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Overview about motor Sparing articular nerves Intervention in Chronic Shoulder Pain: Review Article

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ABSTRACT

Background: Shoulder pain is one of the most often reported musculoskeletal symptoms. Shoulder pain can be caused by a number of different issues, including damage to the rotator cuff, subacromial impingement, osteoarthritis, adhesive capsulitis and pain after surgery, as well as bursitis. Motor-sparing nerve interventions are one of many treatments offered for chronic shoulder pain.

Objective: The goal of these interventions was to alleviate shoulder pain by blocking certain nerves without significant motor deficits.

Methods: In this review, we conducted a thorough search for relevant literature on the topic of chronic shoulder pain and its management. Our search included medical journals and databases such as PubMed, Google Scholar, and Science Direct, and we limited our inclusion criteria to studies published between 1994 and 2022. Additionally, we reviewed references from related works. To ensure consistency and accuracy, only documents published in English were considered for this review, and unpublished manuscripts, oral presentations, conference abstracts, and dissertations were excluded.

Conclusion: Articular nerve interventions that spare motor function have shown great potential in managing chronic shoulder pain. These interventions have a primary goal of improving shoulder function and reducing pain while minimizing the risk of any motor deficit.

Keywords: Articular nerve, Interventions, Chronic shoulder pain, Glenohumeral joint.

INTRODUCTION

Pain of shoulder is common among the elderly, with a reported percentage of 6.9% to 26.0%. Therefore, alleviating shoulder pain is a socially significant activity because it can significantly enhance individuals' quality of life. Physical therapy is a common treatment, however other methods such as steroid injection and nerve block are also performed [(1)]. Chronic shoulder pain is a multifactorial condition, with several underlying pathologies such as arthritis, degeneration, trauma, frozen shoulder, nerve entrapment, and complex regional pain syndromes. Transcutaneous electrical nerve stimulation and physical therapy are two non-pharmacological interventions that may be effective in treating chronic shoulder pain. A combination of these treatments may be used to manage shoulder discomfort, although it is rare to identify a singular etiology for intractable shoulder pain [(2)].

The etiology of chronic shoulder pain is often multifactorial, and nociception-motor interaction plays a significant role in pain which is chronic or persistent due to the complexity of the shoulder joint's range of motion, pain relief must be achieved without causing motor block if an early rehabilitation programme is to be provided following surgery and persistent nociceptive activation related to pain-induced movement is to be controlled [(3)]**.** However, choosing an effective treatment option for shoulder pain can be challenging due to the various potential causes. To address this, a scoping review was conducted to provide information on shoulder pain risk factors, its differential diagnosis, and shoulder pain management. The review focused on (A) glenohumeral and/or acromioclavicular joint articular innervation. (B) the distribution of each articular branch within the capsule as well as the various techniques available for blocking these branches [(3)]**.**

Risk factors of chronic shoulder pain:

Shoulder pain is more likely in women and those who are overweight or elderly or who have a preexisting medical condition like diabetes mellitus, multiple sclerosis, fibromyalgia, inflammatory arthritis, as well as polymyalgia rheumatica. Shoulder pain may also be caused by emotional issues, and depression as well as distress. The chance of reporting pain was shown to rise by a factor of two when correlated with psychological pain [(4)].

Anatomical consideration (Figure 1):

The shoulder is a multifaceted joint that encompasses the and clavicle bones, humerus, scapula, as well compromise individual joints - the AC joint as well as the glenohumeral joint. A ring of fibrous tissue called the glenoid labrum encircles the glenoid fossa and connects to the articular cartilage at the glenoid rim [(5)].

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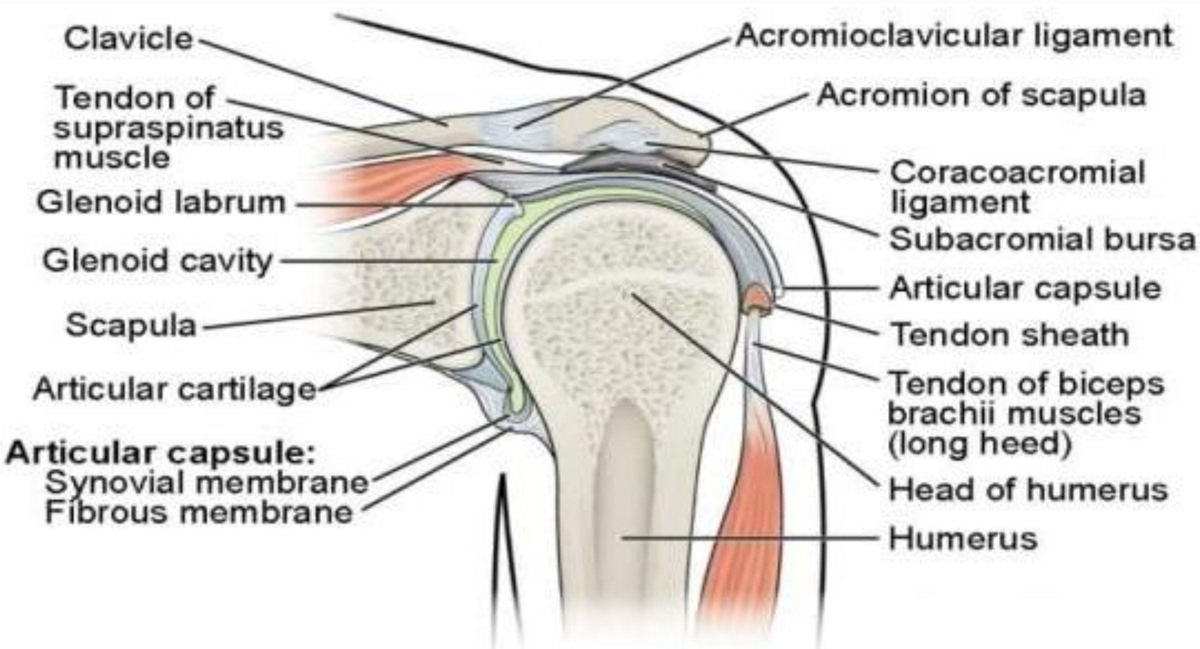

Figure (1): Shoulder joint anatomy [(6)].

The labrum is also adhered to by a portion of the glenohumeral joint capsule as well as biceps tendon long head. The superior and intermediate glenohumeral ligaments, both of which are relatively thick, can be found in the front part of the capsule. The next expanded region is the axillary recess, which is produced by the thick inferior glenohumeral ligament. The inferior glenohumeral ligament is made up of two individual bands: the anterior as well as the posterior bands [(5)].

Most of the shoulder's rotation comes from the rotator cuff muscles, which include the teres minor, subscapularis, supraspinatus, and infraspinatus. The subscapularis tendon attaches to the smaller tuberosity of the humerus, while the supraspinatus, infraspinatus, and teres minor muscles' tendons attach to the greater tuberosity. The acromion process of the scapula and the lateral clavicle serve as origins for the deltoid, which then attaches to the deltoid tubercle of the humerus. The long head biceps tendon passes through the rotator interval and attaches to the superior labrum and supraglenoid tubercle of the scapula [(5)].

Innervation of shoulder joint (Figure 2):

The glenohumeral joint (GHJ) receives its innervation from branches of the suprascapular nerve (SSN), lateral pectoral nerve (LPN) as well as axillary nerve (AN). Posterior and anterior innervations of the GHJ are provided by these articular branches. Specifically, the SN provides posterior-lateral innervation, while the AN provides anterior-lateral, inferior, and posterior-lateral innervation. The LPN provides anterio-superior innervation. It is important to note that these nerves also provide significant motor innervation [(7)].

The suprascapular nerve (SSN) leaves its origin in brachial plexus superior trunk and travels through the necks posterior triangle and along the back of the shoulder to its eventual destination in the suprascapular and spinoglenoid notches [(8)]. It innervates the supraspinatus and infraspinatus muscles and processes sensory information from the lateral upper extremity, acromioclavicular joint, glenohumeral joint, coracohumeral ligament, coracoacromial ligament, and subacromial bursa [(9)].

The LPN branches off from the C5-7 nerve roots and supplies the pectoralis major and deltoid muscles with sensory and motor innervation, respectively. Articular innervation of the ACJ and anterior glenohumeral joint (GHJ) also receives support from the LPN [(10, 11, 12)].

The AN separates into the anterior and posterior branches at its beginning in the posterior cord of the brachial plexus. The deltoid, teres minor, inferior glenohumeral joint, and shoulder joint capsule are all innervated by AN. A sensational supply to the skin of deltoid muscle is also provided via its superior-lateral brachial cutaneous branch [(13, 14, 15)].

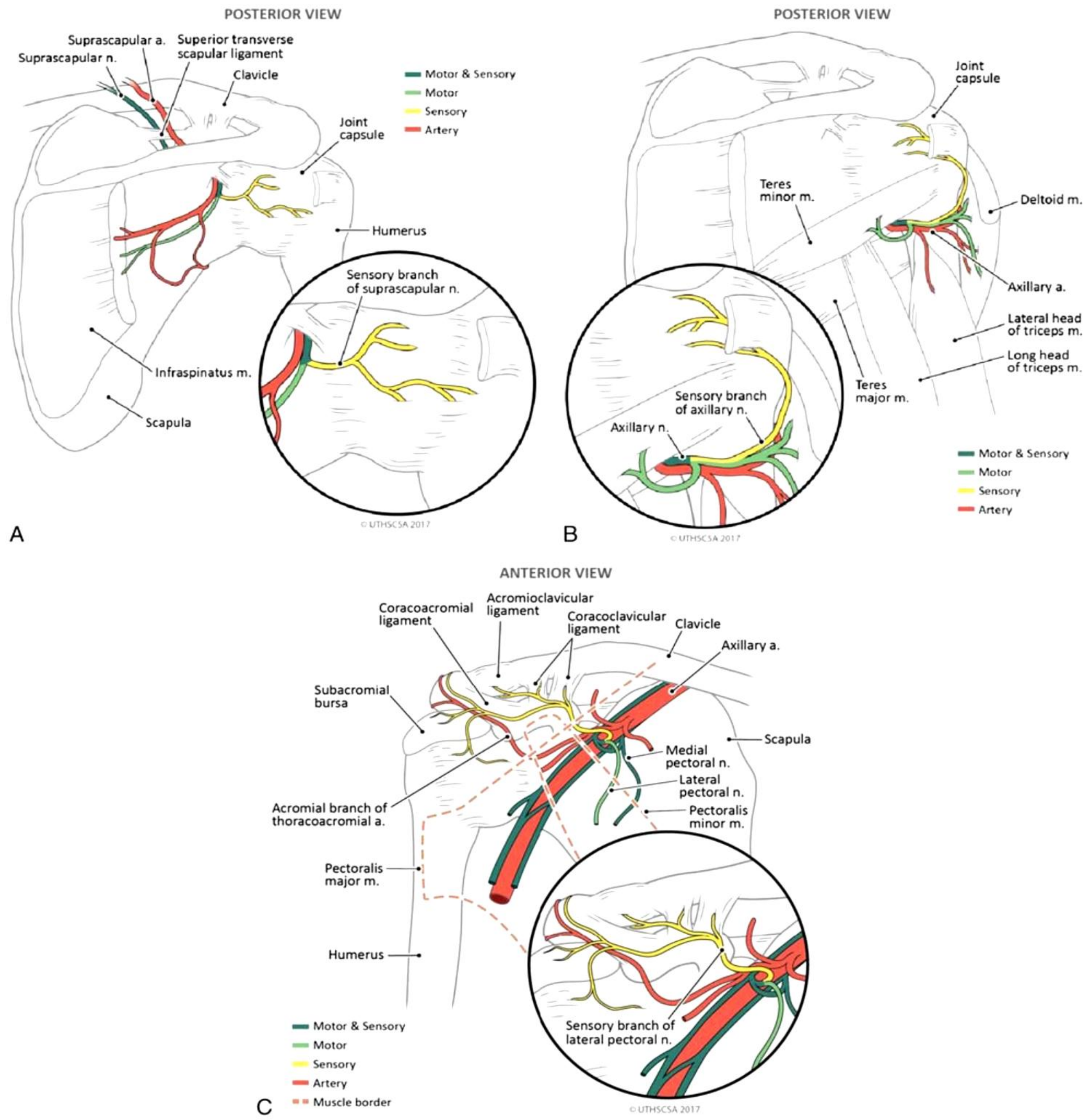

Figure (2): Illustrations of the anatomical pathway of the suprascapular nerve (A), axillary nerve (B), and lateral pectoral nerve (C) **[15].**

In order to give an overview of the innervation of the GHJ, the four corners of the capsule were labeled as posterosuperior, posteroinferior, anterosuperior, or anteroinferior, as shown in figure (3). SSN gives articular innervation to the posterosuperior quadrant through its pathway in both, the supraspinatus fossa to the superior part and in infraspinatus fossa to the posterior part. Posterior articular fibers of the AN supply the posteroinferior region. Articular branches of the superior nerve to the subscapularis supply the anterosuperior quadrant, whereas articular branches of the AN's main trunk do the same for the anteroinferior quadrant. Posterior cord of brachial plexus and lateral pectoral nerves share in the innervation of the anterosuperior and anteroinferior quadrants **[16].**

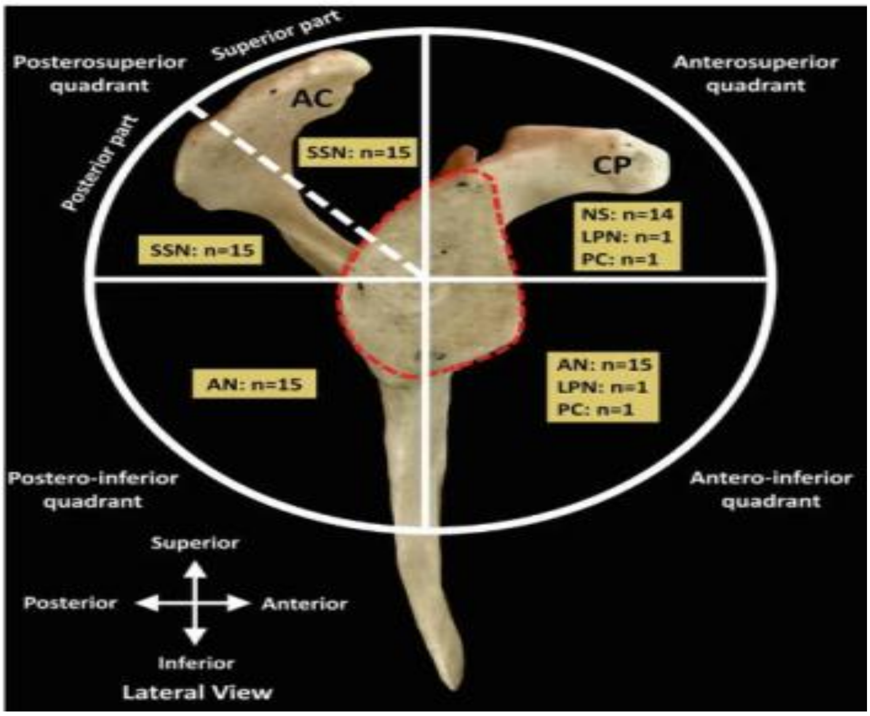

Figure (3): Illustrates the innervation of glenohumeral joint capsule. Lateral pectoral nerve (LPN), subscapularis nerves (NS), posterior cord (PC), and suprascapular nerve (SSN), acromion process (AC), coracoid process (CP) [17].

Sensory receptors of shoulder joint:

The capsule, bursa, and ligaments of the shoulder joint have been identified as potential locations for mechanoreceptors and nociceptors. However, there is considerable variation in the sensory receptor density across the shoulder according to the anatomical regions. Researchers have discovered that the glenohumeral capsule, specifically the antero- and posterosuperior regions and the superior region of the capsulolabral junction, contains the highest density of noci- and mechanoreceptors. The anteroinferior capsule is also rich in mechanoreceptors. Mechanoreceptors are abundant in the labrum and the site of attachment between the capsule and the glenoid rim [18, 19, 20].

The subacromial bursa, glenohumeral, coracoacromial, and coracoclavicular ligaments, as well as the proximal section of the transverse humeral ligament, have all been found to have nociceptors Moreover, it exists in the superior quadrant of the shoulder. The subacromial bursa has the highest concentration of nociceptive nerve endings. According to **Guanche *et al.*** [21], nociceptors can be identified in the long head of the biceps tendon, with the highest density around the tendon's proximal insertion and become low in the distal areas, and so on down to the musculotendinous junction. The centre of the long head of the biceps tendon, mechanoreceptors have also been discovered [19, 22].

Chronic shoulder pain etiology:

Chronic shoulder pain possibly results of pain being transferred from site other than shoulder; from the neck, intra-abdominal organs, pulmonary system, diaphragm, cardiovascular system, or systemic disorders, among other places in the body. Brachialgia or cervical spondylosis may be the cause of neck pain. Referred pain from pulmonary disorders like lung cancer is another possibility [23]. Rheumatoid arthritis is one of the inflammatory rheumatic disorders. Osteoarthritis of the glenohumeral and of the acromioclavicular joints are examples of articular pathology. Pain may also be brought on by bone pathology, such as tumours, avascular necrosis, or fractures. Some examples of local soft tissue illnesses include rotator cuff tendinopathy/impingement syndrome, calcific tendinitis, biceps tendinopathy, shoulder instability, subacromial bursitis and labral tears as well as adhesive capsulitis. Various pain conditions, such as fibromyalgia and shoulder-hand syndrome, can also contribute to chronic shoulder pain [23].

Diagnosis:

The first step in evaluating patients who had chronic shoulder pain is to acquire a history, which entails questions about the onset of the pain, pain location, and the special movement that cause the most pain [24]. Tenderness and range of motion are recorded during the physical examination. There are a number of provocative tests available for determining the root of persistent shoulder pain, but their sensitivity and specificity vary [25]. However, even with the aforementioned evaluation, it is not always easy to determine why a patient is experiencing shoulder pain [26]. For example, it has been shown that clinical testing for rotator cuff tears has a high sensitivity but poor specificity, and that interobserver agreement is, at most, approximately 50% [27]. Accurately diagnosing the underlying etiology of shoulder pain is crucial as treatment approaches vary depending on the specific etiology. For instance, glenohumeral osteoarthritis and adhesive capsulitis are typically treated with intra-articular steroid injections, while rotator cuff impingement and subacromial-subdeltoid bursitis are treated with subacromial-subdeltoid bursal steroid injections [28]**.** The posterosuperior quadrant and anterosuperior quadrant are both common sites for shoulder pathologies that are associated with pain; the rotator cuff, labrum, rotator interval, and supraspinatus tendon, are all included [5]**.**

Imaging of the shoulder Pain :

Shoulder pain can be evaluated using various imaging techniques, including X-ray, ultrasound, MRI or MRA. However, there is no evidence-based guidance on which modality is optimal for investigating shoulder pain. X-rays can be useful in excluding fractures or dislocations after trauma and can also reveal degenerative changes in the shoulder joint and calcific tendinopathy. Full-thickness rotator cuff tears can be detected with either ultrasound or MRI; however, partial-thickness tears may be missed with either method [29]**.** MRI and ultrasound are unable to produce clear images of the extra-capsular ligament or the shoulder capsule, both of which are involved in adhesive capsulitis. The most reliable imaging method for diagnosing capsulitis is arthroscopy. The Cochrane collaboration conducted a comprehensive study and found that preoperative imaging methods for assessing rotator cuff injuries have comparable accuracy [29]. However, there is no evidence-based guidance on which modality is optimal for investigating shoulder pain [5].

General overview for management of chronic shoulder pain:

Conservative management is the initial approach for most patients with chronic shoulder pain. This typically includes activity modification, physical therapy, medications, such as acetaminophen or NSAIDs. Corticosteroid injection and surgery may be considered if no improvement is seen with initial management. The appropriate treatment options may vary depending on the specific condition, such as acromioclavicular joint osteoarthritis, adhesive capsulitis, glenohumeral instability, glenohumeral osteoarthritis, and rotator cuff pathology [24, 30].

Radiofrequency Ablation for articular branches in treatment of chronic shoulder pain:

Eckmann and colleagues [15] have outlined the articular innervation of the glenohumeral joint, which could be applied to nerve ablation-based joint denervation. Although thermal and pulsed radiofrequency ablation techniques have been proposed as a possible solution for managing chronic shoulder pain by targeting the suprascapular nerve, there is a potential risk of causing weakness in the supraspinatus and infraspinatus muscles following the procedure.

The results of this study suggest that motor weakness after ablation can be mitigated by distal articular sensory denervation. The lateral pectoral nerve provides sensation to the acromioclavicular joint and its surrounding ligaments, therefore posterior ablation can be conducted safely on the area lateral to the spinoglenoid notch, the inferior-posterior half of the larger tubercle, and the coracoid process [31]**.** Figure (4) shows examples of such safe zones.

Eckmann *et al.* [15] suggest that the suprascapular nerve's lateral trunk can be ablated positioned in the supraspinatus fossa midway between the suprascapular notch and the spinoglenoid notch, this may protect the supraspinatus but weaken the infraspinatus. The subscapularis nerve may also be

reachable at the glenoid over its anterior superior neck. Anterior and posterior ablation of the inferior side of the glenohumeral joint is not recommended except in uncommon palliative cases since it lies next to the motor component of the axillary nerve, the brachial plexus, and the circumflex humeral artery**.** Prior to undergoing ablation, diagnostic blocks should be used to determine which patients would benefit from the operation. Ablation is thought to be indicated by a positive diagnostic block, which is defined as more than 50%-70% pain reduction [15].

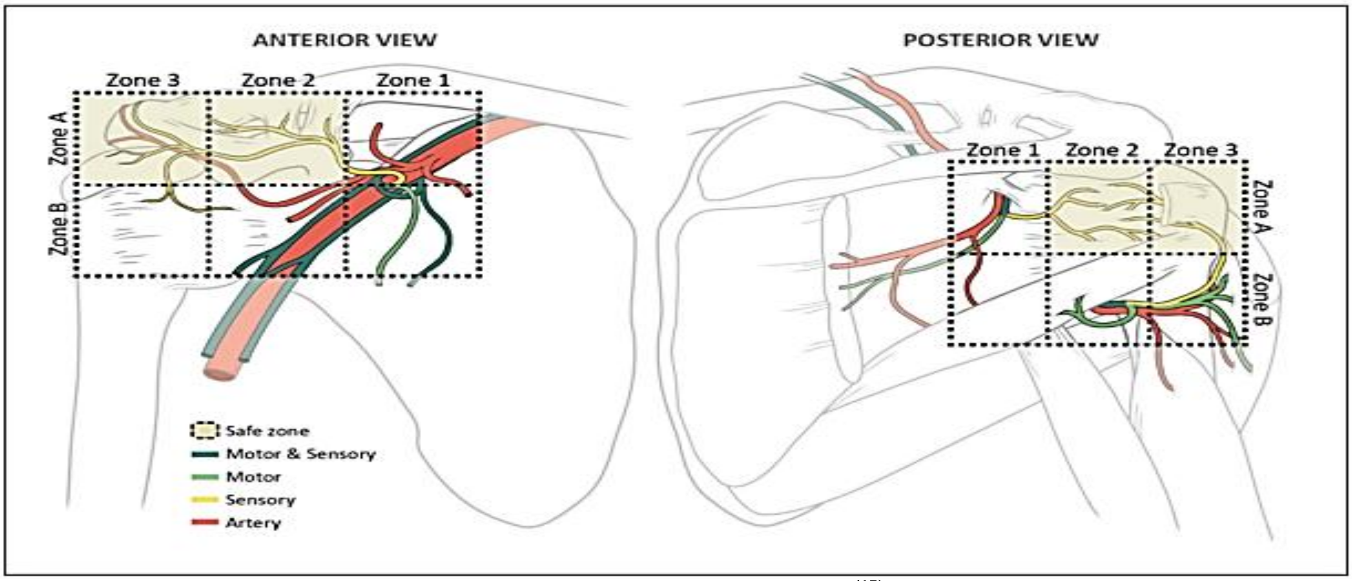

Figure (4): Anatomic safe zones [15].

Prone Approach for diagnostic block of suprascapular and axillary nerves:

When doing suprascapular and axillary articular branch denervation, the operating arm is held at the side for better humeral visibility. To provide a true anterior-posterior image of the glenohumeral joint, it is captured with ipsilateral obliquity. To find the spinoglenoid notch, follow the scapular spine's lateral border to where it connects to the scapula's neck. The glenoid neck and humeral head can be better seen when the angle caudal is decreased, and the image artefact generated by the scapular spine can be minimized (Figure 5) [32]. The lateral head of the humerus needs to look like it tapers off at the inferior border so that the glenoid and greater tubercle could be seen clearly. Obtained an oblique rotation may be required if the humeral head appears rounded, indicating an anteriorly located tubercle. To rule out intravascular or intra-articular spread, contrast is administered after needle contact with the periosteum has been verified. About 0.5 mL of local anesthetic is contained within the block [33].

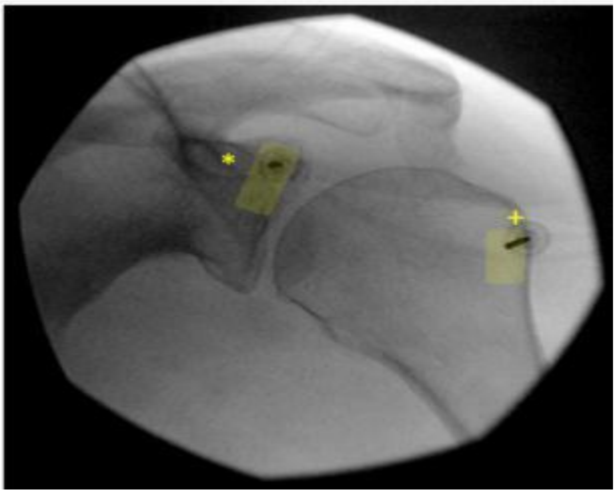

Figure (5): Posterior ablation targets (*) suprascapular (+) axillary nerve [33].

Supine approach for diagnostic block of lateral pectoral nerve:

The patient's operative arm should be positioned at their side, and the coracoid process should be visualized. During a lateral pectoral block and ablation, the superficial middle of the coracoid process is targeted. This area is typically located 2–3 centimeters beneath the skin. Cephalad and ipsilateral rotation of the anteroposterior view can provide a better contour of the coracoid process and display the glenoid's neck and joint line. Needle depth can exceed 3 inches, we should exclude intravascular or intra-articular spread by injecting contrast. Local anesthetic of 0.5 ml was injected for blocking the nerve [33].

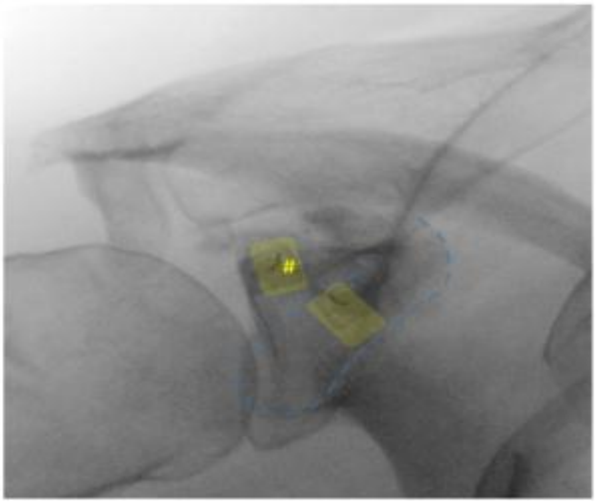

Figure (6): Anterior ablation targets. (#) nerve to subscapularis, (-) lateral pectoral nerve [33].

Supine approach for nerve to subscapularis block:
The patient was positioned supine with their shoulders externally rotated. An accurate AP image of the

glenohumeral (GH) joint was obtained by adjusting the C-arm fluoroscopy. Tilt the C-arm caudally by fifteen to twenty degrees to avoid the coracoid process. Medially and superiorly, towards the medial-to-lateral margin of the scapular glenoid and the upper second quarter of the glenoid ring, a spinal needle was introduced. Pull the needle through until it reaches the bone of the anterior suprascapular fossa. When trying to see the suprascapular fossa, it is necessary to rotate the C-arm to get a Y-view of the scapula [(3)].

Ultrasound combination of interfacial plane and pericapsular nerve blocks in chronic shoulder pain:

Patients can be treated in a seated position with their arms extended for a shoulder anterior capsular (SHAC) block, which combines an interfacial and pericapsular nerve block. The subscapularis muscle, which is extended posteriorly, is easily visible in this position, directly below the deltoid fascia. In order to examine the interfascial gap between the deltoid and subscapularis fasciae, the biceps brachii and coracobrachialis muscles must be displaced while the arm is abducted and rotated externally. When using ultrasound, the lateral insertion of the subscapularis muscle is easier to find because of the mixed echogenicity it generates [(34)].

After the fascial space is injected, advancement of the needle through the subscapularis muscle towards the pericapsular space of the glenohumeral joint was obtained. Injection into the pericapsular space allows access to the terminal articular branches regardless of their origin, as well as the intra-articular space through the Weitbrecht foramen. The SHAC block is easy to perform due to easily recognizable anatomical structures. Additionally, the technique places the needle in a "safe zone" away from any accidental injury to other structures [(34)].

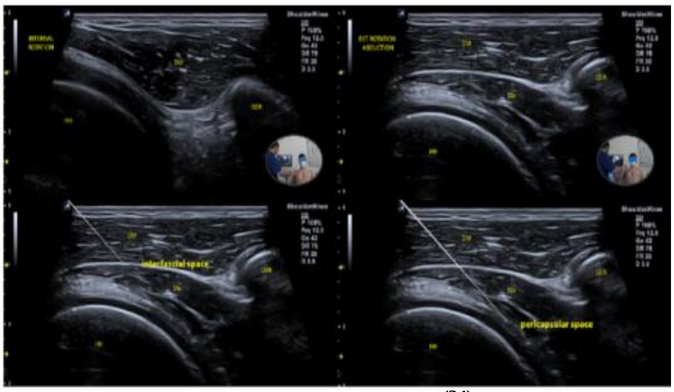

Figure (7): SHAC block procedure [(34)]**.**HH humeral head **,** COR coracoid **,** SSC subscapularis**,** BB biceps brachii**,** CBM coracobrachialis **,** DM deltoid muscle**.**

CONCLUSION

Chronic shoulder pain is a common condition that can significantly affect an individual's quality of life. Diagnosing the cause of shoulder pain can be difficult, as several pathologies can cause shoulder pain. The management of chronic shoulder pain usually involves a multimodal approach that includes physical therapy, NSAIDs, and corticosteroid injections. If conservative treatment fails, interventional procedures such as articular branch blocks can be considered. Articular branch blocks involve injecting local anesthetics into nerves that innervate the glenohumeral joint to provide pain relief. Innervation of the glenohumeral joint is complex, with different quadrants of the joint receiving innervation from different nerves. While articular branch block can be useful in managing chronic shoulder pain, they should be used with caution and in conjunction with other forms of therapy.

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