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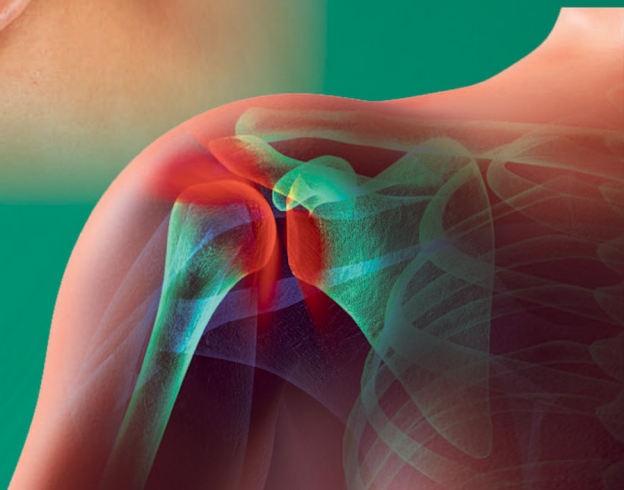
Physiotherapy *of the* SHOULDER





PP Mohanty
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Chapter

3

Impingement Syndrome

The term shoulder impingement syndrome was introduced by Neer (1983) and refers to the compression of rotator cuff, i.e. Supraspinatus, infraspinatus, subacromial bursa and long head of biceps tendon against undersurface of acromion, coracoacromial ligaments and AC joint during arm elevation. This syndrome is characterized by shoulder pain that is exacerbated with arm elevation or overhead activities.

EPIDEMIOLOGY, PREVALENCE AND INCIDENCE

The incidence of shoulder pain in community setting is high, estimated to be 11.2 per 1000 person-years. Chard et al conducted a community survey and found that out of sample of 644 people, 170 (26%) reported shoulder pain with at least 70% subacromial impingement syndrome. A prevalence of 7% has been reported in Swedish population by Jacobson et al. Morrison et al reported in 2000 that 75% of patient presenting with rotator cuff tendonitis had underlying impingement of anterior acromion on the supraspinatus tendon and occasionally infraspinatus. Pink reported shoulder pain in 66% of swimmer, 57% of professional pitcher, 44% of collegiate volleyball player and 20% of collegiate javelin thrower. Several authors have implicated the role of acromioclavicular joint pathology in development of impingement syndrome.

Theory of Impingement

Biomechanical Theory

Initial 30° of abduction takes place in glenohumeral joint.Then movement takes place at glenohumeral and scapulothoracic joints at 2:1 ratio. Elevation of scapula results from the combined movement of SC joint, clavicular rotation and minimal movement at AC joint. At about 60° of abduction there must be external rotation of humerus to move the suprahumeral structures away from the coracoacromial arch in order to avoid impingement. Impairment of shoulder external rotation/scapular motion may result into impingement.

Unbalanced force couple between rotator cuff and deltoid; serratus anterior and trapezeus disturbs the normal shoulder girdle movement and results into impingement syndrome.

Anatomical Theory

The space between greater tubercle and coracoacromial arch is fixed. Reduction of its size due to fracture greater tubercle, AC joint arthritis, etc. or increase in the volume of its content due to edema, fibrosis, calcific deposit, etc. may result in impingement.

Vascular Theory

Main supply to supraspinatus is thoracoacromial artery, which is sometimes absent. Continued over-head activities with the discomfort without rest does not allow it to heal and results into chronic/degenerative tendonitis due to its relative avascularity.

Stages of Impingement Syndrome

Neer described the three classical stages of impingement.

Stage-I involves reversible changes such as edema and hemorrhage of the bursa and cuff is typical in persons under twenty-five years old.

Impingement - Microtrauma - Inflammation/Edema - increased volume of the contents - Further impingement - edema and hemorrhage.

Complaint of toothache like of discomfort following activities, relieved in rest. Impingement sign is positive and painful arc is present.

Stage-II involves irreversible changes such as fibrosis and tendonitis of the rotator cuff, and typically occurs in persons who are twenty-five to forty years old. Collection of inflammatory exudates within its sheath impair circulation, giving rise to gradual degenerative tendonitis, characterized by restriction of movements and crepitus. The tendon substance becomes rough by the lying down of collagen fibers over time giving rise to crepitus. Passive movement is restricted because of fibrous thickening and shortening of the tendon.

Complaint of pain in activities and more in the night. Finds difficulty to lie on affected side shoulder. Resisted isometric contraction of supraspinatus is painful and weak, and passive stretching is restricted and painful.

Stage-III is marked by partial tear or complete tear of rotator cuff and usually is seen in patients over 40 years of age. Attrition of the degenerated tendon over time due to continued overhead activities finally may result into rupture. Rupture is characterized by loss of active movement, while passive movement is present. During abduction there is loss of glenohumeral rhythm; unopposed deltoid action produces more of elevation than abduction.Wasting of supraspinatus, infraspinatus is present and drop arm test is positive.

Later Neer divided impingement into outlet and non-outlet lesions. Outlet impingement occurs when the coracoacromial arch encroaches on the supraspinatus outlet and non-outlet occurs secondarily to thickening or hypertrophy of the bursa or the rotator cuff tendons.

Impingement syndrome can be classified broadly into primary and secondary.

Primary Impingement

Primary mechanical impingement has been described by Neer as impingement of rotator cuff beneath the coracoacromial arch. The cause of impingement process is either by decreasing the

subacromial space or by causing a degenerative process of the rotator cuff tendons. It also results from anatomic variation of acromion shape, acromioclavicular joint degenerative arthritis, which is characterized by capsular hypertrophy and spur.

Secondary Impingement

It usually occurs in the younger individual and in athletes and is defined as a relative decrease in supraspinatus outlet caused by instability of the glenohumeral joint. The symptom can be attributed to rotator cuff tendinitis. The symptoms of secondary impingement are often result of rotator cuff overuse as a consequence of multidirectional glenohumeral instability. Scapulothoracic weakness has also been attributed as secondary cause of impingement syndrome due to a lack of scapula stability causing resultant glenohumeral instability. The net effect of secondary causes is usually an anteriosuperior translation of the humeral head, which causes impingement of the cuff against the coracoacromial arch.

Factors contributing to impingement syndrome can be subdivided into intrinsic or extrinsic factors.

FACTORS OF THE INTRINSIC THEORY

Muscle Dysfunction

The primary etiologic factor causing intrinsic changes has been reported to the multiple tension overload of the rotator cuff, especially supraspinatus. When the arm is in the overhead position, eccentric contraction of supraspinatus decelerates internal rotation and adduction of the arm, causing an overload. This phenomenon is most dramatic in sports persons and manual laborers who use overhead motions in their work. This may be caused by the morphology of supraspinatus muscle, which has a greater belly size in comparison to it relatively smaller tendon size. Subsequent fatigue, injury and weakness of the cuff result in instability and muscle imbalance that produce upward humeral migration and subsequent tissue impingement.

Overuse Shoulder

Overuse syndrome also occurs commonly in young competitive athletes and manual laborers who use overhead motion in their work. The inflammation resulting from repetitive micro-trauma increases the area occupied by soft tissues in the subacromial space and leads to friction and wears against coracoacromial arch. The finding of Soslowsky et al described in animal tendons changes that result from over use activity, they are believed to occur in rotator cuff tendons too.

Degenerative Tendinopathy

Uzaki et al studied the pathological changes on the undersurface of the acromion as associated with tears of the rotator cuff in 200 cadaveric shoulders. After radiographic and histological analysis, they found that in the specimens with a partial tear of the cuff, the undersurface of the acromion was almost intact. They concluded that the pathogenesis of most tear is probably a degenerative process. Ogata and Uhthoff suggested that tendon degeneration is the primary etiology of partial tears of the rotator cuff and that they might allow proximal migration of the humeral head, which could result in impingement syndrome.

Relative Ischemia of Rotator Cuff

Intrinsic causes can also be attributed to inflammatory changes within the cuff tendon. These intrinsic factors are related to microvascular pattern of the rotator cuff tendon and to the zone of relative ischemia that occurs in specific arm position as described by Rathburn and Mcnab. This area of relative ischemia is the zone where most pathologic change of the rotator cuff occurs and is known as the critical zone. Its location is approximately 10 mm from insertion of the supraspinatus tendon on the greater tubercle of the humerus. This critical region has therefore been shown to be the area associated with tearing of the supraspinatus tendon.

FACTORS OF THE EXTRINSIC THEORY

Shape of Acromion

Acromial morphology and differences in the shape and slope of the acromion as a potential source of symptoms in the shoulder has been observed. The shape of acromion is classified into type-I (flat), type-II (curved) and type-III (hooked). A higher prevalence of full thickness tears of the rotator cuff was noted in association with type-III acromion. In another study, Morrison evaluated supraspinatus outlet radiographs and found that 80% of eighty-two patients who had tears of the rotator cuff visible in arthrogram had a type-III acromion. Besides acromial morphology age and sex have an independent observation with rotator cuff pathology.

Glenohumeral Instability

Especially in young competitive athletes with symptoms of impingements, it is necessary to consider underlying glenohumeral instability as the primary source of the problem. Glenohumeral subluxation may cause disturbances in the mechanics of overhead motion, which may lead to secondary impingement. This concept may explain why certain throwing athletes do not show improvement after anterior acromioplasty. The underlying instability needs to be treated either with an exercise program designed to strengthen the dynamic stabilizer or with operative intervention if exercise program fails, electromyographic analysis shows that they are all active throughout the act of elevation.

Disturbed Scapulothoracic Rhythm

Sportsmen, typically throwing athletes and swimmers, who suffer from impingement syndrome, have been demonstrated to have dysfunction of the scapulothoracic muscles. The dynamic effect of weakness on the scapular muscles is best seen when the serratus anterior muscle is involved. The inability to protract the scapula gives rise to winging of the scapula when the arm is raised. Weak or unbalanced scapular

muscles alter the scapulohumeral rhythm and place a greater strain on glenohumeral articulation, which results in secondary extrinsic impingement.

Os Acromiale

Os acromiale is an unfused distal acromial epiphysis first described by Grube in 1863. Folliasson classified the lesion into four distinct types on the basis of anatomical location, with mesoacromion being the most common type. The prevalence of os acromiale, as reported in both radiographic and anatomical studies, has varied a great deal, with a range of 1 to 15 per cent. It is difficult to detect an os acromiale on a routine anteroposterior radiograph, and an axillary radiograph may thus be needed. An association between os acromiale and impingement syndrome and rotator cuff tears has been reported. Impingement may occur because the unfused epiphysis on the anterior aspect of the acromion may be hypermobile and may tilt anteriorly as a result of its attachment to the coracoacromial ligament. Hertel et al recommended stable fusion of a sizeable and hypermobile os acromiale.

Internal Impingement

Struhn in recent publication introduces the concept of internal impingement. It is due to the contact between the posterior superior glenoid labrum and the posterior aspect of supraspinatus tendon or the superior aspect of the infraspinatus tendon or both at the insertion in the greater tuberosity. It is usually seen with arm use that involves abduction and extreme of external rotation, such as late cocking stage of pitching.

Subcoracoid Impingement

Coracoid impingement is newly examined entity causing anterior shoulder pain that usually occurs with forward flexion and internal rotation. This type of impingement occurs in the coracoid humeral compartment which is the space located between coracoid tuberosity and lesser tubercle of humerus. This space contains subcoracoid bursa, subscapularis bursa and tendon.

The Role of the Acromioclavicular Joint in Impingement Syndrome

Despite its small size, the acromioclavicular joint plays a vital part in upper extremity function; it is necessary in all movement of the arms and scapula. The supraspinatus outlet consists of superior aspect of the humerus, inferior surface of acromion, acromioclavicular joint and roof of the glenohumeral joint namely coracoacromial ligament. The subacromial space contains the tendons of the rotator cuff (supraspinatus, infraspinatus and teres minor), the long head of the biceps and subdeltoid bursa. The height of the space in healthy shoulders is between 9 and 10 mm, whereby with radiographic measurement of less than 6 mm, is pathologic for compression of the rotator cuff. The actual thickness of the rotator cuff tendon in this area is 5 to 6 mm leaving very little clearance in case of enlargement of bursa, hypertrophy of capsule of AC joint and spur, etc.

The rotator cuff contacts the under surface of AC joint with as little as 60° of glenohumeral abduction and in the habitual position of 60° of internal rotation. By 70° degree of abduction, the greater tuberosity of the humerus lies directly beneath AC joint.[15] Biomechanical data has demonstrated the impingement force between two structures to range from 0.42 X body weight in a static cadaveric model to 0.15 X body weight in a dynamic shoulder model. Early degenerative changes at AC joint such as capsular hypertrophy and marginal osteophytes formation may therefore result in cuff irritation.

Clinical Features

Patient complaints of insidious onset of pain over the lateral brachial region (C5, C6). Sharp pain experienced during overhead activities.

Inspection

Atrophy of supraspinatus and infraspinatus muscles.

Movements

Active Abduction → Painful arc present during abduction and elevation.
Passive abduction elevation → Painful arc may be present.
Passive internal rotation → May be painful and restricted
RIC for supraspinatus, infraspinatus or long head of biceps painful and weak.

Palpation

Fibrous thickening and tenderness of suprahumeral structures may be present.

Treatment

- Prevent from further damage by avoiding precipitating overhead activities.
- To resolve inflammation and allow for healing.
- Prevent from recurrence.
- To return back to activities as early as possible.

Ultrasound: Micro massage effect resolves edema and heating effect increases circulation to promote healing.

Cyriax's deep transverse friction massages rearranges proliferated collagen tissues in a functional way, i.e. perpendicular to the direction of stress, one of the most effective manners to withstand the stress. It also disperses inflammatory exudates relieving pain and preventing adhesion. It prevents/breaks the adhesion and increases the extensibility and restores mobility.

For supraspinatus, patient in half-lying position with the hand behind the back (internal rotation) to move its tendon anteriorly out of the undersurface of acromion.

Therapist standing behind and back of the affected side places the index finger reinforced by middle finger over the exact spot and applies to and fro movements across the direction of tendon fibers with adequate pressure and sweep. As the initial pain and discomfort disappears gradually increases the pressure and again as the pain and discomfort disappear gradually increases the pressure further. The frequency of

movement is 2/second. The treatment is applied for about 10 minute followed by active movements and passive stretching.

Stretching and mobilization to restore full range of pain free movements reduces pain and prevents recurrence.

To prevent recurrence progressive strengthening of rotator cuff (Fig. 3.1) to balance it with deltoid and balancing scapular rotators, trapezius and serratus anterior force couple is very important.

Townsend, et al examined glenohumeral muscles by EMG analysis during a shoulder rehabilitation program. Result showed that four exercises [Scaption (Fig. 3.2) with internal rotation, horizontal abduction in external rotation, flexion and press-up] were responsible for high level of EMG activity in all muscles. The leading exercise for infraspinatus and teres minor was horizontal abduction with external rotation.

Takeda, et al found that both abduction in the plane of scapula with arm externally rotated and abduction in plane of scapula with the arm in internal rotation (Fig. 3.2) are effective for supraspinatus strengthening. Pushup plus exercises were



Fig. 3.1: Bilateral resisted external rotation using theraband

superior to internal rotation exercise in activating both parts of subscapularis.

Moseley, et al performed an EMG study of shoulder muscle in nine subjects during sixteen different exercises. He recommended the four core exercises program for scapular muscles. They are scaption, rowing (Fig. 3.3), pushup with a plus and press-up.



Fig. 3.2: Scaption supraspinatus strengthening in plane of scapula with arm IR

Ekstrom et al analyzed exercises for the trapezius and serratus anterior muscles by surface EMG and demonstrated that the shoulder horizontal extension with external rotation, shoulder shrug exercises, shoulder external rotation at 90° of humeral abduction, a combination of shoulder flexion, horizontal flexion and external rotation best activated the middle trapezius, upper trapezius, lower trapezius and serratus anterior respectively. Hintermeister et al performed an EMG study of the shoulder muscles using elastic band for the resistance during seven exercises. They recommended that shoulder shrug exercises for the upper trapezius muscle, seated



Fig. 3.3: Rowing

rowing exercises for trapezius muscle, forward punch exercise for serratus anterior.

Pushup, dips, flies and bench press are not included in shoulder rehabilitation program as these exercises may increase symptom of shoulder impingement syndrome with AC osteoarthritis.

Researchers have speculated that shorter resting length of pectoralis minor and tightness of posterior capsule are predisposing factors for impingement syndrome. Stretching program may decrease impingement of shoulder. Stretching of anterior and posterior structures of shoulder joint are to be done.

Shoulder rotation by using theraband strengthens external rotators and improves internal rotation range and vice versa (Fig. 3.4).

SURGICAL MANAGEMENT

Acromioplasty

Purpose of the surgery is to decompress the suprahumeral structures.

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Physiotherapy *of the* SHOULDER

Over the years, Physiotherapy has transformed from an adjunct to medical and surgical care to an autonomous healthcare delivery system. Physiotherapists use their professional knowledge and practical skills, together with thinking skills and skills for interaction in their day-to-day practice. They use their knowledge and skills to identify what is limiting an individual's movement and performance, and to help individuals decide how to address their needs. This book *Physiotherapy of the Shoulder* provides complete information on the functional anatomy of the shoulder, the mechanics of movement, and the evaluation and treatment of common shoulder disorders. Many a times in our clinical practice, we see a delay in the patient returning to functional activity after the healing of the initial injury. This book promotes current, evidence-based practice with a note on prevention of sports injuries and rehabilitation procedures. It also demonstrates shoulder manual therapy techniques and procedures. Written in an easy-to-understand language, this book will serve the interests of physiotherapy students, clinicians and academicians.



PP Mohanty has been heading the Department of Physiotherapy, Swami Vivekanand National Institute of Rehabilitation Training and Research (SVNIRTAR), Cuttack, Odisha, India, since 2000, and has taught a number of subjects. He graduated in 1992 from SVNIRTAR and went onto work in the same organization with a special interest in manual therapy and musculoskeletal rehabilitation. After completing his PG Diploma in rehabilitation and Master's Degree, he undertook a PhD on the management of spondylolisthesis. Since 1993, he has been working in clinical practice and supervising a number of MPT and PhD students. In a career spanning more than 20 years, he has played numerous roles as an administrator, teacher, clinician, guide, resource person, patron, and researcher. He has conducted more than 100 state-level seminars, conferences and workshops and is a person of national repute in the field of Physiotherapy. He has presented more than 50 national and international-level platform presentations. He is also the author of the books *Physiotherapy Secrets* and *Managing Common Musculoskeletal Conditions by Physiotherapy and Yoga*. He is currently leading a large (n=600) RCT on the 'incidence of cervicothoracic dysfunctions in patients with low-back pain and effects of an innovative manual therapy approach in the management of low-back pain'. For his services in Physiotherapy, he was awarded the IAP fellowship award in 2010.



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