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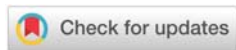
**Received:** 30 July, 2019

**Accepted:** 03 September, 2019

**Published:** 04 September, 2019

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**Research Article**

# Referred scapula pain from C6 or C7 cervical spinal stenosis

**Abstract**

**Objective:** The aim of the present study was to determine if there exists referred medial scapula pain from C6 or C7 cervical spinal stenosis. Scapula pain of neurologic origin at present is felt to be mediated mainly by C5 through the dorsal scapular nerve. An interventional spine clinic noted a series of patients with medial scapula pain without C5 stenosis, however many of these patients had either C6 or C7 stenosis.

**Methods:** The charts of 278 patients seen in an interventional spine clinic over an 11 year period from 2008 to 2018 who were diagnosed with cervical radiculopathy based on location of pain were reviewed. 135 of these had cervical MRI imaging. Data was collected to evaluate for a correlation of the level of cervical stenosis with the location of pain at the medial border of the scapula.

**Results:** Patients with ipsilateral medial scapula pain had 0.0% incidence of stenosis at C4, 29.5% at C5, 64.6% at C6, 49.2% at C7, 0.0% at C8, and 80% with either C6 or C7 stenosis.

**Conclusion:** This is the first report of referred pain to the medial scapula from cervical stenosis at the C6 or C7 levels. The mechanism of referred pain is reviewed and a plausible and testable neurologic explanation for these observed findings is presented.

**Introduction**

Referred pain is pain which is perceived in an area other than that in which the noxious stimulation takes place, and is frequently observed in the clinical setting [1]. This is an important concept which affects treatment and the anatomy of convergent afferent fibers has been described for a number of conditions.

Dorsal root ganglion neurons with dichotomising axons are present in several species and are considered to play a role in referred pain. The early experimental techniques used to investigate this used retrograde neuron transport [2]. Current more sophisticated techniques use the double fluorescent-labeling technique and this method has been successful in understanding referred groin pain from lumbar discs.

An excellent and analogous example is with groin pain which is associated with lumbar discs and had been a perplexing problem and previously believed to be only consistent with a hip pathology source [3]. Subsequent investigations of the sensory innervation of the dorsal portion of the lumbar intervertebral disc were performed. In the rat experimental model the sensory innervation of the dorsal portion of the L5-

L6 intervertebral disc anatomically corresponds to the L4-L5 disc in humans, and the dorsal portion of the human L4-L5 disc is frequently subject to injury that causes low back pain. It was determined that the sensory fibers from T13, L1, and L2 dorsal root ganglia innervate the dorsal portion of the L5-L6 disc through the paravertebral sympathetic trunks. In contrast, those from the L3-L6 dorsal root ganglia may innervate the dorsal portion of the L5-L6 disc through the sinuvertebral nerves [4]. Additional studies of the sensory innervation to the anterior portion of lumbar intervertebral discs using the retrograde transport method demonstrated that the anterior portion of the L5-L6 lumbar intervertebral disc was innervated from L1 or L2 spinal nerves in rats. These results explain why patients with lower lumbar disc lesions sometimes complain of inguinal pain corresponding to the L1-L2 dermatome [5].

These results have been confirmed and the neuroanatomical mechanism for referred groin pain in patients with disc lesions is now known. The definitive evidence is from the double fluorescent-labeling technique in rats where neurons labeled with a colored tracer applied at the ventral portion of the L5-L6 disc correlating to the human L4 disc and a tracer of another color was placed on the groin skin in L1 and L2 dorsal root ganglia.

The animals were later sacrificed and both colors of tracers were observed in the afferent nerves in the spinal cord. This confirmed that the double-labelled neurons had peripheral axons which dichotomised into both the LS-L6 disc and the groin skin, indicating the convergence of afferent sensory information from the disc and groin skin [6].

It is hypothesized that an analogous condition exists with convergent afferent fibers from the human C6 or C7 intervertebral discs and the skin on the ipsilateral medial scapula.

## Methods

We reviewed 278 charts of patients seen in an interventional spine clinic over an 11 year period from 2008 to 2018 who were diagnosed with cervical radiculopathy based on location of pain. HIPPA privacy was maintained.

## Results

There were 135 patients with pain distribution consistent with cervical radiculopathy who had cervical MRI's. Ipsilateral scapula pain was experienced by 65 of these 135 patients. The MRI imaging results are presented in Table 1.

**Table 1:** Number and percentage of 65 patients with ipsilateral medial scapula pain with MRI confirmation of stenosis at specific levels.

Location of Stenosis on MRI	Number	Percent
C4 only	0	0%
C5 only	10	15.4%
C6 only	3	4.6%
C7 only	13	20.0%
C8 only	0	0%
Total with C5, alone or in combination	19	29.2%
Total with C6, , alone or in combination	42	64.6%
Total with C7, , alone or in combination	32	49.2%
Total with C6 or C7	52	80.0%

## Discussion

Scapula pain can be from orthopedic sources [7], a muscular etiology such as with scapular muscle dysfunction [8], dermatologic sources such as notalgia paresthetica [9], intrathoracic sources [10], or associated with the dorsal scapular nerve, either centrally or more commonly though entrapment within the middle scalene muscle [11]. Referred scapula pain from cervical stenosis has not been described.

Medial scapula pain with cervical stenosis is a relatively common association with a nearly 50% incidence among our sample of 135 patients who had MRI imaging. Among these patients we found 80% had either C6 or C7 stenosis with C6 more common than C7 (65% with C6 and 50% with C7). Only 29% had C5 stenosis, either alone or in combination with other levels of stenosis. This would be the expected level of

stenosis if the pain was mediated through the dorsal scapular nerve. There were no patients with either C4 or C8 stenosis. This association cannot be accounted for based on the previous understanding that only the dorsal scapular nerve mediates this location of pain at the medial border of the scapula.

The location of pain medial to the scapula is consistent with the dorsal scapular nerve. This has classically been attributed to the C5 nerve. A more recent cadaveric investigation of the dorsal scapular nerve has identified the cutaneous sensory location of the dorsal scapular nerve, which arises from C5 in 70%, C4 in 22%, and C6 in 8% of individuals, where it innervates only the levator scapulae muscle in 48% of individuals and innervates the levator scapulae muscle, rhomboid major and rhomboid minor muscles in 52 % of individuals [12]. The C6 level is a minor contributor with only an 8% incidence and the C7 level is never involved.

These results are consistent with a newly identified source of referred pain to the ipsilateral medial scapula from either C6 or C7 cervical stenosis. This can be confirmed with future investigations in the same manner as the analogous condition of referred groin pain in patients with lower lumbar stenosis using the double fluorescent-labeling technique.

## Acknowledgements

Kenneth Willeford MD, president Coastal Carolinas Integrated Medicine participated in the study design.

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