

## **MRI Patterns Of Shoulder Denervation: A Way To Make It Easy**

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# Learning objectives

To describe and illustrate the most frequent MR patterns of shoulder muscle denervation.

To review of specific anatomic places commonly involved in this type of pathology.

We perform a diagnosis algorithm in order to simplify the association of denervated muscle and the nerve compromise

## Background

We performed a retrospective analysis of patients with shoulder muscle denervation in our institution with 1.5/3T MRI between the years 2014 and 2017, correlating the radiological findings, nerve compromise and etiology.

Peripheral nerve injury associated with muscular denervation is an uncommon cause of shoulder pain and could lead to mislead to other pathologies with similar clinical presentation.

The knowledge of the brachial plexus anatomy and the suprascapular and axillary nerve path are critical in order to understand the correlation of the denervated muscle group with the compromised nerve and the possible location of its injury.

The nerves most commonly affected are the suprascapular and axillary.

- **Suprascapular Nerve**

Sensorimotor nerve that arises from the upper trunk of the brachial plexus, with is originate by C5 and C6 roots, with variable contribution from C4. Supplies motor branches to the supraspinatus and infraspinatus, receiving sensory branches from glenohumeral and acromioclavicular joints, rotator cuff and posterior two thirds of the capsule.

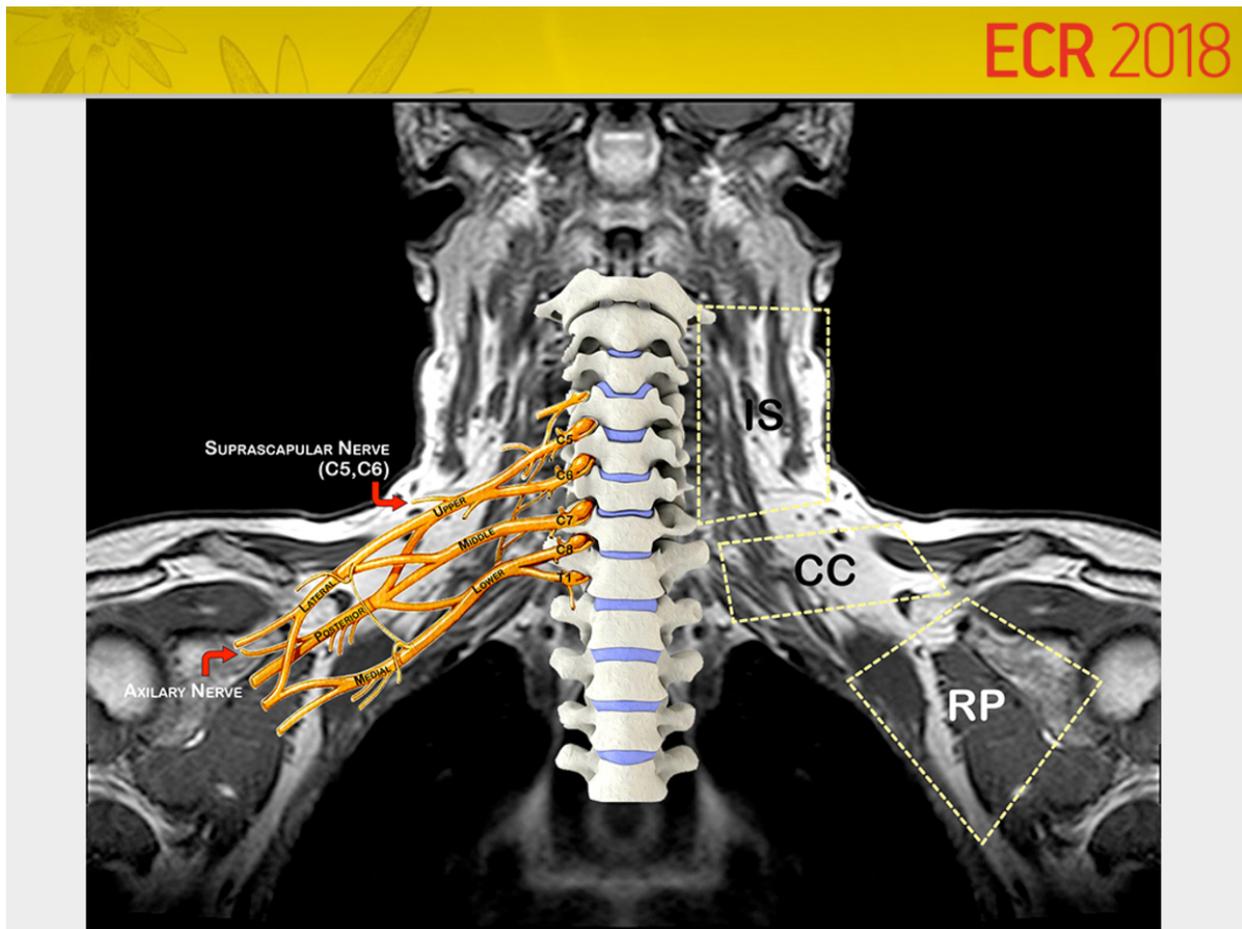
Sites of entrapment include the suprascapular notch and the spinoglenoid notch.

- **Axillary nerve**

Arises from the posterior trunk of the brachial plexus, formed by C5 and C6 roots. Supplies teres minor muscle and anterior and middle parts of deltoid muscle.

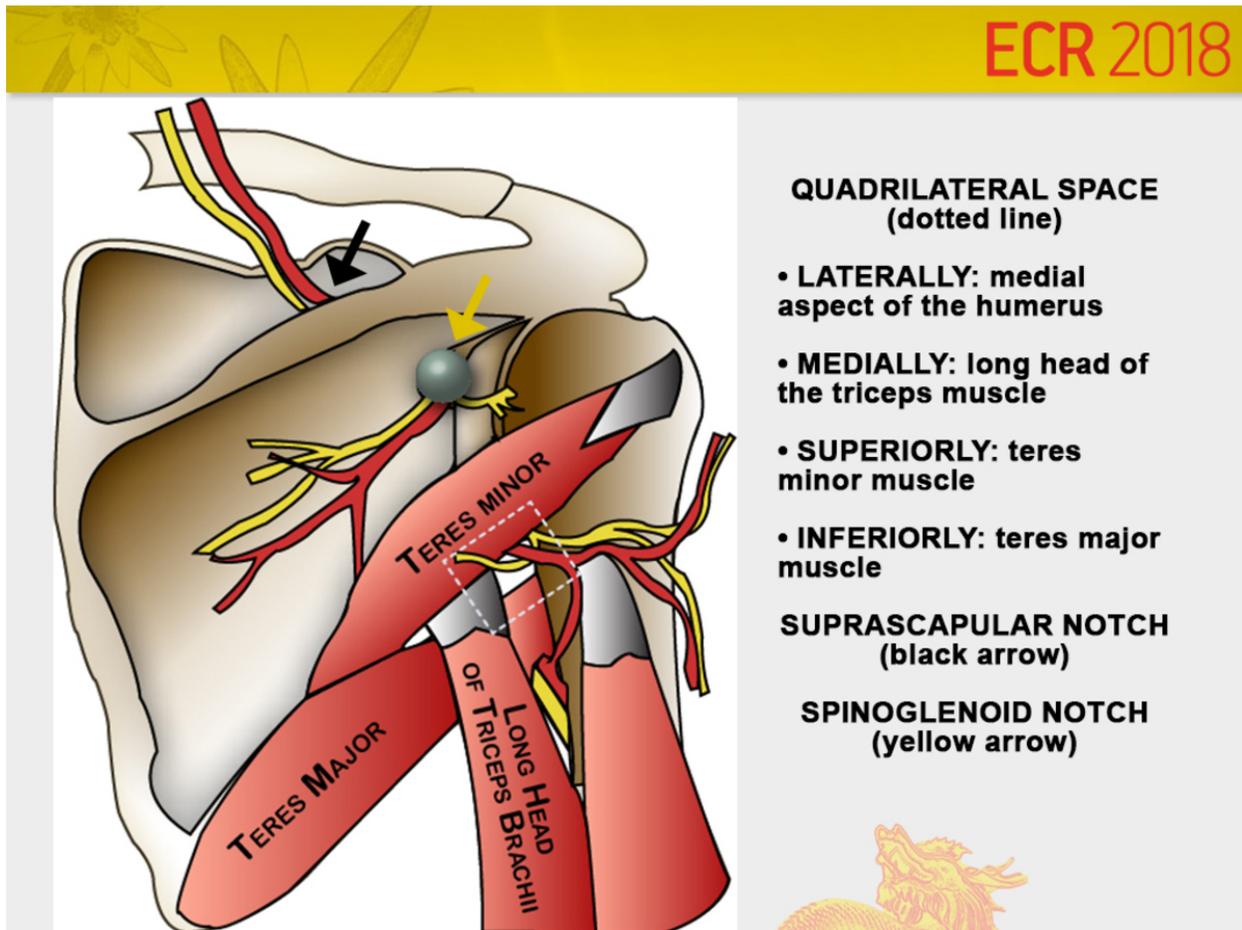
Sites of entrapment include the quadrilateral space and the area anteroinferior to the glenohumeral joint.

Images for this section:



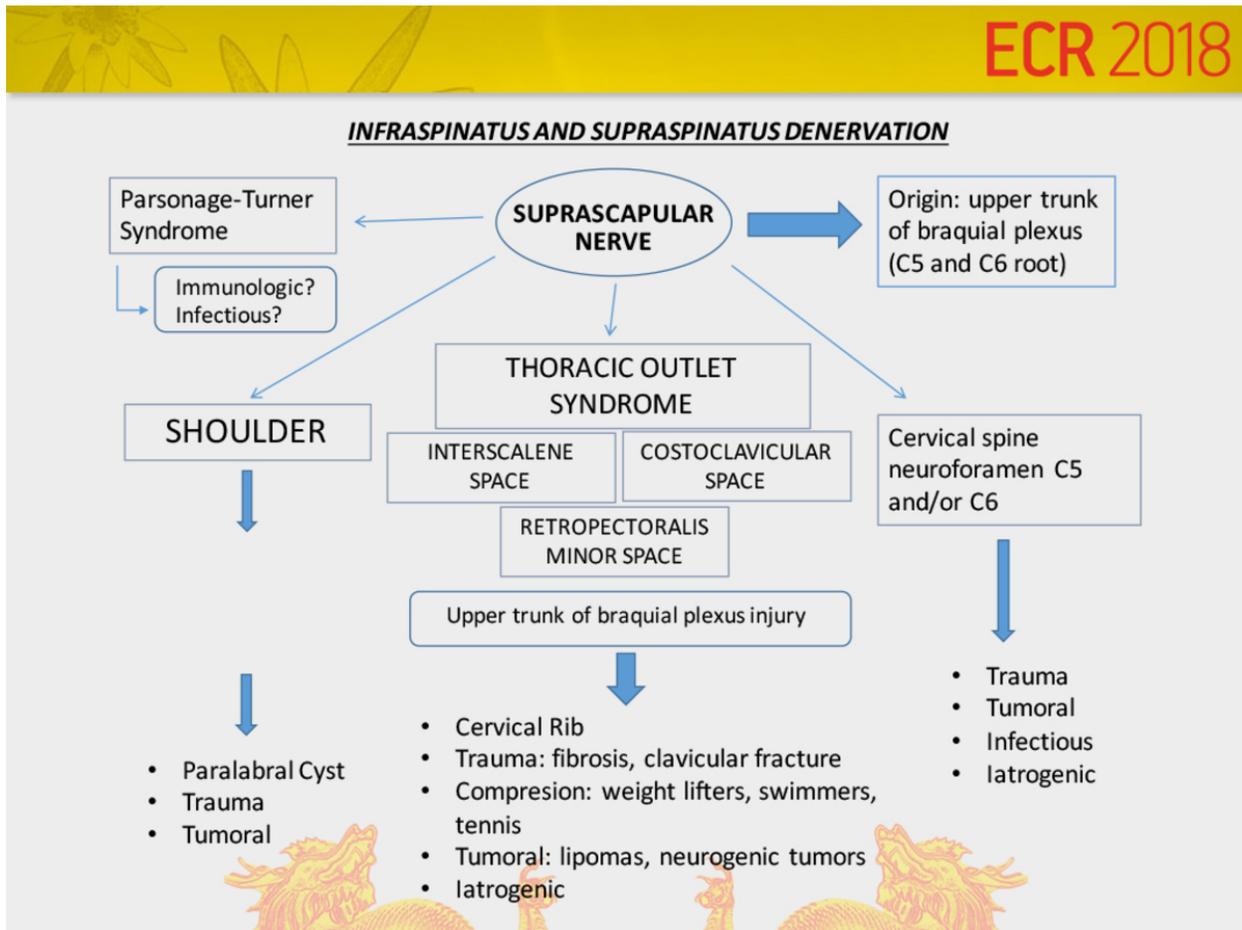
**Fig. 1:** Original 3D illustration on coronal T1-WI shows the origin of the main branches of the brachial plexus. The interscapular (IS), costoclavicular (CC) and minor retropectoralis (RP) spaces are pointed on the thoracic outlet, being frequent places where to locate compressive neural pathology.

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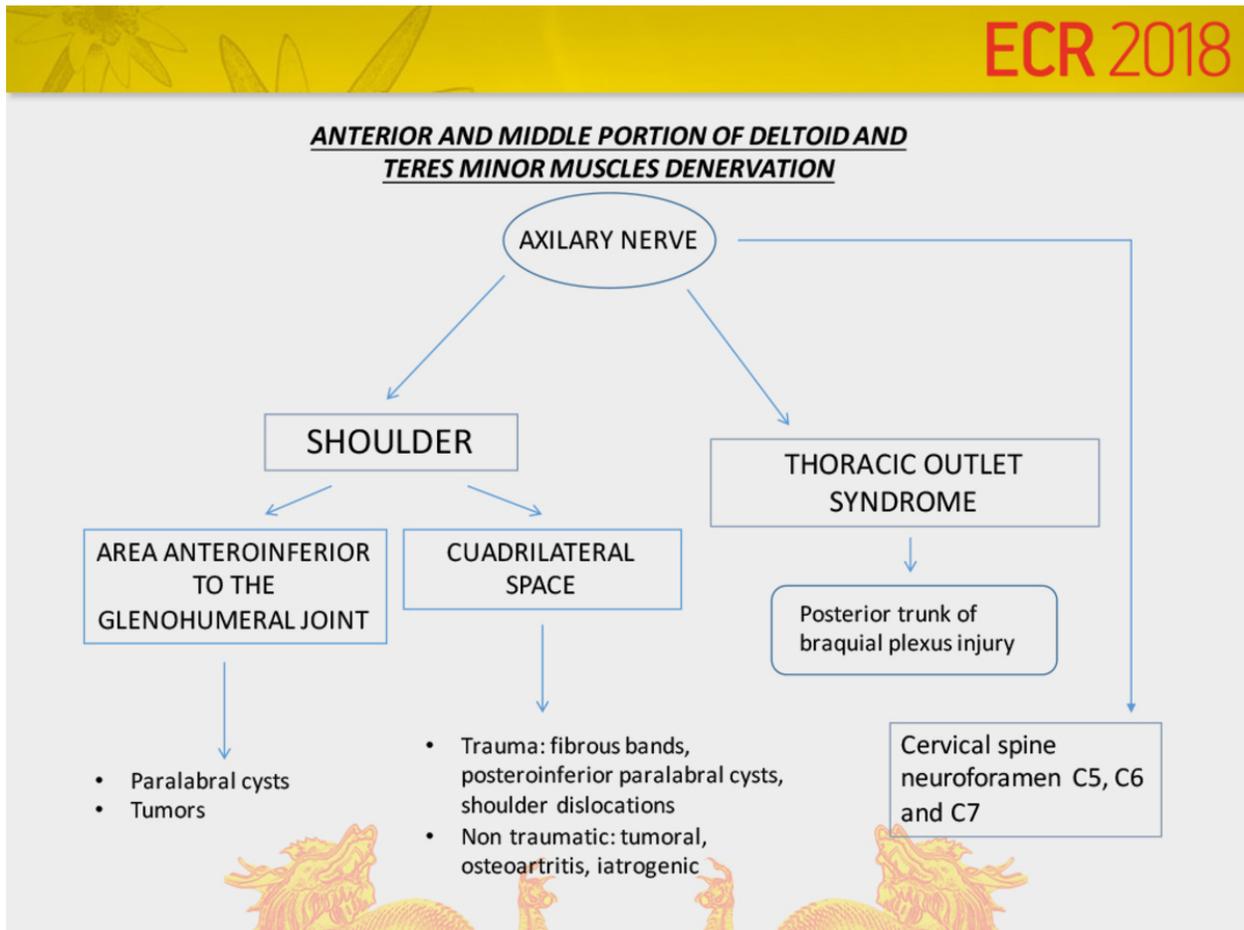
**Fig. 2:** Original illustration of posterior view of the shoulder. Suprascapular notch (black arrow) and spinoglenoid notch (yellow arrow), sites of suprascapular nerve involvement. Quadrilateral space (dotted line), site of entrapment of the axillary nerve. A sphere on the spinoglenoid notch it's representing a paralabral cyst with suprascapular nerve denervation.

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**Fig. 3:** Diagnostic algorithm of suprascapular nerve, with specific anatomical sites.

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**Fig. 4:** Diagnostic algorithm of axilar nerve, with specific anatomical sites.

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## Findings and procedure details

The entrapment and compression neuropathies are usually diagnosed on the basis of clinical history and electrophysiologic studies (electromyography and nerve conduction studies). MRI has proved significantly useful since it allows to identify the precise location of the injury depending on the affected muscle group and has a remarkable advantage over the EMG, which does not show signs of muscle denervation up to 2-3 weeks after injury (Linda, D. et al.<sup>1</sup>)

The denervated muscles show us the possible nerve compromised and guide us to find the location of the nerve injury.

The finding of high signal intensity in T2 and STIR sequences depicting muscle edema, represents an acute lesion. Fatty atrophy reflects chronic denervation, showing hyperintense signal in T1 and T2.

The muscles which usually present a denervatory pattern are: infraspinatus, supraspinatus, teres minor and deltoid.

### **Parsonage-Turner Syndrome (Fig. 5 and 6)**

Also known as acute brachial neuritis and neuralgic amyotrophy.

Etiology: Not clear. Autoimmune mechanisms? Viral?.

Self-limited. 3rd-8th decade. Bilateral 30%.

Characteristic manifestation:

Acute and severe shoulder pain followed by weakness.

Most common muscle involved is supraspinatus (97% of cases, and 50% isolated according to Gaskin et al.<sup>3</sup>).

### **Quadrilateral Space Syndrome (Fig. 7)**

Due to compression of the axillary nerve and posterior circumflex humeral artery, resulting in teres minor and anterior and medial portions of deltoid muscle denervation.

Etiology: Traumatic and atraumatic causes

Mass lesions such as tumors, posteroinferior paralabral cysts or fibrous bands (most frequent), posteroinferior paralabral acute lesion with edema (fig. ), osteoarthritis, etc.

Post-traumatic nerve injury may occur in almost half of shoulder dislocations, since the nerve is stretched over the dislocated humeral head.

Most axillary nerve injuries are secondary to brachial plexus impairment.

Isolated injury may occur in open surgical intervention with a deltoid muscle-splitting approach or reverse shoulder arthroplasty.

### **Suprascapular Nerve Entrapment**

Sites of entrapment include

Suprascapular notch: supraspinatus and infraspinatus denervation (fig. 9).

Spinoglenoid notch: infraspinatus denervation.

2nd - 6th decades.

Etiology:

Compression from space-occupying lesions, including paralabral cysts (fig. 9), tumors, iatrogenic surgical injury, and enlarged varicosities.

Thickened transverse scapular ligament (repetitive strain on the abducted and externally rotated shoulder), with entrapment on the suprascapular notch.

### **Thoracic Outlet Syndrome**

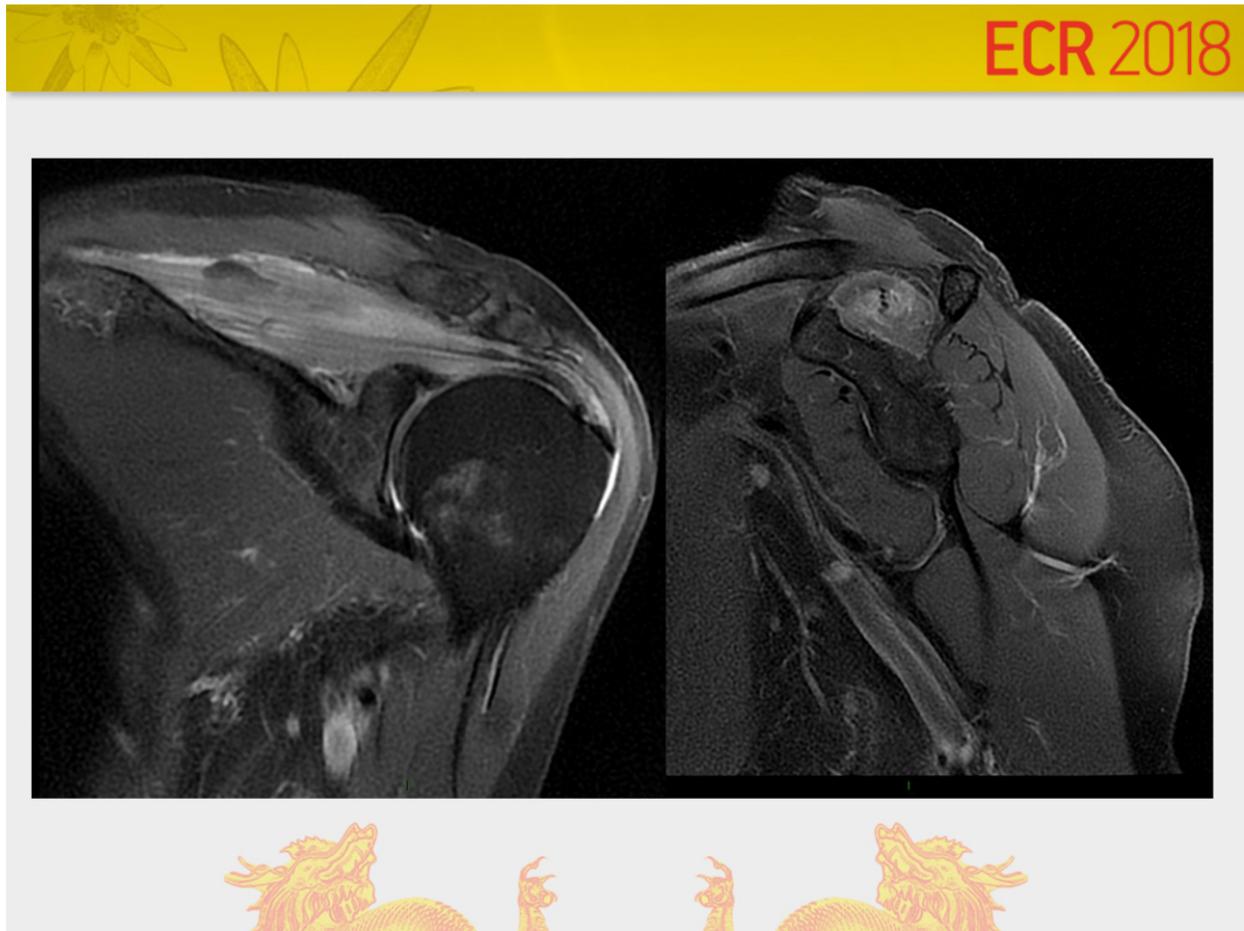
Entrapment of the brachial plexus at specific anatomic places.

Sites of entrapment include the retropectoralis minor, costoclavicular, and interscalene spaces (fig. 1).

Etiology: Cervical Rib; trauma (fig. 8 and 9), fibrosis, clavicular fracture; compression: weight lifters, swimmers, tennis; tumoral: lipomas, neurogenic tumors; iatrogenic (Erb-Duchenne fig. 11).

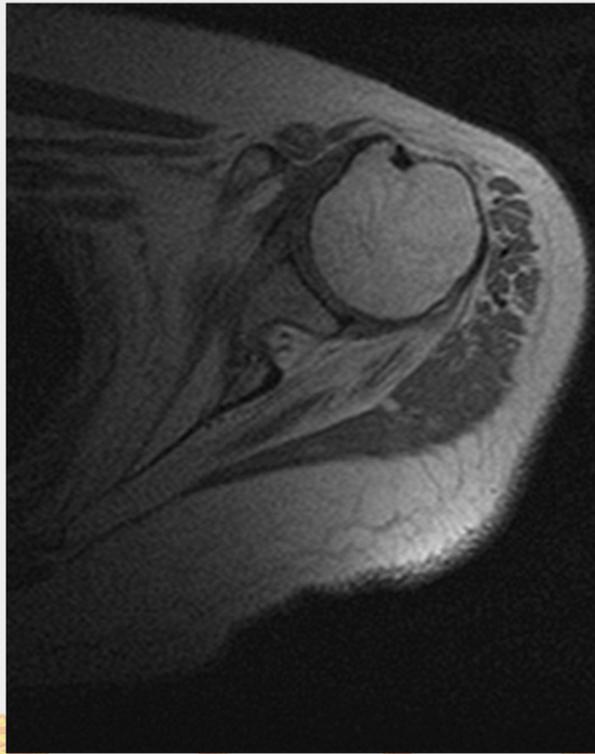
Clinical presentation depends on the affected nerve, involving more frequently axillary and suprascapular nerve.

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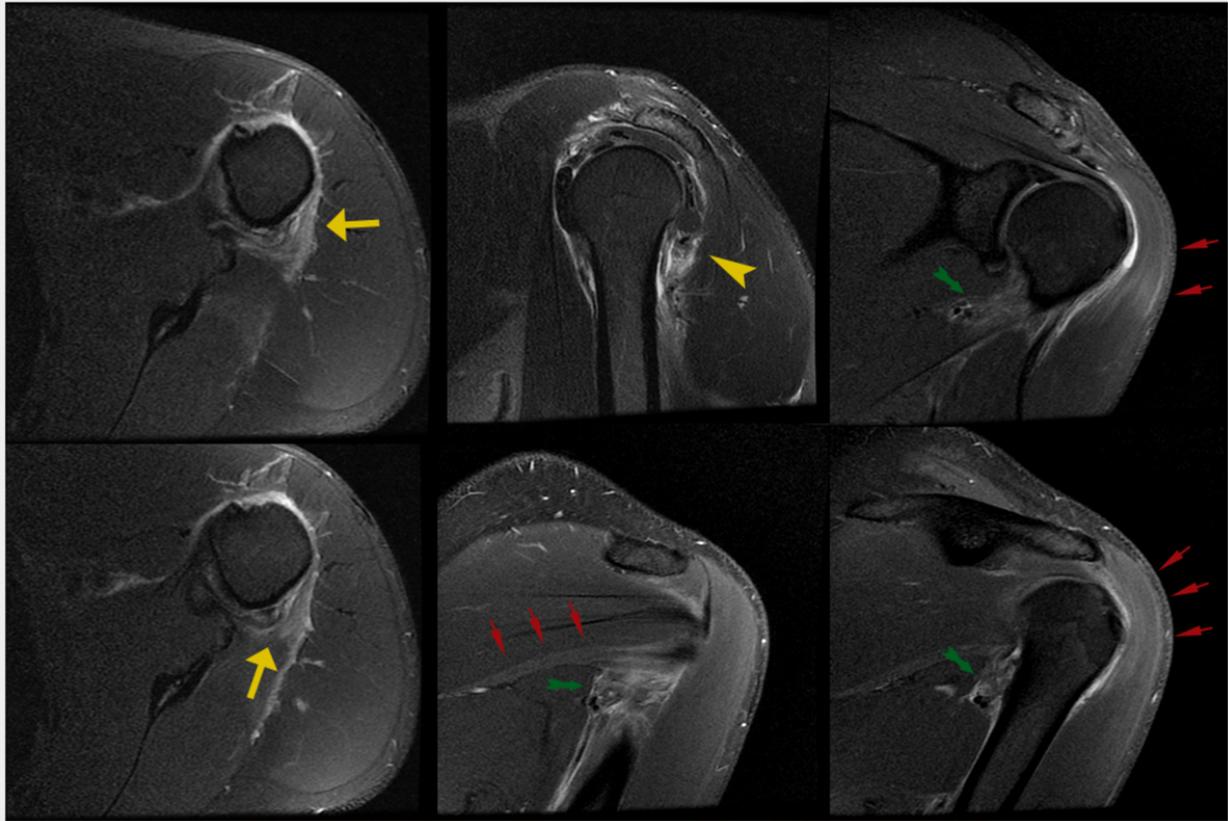
**Fig. 5:** 42 years old male patient with shoulder pain. Coronal and sagittal STIR WI show high signal intensity on supraspinatus muscle, representing muscle edema (acute stage denervation). Parsonage-Turner Syndrome.

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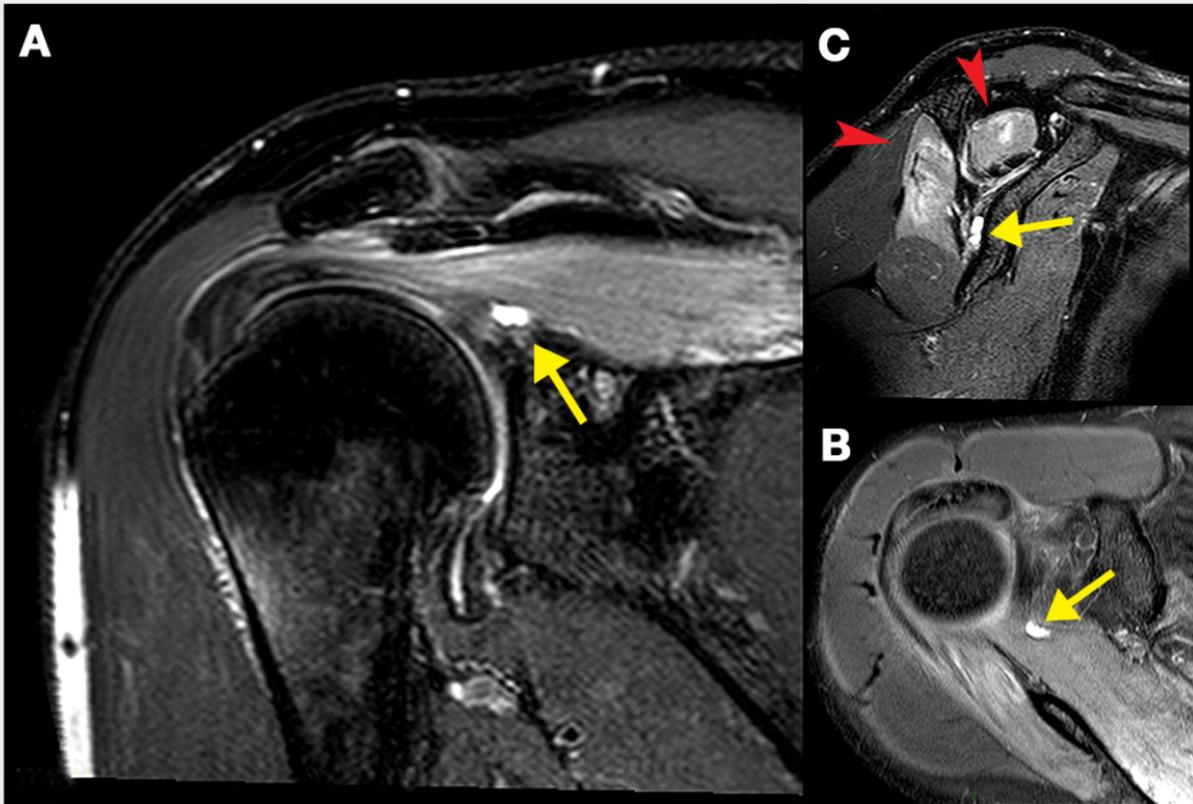
**Fig. 6:** Axial T1-WI demonstrate fatty atrophy of the infraspinatus muscle (arrow) produced by chronic denervation in a patient diagnosed with Parsonage-Turner Syndrome.

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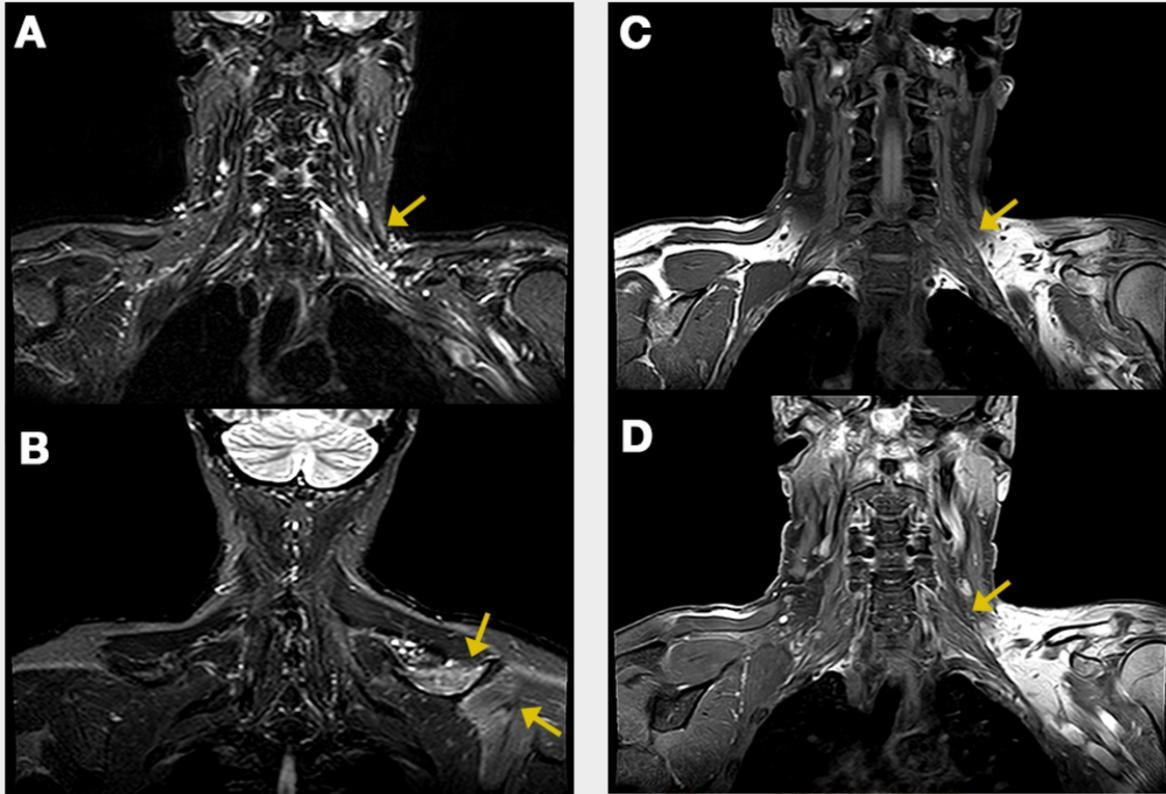
**Fig. 7:** 28 year old rugby player with a traumatic episode. Yellow arrow demonstrate inferior fascicule of posterior glenohumeral ligament tear. Arrow head shows muscle edema of teres minor. Green arrows points soft tissue edema surrounding quadrilateral space with compromise of the axillary nerve. Red arrows shows muscle denervation of teres minor and anterior and middle portions of deltoid muscle. QUADRILATERAL SPACE SYNDROME

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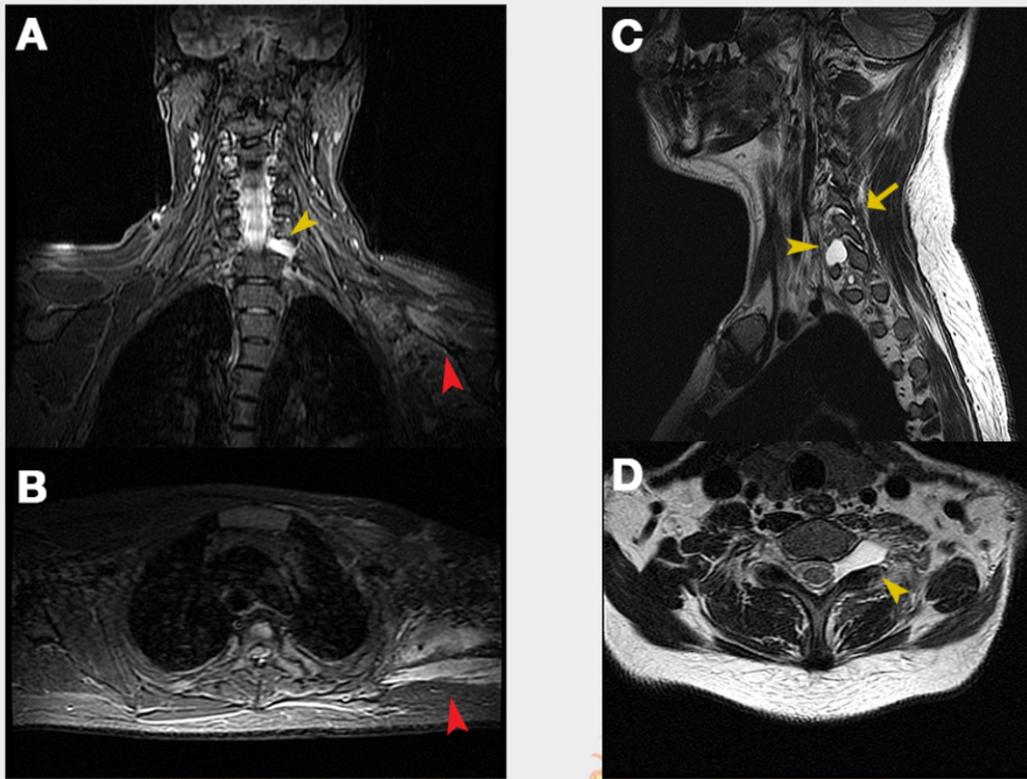
**Fig. 8:** 53-year-old patient with pain and functional impotence of the right shoulder after traumatic episode. A and B) Coronal and axial STIR WI demonstrate paralabral cyst in topography of the suprascapular notch with involvement of the suprascapular nerve (arrow). C) Sagittal STIR WI evidence denervation of the supra and infraspinatus muscles. PARALABRAL CYST.

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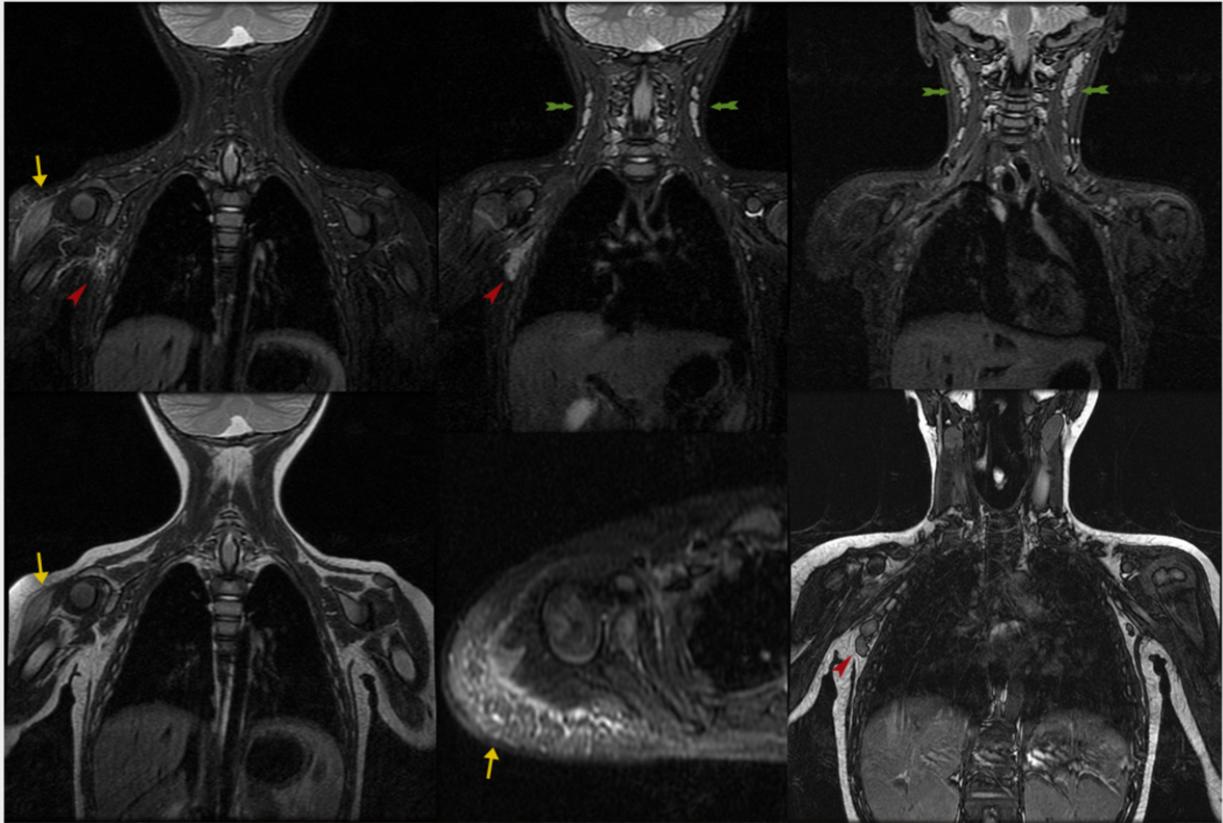
**Fig. 9:** 58 years patient suffer trauma with lateral hyperextension of the neck in a motorcycle accident. A) Coronal STIR shows signal hyperintensity in the superior trunk of the left brachial plexus, in correlation with EMG finding. B) Coronal STIR, shows denervation of supraspinatus and infraspinatus muscles. C and D) T1 FATSAT without and with gadolinium shows enhancement of the mentioned structures.

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**Fig. 10:** 28 years patient. Road accident. A and B) Coronal and axial STIR sequences shows denervation of supra and infraspinatus muscles (red arrow heads). C and D) Sagittal and axial T2-WI demonstrate complete avulsion of C8 root associated with pseudomeningocele (yellow arrow-head), partial avulsion root T1 and partial lesion of root C6 (arrow). Involvement of radial, median and ulnar nerves are not shown.

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**Fig. 11:** 1 year old female patient presents with arm hanging by the side and rotated medially; the forearm is extended and pronated. Yellow arrows shows deltoid denervation and superficial atrophy. Red arrows demonstrate high signal intensity on the retropectoralis space, associated with suggestive images of axillary nodes. Green arrow shows cervical lymph nodes. Mother refers labour dystocia in childbirth. Erb-Duchenne palsy.

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## Conclusion

The knowledge of the patterns of MRI muscle shoulder denervation in correlation with a correct understanding of the anatomy helps to locate the topography of the nerve injury and could determine the possible etiology cause in order to be attended.

## Personal information

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