



Systematic Reviews /Meta-analyses

Scapular pain in cervical radiculopathy: A scoping review

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ABSTRACT

Background: Controversy persists regarding the relationship between scapular pain and cervical radiculopathy, with no consensus on cervical radiculopathy's definition, radicular pain distribution, or the diagnostic value of scapular pain. This review aims to map the literature describing scapular pain distribution in cervical radiculopathy in clinical practice and research.

Methods: This scoping review followed JBI methodology, guided by the PRISMA-ScR extension. Studies reporting on cervical radiculopathies with described radicular pain distribution were included. Exclusions applied to radicular pain from peripheral neuropathy, fracture, cancer, rheumatologic, or vascular disorders, and inadequately described scapular pain. Information sources included Ovid MEDLINE, Embase, Cochrane Library, Web of Science, and CINAHL. JBI methodology was followed, guided by the PRISMA-ScR extension. Pain distributions were mapped by region, cervical nerve root level, and diagnostic confirmation methods.

Results: The review included 86 studies (1957–2022). Among the 81 studies describing pain distribution, neck (88%), arm (85%), and scapula (72%) were most frequently reported. Of 60 studies documenting pain by nerve root level, C6 (82%), C7 (77%), and C8 (63%) were most common, with C7 showing the highest percentage of scapular pain descriptions. Evidence indicates scapular pain may precede arm pain by several weeks in cervical radiculopathy.

Conclusions: Evidence supports scapular pain as a symptom of cervical radiculopathy, potentially preceding arm pain by weeks. Future studies should document symptoms at onset, define radicular pain distributions, include participants with scapular pain, and assess the diagnostic utility of scapular pain in cervical radiculopathy.

Introduction

Cervical radiculopathy affects 203 per 100,000 persons annually resulting in surgery in 20% of patients [1]. Timely diagnosis is crucial for effective treatment, yet controversy persists regarding its complete clinical presentation. In their 1944 paper Spurling and Scoville [2] described compression of cervical nerve roots resulting from lateral rupture of the cervical intervertebral discs. Their review described symptoms arising

from nerve compression: "...pain and stiffness in the neck... with pain into the shoulder and down the arm into the hand." A landmark 1994 epidemiologic survey by Radhakrishnan et al. [1] observed patients with cervical radiculopathy over 14 years in Rochester, Minnesota. This report characterized the presenting symptoms as neck pain "with radiation of pain in a radicular distribution in one or both upper extremities." Notably, scapular pain was not mentioned as a component of cervical radiculopathy. This omission may have significant implications for

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clinical practice, potentially leading to delayed diagnosis, inappropriate treatment selection, and poorer patient outcomes.

The exclusion of scapular pain in descriptions of cervical radiculopathy is apparent in numerous definitions in the literature. For example, in 1996, Levine et al. [3] defined cervical radiculopathy as “pain in a dermatomal distribution.” In 2010 Van Zundert et al. [4], echoed by Yoon et al. [5] in 2014, stated that cervical radiculopathy “is defined as pain arising in the arm caused by irritation of a cervical spinal nerve or its roots.” Bogduk [6] stated that “cervical radicular pain is perceived in the upper limb.” Iyer et al. [7] wrote in 2016 that patients with cervical radiculopathy “typically present with neck pain, arm pain, or both.” The implication of these generally accepted definitions is clear: involvement of the upper extremities is considered the necessary, defining component of cervical radiculopathy.

However, Thoomes et al. [8] challenged this notion, calling attention to the lack of an accepted definition of cervical radiculopathy as well as the lack of agreement regarding the exact distribution of pain associated with this condition. A 2021 systematic review by Borrelli-Andrés et al. [9] agreed, stating “there is no consensus on a good definition of the term.” A typical example of this ambiguity is seen in Radhakrishnan et al. [1], where repeated references to pain in a “radicular distribution” are not accompanied by a definition of these terms. Moreover, no diagnostic reference standard has been identified for cervical radiculopathy. Radhakrishnan’s group reported that the diagnosis of cervical radiculopathy was “largely clinical,” with neuro-radiology (primarily MRI [10]) and electromyography used only for confirmation.

In 1998, Tanaka et al. [11] provided a different clinical picture of cervical radiculopathy, defining the location of neck symptoms as including “nape pain and pain at the suprascapular, scapular or interscapular region.” This study posited that distinct scapular locations of pain may be useful in diagnosing the nerve root level involved. Suprascapular pain was linked to C5 or C6 radiculopathy, and lower scapular or intrascapular pain was linked to C7 or C8 radiculopathy. More recently in 2006, Tanaka et al. [12] described the progression of pain associated with cervical radiculopathy over time, noting that neck or scapular pain preceded arm or finger symptoms in 70% of cases. Within this 70%, arm or finger symptoms did not appear for a week or longer in 55% of patients and did not appear until 1 month or longer in 21% of patients. Forty-eight of the 50 patients (96%) in this study had preoperative scapular pain prior to surgery, and the remaining 2 patients reported pain restricted to the neck. As in their prior study, these authors asserted that the site of scapular pain was “significantly reliable for the localization of the involved nerve root in patients with cervical radiculopathy.” The diagnostic utility of scapular pain in patients with cervical radiculopathy was recognized by the North American Spine Society (NASS) in their 2010 *Evidence-based Clinical Guidelines for the Diagnosis and Treatment of Cervical Radiculopathy from Degenerative Disorders*, published in the literature by Bono et al. in 2011 [13].

Despite this adoption by NASS over a decade ago, controversy persists regarding the relationship between scapular pain and cervical radiculopathy as well as the perceived role of scapular pain in the diagnosis of cervical radiculopathy among investigators and clinicians. Furthermore, Aprill et al. [14] and others [15,16] have long understood scapular pain to be more closely related to cervical facet syndrome than to cervical radiculopathy.

Given the lack of consensus, lack of definition, the lack of diagnostic reference standards regarding cervical radicular pain relative to the scapula, and the common notion that facet joints are primarily responsible for pain in the scapular region, a scoping review of the literature was undertaken to examine the relationship between scapular pain and cervical radiculopathy. Preliminary searches for existing scoping reviews and systematic reviews on scapular pain in patients with cervical radiculopathy were conducted on March 5, 2022, July 10, 2022, and November 13, 2022. To our knowledge no systematic scoping reviews are currently available on this topic.

Review questions

Our primary question was “Does the literature suggest that scapular pain can be a symptom related to cervical radiculopathy? If so, does literature ascribe any value to the presence of scapular pain in the diagnosis of cervical radiculopathy?” Our primary aim was therefore to map the literature describing the distribution of pain in patients with cervical radiculopathy, *including* scapular pain. Second, we sought to summarize the evidence as well as knowledge gaps, if any, by describing the finding of scapular pain as a possible diagnostic indicator of cervical radiculopathy.

Methods

This scoping review employed methodology described in the JBI Manual for Evidence Synthesis, April 2021 edition [17]. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) was followed [18]. The objectives, inclusion criteria, and methodology for this scoping review were developed in advance according to Peters et al. [17] and prospectively registered and published online with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) [19]. This study was deemed exempt by the Colorado Multiple Institutional Review Board (COMIRB).

Inclusion criteria

Participants

This review considered studies reporting on patients and research participants of any age who were diagnosed with cervical radiculopathy and whose radicular pain distribution was recorded. Studies were excluded if radicular pain arose from peripheral neuropathy, fracture, cancer, chemotherapy, or rheumatologic or vascular disorders.

Concept

The core concept of this scoping review was to map the literature describing scapular pain in patients with cervical radiculopathy. For this concept scapular pain distributions are defined as pain located directly over the scapula as well as pain in the periscapular region between the thoracic spinous processes and the scapula along the medial scapular border, just above the superior border of the scapula along the scapular spine, and in the region just lateral to the lateral border of the scapula.

Context

This scoping review considered all clinical and research settings where patients and research participants with cervical radicular pain were examined and/or treated. The breadth of the search was global, with no restrictions regarding publication date, socioeconomic status, healthcare system, age, sex, gender, race, military or civilian status, activity level, or insured status.

Types of evidence sources

The search considered the following concepts: cervical radiculopathy, cervical spine, cervical vertebrae, and diagnosis. Accepted citations for screening included any research design, except for single case reports, that reported the distribution of pain from diagnosed cases of cervical radiculopathy. Studies were excluded from analysis if they were not published as original articles or if nonradicular contributors to pain (e.g., neuropathies) were identified. Studies reporting pain in the neck and arm with visual analog scale (VAS) scores were excluded if there were no localizing descriptions of the anatomic pain distribution. Conference proceedings and letters to the editor were also excluded.

Search strategy

The search was designed as broadly as possible to locate published studies describing the distribution of pain in patients with cervical radiculopathy diagnosed by imaging, clinical examination, electrodiagnosis, and surgical techniques for the confirmation of nerve root involvement. Preliminary searches of literature were performed by the research team, which included a health sciences librarian to develop the search strategy.

The Medline (Ovid), Embase, Cochrane Library, Web of Science Core Collection, and CINAHL databases were searched from inception to January 4, 2023. The complete presentation of the search strategies used for all the databases appears in Supplementary Materials, Appendix 1 of this report.

Source of evidence screening and selection

Citations were uploaded into EndNote (Clarivate Analytics, PA, USA) and subsequently uploaded into Covidence (Veritas Health Innovation, Melbourne, Australia). Two reviewers (KW and JC) independently performed title and abstract screening. A pilot test of the source selection process was conducted with a random sample of 125 titles and abstracts. The reviewers exceeded 75% agreement. The pilot test clarified and refined the evidence screening and selection process, achieving over 80% agreement for all subsequent screenings.

The full texts of potentially relevant studies were retrieved and assessed by the 2 reviewers using the inclusion criteria. Reasons for decisions to exclude evidence sources during full-text screening were recorded in Covidence. Disagreements were discussed and clarified by the 2 reviewers, further refining the source selection process. A third reviewer (SR) from the study team resolved any disagreements.

Data extraction and charting

A detailed spreadsheet was used as the formal source selection tool for this scoping review. The full-text articles were extracted manually by the 2 reviewing authors. Data charting used a spreadsheet to map prespecified variables of interest pursuant to the aims of the study. The reviewers performed reference checking of the extracted full-text publications to identify other potential sources of evidence meeting the inclusion criteria.

The prespecified variables extracted into the spreadsheet are provided in Supplementary Materials, Appendix 2. All the citations used for data extraction were retained in Covidence and exported to EndNote for use by the research team.

Data synthesis and presentation of results

Given the nature of this scoping review, neither risk of bias nor sensitivity analyses were performed. The search process is presented as a flow diagram according to the PRISMA-ScR guidelines. The data extracted from the included publications were reviewed. The authors analyzed the occurrence of concepts, characteristics, and populations with simple frequency counts expressed as percentages of total observations. Disparities within the literature were evaluated regarding the definition of radiculopathy as well as indications listed by the authors for clinical testing and diagnosis. This was done to determine whether the diagnostic investigation was constrained, at the outset, by the exclusion of scapular pain as a possible manifestation of cervical radiculopathy. The results, including the characteristics of the identified studies and their data, are presented, and methods of diagnosis as well as descriptions of radicular pain are shown graphically.

The broad scope and mapping objective of this review precluded risk of bias and sensitivity analyses. Following JBI scoping review methodology, quality appraisal of individual studies was not performed or re-

quired. The nature of the extracted data precluded quantitative synthesis.

Results

Inclusion of sources of evidence

The initial search on January 4, 2023, resulted in 4,021 studies. References from citation searches and other sources yielded 8 more studies, and deduplication in EndNote and Covidence removed 5 studies for a total of 4,024 studies available to be screened. Title and abstract screening excluded 3,526 studies, leaving 486 studies selected for full text review and 86 studies for data extraction. (Supplementary Materials, Appendix 3). A study by Cloward [20] was not included because of the use of direct pressure and electrical stimulation to portions of the anterior annulus fibrosus in conscious patients to map pain distributions. The methods of disc stimulation, although confirmatory in reproducing the presenting radicular pain in the study participants, fell outside the natural mechanisms of pain production in patients with cervical radiculopathy. Additionally, 12 studies could not be retrieved; the reasons are shown in the Supplementary Materials, Appendix 4. A PRISMA flow diagram (Fig. 1) details the inclusion and exclusion of evidence for this scoping review.

Some papers carefully differentiated between “radiculopathy” and “radicular pain,” whereas others conflated these terms. The reviewers therefore restricted inclusion decisions to those studies that referenced the distribution of radicular pain explicitly in the text, tables, figures, or by context within included papers. Studies that reported neck and/or arm VAS outcomes as the only descriptions of radicular pain were excluded because the VAS data did not localize the pain distribution.

Characteristics of the included studies

In total, 19 countries were represented by combined authorship in the 86 included studies ranging from 1957 to 2022. (Supplementary Materials, Appendix 3, Column 5).

Review findings

Diagnosis. The most common method of diagnostic confirmation of cervical radiculopathy in the included studies was surgery (71%; Fig. 2). The second and third most common means of confirmatory diagnosis were electromyography and neurodiagnostic imaging, respectively. Computed tomography and magnetic resonance imaging were combined into 1 category based on the date range of the studies and the changing technology over time. We included 8 studies that did not report on the method of diagnostic confirmation because they included other mapped variables of interest.

Studies reporting radicular pain distribution by region. This review included papers that described cervical radicular pain distribution by region, by cervical nerve root level, or both. Among the 86 articles included for extraction, 81 (94%) described cervical radicular pain distributions by region. Of these, 72% included scapular symptoms in their descriptions (Fig. 3). Overall, the scapular region is the third most common region of reported radicular pain. The neck region was the top region reported (88%), followed by the arm region (85%).

Studies reporting pain distribution by the level of nerve root involvement. Fifty-seven of the 86 included papers (66%) described cervical radicular pain distributions by the single cervical nerve root level involved, with 82% of studies reporting the C6 pain distribution, 77% reporting distributions for the C7 nerve root, and 63% reporting distributions for the C8 nerve root. Complete data for each nerve root level are shown in Figs. 4 and 5.

Fig. 5 illustrates the relative proportion of papers reporting radiculogenic *scapular* pain (red label) compared to other anatomical regions for each nerve root level. Of the 113 radicular pain descriptions found across 60 papers reporting by nerve root level, 21 [19%] associated C7

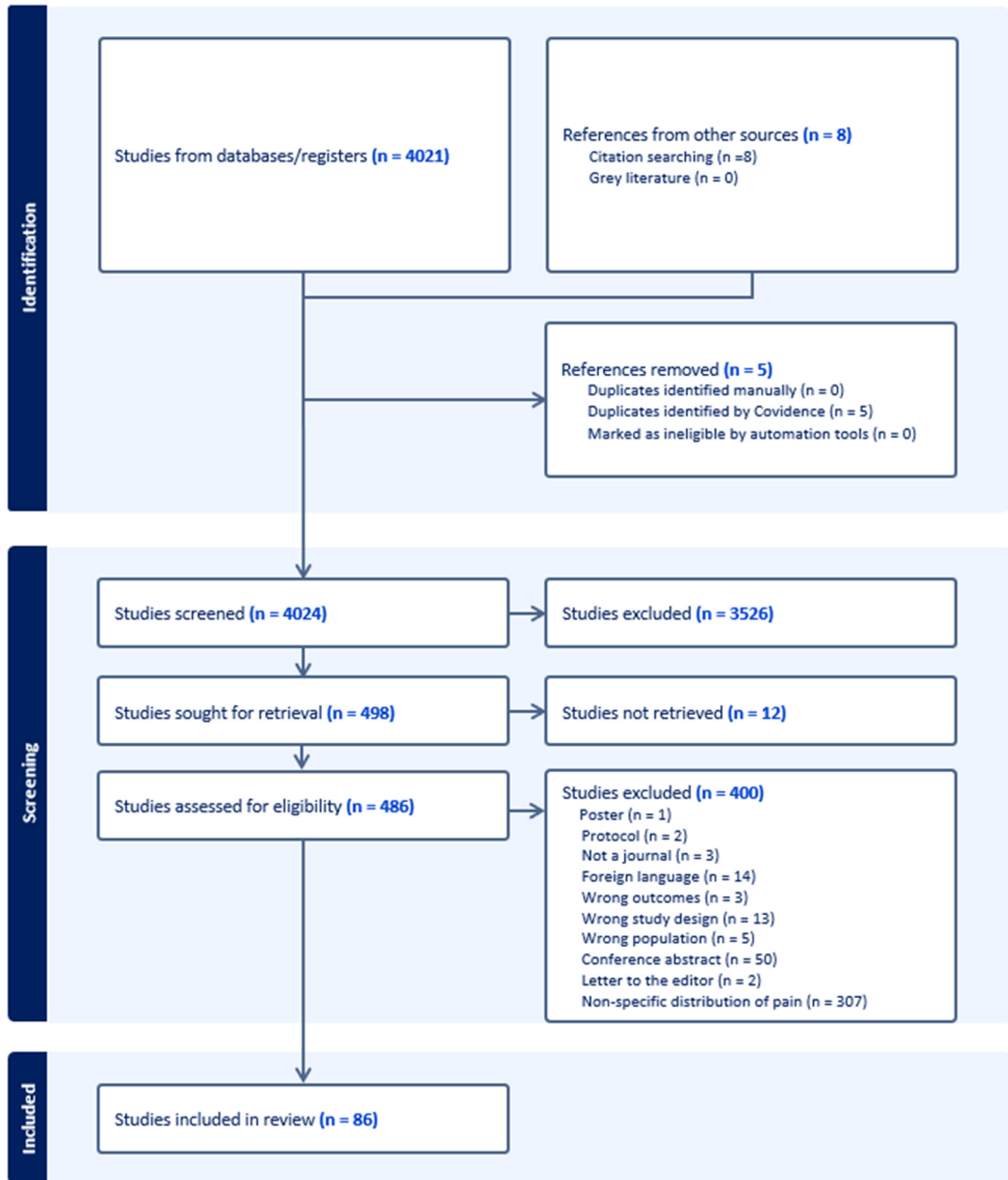


Fig. 1. PRISMA flow diagram of evidence source selection.

involvement with scapular pain, as shown in the black portion of the “SCAPULA” category in Fig. 5. This demonstrates that the C7 nerve root level has the highest proportion of scapular pain descriptions in literature compared to all other cervical nerve root levels.

Concurrent pain patterns. Among the 81 papers reporting regional pain distributions (Table 1), the most common concurrent pattern was neck and arm pain (65 papers, 80%), followed by neck and scapula (51 papers, 63%), arm and scapula (49 papers, 61%), and all 3 regions together (74 papers, 58%). Only 2% of studies reported isolated scapular pain without concurrent pain in other regions, while isolated neck pain and isolated arm pain were not reported.

Discussion

Summary of evidence

We mapped the evidence reporting scapular pain in association with cervical radiculopathy regionally and by the level of nerve root involvement. Regions or nerve root levels were not counted where nonpainful symptoms such as paresthesia or examination findings rather than presenting symptoms were described. We found that scapular pain was often reported in scientific literature as a symptom related to cervical radiculopathy.

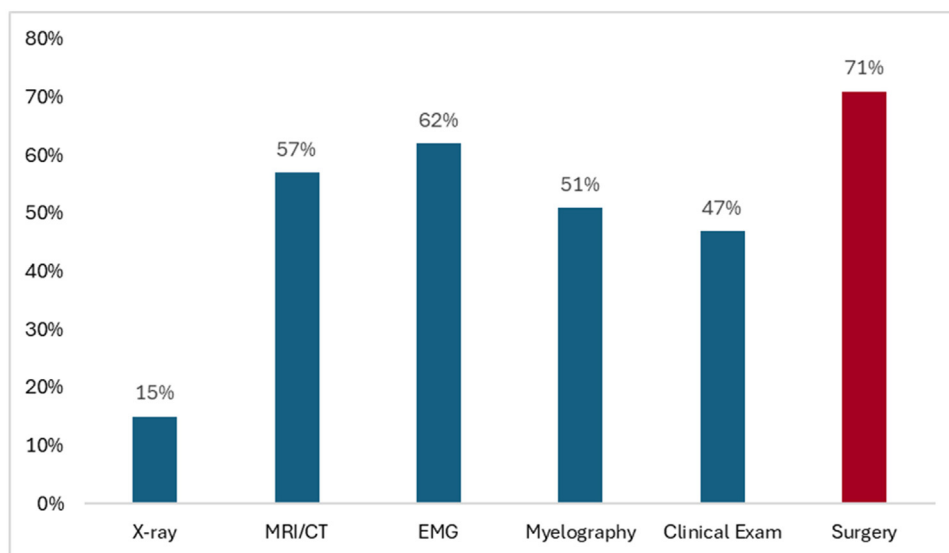


Fig. 2. Methods used to confirm the diagnosis of cervical radiculopathy in the papers reviewed.

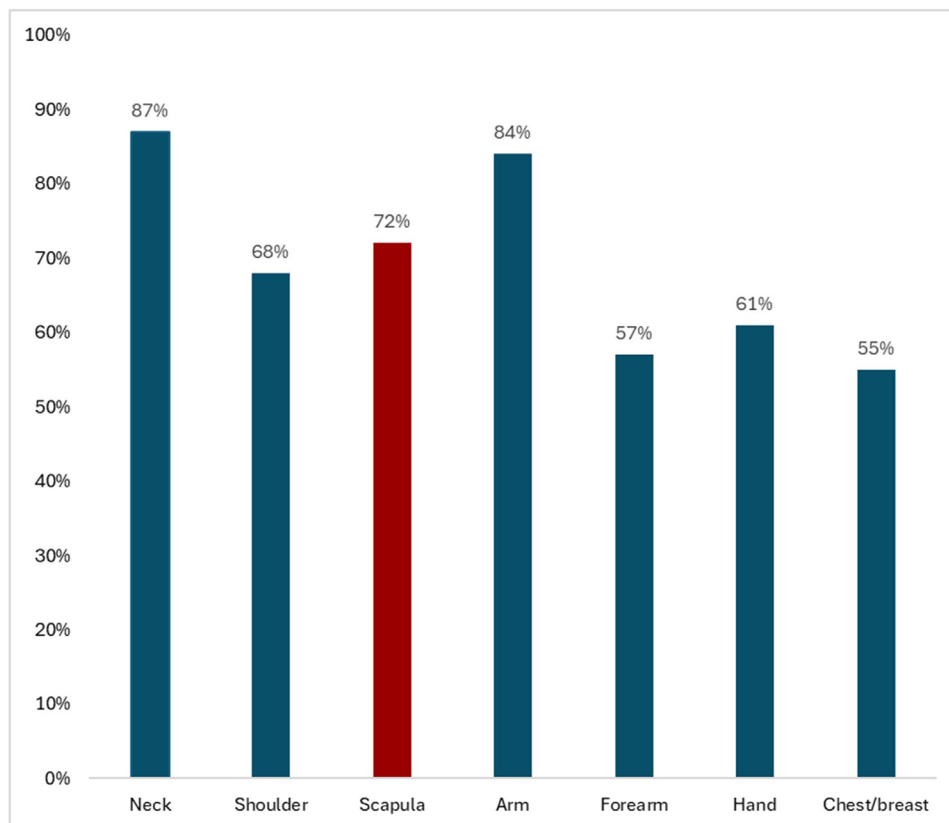


Fig. 3. Percentage of papers reporting pain distributions in cervical radiculopathy, by region.

Radicular pain distributions reported by region

The scapular region is the third most common area of reported pain distribution in literature concerning cervical radiculopathy (Fig. 3). Some evidence proposes that scapular pain may be the first symptom experienced in patients with cervical radiculopathy and that scapular pain from cervical radiculopathy may persist for weeks or months prior to the onset of neck and/or upper extremity symptoms [12]. This suggests that cervical radiculopathy might exist and be clinically diagnosed without arm symptoms. The generally accepted notion

of requisite arm pain for diagnosis was not consistently reflected in our review. Moreover, many studies reported only neck and arm pain without precisely defining the location of these presenting symptoms. Few studies have defined or quantified the anatomic distribution of presenting cervical radiculopathy pain.

Our mapping of the literature is consistent with Bono et al's clinical guidelines, suggesting that the presence of scapular pain has diagnostic utility for cervical radiculopathy [13]. By correlating patient reports of pain distribution in EMG-confirmed cervical radiculopathy, Mizer et al. [21] and Wainner et al. [22] reported that the strongest

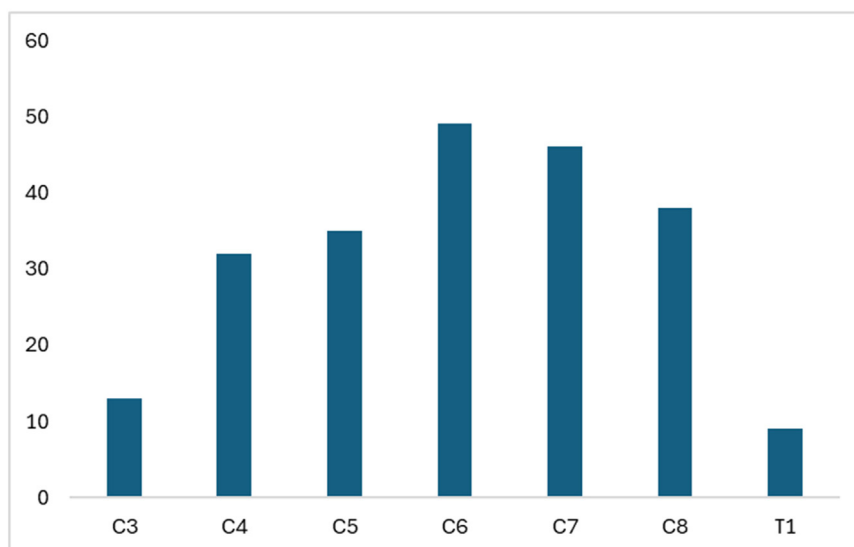


Fig. 4. The number of papers describing radicular pain distributions by nerve root level.

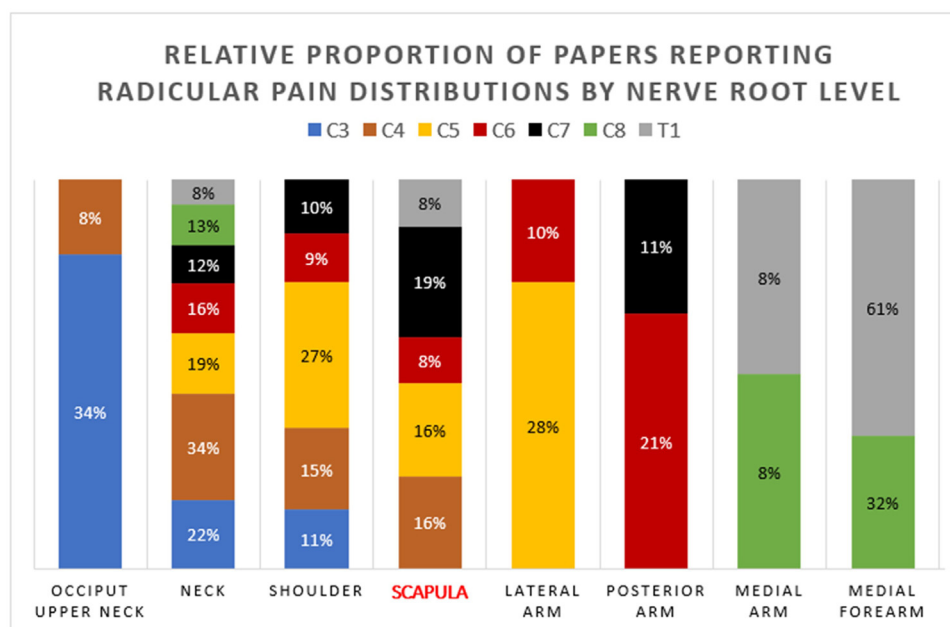


Fig. 5. Percentage of papers reporting radicular pain among the 57 extracted papers that described cervical radicular pain distributions by single cervical nerve root level. The color legend maps cervical nerve root levels by color. The “Scapula” column (in red) refers to scapular, interscapular, and periscapular pain.

posttest probability for the diagnosis of cervical radiculopathy is the complaint of “most bothersome” pain *located in the scapular region* (positive likelihood ratio (+LR = 2.3) *when, concurrently, the pain is favorably modified by neck movement*. The next strongest predictor was neck pain (+LR = 1.90). Considered together, these authors’ observations may have implications for earlier diagnostic opportunities for clinicians who regularly treat cervical disc syndromes, as discussed below.

Radicular pain distributions reported by cervical nerve root level

Sixty-six percent of the extracted evidence sources reported radicular symptoms by cervical nerve root level. Henderson et al. [23] and Murphy et al. [24] reported percentages of scapular pain found in cases of single level nerve root involvement. Henderson et al. reviewed 846 posterolateral foraminotomies performed for cervical radiculopathy and reported that scapular pain was the third most common preoperative

symptom (53% of cases) after arm pain (99%) and neck pain (80%). Murphy et al. reported the percentage of cases associated with scapular pain at each nerve root level. In that study, 40% of C4, 46% of C5, 46% of C6, and 56% of C7 radiculopathies included scapular pain as a presenting symptom.

Mapping the evidence sources by nerve root level yielded papers listing scapular pain at all cervical nerve root levels except C3 and C8 (Fig. 5). However, Bauernfeind et al. [25] provided context for this observation. They reported that only 2% of all cervical radiculopathies involve the C8 nerve root. Mapping of radicular pain distributions by region yielded more detailed insight. Specifically, papers by Tanaka et al. [12] and Mizutamari et al. [26] provided detailed diagrams of scapular pain arising from the C8 nerve root. Therefore, only the C3 nerve root level lacks literature support for its association with scapular pain based on our findings. Like Tanaka’s and Mizutamari’s diagrams, Kang et al. [27] included an illustration showing distinct scapular subregions of pain that correspond directly to single nerve root levels. These studies

Table 1

Concurrent regional pain distribution patterns in cervical radiculopathy literature (n = 81 papers).

Pain distribution pattern	Number of studies	Proportion (%) of papers
Individual region reporting		
Neck	71	88
Arm	69	85
Scapula	58	72
Shoulder	56	69
Hand	50	62
Forearm	47	58
Chest	45	56
Key regional relationships		
Neck + Arm	65	80
Neck + Scapula	51	63
Arm + Scapula + Neck	49	61
Neck + Arm + Scapula	47	58
Most frequent concurrent patterns		
All 7 regions (Neck + Shoulder + Scapula + Arm + Forearm + Hand + Chest)	23	28
Neck + Shoulder + Arm + Forearm + Hand	8	10
Neck + Scapula + Arm + Chest	6	7
Neck + Scapula + Shoulder + Arm + Forearm + Hand	4	5
Isolated region reporting		
Scapula only	1	1
Any other single region only	0	0

suggest that knowledge of these specific distributions of scapular pain may be of diagnostic value.

Implications of our findings for clinical education and practice

Scapular pain at initial clinical presentation in the diagnosis of cervical radiculopathy

In studies reporting the distribution of pain in patients with cervical radiculopathy, the timing of observation may be important. For example, McAnany et al. [28] retrospectively studied 239 single-level surgeries for cervical radiculopathy to characterize pain patterns as either “standard” or “nonstandard.” Ten pain distributions were identified. None of these 10 distributions included scapular, suprascapular, or interscapular symptoms. The key difference between the investigations of McAnany et al. and Tanaka et al. [12] is the timing of the observations. McAnany recorded pain location *at the time of surgical consultation*, which ranged from 19 to 23 weeks *after* the initial onset of pain, whereas Tanaka tracked the evolving pain patterns from the initial onset of cervical radiculopathy, noting progression from the neck to the scapula *first*, with the development of arm and finger symptoms later. This phenomenon should be explored in future prospective studies. Isolated complaints of scapular pain with or without neck or arm pain appeared to represent the first manifestation of cervical radiculopathy.

Utility of presenting scapular pain in localizing the involved nerve root level

Mizutamari et al. [26] and others noted that scapular pain usually precedes upper extremity pain in patients with cervical radiculopathy and that the site of scapular pain may indicate the level of the involved nerve root. This hypothesis is not without dissenting opinion. Nearly 50 years before Tanaka et al., Yoss et al. [16] opined that “the presence of pain in the neck, scapular or interscapular regions, or shoulder is of little value for localization of the level of compression of cervical roots” and added that “arm pain is...of minor importance in so far as accurate localization to 1 root is concerned.” While reinforcing Tanaka’s finding that scapular pain is encountered in cervical radiculopathy, Yoss’s view of the localizing value of presenting pain distributions differed strongly. Prospective diagnostic studies are needed to clarify the answer to this question.

Utility of scapular pain provocation in clinical examination as an early identifier of cervical radiculopathy

A systematic review by Rubinstein et al. [29] in 2007 synthesized the evidence for provocation tests used to diagnose cervical radiculopa-

thy. Since the evidence examining these diagnostic tests was derived from a focus on the reproduction of neck and arm pain in patients with cervical radiculopathy, the reproduction of scapular pain has not been studied. The variable descriptions of Spurling’s test in the literature illustrate this point. Tanaka et al. [12] who, like Mizer et al. [21] and Wainner et al. [22], presented data in favor of scapular pain as a predictor of cervical radiculopathy, reported that a “positive Spurling’s test is pathognomonic for cervical radiculopathy”[11]. In contrast, Anekstein et al. [30] classified a positive Spurling’s test as evoking neck, upper arm, and lower arm pain in patients with cervical radiculopathy. They did not consider the reproduction of scapular pain from Spurling’s test. To fill this gap in knowledge and in literature prospective studies should be conducted to assess the ability of Spurling’s test and other provocation tests to reproduce scapular pain in participants diagnosed with cervical radiculopathy. Future research may elucidate whether an earlier diagnosis of cervical radiculopathy is possible based on the presence of scapular and/or neck pain alone, without arm symptoms, and whether earlier diagnosis may lead to better outcomes and lower costs.

Implications of the findings for future research on cervical radiculopathy

Inclusion/exclusion criteria

A common method used to quantify cervical radiculopathy pain combines neck and arm VAS data. This method constitutes the de facto elimination of scapular pain from consideration in the diagnosis of cervical radiculopathy. Future studies should include, rather than exclude, patients presenting with scapular pain and incorporate a scapular pain VAS.

Document initial symptoms at onset as well as time from onset of symptoms to initial clinical presentation

Future studies should carefully define the anatomic pain distributions used in the selection of participants suspected of having cervical radiculopathy. Additionally, since the presenting pain distribution associated with cervical radiculopathy may change with time, new studies should report the time from initial onset of symptoms to the time of first observation of symptoms.

Mechanistic studies: overlap of radicular and facet pain diagrams

Our review identified a critical issue central to the controversy regarding radiculogenic vs. facetogenic scapular pain: the significant overlap between pain patterns. This overlap is visually evident when comparing facet pain diagrams documented by Aprill [14] and Cooper [31]

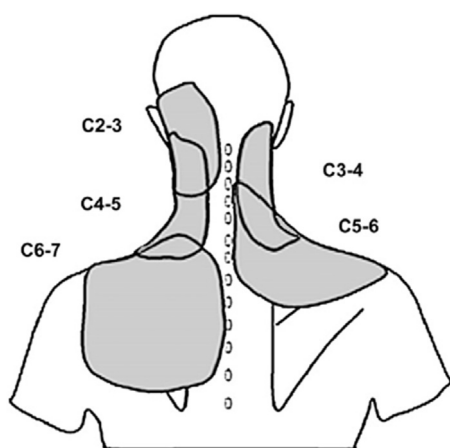


Fig. 6. Facet pain distributions. (References [14,31]; used with permission).

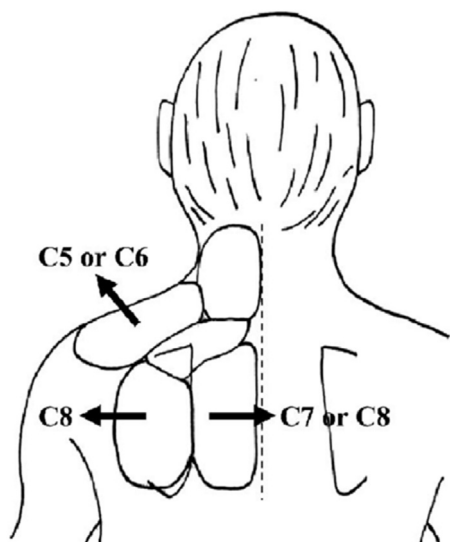


Fig. 7. Radicular pain distributions (References [11,12,26]; used with permission).

[Fig. 6]) with radicular pain diagrams published by Tanaka [12] and others [20,26] (Fig. 7). Although excluded from our formal extraction, Cloward's work [20] provides important mechanistic context by demonstrating that stimulation of the anterior aspect of the annulus fibrosus can reproduce cervical radicular pain patterns. This finding aligns with Bogduk's early research [32], which identified the sinuvertebral nerve, a branch of the *ventral* ramus of the cervical spinal nerves, supplying the outer layers of the annulus fibrosus. Despite decades of investigation, Bogduk later acknowledged that "surprisingly...little is known about the causes and mechanisms of cervical radicular pain" [6].

In what may represent an overlap of pain-generating phenomena, Nevalainen et al. [33] reported a clinically significant association between the presence of bone marrow edema of the cervical facets and radicular symptoms. More recently, Kim et al. [34] reported that sinuvertebral and basivertebral nerve pain often present with patterns indistinguishable from radicular pain, demonstrating that radiofrequency ablation of these nerves effectively reduced discogenic pain [35,36]. Mizutamari et al. [26] further complicate this picture, showing through dissection that the *dorsal* ramus of cervical spinal nerves changes to cutaneous nerves that descend into the scapular region. While Kim's work focused on the role of the *ventral* ramus in disc innervation, the *dorsal* ramus and its medial branch have long been implicated in facet-mediated scapular pain [37].

Since facet and radicular pain overlap in several domains, the interplay between the dorsal and ventral rami, their communicating branches, and neural terminations requires further investigation. Our findings highlight a significant gap in distinguishing between unique and overlapping pain pathways in cervical radicular and facetogenic scapular pain. There is considerable opportunity for mechanistic research focusing on human cervical discs, facet joints (Appendix 5, Supplementary Materials), and their associated neural and connective tissues to better understand their roles in pain generation.

Strengths and limitations

The strengths of this study include the vigorous, systematic scoping review methodology used to map the existing evidence base and the comprehensive search strategy developed by the study team, which included a professional librarian searcher and investigators at 3 major academic universities on 2 continents. The scoping review protocol was registered to reduce research redundancy. We employed the JBI framework and the PRISMA-ScR checklist to guide this study.

Given the concept and context defining the scope of our literature search, we did not plan or conduct risk of bias or sensitivity analyses. Many of the selected studies had small sample sizes. Several others included sampling bias, using scapular pain as an exclusion criterion. One paper specifically *included* scapular pain as a primary topic of study, so the presence of scapular pain was a necessary inclusion criterion. These biases may have skewed the proportion of papers that included scapular pain in the diagnosis of cervical radiculopathy. However, since cervical radiculopathy has been popularly characterized as "neck and arm pain only" and many studies have not assessed the distribution of pain other than the neck and arm, any skew of data is likely biased against scapular pain. This may be due to the tendency for patients with cervical radiculopathy to enroll in a clinical study only after their pain has proven refractory to acute-phase care. Since scapular pain may most often occur early in the evolution of cervical radiculopathy, study enrollment later during this period may fail to coincide with the window of scapular pain. Importantly, few studies have assessed the evolution of pain in patients with cervical radiculopathy; more studies are needed.

Conclusions

Scapular pain of cervical nerve root origin had been described in the literature since at least 1957 [38]. The results of this review indicate that scapular pain could be a manifestation of cervical radiculopathy even in the absence of arm pain. Controversy persists regarding whether scapular pain improved by neck movement may increase the diagnostic likelihood of cervical radiculopathy. Future research addressing cervical radiculopathy should 1) carefully define the initial symptoms and anatomic pain distributions among participants; 2) include participants who present with scapular pain; 3) avoid using arm pain as a necessary inclusion criterion; and 4) determine whether the presence of scapular pain in patients with cervical radiculopathy affords a diagnostic and/or therapeutic advantage.

Summary of findings and implications of this manuscript

This scoping review of 86 studies (1957–2022) demonstrates that scapular pain is a common feature of cervical radiculopathy (72% of studies), ranking third behind neck (88%) and arm (85%) pain. Findings challenge the clinical assumption that arm symptoms are necessary for diagnosis, as evidence suggests scapular pain may precede arm pain by weeks. The C7 nerve root shows the strongest association with scapular pain. These insights could enable earlier diagnosis of cervical radiculopathy when isolated scapular pain is present. Future research should document symptoms at onset, define comprehensive pain distributions, and investigate whether recognizing scapular pain improved by

neck movement creates opportunities for earlier diagnosis and therefore more specific and effectual intervention in cervical radiculopathy.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this revised work the authors used Claude 3.7 Sonnet, a large language model (LLM) developed by Anthropic. The LLM was used to identify spelling, grammar, and redundancy errors, and to assist in reducing word count, while after using this tool the authors made all content decisions with review and editing, performed analyses, and drew interpretations. The authors take full responsibility for the content of the publication. This use of AI assistance is disclosed in accordance with the principles of scientific transparency and pursuant to the policy of the *NASS Journal*.

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Declarations of competing interests

One or more of the authors declare financial or professional relationships on ICMJE-NASSJ disclosure forms (JC Level B, KAW's institution received Level I, SR's institution received Level E).

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.xnsj.2025.100619](https://doi.org/10.1016/j.xnsj.2025.100619).

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