4.6):** Several key areas should be inspected from the posterior aspect, such as neck, spine, muscle wasting, scapular alignment, winging, scapular dyskinesia, swelling, scar, etc.

- ***Neck:*** Assess the hairline (low or normal), any tilt or torticollis, and the presence of neck webbing.
- ***Spine:*** Look for scoliosis or other spinal deformities, which can alter scapular kinematics and impact shoulder function.
- ***Muscle wasting:*** Compare muscle bulk over and around the scapula on both sides. Wasting of muscles such as the supraspinatus, infraspinatus, posterior deltoid, trapezius, and rhomboids **(Fig. 4.6A)** may indicate underlying pathology.

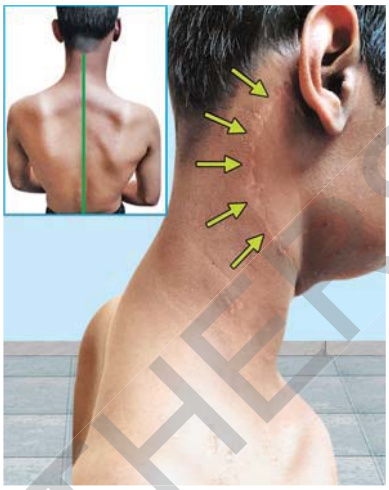
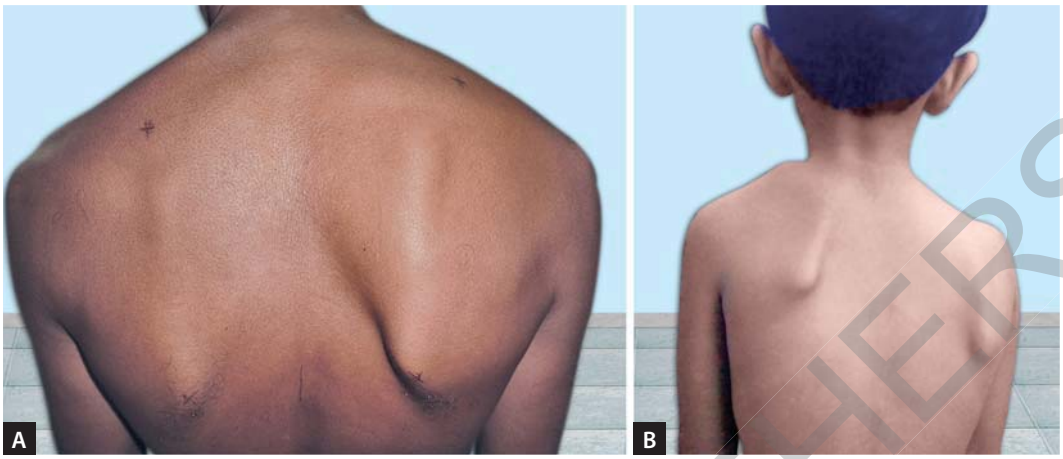


Fig. 4.5: Scar in the right posterior triangle (green arrows) indicating prior lymph node clearance for a thyroid malignancy resulting in spinal accessory nerve injury followed by right trapezius wasting, weakness and lateral winging of scapula (inset image).

Wasting of the supraspinatus and infraspinatus muscles is commonly seen in chronic rotator cuff tears or suprascapular nerve entrapment. In contrast, wasting of muscles such as the trapezius, deltoid, and other shoulder girdle muscles occurs in nerve palsies affecting specific nerves—for example, spinal accessory nerve injury causing trapezius wasting, axillary nerve injury causing deltoid wasting, or brachial plexus injury and cervical root pathology (such as myelopathy or disc prolapse) affecting multiple muscles.

Isolated infraspinatus muscle wasting is specifically observed in cases of a spinoglenoid notch cyst compressing the suprascapular nerve **(Fig. 4.6B)**.

Figs. 4.6A and B: (A) Muscle wasting of the supra- and infra-spinatus of both sides (left more than right); (B) Isolated Infraspinatus wasting on left side (white arrow).



Figs. 4.7A and B: Right scapular angles appear slightly higher than left, and medial borders of the two scapulae are not equidistant from the spine; (B) Sprengel shoulder: Left scapula is higher and smaller than right.

- ***Scapular alignment*:** Compare with the contralateral scapula and observe the level of superior and inferior angles, distance of medial border from the spine, scapular shape, winging, and signs of scapular dyskinesis.
  - *Level of the superior and inferior angle of the scapula*: Normally, the superior and inferior angles of the scapula lie at the level of the spinous process of the D2/D3 and D7/D8 vertebrae, respectively. A higher or lower level of the scapular angles must be noted **(Figs. 4.7A and B)**. It is altered in scapular dyskinesis, scapular winging, Klippel–Feil syndrome, and malunited scapula fracture.
  - *The distance of the medial border of the scapula from the spine*: The medial border of both scapulae should be equidistant from the dorsal spine. This relationship is altered in scapular winging, scapular dyskinesis, malunited fractures of the scapula, or scoliosis.
  - *The shape of the scapula*: Assess whether it is small or normal. A smaller scapula is seen in Klippel–Feil syndrome and Sprengel deformity **(Fig. 4.7B)**.
  - *Winging of the scapula*: It is always pathological. One must note the type of winging, lateral, or medial.
    - *Inferior and lateral winging*: Observed in trapezius palsy, resulting in loss of superomedial pull of the scapula by the trapezius resulting in scapula shifting in more lateral and inferior position. Compared to the normal side, the scapula appears to be shifted laterally, and its superior angle is lower.
    - *Superior and medial winging*: Observed in serratus anterior palsy, resulting in loss of the anterior pull over the medial border of the scapula toward the chest wall by the serratus anterior. Therefore, compared to the normal side, the medial border of the scapula becomes more prominent, and its superior angle is higher.

Winged Scapula

In a "winged" scapula, the medial (or, in some cases, lateral) border of the scapula appears to be protruding from the back, such as wings. Various neurological and musculoskeletal conditions can result in winging of the scapula, which disturbs scapulohumeral rhythm, contributes to loss of power and limited motion (flexion and abduction) of the shoulder, and can be a source of shoulder pain.

- *Scapular dyskinesis/dyskinesia*: It implies "an alteration or deviation in the normal resting or active position of the scapula during shoulder movement". Scapular dyskinesia can affect shoulder function and is also known as SICK scapula syndrome. A dyskinetic scapula could be primary/secondary *(refer to scapular dyskinesia/SICK scapula syndrome, page 120)*.
  Method to elicit scapular dyskinesis: There are two standard methods—static and dynamic.

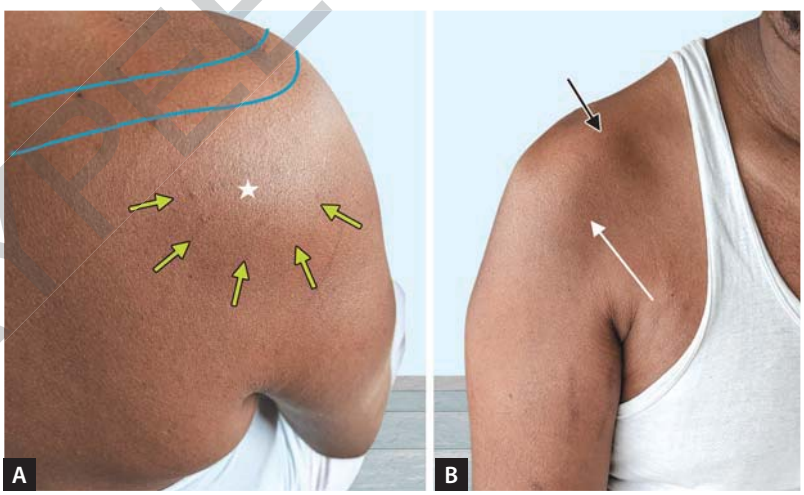
i. ***Static method*:** Ask the patient to sit or stand with both hands placed on the iliac crests. The clinician observes the scapular position and medial borders from behind. In scapular dyskinesis, the positions and borders of the two scapulae are not identical.

ii. ***Dynamic method*:** While standing or sitting, the patient is asked to repeatedly forward flex the shoulder up to 180°. Observe the movements of both scapulae from behind and note any asymmetry or abnormal deviation compared to the contralateral side.

Etiology of Dyskinetic Scapula

Normally, when the patient is asked to repeatedly perform forward flexion from 0 to 180°, both scapulae move symmetrically. In patients with shoulder girdle muscle weakness, cuff tear, labral tear, nerve injury, core muscle weakness, or proprioceptive imbalance, asymmetric movement of the scapula may be observed. This abnormal movement is referred to as scapular dyskinesis. However, identifying the underlying cause of dyskinesis is essential.

- Observe ***posterior aspect of shoulder for any swelling, scars, or sinus tracts***. In cases of posterior shoulder dislocation, subacromial fullness may be noticeable posteriorly **(Fig. 4.8A)**. These patients often exhibit a corresponding anterior hollowness and a prominently palpable coracoid process **(Fig. 4.8B)**.



Figs. 4.8A and B: In a posteriorly dislocated shoulder (A) Prominence or fullness on posterior aspect of the shoulder (green arrows surrounding white star. Blue lines outline spine of scapula and acromion). (B) Anterior aspect of shoulder may show prominent coracoid (black arrow), hollowness (white arrow) with loss of contour.

Courtesy: Dr Deepthi Nandan, Hyderabad.

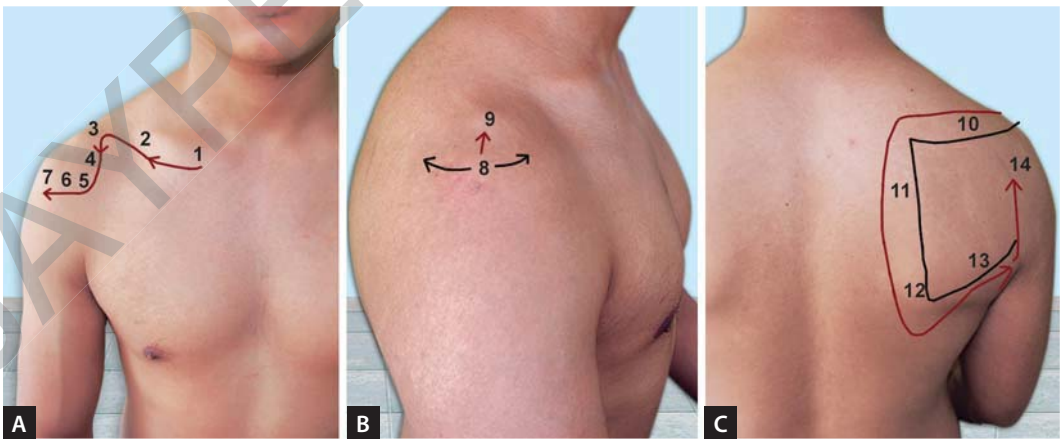
Palpation

The palpation must assess local temperature, tenderness over key bony and soft tissue landmarks and joint lines. The bony landmarks should also be palpated for any deformity, thickening, irregularity, and gaps (nonunion). Furthermore, evaluate joint hyperlaxity using the Beighton score. Palpation of scar, swelling, and sinus should be done in a standard fashion.

1. **The local rise in temperature:** Palpate from the dorsum of the hand over both shoulders to compare for any rise in local temperature. A rise in temperature may indicate local infection, inflammatory arthritis, tumors, or significant subacromial bursitis.
2. **Tenderness:** Always palpate in consistent sequence to feel for tenderness over major soft tissue, bony landmarks, and joint lines. The use of a single-finger or thumb technique during palpation helps localize the lesion. The recommended sequence of palpation is as follows and illustrated in **Figures 4.9A to C**:
   - *Sternoclavicular joint* (1): Tender in arthritis, infection, or acute dislocation
   - *Clavicle* (2): Tender in infections and acute fractures.
   - *Acromioclavicular joint* (3): Tender in arthritis, infection, or acute dislocation
   - *Coracoid process* (4): It is felt just below the lateral third of the clavicle. It is tender in SICK scapula syndrome.
   - *Anterior joint line* (5) **(Figs. 4.10A to C)**: Tenderness may indicate arthritis, synovitis, or labral tear. The rotator interval, lying between the coracoid process and lesser tuberosity, is tender in frozen shoulder or joint synovitis.

     Method to palpate anterior shoulder joint line

     The anterior joint line examination can be performed with the patient sitting or lying supine. The anterior GHJ line is just lateral to the coracoid process. For the right shoulder, the clinician keeps the left thumb just lateral to the tip of the coracoid process while the right hand holds the elbow and the proximal part of the forearm to rotate the arm internally and externally. The thumb can then feel the gap at the anterior joint line between the rotating head and the anterior glenoid margin **(Figs. 4.9A to C)**.



Figs. 4.9A to C: Palpation sequence for important bony landmarks of the shoulder: (A) Anterior aspect; (B) Lateral aspect; (C) Posterior aspect of the shoulder.

Figs. 4.10A to C: Palpation technique of the anterior joint line. (A) The "X" mark over the shoulder denotes the coracoid process, and the dashed line represents the anterior joint line; (B) With thumb over the joint line, shoulder in internal rotation; (C) With thumb over the joint line, shoulder in external rotation.

Figs. 4.11A to C: Palpation technique of the posterior joint line. (A) V mark denotes posterior acromion angle, and the dashed line represents posterior joint line; (B) With a finger over the joint line, shoulder in internal rotation; (C) With a finger over the joint line, shoulder in external rotation. (For clarity in the picture, the clinician is standing before the patient, and the finger is kept over the joint line, not the thumb).

- *Lesser tuberosity* (6): Located just lateral to the anterior joint line. It could be tender in subscapularis tendinopathy or tear.
- *Bicipital groove* (7): Situated just lateral to the lesser tuberosity, the bicipital tendon can be palpated here. For palpation, keep the shoulder in neutral rotation, the arm adducted, and the elbow flexed. Tenderness indicates biceps tenosynovitis.
- *Greater tuberosity* (8): Lies lateral to the bicipital groove and occupies the lateral superior aspect of the humerus. Palpate for bony tenderness, supraspinatus and infraspinatus tendon tenderness, or any tendon defects suggestive of a rotator cuff tear.
- *Acromion* (9) and AC joint. AC joint is tender in ACJ arthritis.
- *The spine of the scapula* (10)
- *Medial border of the scapula* (11)
- *Inferior angle of the scapula* (12)
- *The lateral border of the scapula* (13)
- *Posterior joint line* (14) **(Figs. 4.11A to C)**: Tenderness at the posterior joint line may indicate posterior labral tear, arthritis, or synovitis.

Method to palpate posterior shoulder joint line

The posterior joint line of the shoulder is located 3 cm medial and inferior to the posterior angle of the acromion process. With the patient is standing or sitting and the clinician positioned behind, the left thumb is placed over the posterior joint line landmark. The right hand holds the elbow-proximal forearm junction to rotate the arm internally and externally. The thumb can feel the gap between the rotating humeral head and the posterior glenoid margin **(Figs. 4.11A to C)**.

- *Posterior subacromial region*: Normally, palpation of posterior subacromial region feels soft. However, in a posterior shoulder dislocation, the humeral head can be palpated as a hard mass that moves with arm rotation, known as the DN sign (As described by Dr Deepthi Nandan, Hyderabad, India).
- *Axilla*: Any abnormal mass, lymph node, etc.

3. **Hyperlaxity of the joints:** The hyperlaxity assessment is essential, especially in patients with shoulder instability, as a lax shoulder is prone to instability, especially multidirectional types. However, one must remember that laxity is not akin to instability.

   Currently, two gradings are used to assess laxity—***Beighton and Horan joint mobility index,*** commonly referred to as the ***Beighton hypermobility score*** and ***Coudane-Walch or Ropar test***.

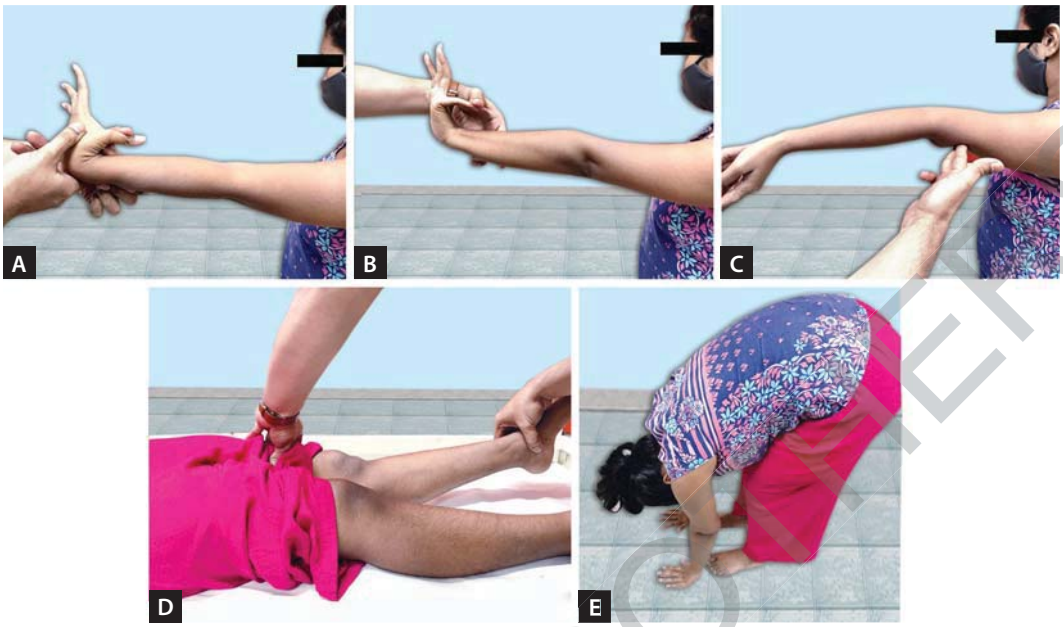
   Beighton score: It utilizes a nine-point system **(Table 4.3)**, wherein the clinician assesses thumb apposition to flexor aspect of forearm, little finger dorsiflexion, elbow and knee hyperextension, and the ability to touch the ground with the palms during forward flexion at the spine **(Figs. 4.12A to E)**. The Beighton score is assessed bilaterally except for the forward flexion part, which is performed once. Each maneuver is scored as 1 if it can be done on the patient, or 0 if not. The maximum score, indicating hyperlaxity, is 9 points. Generally, a Beighton score of 4 out of 9 or greater is considered significant for joint hyperlaxity.

TABLE 4.3: Components of the Beighton score.

Joint/area	*Findings*
Thumb: Right and left side	Passive apposition to the flexor aspect of the forearm
Little finger: Right and left side	Passive dorsiflexion at metacarpophalangeal (MCP) joints beyond 90°
Elbow: Right and left side	Hyperextension beyond 10°
Knee: Right and left side	Hyperextension beyond 10°
Forward flexion of the spine with the knee extended	Touch the ground with a palm-flat

Coudane-Walch test or Ropar test: This is another test that assesses shoulder hyperlaxity.

With the patient standing/supine, the arm is kept by the side of the chest, elbow in 90° flexion, and the shoulder gradually externally rotated (ER) to the maximum. A standing ER >85° (Coudane-Walch test) or supine ER >90° (Ropar's test) is a positive sign of shoulder hyperlaxity.

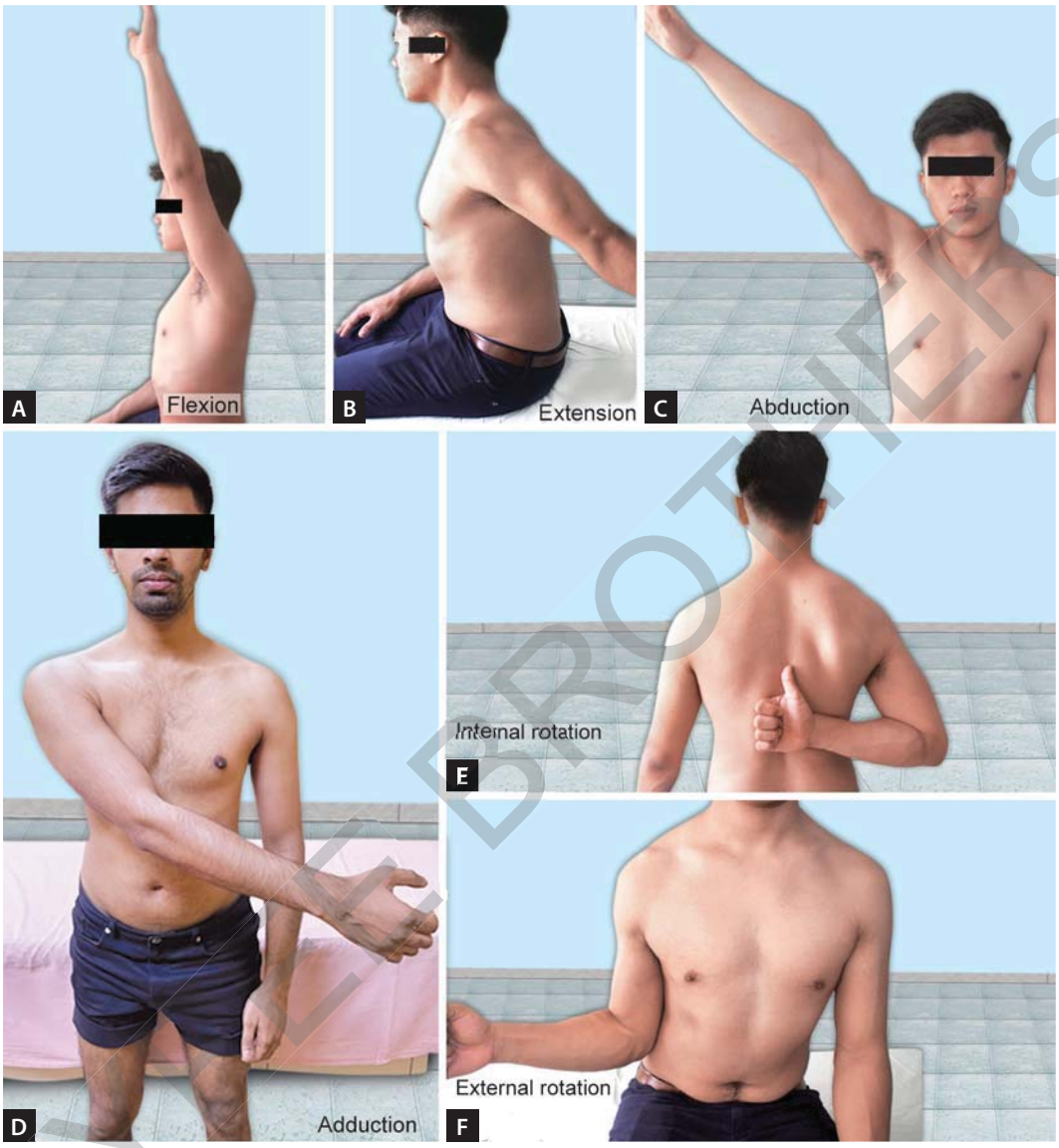


Figs. 4.12A to E: Hyperlaxity assessment with Beighton score at the thumb (A), little finger (B), elbow (C), knee (D) and forward bending (E).

Movements

The shoulder (GHJ) is a ball and socket joint with movement possible in all three planes: Flexion-extension, abduction–adduction, and external–internal rotation **(Figs. 4.13A to F)**. The normal range of movement (ROM) of the shoulder joint (GH) is mentioned in **Box 4.3**. Note that while all other shoulder ROMs are measured in degrees, internal rotation is typically recorded based on how far the thumb can reach on the back of the body (using spinal levels as reference points). One must follow the specific rules outlined below when assessing the ROM of the shoulder.

i. Always assess the active ROM on the normal side first, followed by the index side.
ii. On the index side, note any deformity. Evaluate active ROM first, then passive ROM. The difference between them can help identify the underlying diagnosis **(Box 4.4)**. Many patients with rotator cuff tear present with pseudoparalysis, which is an inability to actively elevate shoulder in scapular plane but can be elevated passively. It is often due to massive rotator cuff tear and occasionally due to severe pain.
iii. In young patients, especially throwers or those who regularly play overhead throwing sports, presenting with vague posterior shoulder pain and loss of throwing velocity, always assess the total arc of rotation in 90° abducted shoulder followed by arc of internal rotation (IR) and compare with contralateral side. So, place patient's shoulder in 90° abduction and forearm parallel to the floor, stabilise scapula and now externally rotate shoulder followed by internal rotation. If there is loss of more than 20° of IR, it indicates a pathologic entity known as glenohumeral internal rotation deficit (GIRD) due to posterior capsule tightness (see details on page 120).



Figs. 4.13A to F: Demonstration of active ROM at the shoulder joint. (A and B) Flexion–extension; (C and D) Abduction and adduction; (E and F) Internal and external ROM at the shoulder joint.

Many authors also consider whether total rotational motion (internal plus external rotation) remains symmetric; if total motion is preserved, GIRD may be considered a benign adaptation rather than pathologic.

iv. The clicks and crepitus may be detected during passive ROM of the affected shoulder by keeping the hand over the shoulder (*Note: Click is a short, often single sound, whereas crepitus is longer-lasting sound, often multiple*).

BOX 4.3: Normal range of movement (ROM) at the shoulder joint.

1. **Flexion:** 0–180°
2. **Extension:** 0–60°
3. **Abduction:** 0–180°
4. **Adduction** *(across the body in front of the chest in coronal/frontal plane)*: 0–60°
5. **External rotation** *(with the arm adducted to the chest wall)*: 0–70°
6. **Internal rotation:** Typically, the thumb reaches up to the spinous process of the D6/D7 vertebrae. Sometimes, it goes up to the spinous process of D3. *Note that internal rotation is clinically measured as "Where the tip of the thumb reaches with respect to a bony landmark"* on the spine (vertebra), PSIS, gluteal region, and greater trochanter. *Note that rotations are also measured with the shoulder in 90° abduction, especially internal rotation to assess glenohumeral internal rotation deficit (GIRD) in young patients with suspicion of internal impingement (see details of GIRD on page 120).*

BOX 4.4: Diagnostic possibilities based on range of movement (ROM) assessment.

- **Restriction of only active ROM:** Seen in rotator cuff tear and nerve injuries
- **Gross restriction of both active and passive ROM:** Typically indicates frozen shoulder, glenohumeral arthritis, or a dislocated joint.
- **Terminal painful restriction of both active and passive ROM:** Commonly caused by rotator cuff tendinopathy, impingement syndrome, and subacromial bursitis.
- **Painful movements (active or passive) in the mid-abduction arc of 60–120°:** Known as Painful Arc Syndrome (PAS).
- **Glenohumeral internal rotation deficit (GIRD) (restricted internal rotation at 90° abduction):** Compared to the normal side, a restriction of internal rotation greater than 20° at 90° abduction suggests GIRD (refer to the GIRD on page 120 under common conditions).

In clinical practice, an easy way to assess overall active shoulder ROM is by asking the patient first to abduct the shoulder in the plane of the scapula, then to keep the hand behind the head with the elbows behind the coronal plane of the body as much as possible, and lastly to place the thumb between the two scapulae. These three maneuvers provide an idea of flexion–abduction, external rotation, and internal rotation, respectively.

What is pseudoparalysis (in the shoulder)?

If active shoulder elevation in the plane of the scapula is less than 45° (some authors consider 90° as the cutoff), while passive range of motion is normal or significantly greater than active motion, the condition is referred to as "pseudoparalysis." It occurs due to an acute rotator cuff tear or a large/massive rotator cuff tear involving two or more tendons or acutely painful Calcific tendinitis.

Before performing passive ROM assessment of the shoulder, it is important to understand two key concepts:

1. During the shoulder movement at the GHJ, especially flexion and abduction, there is always concomitant movement at the scapulothoracic joint (STJ) in the ratio of 2:1. Therefore, to accurately assess GHJ movements, the clinician must minimize the movement at the STJ by firmly stabilizing the scapula, usually by placing a hand over it **(Figs. 4.14A and B)**. However, after 90° of flexion or abduction, the STJ movement cannot be fully prevented, and the scapula will begin to move. Note that the normal scapulohumeral rhythm involves a ratio of about 1:2 (30° of scapular movement to 60° of GHJ movement). Failure to control STJ movement during passive ROM assessment can lead to an erroneous estimation of the actual GHJ range of motion.

Figs. 4.14A and B: Assessment of passive ROM of the shoulder after stabilizing the scapula. (A) Abduction; (B) Flexion.

2. Shoulder abduction is elicited in the plane of the scapula, whereas shoulder flexion-extension is elicited in the plane perpendicular to the scapula. The scapular plane lies approximately 30° anterior to the coronal plane of the body, as the scapula is tilted 30° forward over the rib cage. *Hence, typically, flexion-extension is performed perpendicular to the scapular plane, which is 30° medial to the sagittal plane of the body. In contrast, abduction is performed in the plane of the scapula that is 30° anterior to the coronal plane of the body. Notably, abduction of the shoulder in the scapular plane is also known as "Scaption", a commonly used term in clinical practice.*

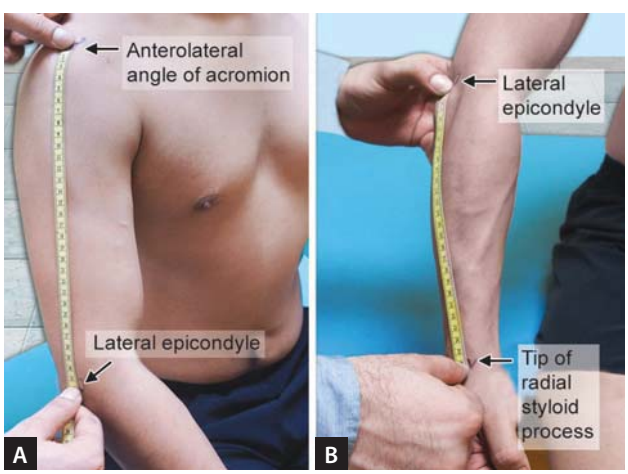
Crepitus may suggest	*Click may suggest*
• Subacromial bursitis, loose body (multiple) • Rotator cuff tear • Glenohumeral arthritis	• Labral tear • Biceps subluxation from the bicipital groove • Loose body (single)

Measurements

The measurements of both upper limbs (limb length and circumference) are performed for comparison **(Fig. 4.15)**.

1. **The length of upper limb:** It is assessed by measuring arm and forearm lengths.

- ***The arm length*** is measured from the anterolateral angle of the acromion to the lateral epicondyle **(Fig. 4.15A)**.
- ***The forearm length*** is measured from the lateral epicondyle to the tip of the radial styloid process **(Fig. 4.15B)**.



Figs. 4.15A and B: Upper limb length measurement. (A) Arm length measurement; (B) Forearm length measurement.

2. **Measure the arm and forearm circumference for muscle bulk:** In an adult, the arm and forearm circumferences should be measured 10 cm above and below the tip of the olecranon, respectively, on both sides for comparison. Alternately, it could be measured in the area of maximum girth of the arm and forearm.

However, most local shoulder conditions result in *noticeable wasting* of the deltoid, supraspinatus, and infraspinatus rather than arm and forearm muscles. Wasting of the arm and forearm muscles is typically noted in pathologies concerning the brachial plexus.

Neurovascular Examination of the Upper Limbs

The neurovascular assessment should be performed in a standardized manner. It is especially important in post-traumatic, post-surgical, or infiltrative conditions.

Special Tests for Shoulder Instability (Anterior, Posterior, and Inferior), Rotator Cuff Tear, SLAP Tear, AC Joint and Biceps Tendon Pathology

Tests for Shoulder Instability

Shoulder instability can occur in three different directions, such as *anterior, posterior, and inferior,* or it could be *multidirectional*, which involves two or more directions. Various clinical are discussed below to understand the methodology and interpretation.

i. **Tests for anterior instability:** Anterior instability is evaluated with several clinical tests, including the apprehension test, relocation-release test, Gagey's hyperabduction test, anterior drawer test, and load and shift test. Notably, the latter can also detect posterior instability.

1. ***Apprehension test:*** One of the most classic tests described to assess anterior instability. *However, note that it carries a risk of dislocation while performing the test.*

Method: While the patient is seated or standing, the clinician stands behind the patient's index shoulder. For the right shoulder, the clinician's right hand holds the patient's elbow-forearm junction and gradually abducts the arm to 90° and externally rotates it. The fingers of the clinician's left hand are kept in front of the anterior joint line of the shoulder, while the thumb is kept over the posterior part of the humeral head. Then, the head is gently pushed anteriorly by the left thumb over the glenoid cavity while the right hand increases external rotation **(Fig. 4.16)**. The left hand finger, which are infront of the shoulder, prevent excess anterior translation or dislocation.

Interpretation: Apprehension, fear, or refusal to continue the maneuver by the patient indicates chronic anterior instability, typically due to torn and lax antero-inferior capsulolabral complex (Bankart

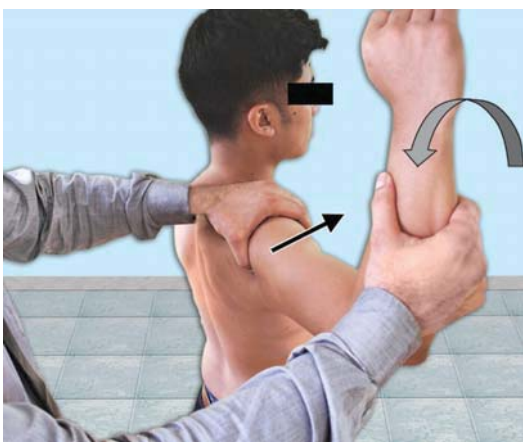


Fig. 4.16: Apprehension test (black arrow indicates anterior thrust given to the humeral head by the thumb while curved arrow indicates external rotation of the arm).

lesion) with or without glenoid bony defect. Pain alone during the maneuver may indicate a labral tear. *Apprehension with mid-abduction (less than 90°) implies significant bony or soft tissue insufficiency.*

Caution during apprehension test

The apprehension test must be performed with care in routine practice because there is a small but real risk of causing an actual shoulder dislocation during the maneuver. This can be painful and traumatic for the patient and embarrassing for the clinician. For this reason, the relocation–release test is generally preferred, as it offers more controlled assessment of anterior labral tear, and significantly reduces the risk of anterior dislocation during testing.

During the relocation–release test, the clinician's hand is placed in front of the shoulder, providing superior control over the anterior translation of the humeral head compared to the fingers used in the apprehension test. This control makes anterior dislocation during the test highly unlikely.

2. ***Relocation–release test:*** This is a *highly sensitive and specific test* used to detect anteroinferior labral tears. Further, it is safe, convenient, and currently preferred over the apprehension test for assessing anterior shoulder instability.

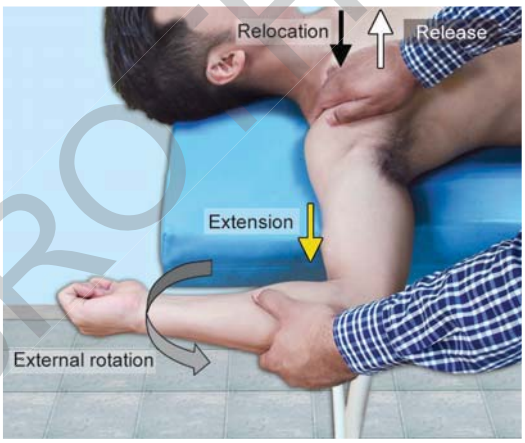


Fig. 4.17: Relocation–release test. The yellow arrow indicates posterior push on the elbow for shoulder extension, while the black and white arrows suggest relocation and release, respectively. The gray curved arrow indicates shoulder external rotation.

Method: This test is performed with the patient lying supine. For the right shoulder, the right arm is abducted to 90° and gradually externally rotated to 90° with the mid-arm lies against the edge of the couch **(Fig. 4.17)**. The clinician holds the patient's right elbow or proximal forearm with left hand, while the right hand is placed in front of the shoulder to apply a posteriorly directed force, relocating the humeral head into a reduced position within the glenoid. The clinician then gradually increases shoulder extension by pushing the elbow downward and further externally rotates the arm while gently decreasing the posterior force (release). (*Note*: The hand in front of the shoulder should never be fully removed; it is relaxed just enough to allow anterior translation of the humeral head). In the wake of imminent subluxation or dislocation, patient may show apprehension and/or pain. Next, the clinician applies a posterior force (relocation) to reduce the humeral head into the glenoid, which typically abolishes the apprehension and/or pain. This maneuver is repeated several times to confirm the finding.

Interpretation: In patients with anterior instability, releasing the anterior hand allows the humeral head to slip anteriorly, triggering apprehension or pain. A positive relocation–release test is indicated by the presence of apprehension or pain during release, which resolves with relocation. This finding suggests anteroinferior instability due to a torn or lax anteroinferior capsulolabral complex (Bankart lesion), with or without an associated bony defect of the anterior glenoid.

3. ***Gagey's hyperabduction test*:** The purpose of this test is to assess the integrity of the inferior glenohumeral ligament (IGHL) complex, which is lax or torn in anteroinferior instability of the shoulder. Gagey et al. (2001) proposed that the IGHL is the most important inferior soft tissue stabilizer of the shoulder. The principle of this test is that in a normal individual with an intact IGHL, passive hyperabduction of the shoulder with the scapula stabilized does not exceed 105°. An increased hyperabduction may indicate a torn or stretched IGHL.
   Method: This test is performed with the patient seated and the clinician stands behind. For the right shoulder, the clinician stabilizes the patient's scapula with the left hand or by resting the forearm over the shoulder, while gradually abducting the shoulder by holding the patient's elbow with the right hand. The clinician notes the abduction range at which the scapula begins to move, comparing it to the normal side **(Fig. 4.18)**.
   Interpretation: In a normal shoulder, passive abduction without significant scapula movement is less than 105°, while a value exceeding 105° suggests a torn or lax IGHL consistent with anteroinferior instability. Some patients with instability may also experience pain when abduction exceeds 105°. It should be noted that bilateral abduction greater than 105° is sometimes seen in patients with generalized joint laxity without instability.
4. ***Anterior Drawer test (Gerber and Ganz)*:**
   Method: This test is performed with the patient in a supine position, with the shoulder in 80–120° abduction, slight flexion (0–20°), and external rotation (0–30°). For the right shoulder, the clinician supports the right arm with the left hand while the clinician's right-hand fingers rest over the scapular spine and thumb over the coracoid process, steadying the scapula **(Fig. 4.19)**. Alternatively, the patient's hand can also be placed in the clinician's axilla, stabilizing the distal part of the extremity. Next, the clinician's left hand pulls the humeral head anteriorly. Observe for excess movement, clicks, or apprehension and

Fig. 4.18: Gagey's test on both shoulders reveals hyperabduction on the left side compared to the right (normal side). The yellow line indicates the vertical midline axis, while the white and red lines indicate the arm abduction axis of normal and index sides, respectively.

Fig. 4.19: Anterior drawer test (blue arrow indicates anterior pull to the shoulder).

compare with the normal side. Note that this test *can also be performed under anesthesia* to observe laxity, and *both excess anterior and posterior movements can be assessed.*

Interpretation: Excessive anterior movement, clicks, and the patient's apprehension compared to the normal side indicates anterior instability.

In 1986, ***RJ Hawkins*** suggested a grading system to assess anterior translation, which is mentioned below.

Grade 0: No or minimal translation

Grade 1: 0–1 cm

Grade 2: 1–2 cm

Grade 3: > 2 cm

However, due to the difficulty in appreciating the "cm" movement of Hawkins grading, **Modified Hawkins and Bokor** grading are used more frequently to assess anterior translation **(Table 4.4)**.

TABLE 4.4: Modified Hawkins and Bokor (1990) grading system to assess translation (anterior or posterior).

Grade 1	Translation of the humeral head to the glenoid rim
Grade 2	Translation of the humeral head over the glenoid rim
Grade 3	The translation was "*lock out*" (the humeral head remains out of the joint when the clinician's hands are removed)

Note: Grade 0 is removed from Hawkin's grading system as it is difficult to differentiate between grades 0 and 1.

5. ***Load and shift test (Silliman and Hawkins)*:** The load and shift test is a modified version of the anterior and posterior drawer tests for shoulder instability. In this technique, the humeral head is first "loaded" or pushed onto the glenoid cavity, then shifted anteriorly and posteriorly. Therefore, this not only *assesses the degree of anterior-posterior translation but also provides insight into the adequacy of the glenoid rim.*

   Method: With the patient seated and the hand resting on the lap, the shoulder should be forward flexed and abducted to 20°. The clinician stands behind the patient. For the right side, the clinician stabilizes the scapula with the left hand, while the right hand holds the proximal humerus. The clinician loads (pushes) the humeral head against the glenoid, then translates it both anteriorly and posteriorly to assess for excessive anterior-posterior movement due to capsule laxity or tear **(Fig. 4.20)**. Normal motion is up to 25% of the humeral head diameter anteriorly and up to 50% posteriorly. Compare the findings with the unaffected side for reference.

Fig. 4.20: Load and shift test. Blue and orange arrows indicate anterior and posterior push to the humeral head, respectively.

Interpretation: Observe and grade any excess translation compared to the contralateral side:

- *Grade I (mild):* 0–1 cm translation
- *Grade II (moderate):* 1–2 cm translation
- *Grade III (severe):* >2 cm translation

A positive test is indicated by increased translation, subluxation, or apprehension compared to the normal side.

ii. **Tests for posterior instability:** It is evaluated using the Jerk test, posterior drawer test, and load and shift test. *Note that the load and shift test (vide supra) can also help detect posterior instability.*

1. ***Jerk test:***

Method: With the patient preferably sitting, the clinician stands in front of or beside the patient. While stabilizing the scapula with one hand, the clinician holds with elbow with other hand and brings the index arm in 90° abduction and internally rotated. Next, clinician exerts an axial load toward the glenoid fossa **(Fig. 4.21A)** by applying a proximal force toward the glenoid and gradually adducts the arm in horizontal plane (horizontal adduction). In case of posterior instability, this maneuver may result in a sudden jerk and or pain due to posterior subluxation or dislocation of humeral head **(Fig. 4.21B)**. Returning the arm to the plane of the scapula may induce a second jerk as the humeral head reduces back into the glenoid. This maneuver should be repeated several times to confirm the findings.

Interpretation: A positive jerk test implies posterior instability due to a posteroinferior labral tear with or without a bony defect in the glenoid. However, more than often, this maneuver results in only pain without a jerk, which also signifies injury to the posterior capsulolabral complex. Therefore, one must try to note both the pain and or jerk components of this test.

Figs. 4.21A and B: Jerk test. (A) An abducted, internally rotated (curved arrow) and axially loaded arm toward the glenoid (black arrow); (B) Internally rotated arm is gradually horizontally adducted with maintained axial load, and with posteriorly directed force.

2. ***Posterior drawer test (Gerber and Ganz):***
Method: This test is performed with the patient in supine, with the shoulder in 90° abduction, slight flexion (20°), and internal rotation (60–80°). For the right shoulder, the clinician supports the right arm with the left hand while the clinician's right-hand fingers are kept over the scapular spine and thumb over the coracoid process, steadying the scapula. The left hand then pushes the head of the humerus posteriorly and observes for any excess movement, clicks, or apprehension. (*Note*: *The posterior drawer test is similar to the anterior drawer test, except that the shoulder is internally rotated*).

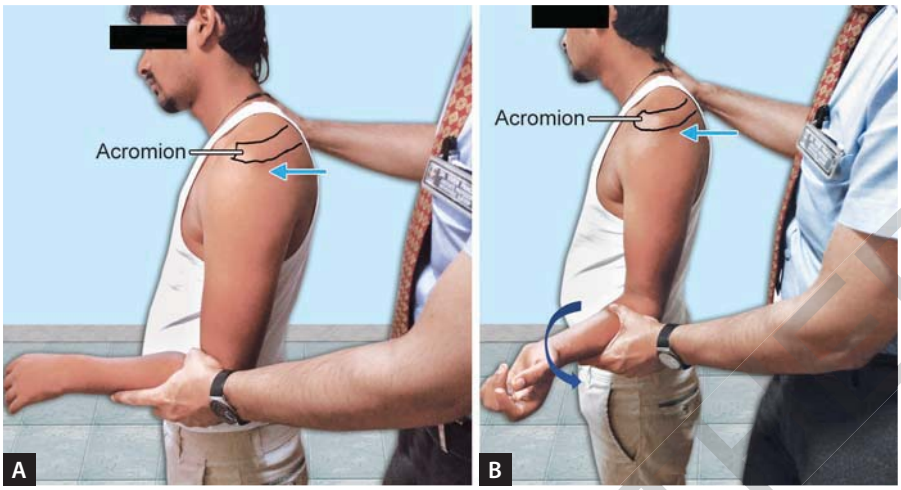
Fig. 4.22: Posterior drawer test. The blue arrow indicates posteriorly directed force on the humeral head.

In a modified and easier method, the clinician holds the patient's forearm in the above-described shoulder position with one hand, while the other hand pushes the head of the humerus posteriorly **(Fig. 4.22)**. Always compare findings findings with the normal side. This test can also be performed under anesthesia to observe excess movement.
Interpretation: Any excess posterior movement, click, or patient apprehension compared to the normal side indicates posterior instability. Posterior translation can also be graded as outlined in **Table 4.4**.

Note: In the anterior drawer test, the shoulder is externally rotated to tighten the anterior glenohumeral ligament complex and the anterior capsule. In contrast, the shoulder is internally rotated in the posterior drawer test to tighten the posterior band of the inferior glenohumeral ligament complex and posterior capsule.

iii. **Tests for inferior instability:** It is assessed by eliciting the sulcus sign, which is performed in 0° and 30° external rotation of the shoulder to assess overall inferior laxity of shoulder and laxity of rotator interval, respectively. Generally, inferior instability does not occur in isolation and is commonly observed in conjunction with multidirectional instability, which is a combination of anterior or posterior instability, or both.

1. ***Sulcus sign (Neer and Foster, 1980):***
The sulcus sign is performed to assess inferior laxity of the shoulder due to incompetence of the inferior capsule, IGHL, SGHL and possibly coracohumeral ligament (CHL). The test is performed in 0° and 30° external rotation of the shoulder. 0° external rotation will assess overall laxity and IGHL laxity. 30° external rotation tightens the anterior capsule and rotator interval structures
Method: With the patient sitting (with hands over their lap) or standing, the clinician stands behind or beside the patient. The index arm hangs by the side of the chest with the elbow flexed at 90° **(Fig. 4.23A)**.
   - Assessment in 0° and 30° external rotation of shoulder: The clinician applies a downward traction force to the arm in 0° neutral rotation by holding the 90° flexed



Figs. 4.23A and B: Sulcus sign. (A) The blue arrow shows the sulcus appearing below the acromion; (B) The test is repeated in 30° or more external rotation with the arm in adduction (deep, blue-curved arrow indicates external rotation of shoulder).

elbow, while the other hand should be placed over the opposite scapula to prevent the spine from tilting due to the traction on the arm. While traction is applied, observe the appearance of a sulcus or a visible depression or a groove below the lateral edge of the acromion (blue arrow in **Fig. 4.23A**). Repeat the test with the shoulder in 30° of external rotation **(Fig. 4.23B)**.

Interpretation: A positive sulcus sign is indicated by the appearance of a sulcus or groove just below the lateral acromion edge, indicating the presence of inferior instability.

- At 0° of neutral rotation, the sulcus sign evaluates the overall inferior laxity of the shoulder capsule, especially the IGHL.
- At 30° of external rotation, the rotation tightens the anterior capsule and rotator interval structures, primarily the SGHL and CHL. By repeating the test in this position, it checks whether laxity persists despite the capsule being tightened. Persistent sulcus sign in external rotation suggests laxity or incompetence specifically in the rotator interval and SGHL supporting the shoulder superiorly and anteriorly.

Grading of sulcus sign: Grade I: <1 cm translation; Grade II: 1–2.0 cm; Grade III: >2.0 cm translation

Tests for Subacromial Impingement and Subacromial Bursitis

Before understanding tests for subacromial impingement and subacromial bursitis, it is essential to remember that presence of impingement or bursitis often indicates another underlying pathology, such as a rotator cuff tear, tendinopathy, calcific tendinitis, frozen shoulder, or altered shoulder mechanics (scapular dyskinesia). Isolated impingement and bursitis are uncommon, making it imperative to identify the underlying cause. To understand the etiology and biomechanics of external impingement, read the note on external impingement

on page 117. Furthermore, it is important to recognize an entity called ***internal impingement***, which is commonly observed in overhead throwers. In this condition, the posterosuperior rotator cuff impinges against the posterosuperior glenoid during the late cocking phase of throwing. The pathology and clinical features of internal impingement differ from those of external impingement (for details, refer to page 121).

1. **Neer's impingement sign:** This test assesses impingement in the subacromial space. Note that this test can be completed only if the shoulder has forward flexion is nearly normal or in other words, the shoulder should not be stiff in flexion.
   Method and interpretation: With the patient in a supine, sitting, or standing position, the patient is asked to rotate the limb internally so that the thumb points downward. In this position, a normal shoulder can be gradually forward flexed till 180° without pain or discomfort provided there is no stiffness **(Fig. 4.24)**. In structural subacromial impingement, patients usually experience pain over the deltoid or arm after 140–150° of flexion and resist further flexion due to increasing pain **(Fig. 4.24)**.

Fig. 4.24: Neer's sign.

2. ***Neer's impingement test:*** Sometimes it is difficult to determine whether pain is originating from the subacromial space or adjacent structures. Neer's impingement test helps differentiate the pain source.
   Method: First, inject 2–5 mL of 2% xylocaine into the index subacromial space. A few minutes later, perform Neer's sign in standard fashion (vide supra).
   Interpretation: A negative Neer sign implies that the pain was due to the impingement within the subacromial space. If Neer's sign remains positive, the pain source is likely outside the subacromial space. A reduction in pain after injection suggests mixed sources of pain from both the subacromial space and elsewhere.

   Remember: Neer's sign is performed before Neer's test.

3. **Hawkins–Kennedy test:** This test detects the presence or absence of "subacromial bursitis" and impingement.
   Method: The shoulder is brought in 90° forward flexion in sagittal plane, and the elbow is flexed to 90°. The shoulder is then gently internally rotated **(Fig. 4.25)**.
   Interpretation: Pain in the internal rotation suggests subacromial bursitis.

Fig. 4.25: Hawkin's sign. Gray curved arrow indicates internal rotation of the arm.

Note: A portion of the subacromial bursa extends beyond the acromial margin, lying outside the main subacromial space. Internal rotation of the arm maneuvers the inflamed bursa beneath the acromion, while forward flexion reduces the volume of the subacromial space. Together, these movements compress the inflamed bursa, which helps to reproduce the patient's pain during the Hawkins–Kennedy test.

Tests for Rotator Cuff Tear

Typically, all cuff tests are performed in a standing or sitting position. Furthermore, the tests performed are comparative in terms of pain, strength, or lag, provided the contralateral shoulder is normal. In cases of bilateral pathology, however, the clinician relies on prior experience—gained from examining numerous normal shoulders—to assess and compare the observed weakness against the expected normal population.

i. **Supraspinatus tear:** The integrity of the supraspinatus tendon can be assessed using full can, empty can, and drop arm test. Always begin supraspinatus assessment with the full can test, as the empty can test is more painful and provocative test.

1. ***Full can test:***
   Method: With the patient is seated or standing, the clinician stands in front of the patient. For comparative assessment, both the shoulders are elevated 60–70° in the scapular plane and externally rotated and elbow extended so that the *thumb points upward* (as if holding a full can of cola). The clinician then applies a downward pressure just above the wrist while the patient resists it by lifting his arm upward into abduction **(Fig. 4.26A)**.

Note: Fallacy while performing full can and empty can tests

Ensure that the patient does not flex their elbow or shrug their shoulder while elevating the arm during the full or empty can test. Such compensatory movements commonly occur when the patient misunderstands the maneuver or attempts to mask weakness in shoulder abduction. Therefore, the clinician should demonstrate the correct elevation using their own upper limb, ensuring the movement is performed without elbow flexion or shoulder shrugging.

Figs. 4.26A and B: Tests for supraspinatus tendon. (A) Full can test with thumb pointing upward; (B) Empty can test with thumb pointing downward.

Interpretation: Weakness in abduction strength with/without pain suggests the supraspinatus tear.

Further,

- ***If the full can test is weak and/painful,*** there is no need to repeat the empty can test, as the latter is provocative. Further, clinician has already confirmed the presence of supraspinatus tear and by repeating empty can test, the clinician would not gain any additional information.
- ***If the full can test is quite strong and not painful,*** the empty can test must be performed.

Of Note: The full can test is more accurate in diagnosing a supraspinatus tear than empty can test. Additionally, the empty can test is more provocative for pain than the full can test.

2. ***Empty can test (Jobe's supraspinatus test):***
   Method: The patient may be seated or standing. For comparative assessment, both shoulders are elevated 60–70° in the scapular plane and internally rotated and elbow extended so that the thumbs *point downward* (as if emptying an can of cola). Then clinician then applies applies downward pressure just above the wrist, while the patient resists it by lifting the arm upward into abduction without shrugging the shoulder **(Fig. 4.26B)**.
   Interpretation: Pain and/or weakness during this maneuver suggests a supraspinatus tear. In addition to detecting a full-thickness supraspinatus tear, the empty can test may also positive in partial supraspinatus tear, rotator cuff tendinopathy, subacromial bursitis, and impingement. Therefore, it must be interpreted with caution in conjunction with the patient's history and examination findings.
3. ***Drop arm test for supraspinatus tendon tear*:**
   Method: With the patient seated or standing, the clinician stands behind or beside the patient and passively abducts the externally rotated arm to 180° in the scapular plane, supporting it at the extended elbow. The patient is then asked to slowly lower the arm until the hand rests at the waist.
   Interpretation: The test is considered positive if there is a sudden drop of the arm, or if pain occurs during while lowering, or if the patient demonstrates weakness in maintaining the arm position while lowering. Occasionally, the patient can lower the arm smoothly to 90° because this function is primarily controlled by the deltoid, rather than the supraspinatus. However, below 90°, the arm suddenly drops as sustained smooth descent of arm requires the strength of the supraspinatus.

ii. **Infraspinatus tear:** The Infraspinatus functions as an external rotator of the shoulder. Several tests have been described for its assessment, including the resisted external rotation test (RERT), external rotation lag test at 20° and 90° (drop sign), and Patte's test.

1. ***Resisted external rotation test*:** With the patient sitting or standing, both arms are positioned in 0° abduction and neutral rotation at the shoulder with elbows flexed to 90°. The clinician then asks the patient to externally rotate both shoulder against the resistance applied at the wrist and forearm **(Fig. 4.27A)**. The clinician must assess both strength and pain in RERT, as strength carries greater diagnostic value for an infraspinatus tear. Compared to the normal side, diminished resistance on the affected side may indicate an infraspinatus tear.

2. ***External rotation lag test at 20°:***
   Method: With the patient seated or standing and the shoulder relaxed, the clinician passively flexes the elbow to 90° and holds it with one hand. Using the other hand at the wrist, the clinician moves the affected shoulder into 20° abduction in the scapular plane and near-maximum external rotation (defined as maximum external rotation minus 5° to avoid elastic recoil) **(Fig. 4.27B)**. The patient is then asked to *maintain the external rotation position for a minimum of 10 seconds as the clinician releases the wrist.*
   Interpretation: The sign is positive if the arm or shoulder springs back into internal rotation >10°, noted by the wrist moving from the coronal plane toward the sagittal plane.
3. ***External rotation lag test at 90° abduction of shoulder (drop sign):***
   Method: With the patient standing or seated, the elbow is passively flexed to 90° supported by the clinician's hand. At the same time, the shoulder is moved to 90° abduction in the scapular plane and near-maximum external rotation (maximum external minus 5° to avoid elastic recoil of the shoulder) by holding it near the wrist with the other hand. The patient

Figs. 4.27A to D: Tests for infraspinatus tendon. (A) External rotation resistance test (blue arrow indicates the patient is resisting clinician's internal rotation force; (B) External rotation lag test at 20° abduction; (C) External rotation lag test at 90° abduction (the blue arrow is the direction of fall of the wrist after clinician leaves the wrist); (D) Patte's test (blue arrow indicates patient's posterior push against clinician's resistance, while clinician supports patient's elbow with other hand).

is then asked to maintain the position of external rotation for a minimum of 10 seconds as the clinician releases the wrist, still supporting at the elbow.

Interpretation: The sign is positive if the arm or shoulder springs back into internal rotation >10° (indicated by wrist internal movement) **(Fig. 4.27C)**.

Note: The drop arm sign and drop sign are different. The former is positive in supraspinatus tear, whereas latter is performed to assess Infraspinatus tendon.

In a study of 54 patients, Walch et al. concluded that the drop sign had 100% sensitivity and 100% specificity for a degenerating or torn infraspinatus.

5. ***Patte's test:*** The original purpose of Patte's test was to assess the teres minor. However, some authors use it to test infraspinatus, too, as the sensitivity of this test for infraspinatus tear is high (93%), and if negative, it rules out infraspinatus tear.

   Method: With the patient standing or seated, the elbow is passively flexed to 90° and supported by one hand of the clinician. At the same time, the shoulder is positioned at 90° abduction in the scapular plane and maximum external rotation. The patient is then asked to externally rotate the arm against the resistance applied by the clinician at the wrist **(Fig. 4.27D)**.

   Interpretation: A patient with an infraspinatus tear will be unable to resist the clinician's force against the wrist.

iii. **Test for teres minor:** Since teres minor is also an external rotator of the shoulder, the tests are almost similar to infraspinatus except for Hornblower's test. An increasing amount of lag or weakness during these tests supports the diagnosis of a teres minor tear.

1. ***External rotation lag test at 20°:*** It is performed similarly to that described above for infraspinatus. The sign is positive for the teres minor if the arm or shoulder springs back into internal rotation >40° (indicated by the wrist moving from the coronal plane toward the sagittal plane).
2. ***External rotation lag test at 90° (drop sign):*** It is performed similarly to that described above for infraspinatus. The sign is positive if the arm or shoulder springs back into internal rotation >40°. The larger the internal rotation drop, the higher the likelihood of teres minor tear.
3. ***Patte's sign:*** This test was designed to detect a tear of the teres minor in the presence of an infraspinatus tear. It is performed similarly to that described above for the infraspinatus.
4. ***Hornblower's sign:*** First described by Arthuis et al. in patients with brachial plexus palsy, this sign indicates difficulty in bringing the hand to the mouth due to deficient external rotators of the shoulder. In brachial plexus injury, it is also known as the trumpet sign.

   Method: The patient is asked to bring both hands to the mouth, while keeping the arms adducted to the chest.

   Interpretation and surgical implication: On the affected side, the patient compensates by elevating the elbow higher—often with shoulder shrugging and abduction—and extending the wrist more than on the contralateral side to bring the hand to the mouth **(Fig. 4.28)**.

   Clinical implication of this sign is that a patient with positive Hornblower sign who is undergoing reverse shoulder replacement (RSR) requires either teres minor repair (if repairable) or tendon transfers (Latissimus dorsi or Lower Trapezius) to gain external rotation power, as mere RSR does not restore meaningful external rotation power at the shoulder.

iv. **Subscapularis tear:** The Subscapularis is an internal rotator, and all the tests described assess internal rotation strength. Apart from the commonly performed Gerber's lift-off and belly press tests, others include the internal rotation lag sign, belly-off test, and bear-hug test. While most subscapularis tests are more specific, the bear-hug test is the most sensitive.

Fig. 4.28: Hornblower's test is positive on the right side (high elbow position on the right side compared to the contralateral normal side).

1. ***Gerber's lift-off test:*** Before performing Gerber's lift-off test, clinician must ensure that the patient has painless passive internal rotation at least upto the mid-lumbar spine to avoid a false positive result, as Gerber's test needs painless internal rotation till mid-lumbar spine and cannot be accurately performed in a painful, stiff shoulder.

   Method: With the patient seated or standing, the clinician keeps the patient's hand over the mid-lumbar spine with the shoulder extended and internally rotated. The patient is then is asked to lift the wrist-hand (in neutral of palmar flexion-extension) away from the back as much as possible. Sensitivity can be increased by asking the patient to hold the hand away against the clinician's resistance **(Fig. 4.29A)**.

Figs. 4.29A and B: Tests for subscapularis tendon. (A) Gerber's lift-off test (Black arrow denotes clinician's resistance while the yellow arrow denotes patient's effort to lift wrist-hand away from the back); (B) Passive lift-off or internal rotation lag test (blue arrow indicates the direction of hand moving toward spine after release of the wrist in patients with subscapularis tear).

Interpretation: The test is positive if the patient is unable to lift the wrist-hand (in neutral) away from the mid-lumbar spine, or if they cannot resist the clinician's force pushing the hand back toward the spine

2. ***Passive lift-off (internal rotation lag sign):***
   Method: With the patient seated or standing, the clinician holds the patient's hand with one hand and passively brings the patient's hand behind the back at the level of the mid-lumbar spine. While supporting the patient's elbow with the other hand, the clinician moves the wrist away from the lumbar spine as much as possible by extending and internally rotating the shoulder. The patient is then asked to maintain this position as the clinician releases the wrist while continuing to support the elbow.
   Interpretation: The test is positive if the patient cannot maintain the hand-away position from mid-lumbar spine and the hand drops over the mid-lumbar spine **(Fig. 4.29B)**.

Note: Gerber's lift-off and passive lift-off tests are difficult to perform in patients with restricted or painful internal rotation of the shoulder. In such patients, belly press, belly off, and bear hug tests should be performed.

3. ***Belly press (Napoleon) test:*** It was described by Gerber et al. in 1996.
   Method: The patient is asked to place both hands over the belly with the shoulder in maximal internal rotation so that the elbows lie in the same plane as the wrist–hand or extend slightly ahead of the trunk's coronal plane.
   Interpretation: The test is positive if the elbow falls behind the wrist-hand plane or the trunk's coronal plane. Further, to assess the strength, the clinician should push the elbow posteriorly and ask the patient to resist. In a positive test, the patient cannot resist the clinician's posterior push over the elbow.
   Modified Belly press test: In the modified belly press test described by Burkhart et al. (2002), the patient places the hand on the belly (abdomen) and brings the elbow forward in front of the trunk. The flexion angle between the wrist–hand and forearm is then measured **(Fig. 4.30A)**.

- 0° wrist flexion angle: negative test, normal subscapularis.
- 30–60° wrist flexion angle: intermediate test, suggestive of partial or upper 2/3rd subscapularis tear.
- 90° wrist flexion angle: positive test, indicating complete tear of the subscapularis **(Fig. 4.30B)**.

However, Bartsch et al. (2009) and recently, Kim et al. (2023) proposed that a wrist flexion angle difference >10–15°, respectively between the affected and unaffected sides is suggestive of a subscapularis tear. Currently, authors follow this guideline.

4. ***Belly-off test:*** This test was described by Schiebel et al. (2005).
   Method: The positioning of upper limb is similar to the belly press test, wherein the arm is kept in maximum internal rotation, hand placed over the belly and elbow ahead of the trunk. The clinician supports the elbow with one hand while the other hand keeps the patient's wrist and hand in a neutral position over the abdomen. While elbow is continued to be held ahead of trunk by clinician's one hand, the clinician removes their other hand from patient's hand (over belly) and patient is asked to keep their hand over the belly.

Figs. 4.30A to D: Tests for the subscapularis tendon. (A and B) Belly press and modified belly press test (zero or near zero angles between wrist and forearm suggest normal subscapularis, whereas side-side wrist-hand angle difference of >10–15° suggests subscapularis tear); (C) Belly-off test—yellow arrow indicates the direction of the patient's hand going off the belly when the clinician removes his hand; (D) Bear-hug test. The green arrow indicates the patient pushing his shoulder against the resistance offered by the clinician.

Interpretation: The test is considered positive test by patient's inability to maintain the hand over the belly and hand going "off the belly", and the wrist may move into palmar flexion to remain in contact with the belly **(Fig. 4.30C)**.

5. ***Bear-hug test:*** This test was described by Barth et al. (2006).
Method: The patient is asked to flex the affected shoulder to 90° with the elbow at the same height as the shoulder, then place the wrist in extension over the opposite shoulder. The patient is instructed to hold this internally rotated position as the clinician attempts to pull the hand away from the shoulder.
Interpretation: A positive test is indicated if the patient cannot maintain hand contact with the opposite shoulder **(Fig. 4.30D)**.

Note that in a massive cuff tear with pseudoparalysis, the patient is unable to actively flex the shoulder to 90°. Therefore, in such a situation, bear-hug test cannot be performed.

Tests for Superior Labrum Anterior-posterior Tear

Superior labrum anterior-posterior (SLAP) tears are usually observed in young people, who are typically involved in overhead sports (badminton, tennis, Javelin throwers, volleyball) or repeatedly perform overhead activities. It can also happen after a fall on an outstretched hand. It is characterized by a tear in the superior labrum at the root of the long head of the biceps, often extending posteriorly and/or anteriorly. Their chief complaint is an inability to throw or smash with "previous velocity" with or without pain. Although many clinical tests have been described for diagnosing SLAP tears, none have been found to possess high sensitivity or specificity alone. Therefore, diagnosis typically relies on a combination of clinical history and performing multiple tests.

Two commonly used clinical tests for SLAP tears are the O'Brien test and the Crank test. It is important to note that these tests can often yield false-positive results in patients who have rotator cuff tears or other painful shoulder conditions. For this reason, the interpretation of these tests should be cautious and considered alongside other clinical information from history and examination.

1. **O'Brien's test:**
   - *Method*: With the patient is standing or supine, the shoulder is forward flexed to 90°, then horizontally adducted by 10°, and fully internally rotated so that the thumb points downward. The patient is then asked to flex his arm upward (blue arrow) while the clinician gives downward resistance to the distal forearm or wrist **(Fig. 4.31)**. It is essential that the patient does not shrug the shoulder during this movement; the clinician should firmly stabilize the shoulder to prevent shrugging. Also, O'Brien is easier to perform in the supine position as the scapula is stabilized against the couch.
   - *Interpretation*: A positive test is indicated by weakness and/or pain during forward flexion against resistance.
2. **Crank test or compression rotation test (Liu's test):**
   Method: With the patient is standing or supine, the shoulder is brought in 160° abduction, and the elbow is flexed to 90°. The clinician then applies an axial load through the arm toward the glenoid, while repetitively internally and externally rotating the shoulder **(Fig. 4.32)**.

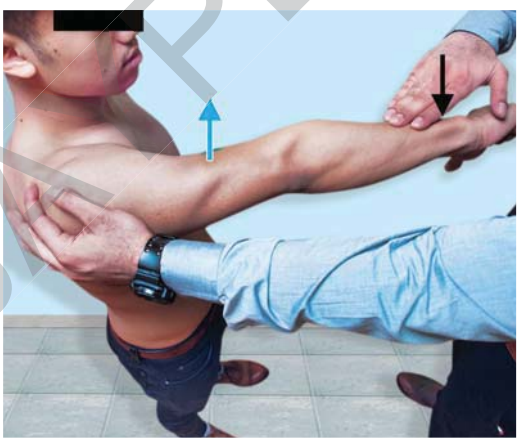


Fig. 4.31: O'Brien's test [blue arrow shows forward flexion by the patient against resistance by the clinician (black arrow)].

Fig. 4.32: Crank test (curved arrows indicate external and internal rotation while maintaining abduction and axial pressure over the glenoid).

Interpretation: The test is positive if the patient complains of pain, and the clinician may feel clicks.

Tests for Biceps Tendon Pathology: Bicipital Tendinitis

1. **Biceps groove tenderness:** In patients with bicipital tendinitis, palpation of the biceps tendon (BT) in the groove might elicit tenderness. Note: *Biceps groove is felt just lateral to the lesser tuberosity*.
   Method: With patient seated or standing, the arm is kept adducted to the chest and neutral rotation with the elbow 90° flexed. The clinician then holds the forearm with one hand, and externally and internally rotates the arm while keeping the other hand's thumb over the groove to palpate BT.
   Interpretation: Tenderness in the bicipital groove suggests biceps tendinopathy. Occasionally, an unstable biceps tendon may be felt slipping out of the groove during shoulder rotation.
2. **Speed's test:**
   Method: With the patient standing, the shoulder is flexed to 90° in the sagittal plane, the forearm fully supinated, and the elbow extended. The patient is asked to further flex the shoulder against resistance applied by the clinician over the forearm **(Fig. 4.33)**. Note that the patient should not flex the elbow while elevating the arm.
   Interpretation: Pain in the bicipital groove or anterior aspect of the arm along the course of the biceps tendon is considered a positive Speed's test.
3. **Yergason's test:**
   Method: The patient remains seated or standing with the arm by the side of the chest and in neutral rotation, the elbow in 90° flexion, and the forearm in pronation. While supporting the patient's elbow with one hand, the clinician holds the hand in a shake-hand manner with the other hand and asks the patient to supinate their forearm against the clinician's resistance **(Fig. 4.34)**. Note that some literature sources also describe simultaneous elbow flexion and forearm supination.
   Interpretation: Yergason's test is considered positive if the pain is reproduced in the bicipital groove.

Fig. 4.33: Speed's test. The blue arrow indicates the arm's forward flexion, and the black arrow indicates the clinician's resistance.

Fig. 4.34: Yergason's test.

Tests for Acromioclavicular Joint Arthritis

1. **Acromioclavicular joint tenderness:** Clinical tenderness on palpation of the ACJ is a sensitive and reasonably specific indicator of ACJ arthritis. When evaluating shoulder pain, if the patient indicates their tender spot by placing a finger directly over the ACJ, this is considered a highly sensitive (96%) and specific sign of ACJ arthritis. It has negative predictive value of 71%.
   Method and interpretation: The ACJ joint is palpated for tenderness. The presence of tenderness over the ACJ indicates ACJ arthritis. In acute trauma, it indicates injury to the AC joint capsule.

   Note: Clinical tenderness is more sensitive to ACJ arthritis than the radiological presence of ACJ arthritis.

2. **Cross-chest adduction test (Scarf test):**
   Method: With the patient is standing or supine, the elbow is flexed, and the shoulder is brought to 90° flexion. The clinician then horizontally adducts the shoulder across the chest by pushing patient's elbow, so the hand crosses over to touch the opposite shoulder **(Fig. 4.35)**.
   Interpretation: Patients with ACJ arthritis will report pain in the ACJ area. If pain is felt elsewhere, ACJ arthritis is unlikely; specifically, pain at the back of the shoulder suggests posterior capsular tightness.

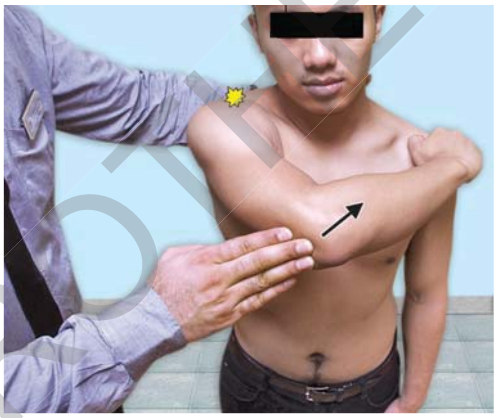


Fig. 4.35: Cross-chest adduction test would cause pain over the *acromioclavicular joint* (ACJ) (yellow star). The black arrow indicates the direction of the push to the elbow.

Examination of the Joint Above and Below

A standard cervical spine and elbow examination is essential for every evaluation of shoulder pathology because pain from the cervical region can present as shoulder pain and vice versa. Clinically, if the patient keeps his hand over the nape of the neck or scapular blade while pointing to the area of pain, and if the pain radiates toward the forearm, wrist, and hand with tingling and numbness, is highly suggestive pain from a cervical spine pathology. Nevertheless, one must remember that shoulder and cervical pathologies frequently coexist, making meticulous examination of both areas crucial for accurate diagnosis. Additionally, shoulder pain can also result in elbow or wrist pain as a consequence of a dysfunctional kinetic chain and can masquerade as tennis elbow or De Quervain's tenosynovitis, respectively. Therefore, a systematic evaluation of neighboring joints is crucial.

Examination of the Lymph Nodes

Examination of the neck and axillary lymph nodes should be performed, especially when an infective or tumor pathology is suspected.

A Note on External Impingement in the Shoulder

The term impingement occurs in the subacromial space and is often used in shoulder pathology. So, what does impingement imply?

Typically, the subacromial space is formed by:

- **Floor:** Top of the greater tuberosity
- **Roof:** Undersurface of the acromion
- **Front:** Coracoacromial ligament (CAL)
- **Contents:** Supraspinatus, infraspinatus, and subacromial bursa

In a normal situation, shoulder flexion or abduction narrows the subacromial space, especially in mid-flexion and mid-abduction. However, the subacromial contents i.e., rotator cuff tendons and subacromial bursa glide smoothly between the floor and roof without getting "impinged" in the anatomically narrowed subacromial space during mid-flexion or abduction due to normal anatomy and the biomechanics of the shoulder joint.

In pathological conditions, structural changes make it difficult for subacromial contents to move without compression during flexion and abduction, leading to pain and restricted motion. Contributing pathological conditions are:

- ***Thickening of contents (cuff, bursa):*** Cuff tendinopathy, subacromial bursitis
- ***Downward projection of the acromion in type III acromion, anterior or lateral spur of the acromion:*** The volume of the subacromial space decreases.
- ***Malunion or nonunion of the greater tuberosity:*** The volume of the subacromial space decreases.
- ***Weak cuff muscles:*** Poor centering effect of cuff over glenoid results in superior migration of humerus, thereby reducing subacromial space, leading to cuff impingement.
- ***Hypertrophied CAL:*** The volume of the subacromial space decreases.
- ***Asynchronous scapula movement (scapular dyskinesia):*** A dyskinetic scapula dynamically alters the subacromial space volume by altering the acromial tilt.

Hence, impingement is not a specific diagnosis, but rather an indication of a syndrome. *The clinician needs* to determine the exact etiology of the impingement on the structures and treat them accordingly.

The impingement described above is "**external impingement**", which occurs outside the GHJ in the subacromial space.

Another entity known as "**internal impingement**" occurs between the posterosuperior cuff and posterior glenoid during extreme external rotation and abduction in throwers. Internal impingement is discussed in the "*Common Conditions section*". Understanding that both impingements are entirely different in their etiopathology, presentation, and treatment is essential.

Shoulder Examination Proforma

1. **Attitude**
2. **Inspection:**
   - *General findings*: All areas for overlying skin, swelling, scar, and sinus**.**
   - *Specific findings of the inspection:*
     a. **From front:**
        - Shoulder contour, muscle wasting (deltoid), shoulder drooping, and swelling/prominence of SCJ/ACJ/other areas

     b. **From side:**
        - Shoulder and neck, dorsal spine Kyphosis (normal/altered)

     c. **From back:**
        - Spine and its curvature, any deformity, neck, hairline level, and webbing
        - *Muscle wasting*: Supra- and infraspinatus, deltoid, and other periscapular muscles
        - *Scapula*: Level of scapula, size of scapula, the distance of medial border from the spine, winging, and scapular dyskinesis
3. **Palpation:**
   - The local rise in temperature
   - *Tenderness*: Soft tissue and bony landmarks, joint line. Feel for bony irregularity, thickening, deformity, any bony gaps.
   - Hyperlaxity of joints—Beighton score, shoulder external rotation in adduction (Coudane-Walch Or Ropar test)
   - Confirmation of palpatory characteristics of swelling, scar, and sinus
4. **Movements:** Active and passive
   - Flexion–extension, abduction–adduction, and external and internal rotation. Assess GIRD in young patients with suspicion of internal impingement. GIRD is indicated if there is a loss of >20° of IR compared to the contralateral shoulder.
   - Crepitus, clicks; if any
5. **Measurements:** Limb length and arm-forearm circumference
6. **Neurovascular examination**
7. **Special tests:**
   - ***Stability tests:*** Apprehension test, relocation-release test, Gagey's hyperabduction, anterior drawer, load and shift, Jerk test, posterior drawer, and sulcus sign in 0° and 30° external rotation of arm.
   - ***Impingement tests:*** Neer's sign and Hawkin's test. Neer's test, if necessary.
   - ***Rotator cuff integrity signs:*** Supraspinatus (full can and empty can test), Infraspinatus (RERT, external rotation lag test at 20° and 90°, and Patte's test), Teres minor (Hornblower sign), Subscapularis (Gerber's lift-off, passive lift-off test, Belly press test, Belly-off test, and Bear-hug test)
   - ***SLAP tear test:*** O'Brien test and Crank test
   - ***Biceps tendon pathology:*** Biceps groove tenderness, Speed's test, and Yergason test
   - ***ACJ pathology:*** ACJ tenderness, cross-chest adduction test
8. **Joint above (cervical spine) and below (elbow)**
9. **Lymph node examination**

Common Conditions Affecting the Shoulder with their Salient Features

Traumatic

1. **Recurrent anterior dislocation (traumatic)**:
   - ***Affects:*** Young patients, especially one involved in contact or overhead sports. It may be associated with ligament laxity.
   - ***Presents with:*** Mostly traumatic episodes (TUBS), occasionally atraumatic (AMBRII)
   - ***Pathology:*** Anteroinferior labral tear (Bankart lesion) and the posterolateral head of humerus impaction injury (Hill–Sachs' lesion). Bony Bankart lesion is also quite common, wherein the labrum is detached along with a glenoid bone fragment.
   - ***Clinically:*** Apprehension, relocation-release test, and Gagey's sign positive, signs of ligament laxity ± (Beighton ≥ 4 is significant)
   - ***Diagnosis:*** X-rays are usually normal. Sometimes, one can see a bony Bankart lesion or a deep Hill–Sachs' lesion; magnetic resonance imaging (MRI) is diagnostic for anterior labral tear and Hill–Sachs lesion; CT scan is done in patients with recurrent dislocation to assess glenoid bone loss and Hill–Sachs index for on- or off-track type.
   - ***Treatment:*** Rehabilitation is recommended if it is a first episode/no bony Bankart lesion. Recurrent episodes often require surgical stabilization. If glenoid bone loss is <20–25%, arthroscopic/open Bankart repair is performed. Add remplissage if Hill–Sachs' lesion is off-track. If glenoid bone loss >20–25%—Latarjet or other bony block procedure.

     Note that a primary dislocation in an older patient (>40–45 years) often results in a rotator cuff tear, which should be investigated. In older patients, the labral tears are often small/absent, while persistent cuff tear is the primary reason for recurrent dislocation, which needs repair to prevent further dislocation.

Note: Posterior dislocation is often seen in epileptic patients, electric shock, or ethanol intoxication and is often missed. Acute posterior dislocation patients have limited external rotation (c.f., patients with anterior dislocation who have limited internal rotation). X-ray shows the light bulb sign.
Treatment: Closed reduction/open reduction and McLaughlin procedure.

TUBS: **T**raumatic, **U**nidirectional, **B**ankart lesion, often needs **S**urgical stabilization

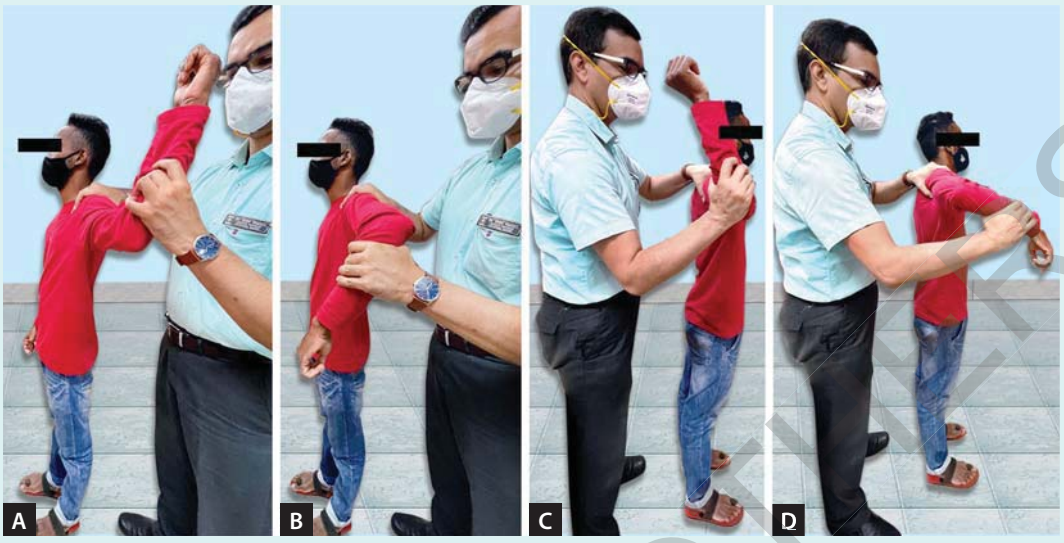
AMBRII: **A**traumatic, **M**ultidirectional, **B**ilateral, **R**ehabilitation is the primary treatment. Surgery, if required—/nferior capsular shift and rotator Interval closure is performed.

2. **Superior labral anterior–posterior (SLAP) tear and posterior labral tear:**
   - ***Affects:*** Young adults, overhead athletes. Sometimes, a fall on an outstretched hand and traction force on the shoulder could result in a SLAP tear. The posterior labral tear occurs after posterior dislocation/bench press/internal impingement injury.
   - ***Presents with:*** Inability in overhead throwing of an object with previous velocity, pain±. A posterior labral tear often presents with pain, a clicking sensation, and difficulty throwing.
   - ***Pathology:*** Tear in the posterosuperior labrum
   - ***Clinically:*** O'Brien's test+, Crank test+, clicks±. A posterior labral tear can also result in a positive jerk test. Often, there is associated GIRD (glenohumeral internal rotation deficit), scapular dyskinesia, and internal impingement.
   - ***Diagnosis:*** An MRI is essential for establishing the diagnosis. An MR arthrogram may sometimes be required to confirm the diagnosis, as plain MRI may miss the diagnosis.
   - ***Treatment:*** NSAIDs, physiotherapy, activity modification. Arthroscopic SLAP/posterior labral repair. Biceps tenodesis in older individuals.

Other Sports-related Conditions

3. **Scapular dyskinesia:** It is also called *SICK scapula syndrome*, where SICK stands for:
   S: Scapula malposition;
   I: Inferomedial border scapula prominence;
   C: Coracoid process tenderness and malposition; and
   K: Kinetic abnormality of the scapula
   - ***Definition:*** It is an alteration or deviation in the scapula's normal resting or active position during shoulder movement.
   - ***Typically affects:*** Young adults, overhead athletes.
   - ***Presents with:*** Pain around the shoulder, especially while performing overhead activities, difficulty throwing objects, and a feeling of losing strength. A previous history of trauma to the shoulder may be present.
   - ***Pathology:*** Weakness in periscapular muscles, rotator cuff, poor mechanics
   - ***Classification/type:*** *Type I:* Inferomedial scapular border prominence; *Type II:* Medial border prominence; *Type III:* Superomedial border prominence. Type I is most common and is observed in rotator cuff dysfunction. Type II is most common in glenohumeral instability; Type III is commonly observed in rotator cuff dysfunction and deltoid-cuff force couple dysfunction.
   - ***Clinically:***
     - Observe for scapular dyskinesia, especially when lowering the hand from an elevated position.
     - Observe the scapular borders with the hand on the hip position.
     - *Scapular retraction test*: The clinician supports the medial border of the scapula, gently pushes against the chest wall, and stabilizes it. Now, the patient is asked to elevate and lower his hand. If his pain and strength improve, the test is positive. It suggests that physiotherapy can help restore the balance in the scapula, which may improve symptoms, provided there are no major structural lesions in the shoulder.
   - ***Diagnosis:*** Always a clinical diagnosis. MRI should be done if there is suspicion of a structural lesion in the shoulder.
   - ***Treatment:*** Physiotherapy is the mainstay of the treatment to restore the scapular balance. Medical or surgical management of the underlying structural defect, if required.

4. **GIRD (Glenohumeral Internal Rotation Deficit):**
   - ***Definition:*** It is a condition resulting in the loss of internal rotation (>20°) of the GHJ compared to the contralateral shoulder. It is most commonly observed in athletes who perform overhead throwing activities. Note that total rotational motion of the shoulder is the sum of internal and external rotation and may be more important than the absolute value of IR loss. Pathologic GIRD has been defined as a loss of IR combined with a loss of total rotational motion.
   - ***Affects:*** Young adult overhead athletes are often involved in repetitive overhead throwing movements, such as those with abduction and external rotation, including badminton, tennis, and Javelin throwers.
   - ***Presents with:*** Pain, difficulty in throwing, loss of velocity, and power to throw
   - ***Pathology:*** The major pathologic process in GIRD is posterior capsular and rotator-cuff tightness, due to the repetitive cocking that occurs with the overhead throwing motion. Other associated pathologic lesions in shoulder are SLAP tear, posterior labral tear, and partial articular side cuff tear (of posterior part of the supraspinatus or infraspinatus).
   - ***Clinically:*** In patients with suspected GIRD, the internal rotation in a 90° abducted shoulder will decrease by 20° or more compared to the normal side. Many authors also consider whether total rotational motion (internal plus external rotation) remains symmetric; if total motion is preserved, GIRD may be considered a benign adaptation rather than pathologic **(Figs. 4.36A to D)**.
   - ***Diagnosis:*** Clinical. MRI is required to rule out associated structural lesion.
   - ***Treatment:*** The mainstay of treatment is conservative comprising analgesics, physiotherapy with posterior capsule stretching (sleeper stretches), Rotator cuff strengthening and restoring scapular balance. If conservative treatment fails, surgical management of the underlying structural defects may be required.



Figs. 4.36A to D: GIRD. (A and B) Demonstrations of rotations in a 90° abducted normal left shoulder, which shows normal external and internal rotation, respectively; (C and D) Demonstrations of rotations in a 90° abducted index right shoulder, which shows normal external rotation (C) and decreased internal rotation than left side (D).

5. **Internal impingement of the shoulder:**
   - ***Definition:*** Internal impingement is a cause of shoulder pain in overhead athletes caused by repetitive impingement between the undersurface of the rotator cuff and the posterosuperior glenoid. It is a significant cause of shoulder pain in athletes who engage in overhead throwing.
   - ***Affects:*** Young adult athletes are often involved in repetitive overhead throwing movements with abduction and external rotation, such as badminton, tennis, and javelin throwers.
   - ***Presents with***: Posterior shoulder pain, which worsens during extreme abduction and external rotation (late cocking phase of throwing), and difficulty in throwing.
   - ***Pathology:*** During the extreme external rotation and abduction, there is internal impingement between the undersurface (articular side) of the posterosuperior cuff and the posterior glenoid, resulting in fraying/articular side tear of the posterosuperior cuff and posterior labral tear, respectively. There is a peel-back lesion of the posterosuperior labrum. It also causes contracture in the posterior capsule and fraying of the posterior glenoid cartilage (Bennett lesion).
   - ***Associations:*** Internal impingement is often associated with GIRD, SLAP/posterosuperior labral tear, or scapular dyskinesia.
   - ***Clinically:*** There are no pathognomonic features of internal impingement. It is diagnosed based on history, several set of clinical features and MRI. There may be posterior joint line tenderness. Features of GIRD and scapular dyskinesia are often present. During the apprehension test, the patient may report pain over the posterior aspect of the shoulder. Supraspinatus strength assessment may reveal mild pain with slight weakness. ROM is overall preserved *except for the* loss of internal rotation.
   - ***Diagnosis:*** X-rays are usually normal. Sometimes, an X-ray may show a small posterior osteophyte in the glenoid (Bennett lesion—Thrower's exostosis). MRI reveals a posterior labral tear with partial tears/fraying of the articular side of the posterosuperior cuff.
   - ***Treatment:*** Initially, conservative treatment is the mainstay, comprising NSAIDs, physiotherapy, activity modification, avoiding throwing for several weeks to months, posterior capsule stretching (also known as sleeper stretches), and restoring scapular balance. Arthroscopic release of the posterior capsule, debridement/repair of the frayed-torn cuff, and debridement/repair of the posterosuperior labrum may be required in patients with failed conservative treatment.

Idiopathic and Degenerative

6. **Frozen shoulder/adhesive capsulitis/periarthritis of the shoulder:**
   Currently, frozen shoulder is ISAKOS' preferred term. Adhesive capsulitis is not preferred as there are no adhesions in the joint, while periarthritis is no longer advocated.
   - ***Definition:*** Primary frozen shoulder is an idiopathic condition affecting the shoulder capsule and coracohumeral ligament (CHL), causing pain and global restriction in the movements without any other structural damage, followed by a gradual resolution in symptoms over a few months to years.
     Secondary frozen shoulder occurs following a trauma, infection, inflammation, or postsurgery. It may not resolve on its own and may require surgical intervention.
   - ***Affects:*** Middle age (40–55 years)
   - ***Risk factors:*** Diabetes and thyroid dysfunction. Many patients develop frozen shoulders after a cardiac procedure (such as angiography or angioplasty) or any ipsilateral chest, breast, or upper limb surgery (excluding shoulder surgery).
   - ***Presents with:*** Pain and *progressive loss of ROM*, both active and passive; inability to perform overhead activities, difficulty in reaching behind the head and back. Pain in the shoulder is severe, especially at night while lying on the affected side.
   - ***Pathology:*** Inflammation followed by contracture of the CHL, capsule, and synovium
     Three clinicopathological stages affecting the CHL, capsule, and synovium:
     - *Freezing stage (0–6 months):* Severe pain, gradual loss of ROM
     - *Frozen stage (6–12 months):* Pain decreases, profound loss of ROM
     - *Thawing stage (12–18 months):* Further decrease in pain, ROM improves, gradually returning to normal or near normal.
   - ***Clinically:*** Global (in all directions) loss of both active and passive ROM, painful ROM. Cuff strength is usually normal.
   - ***Diagnosis:*** Mostly clinical. MRI/ultrasonography (USG) can be used to rule out underlying conditions and confirm a frozen shoulder. MRI and USG can detect CHL, capsule contracture, rotator interval inflammation, and increased vascularity.
   - ***Treatment:*** Largely conservative in the form of NSAIDs, physiotherapy, intra-articular steroid injection, and hydrodilation. Correction of metabolic pathologies such as diabetes and thyroid dysfunction.
     If conservative treatment fails for >6–9 months, arthroscopic capsular release or manipulation under general anesthesia can be performed to regain the movements and alleviate the pain.

7. **Acromioclavicular joint arthritis:**
   - ***Affects:*** Older adults, and individuals who do a lot of repetitive overhead or heavy lifting activity, especially athletes and manual workers. Mostly between 40 and 55 years
   - ***Presents with:*** Painful shoulder movement while performing activities in abduction. Often, the patient lifts his finger and points it over the ACJ (finger sign). Pain is also at night while sleeping on the affected and opposite sides (sleeping on the opposite side acts like a cross-chest adduction test).
   - ***Pathology:*** Acromioclavicular joint arthritis
   - ***Clinically:*** Tenderness + over ACJ, cross-chest adduction +. Both active and passive abductions are painful beyond 90°.
   - ***Diagnosis:*** Plain X-ray and MRI. Note that *X-ray and MRI diagnosis of ACJ arthritis should be avoided. It is almost always a clinical diagnosis with radiological correlation.*
   - ***Treatment:*** Conservative—NSAIDs, physiotherapy, intra-ACJ steroid injection, and activity modification; if conservative treatment fails for >3–6 months—open/arthroscopic excision of ACJ.

8. **Rotator cuff tendinopathy:**
   - ***Affects:*** Middle-aged (35–55 years)
   - ***Presents with:*** Mild-to-moderate pain experienced during activities and while lying on the affected side. Strength is usually maintained.
   - ***Pathology:*** Tendinopathy of the rotator cuff, especially supraspinatus

- ***Clinically:*** Terminally restricted and painful ROM (both active and passive). Neer's and Hawkins' sign is positive. The empty can test is often painful and may be slightly weak, while the full can test is strong.
- ***Cuff integrity test:*** Equivocal but mostly negative for any substantial weakness.
- ***Diagnosis:*** X-rays are normal. MRI/USG confirms the diagnosis. Diabetes and thyroid dysfunction should be evaluated.
- ***Treatment:*** Most cases resolve with conservative treatment—NSAIDs, physiotherapy, activity modification, and subacromial steroid injection. Resistant cases may require arthroscopic subacromial decompression (subacromial bursa and acromial spur excision) with debridement of the frayed tendon.
- ***Differential diagnosis:*** Always rule out underlying early frozen shoulder.

9. **Rotator cuff tear (partial or full thickness):**
   - ***Affects:*** While partial thickness tears start earlier by 40–45 years of age, full thickness tears are common after 55–60 years.
   - ***Presents with:*** Pain during shoulder movements and at night while lying on the affected side. There is difficulty elevating or moving the shoulder. Often, pseudopalsy is observed in acute posterosuperior (supra- and infraspinatus) cuff tears or massive cuff tears (tear in two or more tendons).
   - ***Etiopathology:*** Rotator cuff tears from the tuberosity (greater or lesser) could be degenerative or traumatic in origin; former is more common than latter. Degenerative rotator cuff tears are mainly caused by age-related tendon wear with reduced vascularity and cumulative microtrauma over time. Repetitive overhead activity and chronic mechanical overload (sports or occupational) accelerate this degeneration and predispose to tearing. Generally, degenerative tears start with tendinopathy progressing to partial followed by full thickness tears. Traumatic tears can happen in a normal tendon or in already a weak, frayed tendon due to ageing. Minor trauma, such as a fall/jerk while lifting a heavy object, is often superimposed over a degenerative tendon.
   - ***Clinically:***
     - *Partial cuff tears:* Mostly present with pain and/ variable loss in strength. The ROM is generally preserved. While full can test is often negative, the empty can test may be positive. Other cuff tests are positive as per the tendon involved. Impingement signs may be positive.
     - *Full thickness tears:* Most common presentation is pain. Acute traumatic or massive tears (2 or more tendons) may present with pseudopalsy. The active ROM may be preserved or lost depending upon which and how many tendons are torn. However, passive ROM is often preserved (unless secondary stiffness). Wasting of cuff muscle is present in chronic tears. Tests for rotator cuff tears are positive, depending upon which tendon is torn.
   - ***Diagnosis:***
     - X-ray—mostly normal. In chronic cases, acromial spurs, acromion, and greater tuberosity sclerosis is noted. Massive cuff tears (with infraspinatus tear) reveal proximal migration of the humeral head.
     - MRI—to assess the number of torn tendons, cuff retraction, fatty infiltration, and atrophy. Note that MRI is the most sensitive and specific investigation.
     - USG—dynamic, cheap, but operator-dependent
   - ***Treatment:*** *Conservative treatment*: Analgesics, rehabilitation
   - ***Surgical treatment:*** Arthroscopic or open repair of the cuff tear that fails conservative treatment. In irreparable cuff tears, various surgical options are superior capsular reconstruction, tendon transfers, and reverse shoulder replacement.

10. **Rotator cuff arthropathy:**
    - ***Affects:*** 65–70+ years
    - ***Presents with:*** Pain, gross loss of strength, and or inability to elevate the arm (pseudopalsy), reach the head or back
    - ***Pathology:*** Rotator cuff arthropathy (RCA) develops from massive (2 or more tendons), chronic rotator cuff tears that disrupt the force couple balancing the humeral head, causing superior migration and eccentric glenoid/acromion erosion from repetitive mechanical overload.

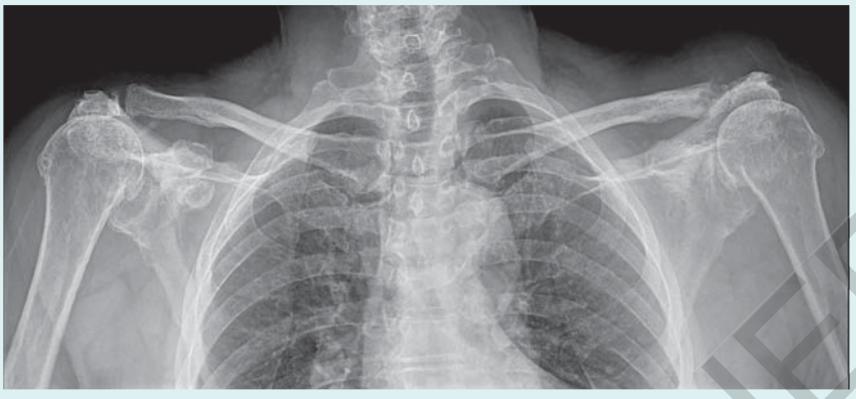


Fig. 4.37: Bilateral rotator cuff arthropathy with proximal migration of the humeral head, and arthritic joint.

This leads to cartilage destruction via combined nutritional deficiency (reduced synovial fluid pressure and nutrients) and inflammatory responses, often with crystal deposition (e.g., hydroxyapatite) accelerating joint degeneration and humeral head collapse.

- ***Clinically:*** Patient presents with pain, varying loss of movements, and lack of strength. Activities of daily living are grossly affected. Gross wasting of cuff muscles is noted. The active ROM is less than passive ROM. Crepitus is often present. Cuff tests are positive. Rarely, Geyser sign may be seen (fluctuant swelling over AC joint).
- ***Diagnosis:*** X-ray shows the superior migration of the humeral head and arthritis of the GH joint **(Fig. 4.37)**.

  MRI—to assess the cuff retraction, fatty infiltration, and muscle atrophy. CT scan to assess the glenoid bony erosion and retroversion.
- ***Treatment:*** Conservative treatment—analgesics, physiotherapy, and subacromial steroid injection; definitive treatment is reverse shoulder arthroplasty with/without tendon transfers.

11. **Glenohumeral joint (GHJ) arthritis:**
    - ***Affects:*** Older patients, mostly >65 years
    - ***Presents with:*** Pain and difficulty in movement. Note that the symptoms of GHJ arthritis are similar to frozen shoulder, but (1) the duration is more prolonged in GHJ arthritis; (2) symptoms continue to gradually worsen over months to years in GHJ arthritis, unlike frozen shoulder, which tends to recover partially or wholly in few months to years; and (3) patients with frozen shoulder are relatively younger than one with GHJ arthritis.
    - ***Pathology:*** GHJ arthritis
    - ***Clinically:*** Tenderness + over the joint line, crepitus is felt during ROM (**Note**: Crepitus is not a feature of the primary frozen shoulder). Both active and passive ROM are decreased.
    - ***Diagnosis:*** Plain X-ray shows decreased GHJ space and osteophytes **(Fig. 4.38)**. A CT scan is performed to assess glenoid erosion and inclination, while an MRI is performed to assess rotator cuff status (integrity, atrophy, and fatty infiltration).

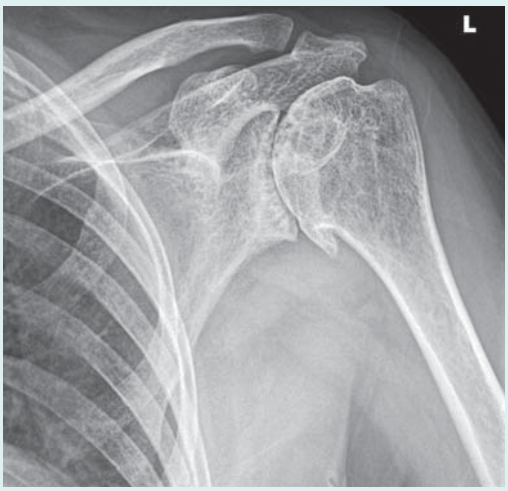


Fig. 4.38: Left glenohumeral osteoarthritis showing narrowed joint space and humeral osteophytes.

- ***Treatment:*** *Conservative treatment*—NSAIDs, physiotherapy, intra-articular steroid, hyaluronic acid injection, and activity modification. If there is no relief, operative treatment is offered in the form of arthroscopic debridement of the GH joint for early stages of GH arthritis or *shoulder replacement for advanced cases*. Total shoulder replacement is performed if the cuff is intact and not atrophied, while a reverse replacement is performed if there is a tear in the cuff or significant atrophy or fatty infiltration.

12. **Painful arc syndrome (PAS):**
    - It is *not* an isolated diagnosis per se but is a syndrome, as many pathological conditions can cause PAS.
    - Cinically, it is characterized by an arc of painful abduction (classically 60–120°) during shoulder abduction of 0–180°, wherein the initial and later part of abduction (other than between 60–120° abduction) is painless **(Fig. 4.39)**.
    - ***Why does a painful arc happen?***
      The subacromial space is typically narrow between the abduction arc of 60° and 120°. However, if the subacromial structures (bursa, cuff, and greater tuberosity) are normal morphologically, they easily navigate the space between the tuberosity and the undersurface of the acromion during the abduction arc of 60–120°. However, any pathology affecting these structures can cause painful negotiation in the 60–120° abduction arc, resulting in PAS.

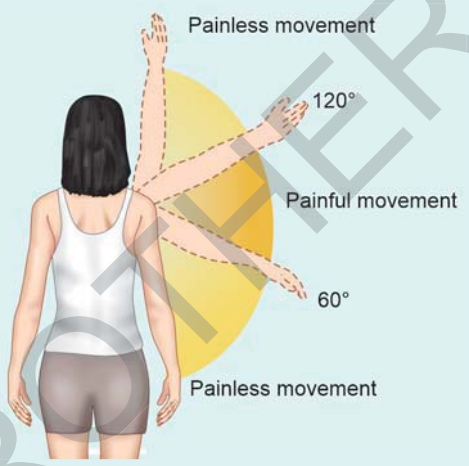


Fig. 4.39: Painful arc between 60° and 120° abduction of the shoulder.

    - ***The following conditions can cause PAS:***
      - Subacromial bursitis (thick bursa)—rotator cuff tendinopathy (thick, frayed tendon)
      - Rotator cuff tears (floating, free margins of cuff)
      - Greater tuberosity avulsion malunion or nonunion (narrowed space)—acromial spur (narrowed subacromial space)
    - ***Treatment*:** The treatment of PAS involves treating the underlying condition.

13. **Calcific tendonitis:** It is one of the most acutely painful shoulder conditions, which is noninfective and atraumatic in origin. Some patients may have chronic mild pain.
    - ***Affects:*** Men and women in the fourth to sixth decade
    - ***Presents with:*** Most patients present with sudden onset, severe pain in the shoulder for a few days. Frequently, there is pseudoparalysis due to severe pain. However, some patient with chronic calcific tendinitis present with chronic shoulder pain with terminal restriction of ROM.
    - ***Pathology:*** Calcific tendinitis of the rotator cuff involves a cell-mediated process where tenocytes undergo fibrocartilaginous metaplasia into chondrocyte-like cells, leading to hydroxyapatite crystal deposition primarily in the supraspinatus tendon (80% of cases). This self-limiting condition progresses through precalcific, calcific (formative and resorptive), and postcalcific phases, with the resorptive phase often causing acute pain due to macrophage phagocytosis and neovascularization.
    - ***Clinically:***
      - ***Acute calcific tendinitis:*** They present with severe pain and and grossly restricted ROM in all planes: Almost "pseudoparalysis". The patient does not allow the slightest movement.
      - ***Chronic calcific tendinitis:*** They present with mild–moderate pain with terminally restricted ROM. The cuff tests may be normal or reveal slight weakness.
    - ***Diagnosis:*** X-ray is always diagnostic **(Fig. 4.40)**. There may be an associated partial cuff tear, which can be detected on USG/MRI. In some cases, PTH levels may be high.

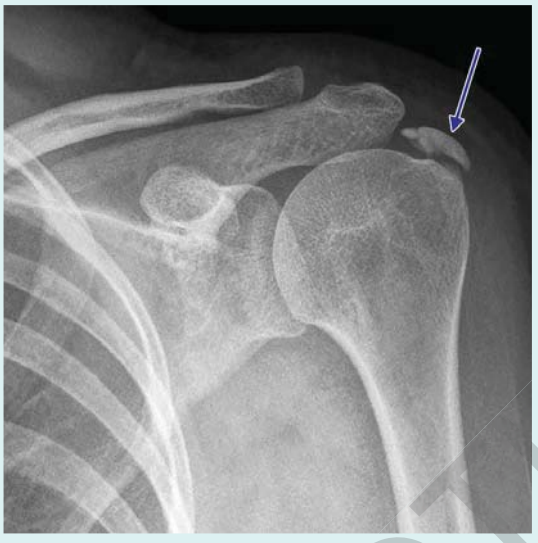


Fig. 4.40: Calcific tendinitis of left shoulder (blue arrow).

– ***Treatment:*** *Largely conservative in the form of* NSAIDs, USG-guided barbotage/percutaneous aspiration of calcific deposits, or subacromial steroid injection. Rarely, arthroscopic decompression of calcific spots may be required.

Nerve Entrapment

14. **Suprascapular nerve entrapment or compression:**
   – ***Affects:*** Middle-aged—men and women. Predominantly overhead workers, throwers, volleyball, or basketball players
   – ***Presents with:*** Pain around the shoulder, sometimes tingling and numbness, loss of velocity to throw, or smash a ball
   – ***Pathology:*** The suprascapular nerve enters the scapula under the transverse scapular ligament and innervates the supraspinatus. Furthermore, it extends distally, negotiating through the spinoglenoid notch, and supplies the infraspinatus. The compression of the suprascapular nerve can occur under or distal to the transverse scapular ligament. The compression of the nerve could be due to a thickened calcified transverse scapular ligament or a ganglionic cyst in the spinoglenoid notch **(Fig. 4.41)**. The cyst often results from a posterosuperior labral tear (akin to a meniscal tear and parameniscal cyst) followed by a synovial fluid leak through the labral rent, forming a paralabral cyst. Rarely, it could be a de novo cyst.
   – ***Clinical features:*** There are no pathognomonic features. Patient presents with vague pain around shoulder, weakness

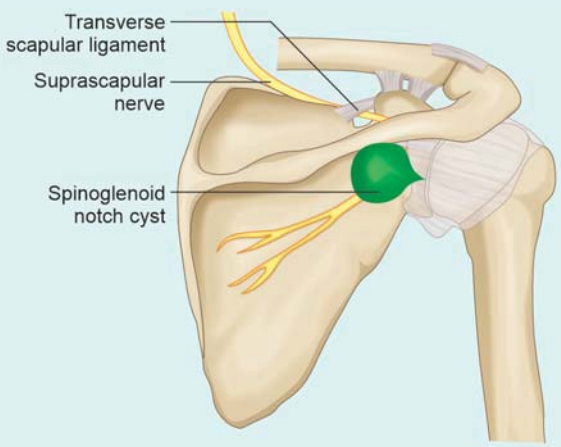


Fig. 4.41: Spinoglenoid notch cyst.

in throwing, or tingling. Wasting of the infraspinatus and/or supraspinatus is noted depending upon the level of compression of the nerve. Weak external rotation strength, O'Brien's test, and other posterosuperior labral tear tests are often positive.
- ***Diagnosis:*** High index of clinical suspicion is the key. MRI is diagnostic. Nerve conduction velocity (NCV) and electromyography (EMG) to assess the status of the suprascapular nerve.
- ***Management:*** Arthroscopic transverse scapular ligament release or decompression of the cyst and labral repair.

Infections

15. **Caries sicca or tuberculosis of shoulder:**
Caries sicca, which is the type I TB shoulder, is the classic dry form of tuberculosis of the shoulder wherein the patient presents with marked wasting of the shoulder and painful restriction of all movements. Other forms of TB shoulder are caries exudata (type II) and caries mobile (type III).
   - *Type II caries exudata* is also known as the florid or fulminating type. It is commonly seen in children and presents with swelling and cold abscesses, which may or may not form a sinus.
   - *Type III caries mobile* is characterized by a preserved range of passive movements, although active movements are restricted.

Others

16. **Charcot's arthropathy of the shoulder:**
   - Rare disorder
   - ***Commonly observed in*** syringomyelia of cervical/cervicodorsal spine, associated with Arnold-Chiari malformation. Rarely in diabetes, Hansen's disease, multiple sclerosis, end-stage renal disease, and chronic alcoholism.
   - ***Presents with:*** Mostly painless or minimally painful gross swelling of the shoulder, difficulty in movement, loss of power, and instability
   - ***Diagnosis:*** X-ray of shoulder shows gross **d**estruction of the joint with much **d**ebris (loose bodies), often **d**islocation/subluxation, **d**ense sclerosed bones, **d**isorganised joint, and soft tissue calcification **(Fig. 4.42)**. Other investigations to find the reason of Charcot (such as cervical spine MRI) should be performed as per the clinical suspicion.
   - ***Treatment:*** Largely conservative. Surgical options such as arthrodesis and arthroplasty carry a high risk of failure. The cause of Charcot must be treated.
   - ***Differential diagnosis:*** Milwaukee shoulder. However, Milwaukee is quite painful.

Fig. 4.42: Right Charcot shoulder. Inset image shows concomitant syrinx in the cervical part of spinal cord (yellow arrows).

17. **Milwaukee shoulder syndrome:**
   - Rare, destructive calcium phosphate crystalline arthropathy
   - ***Affects:*** Elderly (>60 years), primarily females
   - ***Presents with:*** Characterized by recurrent painful massive shoulder effusions along with gross destruction of the joint and large-massive rotator cuff tears.
   - ***Pathology:*** Recurrent painful periarticular calcific deposits in tendons, soft tissues, or intra-articular surfaces. The shoulder is most frequently involved; however, wrists, hands, elbows, neck, lumbar spine, hips, knees, and feet may also be affected.

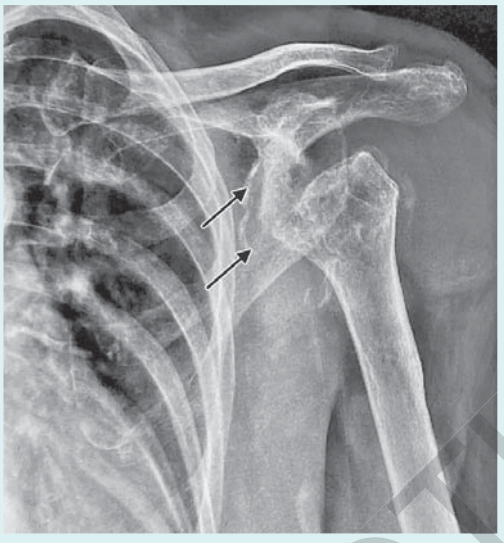


Fig. 4.43: Milwaukee shoulder (arrow denotes capsular calcification).

- ***Diagnosis:*** Aspiration for demonstration of calcium pyrophosphate crystals. X-ray of the shoulder shows capsular calcification **(Fig. 4.43)**. USG shows a massive rotator cuff tear and capsular calcification.
- ***Treatment:*** Conservative, colchicine, arthroscopic debridement, partial or total or reverse replacement
- ***Differential diagnosis:*** Charcot's shoulder. However, Charcot is usually painless. Others are osteonecrosis of the shoulder.

Musculoskeletal Examination

Salient Features

- The book gives an overview of entire orthopedic examination in a simple, structured, and pictorial format.
- The first chapter deals with basic format, tips, and know-how of orthopedic examination.
- The rest of the book covers examining acutely injured limbs, chronic bone and joint disorders, examination of all the major joints, spine, nerve injury, brachial plexus injury in adults and newborns, cerebral palsy, gait, amputation, tumors, and swelling-scar-sinus and ulcers.
- Diagnostic snippets after history assessment help in making a quick provisional diagnosis.
- Every test is described in a standard fashion with a rationale for easy understanding, accompanied by a self-explanatory picture. Most tests have been described in a video accessible by QR code.
- Each region/system examination has been provided with a proforma for easy recapitulation of the entire examination and ends with a brief explanation of several common conditions encountered in that system in a standardized format for easy understanding.
- The videos of standard clinical tests are uploaded on a digital platform for easy understanding.

Vivek Pandey, a graduate from Kasturba Medical College (KMC), Manipal, Karnataka, and a postgraduate from King George's Medical University (KGMC), Lucknow, Uttar Pradesh, is Professor and Unit Head of Sports Medicine and Arthroscopy Division, Department of Orthopedic Surgery, Kasturba Medical College, Manipal, Karnataka, India. He received a gold medal in MBBS and multiple other awards for academic and research excellence. He is passionate about his clinical work, research, and teaching. His passion for research is reflected in his more than 85 indexed publications in international and national journals and in many chapters in textbooks. Besides Musculoskeletal Examination, he has authored three more books: Manipal Manual of Orthopaedics, Musculoskeletal Examination for Undergraduates, and Manipal Practical Orthopaedics, which are very popular among undergraduate students across the country and overseas. He is the course director of the digital version of undergraduate and postgraduate orthopedics on the DigiNerve platform (M/s Jaypee Brothers Medical Publishers), which students highly subscribe to learn orthopedics in an audio-video format. His original research on stem cells in osteoarthritis and rotator cuff tear management is highly cited in the literature. His passion for teaching undergraduate and postgraduate students is reflected by multiple "Excellence in Teaching" awards at KMC Manipal and SMIMS, Sikkim. In the arena of clinical work, shoulder and knee surgeries remain his passion. He has been instrumental in spreading the science and art of arthroscopy through various national and international platforms by delivering guest lectures, performing live surgeries, and training orthopedic surgeons in sports injuries and arthroscopy. Whether in academics or life, his mantra is to keep life and his profession simple! The third edition reflects his passion for simplistic and structured postgraduate teaching.

Hitesh Shah is Professor and Head, Department of Pediatric Orthopedics, Kasturba Medical College, Manipal, Karnataka, India. He specializes in Pediatric Orthopedics. He finished his graduation and postgraduation from BJ Medical College, Ahmedabad, Gujarat, India. He has contributed significantly to patient care and research in Pediatric Orthopedics. He has published more than 120 international index publications with several chapters in various books. He is also actively involved in clinical research on various congenital and developmental limb malformations. He has been actively engaged in the International Perthes' Study Group (IPSG), International Hip Dysplasia Registry (IHDR), and various other projects. He has also received the Young Scientist Award at the EPOS instructional course in Marseille and in Vienna. He has been actively spreading science through various workshops, CME, and conferences.

Shelving Recommendation
ORTHOPEDIC SURGERY

ISBN 978-93-7202-737-2