Stop Guessing: A Clinicians Guide to Demystify Spine-Related Arm Pain in Primary Care

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Abstract:

Pain in the arm could arise from a wide range of conditions, from non-specific musculoskeletal disorders to serious spinal pathology. Spine-related arm pain (SAP), i.e. pain that is best explained by processes in the spine or spinal nerves, poses a particular diagnostic challenge in primary care due to its diverse overlapping symptoms and evolving presentations.

This paper proposes a structured, literature-informed, consensus-based guide to assist clinicians in classifying SAP according to predominant pain mechanisms and stratifying the level of clinical concern. The guide takes the form of a diagnostic algorithm derived from contemporary frameworks, including the terminology and mechanistic descriptors of the criteria of International Association for the Study of Pain and the recommendations of the Neuropathic Pain Special Interest Group. It is illustrated through three hypothetical clinical scenarios that demonstrate how the algorithm can be applied to integrate subjective and objective findings, including mandatory neurological examination and ongoing safety-netting. The algorithm is intended as a pragmatic knowledge-translation and educational tool to support mechanism-based reasoning, improve confidence in managing SAP in primary care, and help students and early-career clinicians navigate its diagnostic complexity.

Introduction

Neck pain is frequently classified as non-specific, as it is often not possible to attribute pain symptoms to a single anatomical structure (Blanpied et al., 2017; Bogduk, 2009). In some cases, however, the pain may be considered specific when a clear underlying mechanism is identified, such as in painful radiculopathy (Schmid et al., 2023).

To reduce terminological ambiguity and improve clinical reasoning, the Neuropathic Pain Special Interest Group (NeuPSIG) has recommended the term *spine-related arm pain* (SAP) for pain best explained by processes in the spine or spinal nerves. This terminology avoids the misnomer "*cervicobrachialgia*" (Schmid et al., 2023) and encourages a mechanism-based approach to classification (Schmid et al., 2023). In particular, it distinguishes three predominant categories: somatic-referred pain, radicular pain without radiculopathy, and painful radiculopathy, because these mechanisms may respond differently to treatment and carry distinct prognostic and safety implications (Bogduk, 2009; Schmid et al., 2023).

In routine primary care, insufficient or inaccurate identification of SAP can lead to delayed, and suboptimal treatment (Dove et al., 2023; Lascurain-Aguirrebeña et al., 2024; Schäfer et al., 2009). Sub-optimal diagnostic skills can be further amplified by clinical insecurity (e.g., lack of training or experience) or diagnostic uncertainty (Alam et al., 2017; Almond et al., 2021). Moreover, when clinicians are confronted with SAP diagnosis, uncertainty can hinder decision-making, especially when they face overlapping symptoms and evolving presentations without clear clinical indicators (Meyer et al., 2021; Santhosh et al., 2019). This uncertainty is not inherently problematic, but without a structured reasoning process, it can hinder timely recognition of serious pathology, appropriate referral, and safe trials of conservative care. Moreover, nominative diagnoses such as cervicobrachialgia may mislead clinicians in their decision-making (Karayannis et al., 2016).

Over the last decade, several strands of literature have emerged that are highly relevant to SAP, including: (1) framework-based classification of SAP and associated somatosensory profiles (Tampin et al., 2019); (2) consensus-based criteria for neuropathic pain in people with spine-related leg pain (Schmid et al., 2023); and (3) international frameworks for red flags and levels of concern for serious spinal pathology (Finucane et al., 2020). However, these resources are dispersed across guidelines, consensus statements, and research papers, and may be difficult for busy clinicians and students to integrate into day-to-day reasoning.

This article introduces a literature-informed, consensus-based diagnostic guide for SAP that synthesizes these contemporary frameworks into a pragmatic clinical reasoning tool. The guide adapts recommendations for neuropathic pain in individuals with spine-related leg pain (Schmid et al., 2023) to the context of arm pain, applying the principles of radiculopathy described for the lower limbs. It incorporates also concepts from the International Federation

of Manual and Musculoskeletal Physical Therapists (IFOMPT) and the International Framework for red-flag screening and levels of concern. It is illustrated through three hypothetical clinical scenarios that systematically grade both subjective and objective findings, including obligatory neurological examination. The aim is *not* to present a validated decision rule *or* to demonstrate outcome effectiveness, but *rather* to translate current mechanistic and safety-oriented evidence into a structured approach that can support clinical reasoning.

Within the broader paradigm of evidence-based practice, which combines best available research evidence, clinician expertise, and patient values, the present work focuses on the integration of existing evidence and expert-derived frameworks into clinical reasoning. By explicitly acknowledging that acceptance of diagnostic uncertainty is inherent to practice and the limitations of single clinical tests, the guide encourages iterative hypothesis refinement, ongoing neurological surveillance, and use of safety-netting strategies. Beyond its clinical relevance, it is intended as an educational resource to help students and early-career clinicians navigate the diagnostic complexity of SAP and to foster transparent, mechanism-based decision-making in primary care.

Subjective examination

To build on our structured approach, this article outlines how clinicians may approach arm pain during an initial primary care consultation. In clinical practice, however, the evolution of symptoms and the patient's capacity to manage everyday activities should be monitored continuously. Treatment, explanations, and prognosis must be adjusted accordingly, as theoretical frameworks serve only to guide evidence-based decision-making. Ultimately, clinicians should maintain ongoing vigilance through watchful waiting and safety-netting strategies to facilitate early recognition of potentially concerning developments (Hutting et al., 2018, 2023).

The three hypothetical clinical scenarios

Figure 1. shows three body charts showing the hypothetical neck and arm pain scenarios that will be developed in the clinical reasoning algorithm.

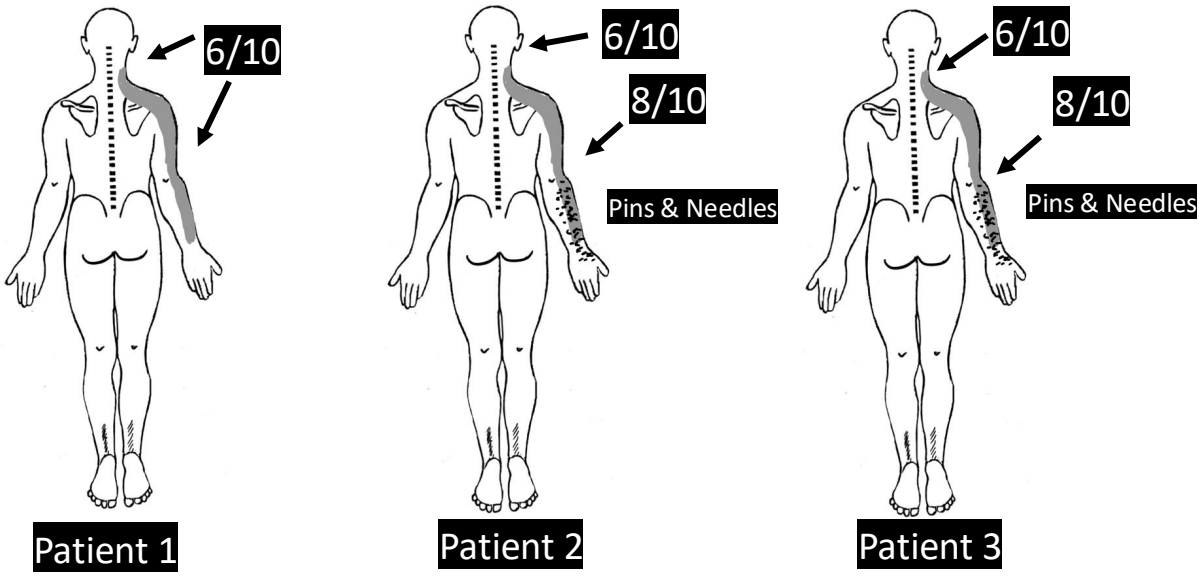


Figure 1. Three body charts describing the spatial distribution of spine-related arm pain.
These three body charts appear similar at first glance, but certain features separate them and helps the clinician use the categorical approach to identify SAP. Intensity of the pain is assessed on numerical pain rating scale. Patients 2 and 3 both report "pins and needles" in the forearm.

Ruling out other causes of pain that may be related to serious pathologies

Red flags or serious pathology?

The term *red flags* refer to clinical indicators that may suggest an underlying serious pathology. However, their diagnostic value is limited when interpreted in isolation, as single red flag neither confirm nor exclude serious disease (Feller et al., 2024). Consideration of red flags must be part of a broader clinical reasoning process aimed at estimating the likelihood of serious or specific pathology. Recent literature reframes red flags as signs or symptoms that heighten clinical suspicion for life-threatening or disabling conditions requiring timely medical attention, such as malignancy, infection, fracture, or cervical myelopathy (Finucane et al., 2020; Storari et al., 2025).

Ruling out the suspicion of serious pathology and use the concept of level of concern

Recognition of clinical signs and symptoms should be integrated within a broader reasoning process rather than used as a checklist (Feller et al., 2024). Serious pathologies are considered relatively uncommon in primary care (≈2.3%) and occur more frequently in older adults and those with comorbidities (Budtz et al., 2021). Clinicians should therefore stratify risk based on the level of concern to guide safe management and referral decisions (Peterson & Heick, 2023). Building on the IFOMPT framework (Finucane et al., 2020) and its adaptation to the cervical spine (Hutting et al., 2018, 2023), our guide that takes the form of an algorithm integrates mechanism-based reasoning (i.e. description of the subjective and objective examination) and structured neurological assessment to enhance the identification of specific spinal mechanisms underlying neck-related arm pain (Kapitza et al., 2025; Yousif et al., 2025).

Differentiation by predominant pain category for SAP

With regard to the three scenarios (neck and arm pain), after ruling out serious pathology (e.g. fracture, infection, central neurological disorder, vascular pathology and rheumatological disease as the primary driver of arm pain), clinicians can differentiate SAP into three predominant categories (Schmid et al., 2023), each with specific signs and symptoms, that can assist management decisions. While there will be some overlap between interventions used for each category, they should be able to guide clinicians towards a "tool-box" that is more appropriate based on the dominant mechanism (Hoegh & Hodges, 2025; Schmid et al., 2023). The predominant pain categories are described in the following sections, but for more details please refer to (Fourré et al., 2022; Hage et al., 2023).

Category 1: Somatic-referred arm pain

SAP originating from somatic-referred pain is associated with nociceptive input (Luz et al., 2015) from cervical structures (such as facet joints, ligaments, muscles, or the outer portion of the intervertebral disc) without axonal sensory and/or motor compromise (Jin et al., 2023; Kapitza et al., 2020).

Category 2: Radicular pain without radiculopathy/objective neurological deficit

Radicular pain without radiculopathy is consistent with nerve-root involvement without objective neurological deficit (normal strength, sensation, and reflexes on examination). Radicular pain without radiculopathy is believed to originate from mechanical, chemical, or ischemic irritation of the nerve root or dorsal root ganglion, leading to ectopic discharges and transient hyperexcitability without structural damage (Kapitza et al., 2025; Schmid et al., 2023). Electrophysiologically, axonal sensory and/or motor conduction remains intact within a spinal nerve or its roots (Mallik, 2005). It implies that clinically, no objective loss of sensory, motor, or reflex function is observed, indicating a nerve root "irritation" rather than structural nerve damage (Schmid et al., 2020).

Category 3: Radicular pain with radiculopathy/objective neurological deficit

Radicular pain with radiculopathy is consistent with a nerve-root pattern with objective neurological deficit.
Electrophysiologically, an impaired axonal sensory and/or motor conduction is observed within a spinal nerve or its roots (Lam et al., 2021; Lam et al., 2022; Mallik, 2005; Schmid et al., 2023). Clinically, when pain coexists with these neurological signs, the condition may be referred to as "painful radiculopathy". It is also commonly known as a nerve root "compression" (Scholz et al., 2019; Takahashi et al., 1999).

In this framework, the practical clinical differentiator between Category 2 and Category 3 is the presence (Category 3) or absence (Category 2) of objective neurological deficit on examination (i.e., reproducible myotomal weakness, dermatomal sensory loss, and/or reflex change). Accordingly, the distinction is not based on presumed 'compression' versus 'irritation', which may coexist, but on examination findings indicating impaired nerve function.

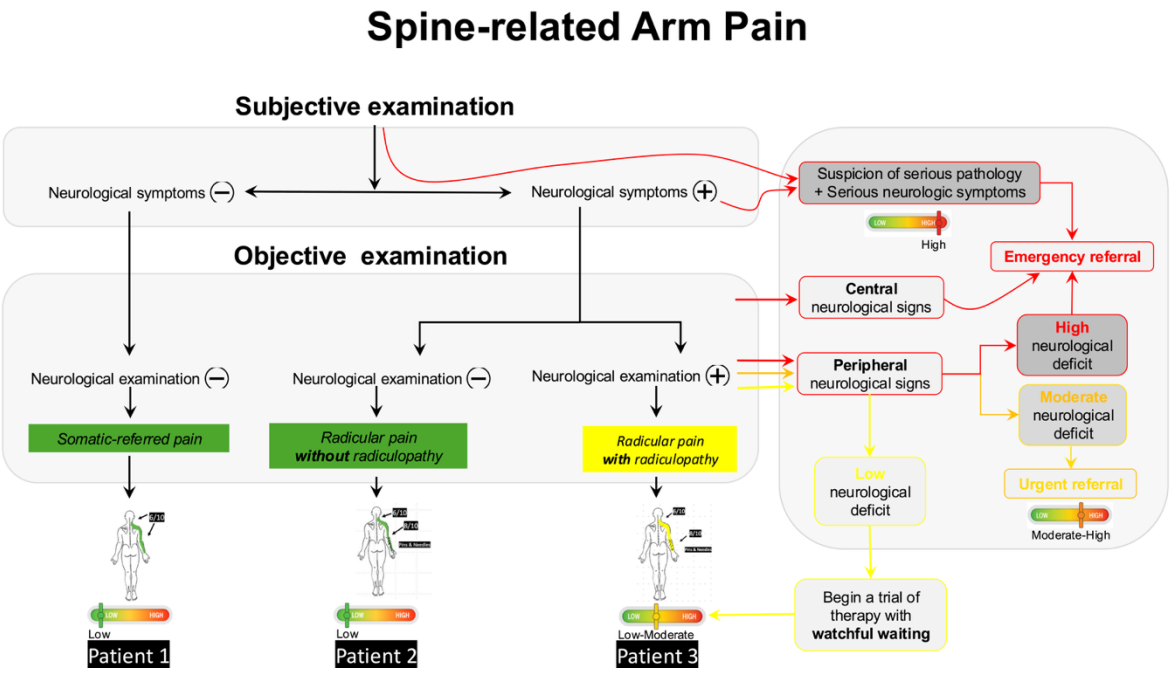


Figure 2. Clinical reasoning algorithm for the assessment and management of spine-related arm pain.

This algorithm serves as a clinical and educational tool to reduce diagnostic uncertainty and promote confident, mechanism-based decision-making in primary care. It identifies the predominant pain category in SAP, distinguishing between somatic-referred pain, radicular pain without and with radiculopathy based on integrated findings from the subjective and objective examination with a particular emphasis on neurological components. It supports decision-making at the time of assessment and does not imply that early presentation is associated with poorer natural course or prognosis. It helps determine the level of clinical concern in SAP and guides clinicians through a structured, dynamic process that incorporates continuous reassessment using clinical reasoning. The three illustrated cases (Patients 1, 2, and 3) correspond to the hypothetical clinical scenarios presented in Figure 1 and demonstrate how quasi-similar or similar pain distributions may reflect distinct underlying mechanisms (Categories 1, 2, and 3).

The colors used for the full lines are inspired by Finucane et al. (Finucane et al., 2020) to illustrate the level of concern, i.e, clinical vigilance at that step and does not represent prognosis. In green : low concern; in yellow : low/moderate concern; in orange: moderate/high concern; in red: high concern. *Low* deficit means radiating pain only or combined with dermatomal sensory loss. *Moderate* means mild myotomal weakness (4/5 on the MRC (MRC = Medical Research Council grading scale) with combined altered deep tendon reflexes (clinical urgency depends on the onset, progression, and associated neurological deficits rather than on the loss of reflex alone (Morimoto et al., 2024)). Note that while this reference pertains to the lumbar spine, the underlying logic applies equally to the cervical spine. *High* means severe myotomal weakness and/or altered deep tendon reflexes (MRC ≤3/5 or multi-root). Vertical pathways represent mandatory assessment steps (subjective/ objective/ neurological examination), and the horizontal pathways indicate the levels of concern and do not, by themselves, indicate potential referral. Escalation (yellow, orange and red) is determined at the decision nodes when red-flag features or objective neurological deficits are identified.

Neurological indicators, such as dermatomal sensory loss, myotomal weakness, with altered deep tendon reflexes, may prompt a reclassification of the concern level and a reassessment of the care pathway (Yousif et al., 2025). While individual neurological tests may vary in diagnostic accuracy, their systematic use in all patients presenting with SAP (caution regarding potential deterioration), enhances both safety and diagnostic precision (Bender et al., 2023; Finucane et al., 2020) (for more details see Fig 3). Urgent referral is mandatory for severe or progressive objective neurological deficits (particularly motor), suspected multi-root involvement,

or red flags. Stable isolated mild myotomal weakness (MRC 4/5), even with reduced reflexes, does not by itself mandate urgent referral. Escalation to urgent referral depends on rapid progression over a few days, worsening motor deficit, associated neurological deterioration, or suspected multi-root involvement. Urgent referral means that the patient should be referred to a physician or specialist within a few days to two weeks. This concept has been added to our algorithm to demonstrate the importance of the referral process, as McCartney (McCartney et al., 2018) specifies that the patient should be referred for imaging or evaluation by a specialist if there are early signs of neurological abnormalities. Emergency referral means that the patient must be referred immediately to emergency medical services (< 24h).
The algorithm integrates subjective and objective findings (with levels of concern shown on the right side of the figure) that should be understood as a grading system, including an obligatory neurological examination (here, negative and positive signs mean that the neurological examination was performed but appears negative or positive), to determine whether physiotherapy is appropriate or whether referral is required. It is important to note that, by neurological test, we are simplifying and implying the use of the grading system developed by Finnerup et al. (Finnerup et al., 2016).

How to differentiate the three hypothetical scenarios during subjective evaluation?

Following the initial screening, the clinician's objective is to determine the most plausible pain category (somatic-referred, radicular with or without radiculopathy) by correlating the patient's symptom narrative with established clinical patterns while maintaining vigilance for early or subtle indicators of serious pathology and loss of neurological function (see Figure 2. lateral right part) (Grieve, 2025). A comprehensive subjective examination synthesizes information on pain characteristics, symptom behavior, and general health to refine diagnostic hypotheses. Beyond pain intensity alone, patient-specific descriptors can offer critical insight into the underlying pain mechanism (Bates et al., 2019; Lam, Heneghan, Mistry, Ojoawo, Peolsson, Verhagen, Tampin, Thoomes, Jull, Scholten -Peeters, et al., 2022). This is particularly relevant because, in a screening cohort of patients presenting with cervicobrachial/shoulder-arm pain, Gangavelli et al. (Gangavelli, 2016) reported neurogenic involvement in 19.9% of cases (i.e., 80.1% classified as non-neurogenic). While the exact proportion is sensitive to diagnostic criteria and screening approach, estimates from related shoulder-pain cohorts using validated neuropathic pain screening tools similarly suggest that neuropathic/neuropathic-like pain is present in a minority of patients (approximately 10–20%) (Karasugi et al., 2016; Ko, 2018; Ucar et al., 2022). Consequently, subjective findings must be interpreted within the broader clinical context to guide objective assessment and clinical decision-making.

Table 1. Subjective examination: Key elements to support initial hypotheses for the three hypothetical SAP scenarios (Hage et al., 2023; Shraim et al., 2022; Smart et al., 2010, 2011). The most important elements that differentiate the three patient scenarios shown in Figure 2. are highlighted in bold in the table.

<table>
<tr><td>Item</td><td>Patient 1</td><td>Patient 2</td><td>Patient 3</td></tr>
<tr><td>Preliminary level of concern</td><td colspan="3">No serious systemic or neurological symptoms are reported. No immediate referral is required. However, the presence of sensory disturbances in patients 2 and 3, and early motor signs in patient 3, warrants a full objective and neurological examination. Since patient 1 has radiating symptoms, she/he must also undergo a complete objective and neurological examination.</td></tr>
<tr><td></td><td>Patient 1</td><td>Patient 2</td><td>Patient 3</td></tr>
<tr><td>Subjective assessment</td><td rowspan="2">Reports acute neck pain radiating to the arm and forearm, without a clear dermatomal distribution. Pain intensity: 6/10 (NPRS*). Described as intermittent, dull-to-sharp, and mechanical. Aggravated by prolonged sitting, cervical extension or head rotation to the right. Pain subsides rapidly when returning to a neutral position, showing a clear mechanical/on-off pattern. No sensory or motor deficits reported.</td><td colspan="2">Reports neck pain (6/10*) extending to the arm with greater intensity (8/10*). The pain is described as vague, unpleasant, and dysaesthetic. Symptoms include tingling, burning, and electric shock-like sensations in the arm, with a distribution that appears neuroanatomically plausible.
Pain is unpredictable, sometimes spontaneous, and takes longer to subside. It is felt more intensely distally (arm > neck). Symptoms may be aggravated by movements such as getting out of a car or maintaining prolonged cervical flexion. Pain may also occur during head extension or lateral flexion (e.g., household or overhead activities), during driving maneuvers such as parking, or at night when sleeping in positions that place the cervical spine in sustained extension (e.g., with a low or flat pillow) (E. Thoomes et al., 2023).</td></tr>
<tr><td>Reports sensory symptoms limited to the forearm; for example, pins and needles, which may suggest gain-of-function symptoms and may lead the clinician to consider radicular pain(Kapitza et al., 2025).
No difficulty reported in gripping objects with the hand (i.e. no motor impairments).</td><td>Reports sensory symptoms limited to the forearm; subjective numbness and electric shock-like sensations may lead the clinician to consider radiculopathy (Kapitza et al., 2025).
Reports also upper-limb fatigue after prolonged neck-related activities (e.g., computer work), and some difficulty gripping objects (i.e. motor impairments), although daily activities remain manageable.</td></tr>
</table>

Interpretation of key features	Symptoms are consistent with somatic-referred pain, linked to a nociceptive mechanism. **The clear aggravating/easing pattern, lack of a specific radicular distribution, and absence of neurological signs support this hypothesis.**	Symptoms suggest a *possible* radicular pain *without* radiculopathy. The presence of dysaesthesia and spontaneous pain, in the absence of motor deficits, supports this interpretation: **these findings are subjectively reported but require objective confirmation. This presentation may correspond to criteria 1 and 2 of the grading system for neuropathic pain in individuals with spine-related limb pain.** (Schmid et al., 2023).	Symptoms are consistent with a *possible* radicular pain *with* radiculopathy. **The combination of sensory changes and emerging motor difficulties increases the likelihood of nerve root involvement; these findings are currently subjective and require objective confirmation. This presentation may correspond to criteria 1 and 2 of the grading system for neuropathic pain in individuals with spine-related limb pain.** (Schmid et al., 2023).
First hypothesis	Somatic-referred origin	*Possible* radicular pain without radiculopathy seems more plausible, although radiculopathy cannot yet be excluded.	*Possible* radicular pain with radiculopathy seems to be plausible

*NPRS= numerical pain rating scale. Examples are inspired by the Patient-Specific Functional Scale (PSFS) items reported by Thoomes et al. (2023)

How to differentiate the three hypothetical scenarios during objective evaluation?

The objective examination aims to confirm or refute the pain mechanisms hypothesized during the subjective assessment through observation, cervical motion testing, neurodynamic assessment, and most importantly, a comprehensive neurological examination (Bender et al., 2023; E. J. Thoomes et al., 2026; Yousif et al., 2025). All physiotherapists should apply the principle that, in cases of arm pain, neurological testing is recommended even in the absence of overt neurological symptoms, to detect subtle or evolving radiculopathies.

For greater convenience the key elements of the objective evaluation of the scenario are presented in table form.

Table 2. Objective Examination: Key elements to confirm or refute the initial hypotheses in the three hypothetical SAP scenarios (Bates et al., 2019; Haanpää et al., 2011; Hage et al., 2023; Lam, et al., 2022). The most important elements that differentiate the three patient scenarios are shown in Figure 2 and highlighted in bold in the table.

	Patient 1	**Patient 2**	**Patient 3**
OE	Active neck movements reveal that neck and arm pain **(without neurological symptoms such as tingling)** increases during extension and right rotation, with a limited range of motion. Upon returning to the neutral starting position, the pain diminishes rapidly. This pattern may correspond to findings from the evaluation of passive physiological intervertebral movements: pain is localized at a specific vertebral level and radiates toward the forearm—for example, at C5–6 during right unilateral posteroanterior mobilization—and then fades quickly. In this patient, although a neuropathic pain mechanism is not the primary hypothesis, a neurological examination remains essential when arm pain is reported, to ensure that the nervous system is functioning normally. Clinicians should	Active neck movements, such as extension and right rotation or right lateral flexion, may **provoke unpleasant sensations (e.g. tingling, pins and needles),** with radiating pain from the neck to the arm often becoming more pronounced during these motions. Active movements also confirm that returning to the neutral (starting) position gradually reduces pain. **Given the reproduction of neck and arm pain during extension and right cervical lateral flexion,** the Spurling test was carried out (Shabat et al., 2012; E. J. Thoomes et al., 2026) and yielded a positive result. **The neurological examination reveals no abnormalities. Reflexes, sensory testing, and muscle strength were all within normal limits, indicating the absence of objective neurological impairment at the time of assessment.**	Active movements elicited a pain pattern similar to that observed in patient 2. **However, neurological examination revealed mild sensory disturbance in the lateral arm (hypoesthesia to pinprick), with no motor or reflex *deficit. Additionally,* the Spurling and neurodynamic test were both positive.** This presentation may correspond to criterion 3 of the grading system for neuropathic pain in individuals with spine-related arm pain (Schmid et al., 2023).

	remain attentive to any changes in symptomatology and conduct further investigations if neuropathic features emerge during follow-up. **In this scenario, the patient's neurological examination was negative.**	However, the Spurling test and neurodynamic assessment were positive (the ULNT1 test reproduced the patient's symptoms (pain and unpleasant sensation in the forearm) with positive structural differentiation).	
Integrated hypothesis (SE+OE)	Somatic-referred pain confirmed	Probable radicular pain without radiculopathy confirmed by a negative neurological examination (Schmid et al., 2023).	Probable radicular pain with radiculopathy confirmed without confirmatory test (e.g. imaging) (Schmid et al., 2023).

SE= subjective examination; OE= objective examination. Neurodynamic tests are highlighted to emphasize their limited reliability as stand-alone indicators for diagnosing radiculopathy. They may produce false positives in the absence of radiculopathy *(Koutsoflini et al., 2025)*) or false negatives despite confirmed radiculopathy *(Baselgia et al., 2017).* This aligns with prior research showing negative neurodynamic findings even in severe radiculopathy, reinforcing that these tests should not be used in isolation to assess nerve involvement or damage.

Level of concern related to neurological findings

In line with Figure 2 showing different possibilities for levels of concern following neurological examination, Table 3 presents three different scenarios that may require different levels of concern.

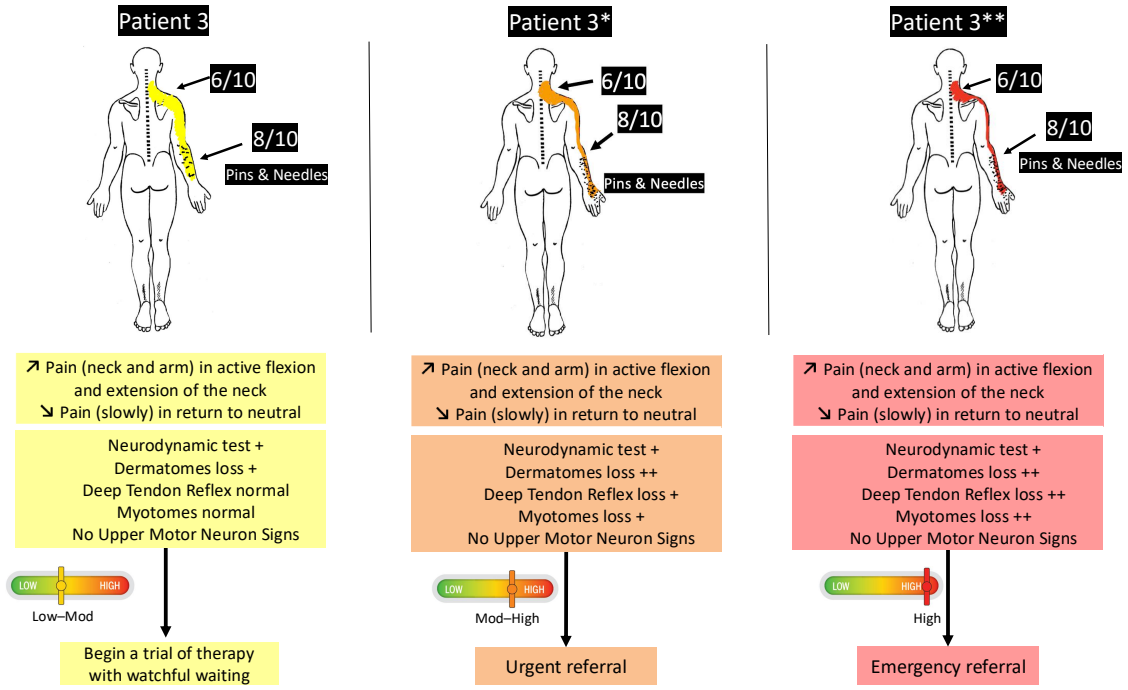
Table 3. Stratification of level of concern for Patient 3 (radicular pain with radiculopathy without suspicion of any serious pathology).

Scenario	Neurological Profile	Level of Concern	Clinical Action
Patient 3	Mild sensory disturbance only. No motor or reflex change. Neurodynamic test+	Low-moderate	Physiotherapy management appropriate. Monitor with safety-netting and reassess for progression.
Patient 3*	Rapidly progressive C6-pattern sensory loss, reduced biceps/brachioradialis reflex, and new mild C6 myotomal weakness (e.g., elbow flexion/wrist extension MRC 4/5) over a few days. Neurodynamic test+	Moderate-high	Possible urgent referral to a general practitioner for medical opinion or co-care (ideally within < 5 days), depending on careful neurological monitoring (if neurological deterioration occurs).
Patient 3**	Profound C6–C7 sensory loss/anesthesia, absent biceps and/or triceps reflexes, and marked C6–C7 myotomal weakness (e.g., elbow flexion, wrist extension, or elbow extension MRC ≤3/5), suggesting severe or multi-root involvement. Neurodynamic test+	High	Emergency: immediate referral required to avoid permanent neurological impairment.

The stratification of concern for patient 3, presenting with radicular pain with radiculopathy and showing positive neurological findings, aligns with the three illustrative clinical variants (Patients 3, 3*, 3**) and demonstrates how neurological examination results assess risk and guide clinical decisions in SAP, particularly for patients at risk of deterioration (see also Figure 2, right part, referring to positive neurological examination). The continuum ranges from mild, non-progressive sensory change (low–moderate concern) to severe or progressive multi-root deficits (high concern/emergency) see the color coding in the table. Multi-root deficits

could be considered as more than one neurological level: e.g. C6 (elbow flexors and wrist extensors) + C7 (elbow extensors and wrist flexors). While many patients improve within 6-8 weeks, rapid neurological deterioration occurring within a few days should lead to urgent referral (ideally within 5 days) to a general practitioner for medical opinion or co-care. Levels of concern concerning neurological examination and clinical actions are adapted from the concept of Finucane et al. (Finucane et al., 2020; Hutting et al., 2023) and aligned with American College of Radiology, World Federation of Neurosurgical Societies Spine Committee and Belgian Health Care Knowledge Center recommendations (Costa et al., 2024; McDonald et al., 2019; van Wambeke et al., 2020). The World Federation of Neurosurgical Societies further emphasizes that urgent referral (patient 3*) is warranted in cases of rapidly (few days) progressive deficits or multi-root involvement to prevent irreversible neurological impairment (Costa et al., 2024). Stable mild weakness alone (e.g., isolated MRC 4/5), even when accompanied by reflex reduction, does not automatically require urgent referral. In contrast, urgent referral is warranted when neurological deficits are rapidly progressive over a few days, when motor weakness is worsening, or when findings suggest multi-root involvement. Moreover, Kwon et al. (2025) reported that 26.9% of patients presenting with grade ≥4 motor weakness at the initial consultation did not recover, with poorer outcomes observed in older patients, particularly those aged 65 years or above (Kwon et al., 2025). International guidelines (largely extrapolated from lumbar radiculopathy) recommend specialist referral primarily in cases of *suspected serious pathology, severe or progressive motor deficits* (patient 3**) *(≤3/5 on the* Medical Research Council *scale), or persistent/worsening symptoms after 4–6 weeks of evidence-based conservative management* (Apeldoorn et al., 2024; Bernstein et al., 2017; McDonald et al., 2019; van Wambeke et al., 2020). Neurodynamic tests are highlighted to remind clinicians that they are *not reliable indicators* for determining the level of concern (Baselgia et al., 2017; Koutsoflini et al., 2025), as they may yield positive results across all three concern categories with similar frequency (Apelby-Albrecht et al., 2013; E. J. Thoomes et al., 2026). MRC = Medical Research Council grading scale.

Figure 3. Clinical reasoning based on objective examination for radicular pain with radiculopathy (without suspicion of any serious pathology): stratification of level of concern in primary care for patient 3.



This figure shows how neurological findings help assess risk and guide clinical decisions for patients with SAP during neurological examination, particularly those at risk of deterioration.
This figure illustrates how neurological findings influence risk stratification and clinical decision-making in cases of SAP involving radicular pain with radiculopathy. Although Patients 3, 3*, and 3** present with similar symptom distributions (i.e. pain that increases/decreases), their neurological profiles differ in severity, ranging from mild to profound deficits, highlighting the continuum of clinical concern. Importantly, radiculopathy may also arise from serious pathology such as vertebral fracture, infection, neoplasm (Kang et al., 2020; Radhakrishnan et al., 1994) and should not be misinterpreted with the early signs of degenerative cervical myelopathy, which initially presents with a more diffuse bilateral neurological picture (Cervellini et al., 2025; Cohen & Hooten, 2017). Patient 3 demonstrates minor sensory changes without motor or reflex involvement, allowing for physiotherapy management with close monitoring and safety-netting. Patient 3* shows more pronounced neurological signs, including sensory loss, hyporeflexia, and mild motor weakness, necessitating urgent referral. Patient 3** exhibits severe, multi-root involvement with marked motor deficits, reflex loss, and anesthesia, indicating a need for emergency medical intervention. This continuum underscores the clinician's responsibility to systematically integrate neurological findings into clinical reasoning. Doing so enables early detection of serious pathology and ensures safe, appropriate care pathways. The figure reinforces the importance of repeated neurological assessment in guiding timely decisions in primary care. Neurodynamic tests are highlighted to remind clinicians that they are *not reliable indicators* for determining the level of concern, as they may yield positive results across all three concern categories with similar frequency (Apelby-Albrecht et al., 2013; E. J. Thoomes et al., 2026).

Discussion

This article aims to reduce diagnostic uncertainty in the evaluation of SAP by offering a structured, clinically applicable algorithm for differentiating pain mechanisms and stratifying risk. The proposed algorithm is designed to assist clinicians and students in navigating this complexity through a Bayesian clinical reasoning process (Stojan et al., 2022), in which initial hypotheses generated during the subjective examination are iteratively refined as new information gathered from the objective examination. Although the term SAP appears straightforward, it encompasses a variety of overlapping clinical patterns; its apparent simplicity conceals substantial diagnostic complexity. The algorithm therefore seeks to make this complexity more transparent rather than to simplify it away.

Our algorithm should be understood as a literature-informed, consensus-based knowledge-translation tool, rather than as a validated clinical prediction rule or a complete representation of evidence-based practice. Its content is derived from contemporary frameworks and guidelines, including the NeuPSIG recommendations for terminology and identification of neuropathic pain in spine-related limb pain, the IFOMPT International Framework for red flags and levels of concern, classification criteria for cervical radiculopathy, and updated grading systems for neuropathic pain. Our algorithm has not yet undergone formal evaluation, but its conceptual foundations align with existing frameworks, supporting its preliminary construct validity. For instance, it shares key principles with Kapitza et al. (2025), particularly in prioritizing the assessment of radiculopathy through clinical neurological deficits. The recent validation by Kapitza et al. of a classification system for spine-related arm pain through comprehensive clinical examination and strict grouping

based on recent recommendations and terminology further reinforces the relevance of this approach, as their work demonstrates the utility of structured clinical reasoning in the diagnosis of cervical radiculopathy. However, unlike this framework, our algorithm does not yet incorporate quantitative sensory testing (QST). While this limits direct comparability, the shared emphasis on neurological assessment provides a foundation for future refinement, including the potential integration of QST or other complementary measures.

We chose to base our algorithm on the definitions of specific types of spine-related arm pain and radiculopathy and the flow chart of the panel recommendations on adaptations of the grading system for neuropathic pain (Schmid et al., 2023). This algorithm is grounded in an internationally endorsed, consensus-based classification that provides greater conceptual clarity and clinical applicability for daily practice. This choice aligns with the primary aim of the paper: to offer a pragmatic, teachable structure for mechanism-based reasoning in primary care, rather than to optimize research categorization. Nonetheless, important uncertainties remain. Mechanistic descriptors have not yet demonstrated consistent associations with specific optimal treatment pathways, contextual factors and clinician experience may substantially influence decision-making. Although the framework was developed and is currently taught in Northern European contexts, it draws on international recommendations and is therefore likely to have relevance in other settings, including North America and Australia, while its implementation may still vary across health-care systems. Its applicability may therefore differ in other health-care systems, especially in rural or low-resource settings. The three hypothetical scenarios in this paper serve as illustrative 'snapshots' of typical clinical presentations. While they may appear static, real-world cases are inherently dynamic. Patients' symptoms evolve over time, and the predominant pain mechanism may shift along a continuum (Schmid et al., 2020; Toda, 2019). Emerging literature challenges the idea that nociceptive, neuropathic and nociplastic pain are always discrete and mutually exclusive, instead suggesting overlapping and evolving profiles. (Cohen and Mao, 2014; Schmid et al., 2020; Shraim et al., 2022). Clinicians must therefore be prepared to re-evaluate and revise their diagnostic conclusions as the clinical picture changes. This can be conceptualized both at a pathophysiological level (Van Boxem, 2014) and across anatomical structures. For example, a cervical disc herniation may initially produce predominantly nociceptive pain; as inflammation progresses and neural structures become involved, mixed and eventually neuropathic mechanisms may emerge. Moreover, in chronic pain, clinicians must also consider nociplastic mechanisms (I). Unlike nociceptive or neuropathic pain, nociplastic pain reflects central nervous system dysfunction and often overlaps with neuropathic pain features (Shraim et al., 2022). Its management requires a broader biopsychosocial approach (Bates et al., 2019; Hoegh & Hodges, 2025; Schmid et al., 2023). This point of view which focuses on the importance of ongoing reassessment must be emphasized. Even when a diagnosis appears clear, clinicians should remain alert to changes in symptoms, neurological signs, or functional status. In persistent or atypical cases, the possibility of a transition to nociplastic pain mechanisms, those not fully explained by

nociceptive or neuropathic processes, should be considered, and a broader biopsychosocial approach may be warranted (Bates et al., 2019; Hoegh & Hodges, 2025; Schmid et al., 2023).

Another important dimension is the level of concern, derived from the IFOMPT International framework (Finucane et al., 2020). Integrating this concept into the algorithm helps clinicians distinguish benign musculoskeletal presentations from conditions requiring urgent or emergency referral. The stratified sub-scenarios for patient 3 (see Figure 3) illustrate how similar symptom locations can obscure markedly different neurological risks. In this way, the algorithm encourages clinicians to combine mechanism-based reasoning with structured vigilance for serious pathology. Something important in the algorithm is the concept of "urgent referral" which was deliberately added to emphasize to clinicians the importance of the referral process if elements of the neurological examination *change rapidly*. For clinicians, this means that they need to incorporate continuous assessment of neurological elements into their clinical reasoning process.

This decision-making framework provides a structured approach but has inherent limitations. The algorithm, not yet prospectively tested, relies on simplified hypothetical scenarios to clarify key distinctions. Real-world clinical presentations, however, are often more complex, influenced by psychosocial and contextual factors. Future research should evaluate, for example, the reliability and educational impact of the algorithm, its acceptability and usefulness to clinicians and patients, and its potential effects on referral patterns, safety outcomes, or treatment choices. While the framework awaits formal validation, it is not intended to replace clinical judgment and shared decision-making. Instead, it acts as a literature-informed scaffold to help clinicians organize their reasoning, adjust their level of concern, and adapt to evolving presentations of SAP. A notable limitation, shared with similar models, is the lack of explicit integration of patient preferences or shared decision-making**,** a cornerstone of patient-centered care. Nonetheless, its iterative and adaptive design encourages clinicians to tailor diagnostic and therapeutic approaches to individual needs. This flexibility aligns with established paradigms like McKenzie (Edmond et al., 2020) or Maitland (Banks et al., 2010; Lee & Lee, 2017), ensuring dynamic and responsive clinical reasoning within structured frameworks.

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