Paralyzed Veterans of America

consortium for SPINAL CORD MEDICINE
CLINICAL PRACTICE GUIDELINES

CLINICAL PRACTICE GUIDELINES: SPINAL CORD MEDICINE

Evaluation and Management of Pain After Spinal Cord Injury

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Evaluation and Management of Pain After Spinal Cord Injury

Administrative and financial support provided by Paralyzed Veterans of America

These guidelines have been prepared based on scientific and professional information available in 2025. Users should periodically review this material to ensure that the advice herein is consistent with current reasonable clinical practice. The websites noted in this document were current at the time of publication; however, because web addresses and the information contained therein change frequently, the reader is encouraged to stay apprised of the most current information.

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Preface

The assessment, classification and management of pain after spinal cord injury (SCI) is a rather common clinical challenge, with the average estimate suggesting that more than two thirds of individuals with SCI face this issue. The literature addressing the particular nuances of pain management in those with SCI is still rather young, and the amount of evidence available to establish guidelines remains limited. Nonetheless, sufficient progress has been made in this field to allow for the development of clinical practice guidelines based on existing SCI focused publications, pain guidelines already established for other disease entities, and expert opinions in the field. This clinical practice guideline represents the first edition put forth by the Consortium for Spinal Cord Medicine on the topic of pain in those living with spinal cord injury.

As with other previously developed CPGs, a clinical expert panel established key questions related to evaluation and management of pain after SCI. English language literature was then selected and reviewed using an established framework. Ultimately, 357 studies filtered through the Preferred Reporting Item for Systemic Reviews and Meta-Analyses (PRISMA) and were deemed appropriate for inclusion in this review. The literature search encompassed papers published up until and including 2021.

The guidelines have sections on prevention, assessment, general treatment principles, opioids, neuropathic pain management, and nociceptive pain management. Treatment modalities discussed include both pharmacologic and non-pharmacologic approaches for both neuropathic and nociceptive pain. The recommendations are as up to date as possible given the long lead times inherent in the development of clinical practice guidelines essentially de novo in a relatively new field. Readers may be aware of other more recently published guidelines that have some relevance to treatment of SCI pain. One that deserves mention is Dowell D, Ragan KR, Jones, CM. CDC Clinical Practice Guideline for Prescribing Opioids for Pain — United States, 2022. *MMWR Recomm Rep* 2022;71(No. 3). This citation is not an endorsement, but rather it is provided as a reference from a more recent piece of work that may be useful to some readers.

On behalf of the consortium steering committee, I wish to acknowledge the chairman of the guideline panel, Dr. Eldon Loh, for his leadership in this substantial work. I also acknowledge the panel itself, which consisted of a multidisciplinary group of experts in the SCI pain management field. All the work that they have done is volunteer work. There were also many reviewers who provided valuable feedback along the way. In addition, I wish to acknowledge the ongoing support of the Paralyzed Veterans of America (PVA), including President Robert Thomas, Chief Executive Officer Carl Blake and Chief Operating Officer Shaun Castle. Thanks also to Lindsay Perlman, Director of Research and Education. Finally, I would like to remind the reader that the PVA is a nonprofit organization which relies heavily on philanthropic contributions in order to support its important work, including the ongoing development and revision of these guidelines.

Peter H. Gorman, MD MS FAAN FASIA
Chair
Consortium for Spinal Cord Medicine

Foreword

Pain is common after spinal cord injury (SCI) and has different etiologies and presentations. For example, pain can be neuropathic and a direct consequence of the spinal cord injury, or nociceptive and a result of adaptations to living with SCI. In addition to the intensity of pain and discomfort that is experienced, pain can significantly affect functional independence and quality of life after SCI. Despite how commonly pain occurs, people with SCI, and those who help to care for them, can struggle with the limited options available for pain management. Furthermore, satisfactory management of pain, with a reduction in pain intensity and improvement in function, can often be elusive.

Given the significant impact that pain can have on people with SCI, the Spinal Cord Consortium commissioned the creation of Clinical Practice Guidelines (CPG) on pain evaluation and management after SCI. The purpose of the CPG is to offer a comprehensive overview of the management of pain after SCI, encompassing prevention, assessment, general principles for treatment, and pharmacologic/non-pharmacologic management options for neuropathic and nociceptive pain. Given the prevalence of opioid prescription after SCI, particularly in light of changing attitudes and practice patterns related to opioid use in general, a section on opioid management for pain after SCI is included within the CPG. During the development of the CPG, the expert panel focused not only on reduction in pain intensity as a goal of management but formulated recommendations in the context of improving function and ultimately, quality of life, as much as possible. A holistic approach was also emphasized, with consideration given to pharmacologic and non-pharmacologic therapeutic approaches.

An important consideration arising from these CPG is the lack of strong evidence in the literature for preventative and treatment measures related to pain management after SCI. The expert panel took a practical approach to this issue, incorporating the available evidence as much as possible to generate recommendations grounded in the scientific literature, while at the same time considering clinical practice patterns, resource availability, advocacy, and equity, among other factors. This was not a straightforward task, and I wish to thank the panel for their expertise, wisdom and complex decision-making around the challenge that this presented.

Given the general lack of strong evidence around pain management after SCI, additional research on prevention and treatment options is vital. As pain management will likely be an ongoing challenge in the foreseeable future, access to multidisciplinary resources is essential to ensure that function and quality of life can be optimized in the context of pain after SCI. The expert panel and I hope that the CPG can serve as a starting point to identify gaps in the literature regarding pain management after SCI, and potential future avenues of research. The CPG also provides guidance regarding the resources necessary to optimize function and quality of life for those with pain after SCI, and we hope that these CPG can help to support adequate resource allocation for pain management after SCI.

These CPG would not be possible without the vision, guidance, and leadership of the PVA. I wish to thank Cheryl Vines, whose dedication and help was indispensable to this work. I also wish to express my heartfelt gratitude to Lindsay Perlman, who has spent countless hours coordinating this project, allowing us to transition smoothly after Cheryl's well-deserved retirement. Many thanks as well to Cheryl and Lindsay's team at PVA who assisted with all aspects of the CPG. These CPG relied heavily on the work of the Spinal Cord Injury Research Evidence (SCIRE) team, which was guided by Dr. Robert Teasell for this CPG. Their extensive review and evaluation of the scientific literature was indispensable to this process and is greatly appreciated. Finally, I would like to acknowledge Dr. Thomas Bryce, previous Chair of the Spinal Cord Consortium, and Dr. Peter Gorman, current chair, and the consortium steering committee for their support and guidance throughout this project.

The expert panel and I hope that the CPG will provide helpful guidance in the challenging management of pain after SCI, and that it will spur further research and advocacy in the evaluation and management of pain after SCI.

Eldon Loh, MD, FRCPC

Acknowledgments

Paralyzed Veterans of America (PVA) is proud to sponsor the development and dissemination of the spinal cord injury (SCI) clinical practice guidelines (CPGs). For over 30 years, we have partnered with the Consortium of Spinal Cord Medicine in a shared mission to improve the health of individuals living with SCI. Today, hundreds of thousands of copies of the guidelines are used around the world by physicians and other medical professionals who provide care to individuals living with SCI at every level, from the emergency department to acute care, rehabilitation to community services.

We thank Dr. Eldon Loh for his leadership and perseverance in guiding this important new guideline into practice. Sincere thanks are also extended to each of panel members who worked tirelessly, without remuneration, to bring this project to fruition. Dr. Peter Gorman and the members of the SCI Consortium have provided vision, leadership, and support in bringing this and many other CPGs to completion. Their efforts and those of the field reviewers assure the high quality of the recommendations.

As with any project of this magnitude, many were involved in the process. Sincere appreciation goes to Dr. Janice Eng, Dr. Robert Teasell and their team at SCIRE, who conducted the review of the literature and methodology for this guideline.

Within PVA, work on this guideline benefitted from the efforts of nearly every department, but special appreciation goes to medical editor Barbara Every and graphic designer Noel Abizo.

Finally, it is only with the significant mission-driven support of PVA, our leadership and our members, that we are able to provide these services. Sincere thanks to PVA President Robert Thomas, CEO Carl Blake, and COO Shaun Castle for their support.

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Abbreviations

ADLs – Activities of Daily Living

AIS – American Spinal Injury Association Impairment Scale

ASIA – American Spinal Injury Association

CBT – Cognitive Behavioral Therapy

CDC – Centers for Disease Control and Prevention

CPG – Clinical Practice Guideline

DOD – Department of Defense

EPA – Evoked Pain Absent

EPP – Evoked Pain Present

GAD – Generalized Anxiety Disorder

HAS – Hospital Anxiety and Depression Scale

ISNCSCI – International Standards for Neurological Classification of Spinal Cord Injury

ISCIP – International Spinal Cord Injury Pain

ISCIPBDS – International Spinal Cord Injury Pain Basic Data Set

ISCoS – International Spinal Cord Society

NLI – Neurological Level of Injury

NP – Neuropathic Pain

NRS – Numeric Rating Scale

PCTs – Prospective Controlled Trials

PHQ – Patient Health Questionnaire

PICOTS – Population, Interventions, Comparators, Outcomes, Timing, Setting, Study Design

PVA – Paralyzed Veterans of America

RCTs – Randomized Controlled Trials

rTMS – Repetitive Transcranial Magnetic Stimulation

SCI – Spinal Cord Injury

SCIRE – Spinal Cord Injury Research Evidence

SCI-QOL – Spinal Cord Injury-Quality of Life

TCA – Tricyclic Antidepressant

tDCS – Transcranial Direct Current Stimulation

TENS – Transcutaneous Electrical Nerve Stimulation

VA – Veterans Affairs

Executive Summary of Recommendations

2.1 All people with SCI should be asked about the presence of pain at each encounter.

Risk of Bias: C Level of Recommendation: Strong

2.2 We recommend that clinicians apply the International Spinal Cord Injury Pain (ISCIP) Classification System to categorize pain.

Risk of Bias: C Level of Recommendation: Strong

2.3 We recommend that healthcare providers use various pain characteristics, such as location, quality, presence (continuous or intermittent), intensity, variability, provocateurs, and connection with autonomic function, to difference between non-NP and NP.

Risk of Bias: C Level of Recommendation: Strong

2.4 We suggest that the SCIPI be considered as a supplemental measure to the diagnosis of NP.

Risk of Bias: C Level of Recommendation: Conditional

2.5 We recommend that healthcare providers use the International Spinal Cord Injury Pain Basic Data Set (ISCIPBDS) v3.0 as a standardized measure to document pain during the first evaluation and follow up visits.

Risk of Bias: C Level of Recommendation: Strong

2.6 We recommend documenting all treatments used for managing pain after SCI. The International Spinal Cord Injury Pain Extended Data Set has an exhaustive list of treatments that can be used to review possible treatments trialed.

Risk of Bias: C Level of Recommendation: Strong

2.7 We recommend an assessment for red flags to identify underlying conditions that may either cause or worsen pain. This evaluation should be performed on all individuals with SCI who are experiencing new or worsening pain, and prompt medical attention should be sought if any red flags are detected. Individuals with SCI and their caregivers should be educated on the importance of notifying their healthcare team of new or worsening pain.

An assessment for red flag conditions should include neurological status (strength, sensation, tone, reflexes), vital signs, range of motion of the extremities, joint swelling/redness/warmth, and skin integrity, as well as focused assessments of relevant body systems based on presentation (e.g., abdominal, respiratory).

Risk of Bias: C Level of Recommendation: Strong

2.8 We recommend an International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) examination for all individuals with SCI who are experiencing new or worsening pain.

Risk of Bias: C Level of Recommendation: Strong

2.9 We recommend an assessment to identify psychosocial factors (also known as yellow flags) that may be contributing to distress and disability in individuals with SCI who are experiencing pain.

As part of this assessment, it is essential to consider sleep disturbance and emotional function (e.g., mood-related concerns). These issues should be addressed through an individualized approach that considers the unique circumstances and needs of each patient.

Risk of Bias: C Level of Recommendation: Strong

3.1 We recommend that referral be made to a clinician familiar with SCI for new-onset NP in an individual with chronic SCI.

Risk of Bias: C Level of Recommendation: Strong

3.2 We recommend establishing realistic, individualized pain management goals, incorporating the concerns and goals of the individual with SCI and their care partners.

Risk of Bias: C Level of Recommendation: Strong

3.3 We recommend education on pathophysiology, expected pain course, and pain management strategies for caregivers and individuals after SCI in order to facilitate improved ADL performance, patient awareness, well-being, and adherence.

Risk of Bias: C Level of Recommendation: Strong

3.4 We recommend multidisciplinary care coordinated to manage pain after SCI.

Risk of Bias: C Level of Recommendation: Strong

3.5 We recommend physical and/or occupational therapy, including prescription of a home exercise program, to maintain optimal range of motion and strength.

Risk of Bias: C Level of Recommendation: Strong

3.6 We recommend involving psychology as part of a multidisciplinary treatment team in individuals with SCI who have recalcitrant pain or significant pain interference.

Risk of Bias: C Level of Recommendation: Strong

3.7 We suggest psychosocial interventions, including cognitive behavioral therapy, psychotherapy, and pain education to manage mood issues in the context of pain. Early management of pain with such interventions can be crucial in reducing pain and its impact over the long term.

Risk of Bias: C Level of Recommendation: Strong

3.8 We recommend that treatments with multiple therapeutic effects be considered in individuals with SCI who have pain and concomitant issues with mood and sleep.

Risk of Bias: C Level of Recommendation: Strong

3.9 We recommend referral to specialized pain management when an individual's pain has plateaued prior to achieving their desired functional goals and if it is leading to a decrease in function, health, participation, or independence.

Risk of Bias: C Level of Recommendation: Strong

3.10 We recommend timely and ongoing follow-up care to monitor the changing needs of individuals with SCI and pain. For an individual in the community, this follow-up should be done on an annual basis at minimum.

Risk of Bias: C Level of Recommendation: Strong

3.11 We recommend that healthcare providers consider weaning treatment for individuals with SCI who have reached a plateau in pain management, including individuals whose pain has resolved.

Risk of Bias: C Level of Recommendation: Strong

4.1 We recommend that opioids, if necessary, be used for only a short course (e.g., after the initial injury) for musculoskeletal pain. Ideally, the goal is to wean opioids as soon as possible, especially before discharge from inpatient rehabilitation. Initiation of opioids for chronic pain after SCI is not recommended.

Risk of Bias: C Level of Recommendation: Strong

4.2 We recommend that if opioids are prescribed, short-acting opioids should be used at the lowest dose necessary.

Risk of Bias: C Level of Recommendation: Strong

4.3 We recommend continuation of stable doses of opioids in individuals with SCI who have used these medications chronically (i.e., years) for pain after the dose is reduced to its lowest tolerated amount.

Risk of Bias: C Level of Recommendation: Strong

5A.1 We recommend pregabalin or gabapentin for the reduction of NP intensity.

Risk of Bias: B Level of Recommendation: Strong

5A.2 We suggest amitriptyline for the reduction of NP intensity.

Risk of Bias: C Level of Recommendation: Conditional

5A.3 We suggest that additional pharmacological management options can be considered for NP after SCI if gabapentin, pregabalin, and/or amitriptyline are trialed without success, or if there are unmanageable side effects. These options may have evidence in other NP conditions, or limited evidence in SCI. Careful consideration and discussion of the limited evidence and potential risks for these medications is important prior to use.

Risk of Bias: C Level of Recommendation: Conditional

5B.1 We suggest considering transcranial direct current stimulation (tDCS) for reducing NP intensity.

Risk of Bias: C Level of Recommendation: Conditional

5B.2 We suggest considering transcutaneous electrical nerve stimulation (TENS) for reducing NP intensity.

Risk of Bias: C Level of Recommendation: Conditional

5B.3 We recommend considering virtual reality interventions, including virtual walking, for the reduction of NP intensity.

Risk of Bias: C Level of Recommendation: Conditional

5B.4 We suggest that additional nonpharmacological management options can be considered for pain after SCI. These options may have evidence in other pain conditions or have only limited evidence in SCI. Careful consideration and discussion of the limited evidence and the potential risks associated with these treatments is important prior to use.

Risk of Bias: C Level of Recommendation: Conditional

6.1 We recommend that management of nociceptive pain in individuals with SCI include general principles used to manage nociceptive pain in individuals without SCI, although specific treatments and management options may have to be modified depending on the unique considerations and circumstances of the individual with SCI.

Risk of Bias: C Level of Recommendation: Strong

6.2 We recommend regular evaluation of the equipment used by individuals with SCI, including ergonomics. Evaluation includes appropriate selection of equipment, adequate training to ensure that proper techniques are used, and ensuring that environmental adaptations are in place.

Risk of Bias: C Level of Recommendation: Strong

6.3 We recommend that powered mobility (which could be a power assist device) be offered to full- time manual wheelchair users because of the risk of developing chronic upper limb pain.

Risk of Bias: C Level of Recommendation: Strong

6.4 We recommend biomechanically optimized seating and positioning to prevent the development of musculoskeletal pain.

Risk of Bias: C Level of Recommendation: Strong

6.5 We recommend that a healthcare provider assess wheelchair suitability, skills, and techniques at least yearly to prevent and manage musculoskeletal pain (e.g., shoulder pain).

Risk of Bias: C Level of Recommendation: Strong

6.6 We recommend functional observation (on at least a yearly basis), including assessment of compensatory strategies that an individual may use to minimize pain and discomfort, as this may indicate the potential presence of pain.

Risk of Bias: C Level of Recommendation: Strong

6.7 We recommend that healthcare providers manage shoulder pain using a prescribed, monitored, gradually progressive exercise program that is tailored to the specific shoulder pathology.

Risk of Bias: C Level of Recommendation: Strong

6.8 We recommend that a neck or back functional assessment include assessments of acquired structural abnormalities that can predispose the individual to poor posture and the development of back or neck pain.

Risk of Bias: C Level of Recommendation: Strong

6.9 We suggest that additional management options (e.g., TENS) can be considered for nociceptive pain after SCI. Careful consideration and discussion of the limited evidence and the potential risks associated with these treatments is important prior to use.

Risk of Bias: C Level of Recommendation: Conditional

Introduction

Pain is common after spinal cord injury (SCI) and can have significant consequences on function, mood, sleep, and quality of life.[1-5] The estimated prevalence of chronic pain after SCI varies widely from 33% to 100%. The pooled prevalence of any type of chronic pain after SCI from one recent meta-analysis was 68% (95% confidence interval [CI] 63%-73%).[6] Pain can be present at any time after SCI, from the immediate post-injury period to the chronic phase many years later. Further, the type of pain after SCI can vary (e.g., neuropathic pain [NP] vs. nociceptive pain). NP is pain caused by a lesion or disease of the somatosensory system, whereas nociceptive pain is pain that arises from actual or threatened damage to non-neural tissue and is due to the activation of nociceptors.[7] Given the prevalence of pain and its often significant impact on function and quality of life after SCI, it is important to regularly screen for the presence of pain in individuals with SCI and to consistently monitor management strategies.

Although pain is common after SCI, effective management can be a significant challenge. Treating pain often requires a multifaceted approach that addresses the biological, psychological, and social factors that influence pain. Although pain management in individuals without SCI is challenging, the presence of SCI adds additional considerations for pain management. For example, pain can be a specific indicator of more serious complications after SCI (i.e., red flag conditions, such as syringomyelia). Pain after SCI may also arise from functional adaptations (e.g., manual wheelchair use leading to upper extremity pain) that need to be addressed and managed if present. There may be additional considerations regarding the effect of treatment interventions after SCI; e.g., the anticholinergic effects of amitriptyline could negatively affect bowel and bladder function in an individual with SCI, or there may be potential interactions of commonly prescribed medications after SCI (e.g., ciprofloxacin for urinary tract infection) with medications for pain (duloxetine).

It is important to establish goals of pain management early, as treatment goals may differ between individuals who experience pain. In addition, pain management should be reassessed periodically and modified appropriately, as goals may change over time. For example, early in the postoperative phase, minimizing pain intensity to allow participation in rehabilitation may be a main focus, whereas later, goals may relate more to quality of life (e.g., its functional impacts). A multidisciplinary approach involving clinicians with expertise and experience in SCI is often necessary to manage pain after SCI to ensure appropriate assessment and consideration of issues specific to SCI.

The difficulty in managing pain after SCI is compounded by significant limitations in the amount and quality of evidence available to support therapeutic options and approaches. The challenge in generating high-quality evidence is particularly acute for nonpharmacological therapies, where issues of blinding and bias are difficult to control for. Although the goal of generating high-quality evidence is ongoing and essential, it can take years, if not decades, to achieve. To provide relevant clinical guidance for the management of pain after SCI, the expert panel considered and included recommendations informed by their knowledge and experience where current evidence was limited. When interpreting recommendations, the reader should recognize the limitations in the evidence for many of the recommendations in this clinical practice guideline (CPG).

This CPG outlines recommendations for the diagnosis, classification, and treatment of SCI pain and is intended for use by clinicians in managing pain in individuals following SCI. The expert panel hopes that the CPG will spur additional research in areas where evidence is lacking and therefore improve management of pain after SCI.

Methods

To guide the development of the CPG, the Paralyzed Veterans of America (PVA) Pain Management Guideline Clinical Expert Panel initially formulated key questions related to the assessment and management of pain after SCI (Appendix A).

From these key questions, members of the Spinal Cord Injury Research Evidence (SCIRE) team developed a literature search strategy by using the PICOTS (Population, Interventions, Comparators, Outcomes, Timing, Setting, Study Design) framework:

Population

- Adults (18 years and older) with traumatic or nontraumatic SCI resulting in paralysis. In studies with mixed populations, at least 50% of the sample needs to include participants with SCI.

Interventions

- Screening, assessment, or outcome measures
- Management

Comparators

- Adults without SCI or matched controls (people of the same age, gender, physical characteristics)
- Adults with another type of neurological dysfunction
- Another intervention (head-to-head study in SCI population)
- Usual care
- Placebo

Outcomes

- Pain occurrence and/or frequency
- Pain outcome measures (e.g., Numeric Rating Scale [NRS])
- Psychosocial effects of pain, including quality of life, participation and activities, sexual health and participation in sexual relationships, depression, anxiety, mental health, and compliance with treatment regimens
- Adverse events

Timing

- SCI of any duration

Setting

- Acute care
- Inpatient/outpatient rehabilitation
- Primary care
- Community (e.g., long-term care, retirement home, home)

Study Design

- Randomized controlled trials (RCTs)
- Matched controlled trials
- Crossover trials
- Prospective controlled trials (PCTs)
- Cohort studies
- Longitudinal studies
- Case-control studies
- Pre-post designs
- Post-tests
- Case series
- Observational and cross-sectional studies
- Case reports only included in areas where no other credible information exists

The SCIRE team then conducted a search of Cochrane, CINAHL, EMBASE, MEDLINE, and PsycINFO (from 1980 to July 2022) to identify the relevant literature. Additional studies were identified by hand searching the reference lists of included studies and reviews. The literature search strategy is presented in Appendix B.

Study Selection
The selection of studies was based on inclusion criteria created in consultation with the expert panel. Two reviewers independently assessed titles and abstracts of citations for inclusion that were identified through literature searches from the following criteria, using the systematic review software COVIDENCE. Full-text articles of potentially relevant citations were retrieved and assessed for inclusion by both reviewers.

Studies were included if they principally dealt with pain following a SCI. Two principles guided study inclusion: (1) the population of interest comprised individuals with SCI, and (2) outcomes related to pain were assessed.

Customizations to the inclusion criteria were made, such as the following:

- Prevalence studies (e.g., how frequent pain is within a sample population) must be N>100 to ensure some validity of findings.
- RCTs must have n>10 in each trial arm.
- Mixed populations (i.e., individuals without SCI were included) were acceptable if the sample consisted of at least 50% of individuals with SCI.

Review articles were included if they were systematic reviews with pain as the focus of discussion. Other review articles, such as those describing current opinions or research in the area (e.g., a book chapter), were excluded. Prior CPGs were also summarized and presented to the panel for additional information and context.

All articles were limited to English language only. Animal studies and articles describing the neurophysiology of pain were excluded. Studies that were focused on pediatric populations were excluded. In addition, qualitative or mixed method studies, dissertations, and conference abstracts were also excluded. Articles with a sample size of less than 20 were excluded initially. If no high-quality evidence was available to answer a particular question, studies with a sample size of less than 20 were included.

The SCIRE research team was available to respond to queries from the panel chair and panel members about the literature review and included studies. Additional literature searches or evidence summaries were completed as necessary.

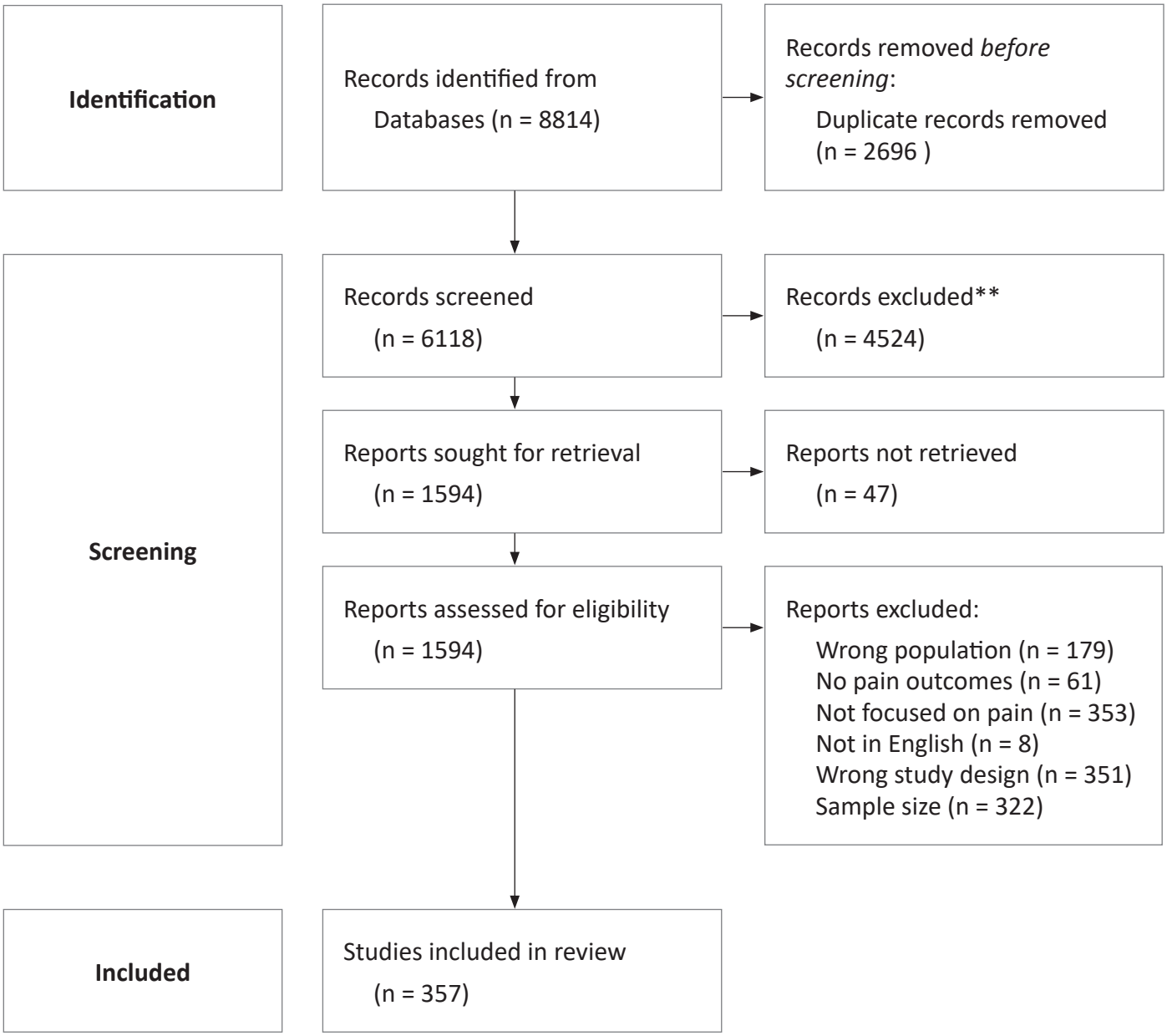
Search Results
We identified 8814 potentially relevant articles through our search and reviewed their titles and abstracts. We assessed 1594 articles for eligibility at the full-text level, of which 357 were included and are discussed in this report (Figure 1).

Existing Guidelines
We found 4 CPGs published between 2012 and 2022 that made recommendations for the management of pain in individuals with SCI.[8-11] Three of these guidelines made recommendations for the management of pain during rehabilitation,[8,10,11] whereas 1 focused on acute care.[9] One guideline made recommendations focused on NP,[10] and the other 3 discussed recommendations for NP and nociceptive pain.[8,9,11] We included 1 CPG, published in 2005 by the Consortium for Spinal Cord Medicine, that made recommendations for that preservation of upper limb function in individuals with SCI.[12] This guideline was included, as there is a lack of practice recommendations for pain management in the upper limb.

Given the paucity of CPGs in populations with SCI, we expanded our search to look at CPGs for pain management in non-SCI populations. We identified 7 CPGs for NP management, which are highlighted by Bernetti et al.[13] and the National Institute for Health and Care Excellence.[14] We found 44 CPGs for the management of musculoskeletal pain in non-SCI populations, reviewed by Lin et al.,[15] as well as 28 CPGs related to perioperative, intraoperative, and postoperative pain management in a non-SCI population, reviewed by Joshi and Kehlet.[16]

Figure 1. PRISMA Diagram of Literature Search Results

Identification of studies via databases and registers



Data Extraction
Information on demographics, interventions, prevalence, outcomes, and adverse events was extracted from included studies by the SCIRE team. Data abstraction was performed by 2 reviewers, with any differences resolved by discussion or with a third reviewer. Data were then compiled into evidence tables according to the research question.

Validity Assessment
The SCIRE team assessed the internal validity of RCTs by using the Cochrane risk-of-bias tool. The available evidence was classified as high, moderate, or low quality (Table 1) based on randomization, allocation concealment, blinding, loss to follow-up, selection of reported results, and the degree to which the interventions were delivered as intended. Studies that were not RCTs were classified as low-quality evidence, with a high risk of bias. RCTs conducted between 2012 and 2022 were evaluated for risk of bias; RCTs prior to 2012 were assessed for risk of bias if there were no RCTs between 2012-2022 to address the intended question, or the included RCTs had a high risk of bias.

Evidence tables were created that included study characteristics, outcomes, and quality ratings/risk of bias for all included studies. The expert panel was provided with the evidence tables and risk-of-bias assessments, as well as an executive report summarizing key findings.

Recommendation Formulation
From the available evidence, the expert panel developed recommendations for the management of pain after SCI. The panel was divided into 3 subgroups to develop the recommendations for different key questions. The recommendations developed by all subgroups were then combined and presented to the entire expert panel for review and discussion. Members of the expert panel were then assigned different recommendations to provide additional text for justification and/or context. The full CPG document was then reviewed by all expert panel members for approval.

In addition to the "risk-of-bias" classification assigned to each recommendation (described in the previous section), the expert panel assigned a "strength of recommendation" to each recommendation, depending on the evaluation of various factors, including benefits vs. downsides, certainty of evidence, value and preferences, resource use (cost), feasibility, acceptability, and equity. Recommendations that were likely to be beneficial, and which the panel found to be favorable regarding the factors listed earlier, were assigned a "strong" strength of recommendation (these recommendations were generally phrased as "We recommend"). Recommendations that were more uncertain regarding their benefit or favorability related to the assessed factors were given a "conditional" strength of recommendation (these recommendations were generally phrased as "We suggest").

Table 1. Cochrane Risk-of-Bias Classification

Classification	Description
A	High-quality evidence: Consistent evidence from RCTs with a low risk of bias
B	Moderate-quality evidence: Evidence from RCTs with some concern of bias
C	Low-quality evidence: Evidence from studies with a high risk of bias (including observational studies) or expert opinion

Abbreviation: RCT, randomized controlled trial

A final list of recommendations was presented to the expert panel, and members voted individually and anonymously on whether they agreed with the recommendation. Additional comments to improve a recommendation could be provided, and panel members were able to abstain from voting on a recommendation that they did not feel they had the expertise to address, or if they had a conflict of interest for that recommendation. Any recommendation with less than 75% consensus was reviewed by the panel, and a decision was made to either remove the recommendation or reword it.

The CPG was sent for peer review to several SCI organizations and experts. These organizations provided comments and suggestions that were reviewed by the expert panel and incorporated into the CPG if necessary.

Panel Findings

Knowledge of why some individuals develop pain after SCI (nociceptive pain or neuropathic pain (NP)) is limited, as is why this pain can be resistant to treatment for some. A number of cross-sectional studies have examined potential associations between the development or persistence of pain and psychosocial factors, other clinical conditions, demographics, and injury characteristics (e.g., traumatic vs. nontraumatic etiology, level of injury, severity of injury) in individuals with SCI. The associations are not straightforward, and the existing evidence for various factors can be conflicting and contradictory. For example, although 2 studies have reported significant differences in the prevalence of NP between individuals with paraplegia and individuals with tetraplegia,[17,18] results from these studies differ regarding which group is at greater risk for developing NP.

In practice, the most important principle for the clinician is to be aware that pain is commonly present in the SCI population and that it is imperative to screen for its presence and impact on function and mood regularly. Other general principles regarding the development and persistence of pain that clinicians should be aware of include the following:

- It is uncommon to develop new onset NP after 1 year post-injury and NP that develops early after injury (within 3-6 months) is likely to persist.[19,20] If individuals develop new NP more than 1 year after injury, the clinician should assess for red flag and yellow flag conditions that may account for the new pain (Section 2).
- Depression is strongly associated with pain.[21,22] Consideration and management of mood issues is essential for pain management after SCI (Section 3).
- Optimizing biomechanics is important to prevent and address nociceptive, specifically musculoskeletal, pain (Section 6).

Section 2: Assessment

2.1 All people with SCI should be asked about the presence of pain at each encounter.
Risk of Bias: C
Level of Recommendation: Strong

Pain is commonly reported by individuals with SCI. In a systematic review and meta-analysis, the pooled prevalence for chronic pain after SCI was 68% (95% CI 63%-73%).[6] Given that the presence of pain can have a significant impact on function (e.g., participation in therapies, performance of activities of daily living [ADLs]), mood, and sleep, and given its prevalence in the SCI population, clinicians should be vigilant about screening for pain after SCI. Early initiation of a management plan may help decrease the morbidity associated with pain.

2.2 We recommend that clinicians apply the International Spinal Cord Injury Pain (ISCIP) Classification System to categorize pain.
Risk of Bias: C
Level of Recommendation: Strong

The use of the ISCIP Classification (Table 2)[23] has standardized the language used to define and identify different types of pain commonly experienced by individuals with SCI, facilitating communication among healthcare providers.

The ISCIP Classification organizes subtypes of pain reported after SCI into different defined categories.[23] Pain is classified into 4 broad categories: NP, nociceptive pain, other pain, and unknown pain. Other pain is pain that cannot be classified as either nociceptive pain or NP and for which no evidence of

Table 2. The International SCI Pain (ISCIP) Classification

Tier 1	Tier 2	Tier 3
Nociceptive pain	**Musculoskeletal** **Visceral pain** **Other nociceptive**	**Musculoskeletal _____** e.g., glenohumeral arthritis, lateral epicondylitis **Visceral pain _____** e.g., abdominal pain due to bowel impaction **Other nociceptive _____** e.g., autonomic dysreflexia headache migraine headache
Neuropathic pain	**At-level SCI pain** **Below-level SCI pain** **Other neuropathic**	**At-level SCI pain _____** e.g., spinal cord compression, nerve root compression **Below-level SCI pain _____** e.g., spinal cord ischemia, spinal cord compression **Other neuropathic _____** e.g., carpal tunnel syndrome, trigeminal neuralgia, diabetic polyneuropathy
Other pain		
Unknown pain		

Bryce TN, Biering-Sorensen F, et al. International spinal cord injury pain (ISCIP) classification: part I. background and description. Spinal Cord. 2012: 50 413-417

a noxious stimulus, inflammation, or damage to the nervous system can be identified that is responsible for the pain. Established pain syndromes of unknown etiology can fall into this category, such as fibromyalgia.

The broad categories of NP and nociceptive pain can be subclassified. The 3 NP subcategories are at-level SCI pain, below-level SCI pain, and other NP. The main distinguishing characteristic differentiating at-level and below-level SCI pain is the location in the body where they are perceived in relation to the neurological level of injury (NLI).

At-level SCI pain is NP perceived within 3 dermatomes below the NLI. It must be attributed to damage to the spinal cord or nerve roots. Therefore, pain due to injury of the cauda equina (nerve roots) is always classified as at-level SCI pain. Although the distribution of at-level SCI pain can be thought of as segmental or dermatomal, the pain is often not present throughout the entire topographic distribution of that dermatome. Some people with thoracic-level SCI may perceive pain only in a localized area within the 3 dermatomes below the NLI (e.g., on their back only). Others may perceive the pain as a band extending circumferentially without interruption around their trunk.

Below-level SCI pain refers to NP perceived more than 3 dermatomes below the NLI that is attributed to damage to the spinal cord. If pain occurs within the 3 dermatomes immediately below and distal to the NLI, and is considered by the individual experiencing it to be the same pain, this pain should be classified as below-level pain only and not as both at-level and below-level pain.

NP perceived at any level below the NLI that is not attributable to spinal cord or nerve root damage should be classified as other NP and not as at-level or below-level SCI pain. Examples of other NP are pain due to carpal tunnel syndrome or to a brachioplexopathy in a person with a cervical SCI.

The 3 nociceptive pain subcategories are musculoskeletal pain, visceral pain, and other nociceptive pain. Musculoskeletal pain is pain originating from the activation of nociceptors within musculoskeletal structures. Musculoskeletal shoulder, neck, and back pain are the most common subtypes.

Visceral pain is defined as pain located in the thorax, abdomen, or pelvis, which is believed to be primarily generated by visceral structures.[24] Abdominal visceral pain related to impaired motility of the lower gastrointestinal tract has a late onset; it is relatively uncommon during the first 5 years after SCI and increases in prevalence afterward.[25] This type of pain is often associated with nausea and ameliorated by defecation. Pelvic visceral pain may be associated with neurogenic lower urinary tract dysfunction. In an individual with some preserved thoracolumbosacral sensation, pelvic visceral pain may be a manifestation of a urinary tract infection. However, it may also be present in individuals with no evidence of infection or in individuals who have been adequately treated for infection but have persistent symptoms over many years. In individuals who experience abdominal pain within the first year after injury, and after other treatable causes of abdominal pain have been ruled out (e.g., there is no clear relation to constipation or bowel evacuation procedures), at-level or below-level neuropathic SCI pain should be considered. Conversely, if an individual begins to report abdominal pain several years after injury, at-level or below-level neuropathic SCI pain should be considered less likely given that at-level and below-level pain rarely begin later than 1 year after injury.[26]

Other nociceptive pain refers to pain that is not musculoskeletal or visceral, and may be indirectly related or unrelated to the SCI. Examples include pain from pressure injuries, autonomic dysreflexia headache, and migraine headache.

2.3 We recommend that healthcare providers use various pain characteristics, such as location, quality, presence (continuous or intermittent), intensity variability, provocateurs, and connection with autonomic function, to differentiate between non-NP and NP.
Risk of Bias: C
Level of Recommendation: Strong

NP can be difficult to diagnose[27] and presents in a unique way for each individual. There is no single characteristic that is pathognomonic (i.e., uniquely specific) for either NP or non-NP.[28] In addition, more than 1 pain problem is often present in individuals with SCI, making diagnosis challenging. However, certain characteristics of pain may help to differentiate NP from non-NP.

The **location** of pain can be suggestive of subtype. Pain localized to a particular musculoskeletal structure such as a joint is suggestive of musculoskeletal etiology. Pain presenting in a dermatomal pattern just below the NLI is suggestive of at-level SCI pain, whereas pain presenting in a regional pattern below the NLI is suggestive of below-level SCI pain. The clinician should be aware, however, that more than 1 pain subtype can be present in the same area.

Pain quality descriptors can also be suggestive of subtype.[29-34] Descriptors associated with NP include heat (hot burning, fire, hot coals, etc.), cold (freezing, cold, ice, etc.), numbness (numb, pins and needles, tingling, etc.), and electricity (electric shock or jolt, shocking, shooting, etc.). Descriptors such as pressure (squeezing, crushing, pressing) may be reported with both NP and non-NP. For example, muscle spasm (musculoskeletal pain), a cardiac infarction (visceral pain), and at-level SCI pain are all commonly described as pressure, or a synonym of such. Descriptors related to achiness (ache, soreness, etc.) can also be associated with both NP and non-NP.

The **continuous vs. intermittent presence** of pain can help differentiate between subtypes of pain, as non-NP often is present only when there is stimulation of offending nociceptors, whereas NP often may be more persistent due to damage related to neuronal ectopy. More continuous pain can be suggestive of certain types of NP such as below-level SCI pain and at-level SCI pain due to cord damage. However, NP caused by nerve root damage may present intermittently because of sporadic nerve irritation. Musculoskeletal pain may be more intermittent, with movement of the affected area causing activation of nociceptors.

Lack of pain intensity variability can suggest certain types of SCI NP, such as below-level SCI pain and spinal cord damage related at-level SCI pain. **Variable intensity** pain is defined as pain that is less severe at times and more severe at other times; in contrast, **constant intensity** pain is defined as pain that is virtually the same severity all the time with little change. However, the presence of pain intensity variability does not exclude below- or at-level NP after SCI, as intensity may vary due to a large number of external and internal factors, including fatigue, coincident infection, and distraction. The clinician should also be aware of red and yellow flags that may contribute to this variability (see Sections 2.7 to 2.9).

Pain provocation may provide clues as to the type of pain present. For example, pain that is evoked with light touch (a type of allodynia) or markedly increased pain from a normally mildly painful stimulus such as a pinprick (a type of hyperalgesia) is more commonly associated with NP. However, it can be seen with non-NP, such as during a gout flare. In contrast, pain with firm pressure is most commonly seen with non-NP. Movement-associated pain (including pain with weight-bearing and pain with applied stretch) is generally associated with musculoskeletal pain. Examples of common movement-associated pain seen after SCI include pain related to joint and tendon degeneration, back pain related to muscle imbalance or degeneration, and limb or trunk pain due to muscle spasm. Movement-associated pain may occur with NP in certain cases; e.g., NP from nerve root impingement may increase with changes in position that result in stretching or impingement of the involved nerve.

2.4 We suggest that the SCIPI be considered as a supplemental measure in the diagnosis of NP.
Risk of Bias: C
Level of Recommendation: Conditional

Distinguishing the specific etiology or etiologies for pain in a particular location can be a challenge. Although consideration of an individual's history and the findings from physical examination are essential in differentiating between pain types and causes, they are not always sufficient.

Validated questionnaire-based assessment tools, such as the Spinal Cord Injury Pain Instrument (SCIPI), can provide guidance in differentiating nociceptive pain from NP. These tools are most useful on a population level, as they primarily rely on history with minimal, if any, physical examination components. Therefore, they may be less useful in clinical settings when used on an individual basis and should not be solely relied on for determining a diagnosis.

The SCIPI is a 4-item interview-based screening instrument for NP in SCI (Figure 1).[24] Endorsement of at least 2 of the 4 items demonstrated a sensitivity of 78%, a specificity of 73%, and an overall diagnostic

Figure 1. The Spinal Cord Injury Pain Instrument (SCIPI)

Classification	No	Yes
Is the quality of the pain electrical or electric shock like?	0	1
Is the quality of the pain like pins and needles or tingling?	0	1
Does the skin over the area of pain or inside your body where the pain is located feel hot or burning or cold or freezing?	0	1
Does the pain only occur in an area of the body in which you have no feeling on the skin overlaying that area?	0	1
Total score [T]: 0-4		

accuracy of 76% for correctly classifying pain as likely NP in a sample of 36 subjects reporting 82 pain sites. In another study[35] validating a back-translated German version, a sensitivity of 77%, a specificity of 87%, and overall accuracy of 80% were found.

2.5 We recommend that healthcare providers use the International Spinal Cord Injury Pain Basic Data Set (ISCIPBDS) v3.0 as a standardized measure to document pain during the first evaluation and follow-up visits.
Risk of Bias: C
Level of Recommendation: Strong

The purpose of the International Spinal Cord Injury Pain Basic Data Set (ISCIPBDS) is to standardize the collection and reporting of pain in the SCI population. The ISCIPBDS contains the necessary clinically relevant information concerning pain that can be collected in the daily practice of healthcare professionals. The ISCIPBDS is widely used throughout the world for both clinical and research purposes; ISCIPBDS Version 3.0[36] has been officially endorsed by the ASIA (American Spinal Injury Association) and ISCoS (International Spinal Cord Society).

The data set begins with information on the date of data collection, the number of pains experienced within the previous 7 days, and 3 questions addressing pain interference with activities, mood, and sleep for all pain. Next is a series of 5 sections (see Figure 2) that can be used to ascertain the minimal information for a single designated pain. If multiple distinct pains are reported, these 5 sections can be applied to each pain in succession. The sections include location of pain, classification of pain based on the International SCI Pain Classification scheme, average pain intensity rating for the prior 7 days, date of pain onset, and treatments used to reduce this pain. In addition, pain interference with activities, mood, and sleep can be documented for each pain separately.

2.6 We recommend documenting all treatments used for managing pain after SCI. The International Spinal Cord Injury Pain Extended Data Set has an exhaustive list of treatments that can be used to review possible treatments trialed.
Risk of Bias: C
Level of Recommendation: Strong

When assessing individuals with SCI who have pain, it is important to ask about treatments they have used in the past or are using currently, including complementary and alternative interventions. As individuals may not remember what they are taking or what they have tried in the past, having a list of potential treatments to ask about may be helpful. The International Spinal Cord Injury Pain Extended Data Set[37] includes an exhaustive list of treatments (see Table 3) that may have been used by an individual for pain. The list includes 42 treatments grouped into 7 categories: physical therapy, passive and stimulation therapy, relaxation and psychotherapy, oral and topical medications, procedural interventions, surgical interventions, and other treatments.

Figure 2. The International Spinal Cord Injury Pain Basic Data Set (ISCIPBDS), version 3

Pain problem/pain type (please add one sheet per pain):

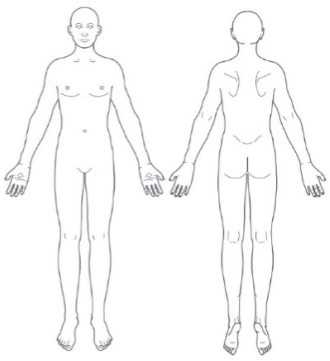
Pain locations /sites (can be more than one, so check all that apply): right (R), midline (M), or left (L)	**R**	**M**	**L**	**Type of pain** **Intensity** and **duration of pain** **Treatment of pain**
Head				**Type of pain (check one):**
Neck/shoulders				
throat				**Nociceptive**
neck				□ Musculoskeletal
shoulder				□ Visceral
Arms/hands				□ Other
upper arm				
elbow				**Neuropathic**
forearm				□ At-level SCI
wrist				□ Below-level SCI
hand/fingers				□ Other
Frontal torso/genitals				
chest				□ **Other**
abdomen				
pelvis/genitalia				□ **Unknown**
Back				
upper back				**Intensity** and **onset of pain:**
lower back				**Average pain intensity in the last week:**
Buttocks/hips				0 = no pain; 10 = pain as bad as you can imagine
buttocks				□ 0; □ 1; □ 2; □ 3; □ 4; □ 5;
hip				□ 6; □ 7; □ 8; □ 9; □ 10
anus				**Date of onset:** YYYY/MM/DD
Upper leg/thigh				
Lower legs/feet				**Treatment used to reduce this pain**
knee				Examples for each treatment category can be found in the syllabus under comments.
shin				□ **None**
calf				□ **Physiotherapy**
ankle				□ **Passive and stimulation therapy**
foot/toes				□ **Relaxation and Psychotherapy**
Optional Pain drawing 				□ **Oral and topical medication** □ **Procedural intervention** □ **Surgical intervention** □ **Other**

Table 3. Treatment List From the International Spinal Cord Injury Pain Extended Data Set

Please indicate all treatments you have had (over the last 12 months)		Was the treatment helpful?		
Check		**Yes**	**No**	**Uncertain/ Unknown**
	Physiotherapy			
	Aerobic exercise (low to moderate intensity)			
	Passive exercise (non-weight bearing or against resistance, e.g., stretching)			
	Resistance exercise (strength building, e.g., weight training)			
	Position adjustment (in wheelchair, bed, etc.)			
	Joint mobilisation/manipulation (incl. chiropractic, osteopathic)			
	Other, specify			
	Passive and stimulation therapy			
	Massage			
	Acupressure			
	Transcutaneous electrical nerve stimulation (TES, TNS, TENS)			
	Ultrasound			
	Laser			
	Heat therapy (incl. heat-packs, shortwave)			
	Other, specify			
	Relaxation and Psychotherapy			
	Bio-feedback/relaxation training			
	Relaxation (relaxation techniques, e.g., muscle relaxation or deep breathing)			
	Meditation (meditation techniques, e.g., concentrative, religious)			
	Mindfulness meditation (meditation using mindfulness technique)			
	Hypnosis			
	Cognitive/Behavioral therapy			
	Other psychotherapy			
	Other, specify			

	Oral and topical medication			
	Antidepressants (e.g., amitriptyline, nortriptyline, duloxetine)			
	Antiepileptics (e.g., pregabalin, gabapentin, carbamazepine)			
	Tramadol			
	Opioids (e.g., morphine, oxycodone, buprenorphine, fentanyl)			
	Cannabinoids (e.g., marijuana)			
	Acetaminophen/paracetamol			
	NSAIDs/aspirin e.g., ibuprofen, naproxen, celecoxib, meloxicam			
	Benzodiazepines e.g., diazepam			
	Antispasticity drugs e.g., baclofe, tizantidine			
	Topical anaesthetics e.g., lidocaine/lignocaine			
	Topical capsaicin			
	Other, specify			
	Procedural interventions			
	Trigger point injection/Dry needling			
	Acupuncture			
	Peripheral nerve/motor point block (incl. alcohol, phenol, steroid, anaesthetic blocks, botulinum toxin injection)			
	Joint injections (incl. shoulder, knee, facet joint, ilio-sacral)			
	Intravenous lidocaine			
	Intravenous ketamine			
	Epidural block			
	Intrathecal pumps (incl. morphine, ziconotide, clonidine, baclofen)			
	Spinal cord stimulator			
	Transcranial brain stimulation (tDCS or rTMS)			
	Percutaneous Peripheral Nerve Stimulation			
	Other, specify			
	Surgical interventions			
	Dorsal root entry zone lesion			
	Spinal surgery (incl. stabilization, rod removal, untethering the cord, shunt)			
	Deep brain stimulation (implanted brain electrodes)			
	Other, specify			
	Other treatments			
	Specify			

2.7 We recommend an assessment for red flags to identify underlying conditions that may either cause or worsen pain. This evaluation should be performed on all individuals with SCI who are experiencing new or worsening pain, and prompt medical attention should be sought if any red flags are detected. Individuals with SCI and their caregivers should be educated on the importance of notifying their healthcare team of new or worsening pain.

An assessment for red flag conditions should include neurological status (strength, sensation, tone, reflexes), vital signs, range of motion of the extremities, joint swelling/redness/warmth, and skin integrity, as well as focused assessments of relevant body systems based on presentation (e.g., abdominal, respiratory).

Risk of Bias: C
Level of Recommendation: Strong

Recent CPGs have increasingly emphasized key symptoms and signs (red flags) that could help identify conditions that can either cause, worsen, or imitate pain (see Table 4).[8,10,11] Additional investigations may be indicated, depending on the suspected condition(s). It is essential to detect these conditions because appropriate treatment can substantially improve or eliminate pain and prevent the development of other severe adverse consequences.

An important consideration is that signs and symptoms may not indicate the presence of a particular condition but could be a consequence or complication of the SCI itself (e.g., spasticity or constipation). In these situations, symptoms and signs should still be addressed as part of a pain management plan, as they may contribute to pain.

2.8 We recommend an International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) examination for all individuals with SCI who are experiencing new or worsening pain.
Risk of Bias: C
Level of Recommendation: Strong

Accurately determining the NLI and the degree of completeness is crucial in classifying at-level and below-level SCI pain. The degree of retained sensation can help in diagnosing pain type. For example, musculoskeletal pain or non-NP is unlikely to occur far below the caudal extent of the zone of partial preservation of motor and sensory function. Worsening or new pain with neurological deterioration, as determined by a change in status on an International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) examination, should be further investigated. Spinal imaging, typically magnetic resonance imaging, is often warranted in these situations, as intrinsic and extrinsic spinal cord and nerve root changes, related to post-traumatic syringomyelia, spinal cord tethering, or arachnoiditis, should be excluded.

2.9 We recommend an assessment to identify psychosocial factors (also known as yellow flags) that may be contributing to distress and disability in individuals with SCI who are experiencing pain.

As part of this assessment, it is essential to consider sleep disturbance and emotional function (e.g., mood-related concerns). These issues should be addressed through an individualized approach that considers the unique circumstances and needs of each patient.

Risk of Bias: C
Level of Recommendation: Strong

Numerous factors can affect a person's experience of pain. These factors include depression, sleep quality, anxiety, post-traumatic stress disorder, social and economic support, and catastrophizing.[39] An assessment of yellow flags should focus on relevant psychosocial factors in the history.

Table 4. Red Flags for Pain after SCI[a]

Red Flags
• **Musculoskeletal:** History of recent trauma, visible deformity, changes in range of motion, new-onset localized swelling and warmth. Conditions include fracture or dislocation, heterotopic ossification, regional pathology that may be contributing to NP presentation, and contracture. • **Dermatologic:** Redness, pressure injury, ingrown nail. • **Cardiovascular:** Chest pain, shortness of breath, fevers, chills or sweats, autonomic symptoms, tachycardia, bradycardia, hypoxia, changes in blood pressure and differences in calf circumference measurements between left and right sides. Conditions include abdominal aortic aneurysm, aortic dissection, myocardial infarction, infection, and deep vein thrombosis. • **Respiratory:** As for cardiovascular. Conditions include pulmonary embolism, deep vein thrombosis, infection, or pneumonia. • **Urinary:** Changes in urine appearance or smell, pain over kidneys, new incontinence, leakage between catheterizations, a history of renal or bladder calculi and scrotal or testicular swelling. Conditions include urinary tract infection or pyelonephritis, renal or bladder calculi, urinary retention, testicular torsion, and epididymitis. • **Pelvic:** Relation of pain to menstruation. Conditions include ovarian cysts, endometriosis, and other genitourinary conditions. • **Gastrointestinal:** Changes in bowel habit, examination findings of acute abdomen. Conditions include stool impaction, constipation, acute abdomen, appendicitis, and cholecystitis. • **Neurological:** Changes in neurological examination, such as increase or decrease in tone, decline in motor or sensory neurological level, change in reflexes. Conditions include peripheral neuropathy, syringomyelia. • **Other:** Fever, chills, sweats, and weight loss (malignancy).

Table 5. Yellow Flags for Pain after SCI[a]

Yellow Flags
• Depressive symptoms. • Poor motivation to complete daily activities or work because of pain. • Decreased participation in valued activities. • Pre-existing pain problems with evidence of poor adjustment. • Avoidance of activities associated with pain. • Extensive periods of rest or bed rest. • Evidence of catastrophic thinking, preoccupation with pain prognosis. • Significant anxiety, panic symptoms. • Use of and dependence on alcohol or illicit substances. • Increasing opioid dependence. • Opioid misuse. • Disruption of sleep quality or duration. • Lack of support from family members for pain and activity. • Personality disorder.

[a]Adapted from Mehta et al., 2016.[38]

Screening for mood and sleep issues is essential, as it enables early identification and timely referral for nonpharmacological or pharmacological management. Such management may be provided by psychologists, social workers, or psychiatrists, either individually or as part of a comprehensive multidisciplinary program.

Screening tools such as the Patient Health Questionnaire-9 (PHQ-9) can be used to rapidly identify individuals with SCI who may be experiencing significant mood issues and require referral for further assessment. For SCI, a cutoff of ≥11 on the PHQ-9 during inpatient care is considered a positive screen, indicating a need for further mood assessment.[40] For assessing anxiety, recommended measures include the HADS (Hospital Anxiety and Depression Scale),[41] the SCI-QOL (Spinal Cord Injury-Quality of Life) Anxiety Item Bank,[42,43] and the GAD-7 (Generalized Anxiety Disorder 7-item scale).[44] For evaluating depressive symptoms, suggested measures include the PHQ-9, Center for Epidemiologic Studies Depression Scale, and Older Adult Health and Mood Questionnaire.[40]

Screening should be conducted at transitional points in care and on a regular basis thereafter (e.g., at each follow-up visit); ongoing assessment is necessary to track changes in mood and ensure that appropriate interventions are implemented in a timely manner.

For best practices related to the management of mental health issues after SCI, please refer to the PVA guidelines on this topic.[40]

Section 3: General Principles for Management

3.1 We recommend that referral be made to a clinician familiar with SCI for new-onset NP in an individual with chronic SCI.
Risk of Bias: C
Level of Recommendation: Strong

New-onset NP in individuals with chronic SCI is uncommon; therefore, a review of red flags is essential. A proper ISNCSCI examination is required to assess neurological changes in these situations. Thus, referral to clinicians experienced in managing SCI is recommended. Further, there may be unique considerations that affect optimization of pain management (including functional ability and pain severity) after SCI. These considerations include complications of potential treatments (e.g., bowel and bladder side effects, exacerbation of fatigue) and the impact of SCI sequelae and secondary complications (e.g., limited mobility, spasticity), further highlighting the need to involve clinicians who have experience in managing SCI.

3.2 We recommend establishing realistic, individualized pain management goals, incorporating the concerns and goals of the individual with SCI and their care partners.
Risk of Bias: C
Level of Recommendation: Strong

Pain management should be customized to the individual. Managing expectations and concerns (benefits vs. potential adverse effects, expected efficacy of pharmacological treatment, coping strategies, etc.) is critical to engaging patients in managing their pain. The main objectives of any treatment plan should incorporate the perspectives of both the individual with SCI and the care partner. In this context, individual and care partner education is an important component of treatment (acute pain vs. chronic pain, managing expectations, understanding that the recovery processes may not be a consistent upward trajectory, etc.) and integration of the goals and concerns of the individual with SCI and any care partners.

Numerous clinical guidelines have emphasized the importance of patient engagement in pain management in both the SCI population[8,38] and the non-SCI population.[13,15]

3.3 We recommend education on pathophysiology, expected pain course, and pain management strategies for caregivers and individuals after SCI in order to facilitate improved ADL performance, patient awareness, well-being, and adherence.
Risk of Bias: C
Strength of recommendation: Strong

It is crucial to include personalized objectives that reflect the values of the individual, as well as to set realistic expectations when structuring any education or other intervention programs aimed at decreasing the likelihood of function-limiting pain conditions after SCI. It is imperative that pain education be introduced early in the rehabilitation process and that it also be continued throughout the lifespan, as aging and changes in environmental factors may affect the development of pain conditions or increases in existing pain. Clinicians should consider all aspects of the individual's biology, psychology, and social context when providing pain education. Pain education is also important because it may have a role in managing concomitant mood symptoms (see recommendation 3.7). These recommendations are in line with previously published guidelines and literature.[8,45-47]

3.4 We recommend multidisciplinary care coordinated to manage pain after SCI.
Risk of Bias: C
Level of Recommendation: Strong

A multidisciplinary approach to pain management should be emphasized, as multiple factors often contribute to an individual's pain experience. Individualized and reasonable pain management goals should be discussed from a multidisciplinary approach. Such an approach is particularly important after SCI, as there are additional functional considerations in the context of pain (bowel and bladder management, spasticity, motor impairments, etc.). Multidisciplinary care could include physiatry, psychiatry, anesthesia, nursing, physical therapy, occupational therapy, social work, psychology, pharmacy, and other services, as necessary.

3.5 We recommend physical and/or occupational therapy, including prescription of a home exercise program, to maintain optimal range of motion and strength.
Risk of Bias: C
Level of Recommendation: Strong

Activity-dependent pain may require a multidisciplinary approach (involving occupational therapy and/or physical therapy) to optimize treatment. Management of activity-dependent pain should include observing and modifying an individual's mechanics during functional tasks (e.g., techniques for ADLs and wheelchair use), as well as their environment. The assessment should consider an individual's specific needs and functional goals.

An RCT by Gee et al.[48] (N<50; low quality) revealed that arm-cycle ergometry exercise significantly reduced SCI-related pain compared with that after body weight-supported treadmill training. In a prospective controlled trial (PCT) by Sato et al.,[49] a single 15-minute session of a wheelchair propulsion exercise was observed to significantly reduce NP temporarily among participants with SCI, as measured by the Numeric Rating Scale (NRS). Similar results were also found in a pre-post study (N<20) by Norrbrink et al.[50] The panel emphasizes the importance of promoting and maintaining physical activity, joint flexibility, and muscular strength through a home exercise program to promote functional independence in addition to their potential positive effects on pain. The evidence for exercise and shoulder pain is discussed in a separate recommendation.

3.6 We recommend involving psychology as part of a multidisciplinary treatment team in individuals with SCI who have recalcitrant pain or significant pain interference.
Risk of Bias: C
Strength of Recommendation: Strong

The biopsychosocial conceptualization of pain highlights the dynamic and interactional relationship of multiple factors that contribute to pain, including physiological, psychological, and social factors.[39] Research continues to support a bidirectional relationship between pain and negative mood.[51] Chronic pain is consistently associated with lower quality of life and negative mood.[52,53] Conversely, psychological factors such as mood, coping, and cognitive appraisals influence the pain experience.[39] Addressing mental health concerns can help mitigate the psychological and behavioral impacts of pain, resulting in improved mood, improved physical function, and increased community participation.[52,54]

The expert panel emphasizes the importance of integrating the management of mental health throughout the rehabilitation continuum. Clinicians with expertise in mental health are critical for addressing mood and quality-of-life issues that can result from and affect chronic pain, but they are also key team members in addressing the psychological, cognitive, and behavioral factors that contribute to and maintain pain symptoms.

As there can be a large disparity in access to evidence-based mental health treatment, delivery of these integrated programs may be challenging. Training front-line clinicians such as physical therapists, occupational therapists, nurses, and social workers to provide this care may help improve access to integrated mental health services. In addition, telehealth and mobile health interventions are rapidly growing alternatives that may present a more cost-effective solution.[55]

3.7 We suggest psychosocial interventions, including cognitive behavioral therapy, psychotherapy, and pain education to manage mood issues in the context of pain. Early management of pain with such interventions can be crucial in reducing pain and its impact over the long term.
Risk of Bias: C
Strength of Recommendation: Conditional

Psychosocial interventions are recommended for managing comorbid pain and mood issues in individuals with SCI. Several studies have reported improvement in symptoms of depression and anxiety in individuals who receive psychosocial interventions.[56-58]

In terms of pain intensity, evidence for the use of psychosocial interventions is conflicting. 2 studies examined the effect of internet-delivered cognitive behavioral therapy (CBT) on pain intensity after SCI.[56,59] Burke et al.[59] found significant improvement in pain intensity after CBT compared with that in a control

group. In a pre-post trial, Dear et al.[56] described improvement in pain intensity after CBT intervention. Li et al.[60] reported that a coping-oriented supportive program significantly reduced pain levels among individuals with SCI. In another study, Jensen et al.[61] found that participants who performed meditation experienced a significant reduction in pain after the intervention. In contrast, Heutink et al.[58] indicated that a multidisciplinary CBT program did not significantly improve pain intensity and pain-related disability compared with that in the waiting list control intervention group. However, the intervention group showed a significant decrease in pain intensity and pain-related disability at 3-month follow-up compared with baseline. In addition, in a pre-post study by Burns et al.,[19] they did not observe significant changes in pain severity following CBT, although CBT significantly improved pain interference, pain coping strategies, and pain cognition in participants.

Other behavioral and psychological strategies to improve pain include guided imagery, hypnosis, meditation, mindfulness, and positive psychology exercises. 1 systematic review and 3 RCTs have studied guided imagery for the management of pain after SCI. In a systematic review, Opsommer et al.[62] showed conflicting evidence regarding the effects of motor imagery on pain severity. Studies included in their review that combined visual illusion with motor imagery showed either an improvement after the intervention or no effect. Three small RCTs[63-65] with sample sizes of less than 50 demonstrated positive effects of guided imagery on pain after SCI. Hypnosis,[61] mindfulness,[57] and positive psychology exercises have also been explored as methods for reducing pain[66] in small-scale RCTs (<100). Two RCTs also investigated the effects of meditation on pain after SCI. Jensen et al.[61] showed that meditation significantly reduced pain after SCI, as measured by the NRS. In a pilot RCT[67] that examined clinical meditation and imagery (CMI) vs. an education intervention, pain outcomes did not significantly differ within or between groups.

Because of the challenge of conducting blinded interventions in behavioral studies, their evidence quality is often downgraded due to a high potential for bias. However, as many of these interventions include patient education related to pain mechanisms and building pain management coping skills, implementation of these interventions is suggested for individuals with comorbid pain and mood issues after SCI.

3.8 We recommend that treatments with multiple therapeutic effects be considered in individuals with SCI who have pain and concomitant issues with mood and sleep.
Risk of Bias: C
Strength of Recommendation: Strong

The most frequent difficulties that co-occur with pain are psychological in nature,[4] in particular depression. Therefore, when choosing treatments to address pain, it is helpful to consider how treatments can address multiple issues concurrently.

Meta-analyses suggest that pregabalin[68-70] and gabapentin[69] are effective for improving mood, including depression and anxiety, as well as sleep in individuals with NP after SCI. In a comparison of the effects of pregabalin and gabapentin, 2 RCTs (N<50) reported no statistically significant differences in mood, as measured by the Beck Depression Inventory (BDI).[71,72] Pregabalin and gabapentin tend to be well tolerated, with a favorable side effect profile.

Amitriptyline, as a tricyclic antidepressant (TCA), may have an impact on mood; further, amitriptyline can cause fatigue, which could be used to improve sleep. One crossover trial[73] noted improvement in NP only in individuals with SCI who have high depressive symptoms on the Center for Epidemiologic Studies Depression Scale–Short Form. However, anticholinergic side effects (affecting, for example, bowel and bladder management) may limit the use of amitriptyline after SCI.

Other medications that are used to address mood issues in broader populations, such as venlafaxine, may be an option for dual management. In one RCT (N>100, low quality), there was improvement in non-NP but not NP pain after controlling for depression, anxiety, and multiple pain sites.[74] Other medications in the same class (i.e., serotonin-norepinephrine reuptake inhibitors), such as duloxetine, may also be considered for dual management in individuals with depression and pain after SCI. However, it is important to note that SNRIs have not been shown to be effective in the treatment of NP after SCI.[75]

Among nonpharmacological interventions, a fair-quality RCT (N<100) that assessed transcutaneous electrical nerve stimulation (TENS) for myofascial pain and SCI[76] demonstrated significant improvements in pain intensity, mood, and sleep quality. Other nonpharmacological options that can be considered for the management of mood issues in the context of pain include noninvasive brain stimulation techniques, mindfulness, CMI, and exercise.

Evidence for the effect of noninvasive brain stimulation techniques on mood is conflicting. Combined transcranial direct current stimulation (tDCS) and visual illusion was shown to improve pain, sleep, and mood after 2 weeks in a prospective, open-label, controlled trial.[77] However, 2 meta-analyses found that noninvasive brain stimulation techniques had no beneficial effect over sham stimulation on the improvement of depression.[78,79] A lack of benefit on the BDI was found by Wrigley et al.[80] in a small crossover RCT (n=10) that examined the effects of tDCS.

One RCT (N<100) examined an online mindfulness training intervention for individuals with SCI and NP. The authors found improvements in pain catastrophizing, pain unpleasantness, depression, and anxiety after intervention.[57] One pilot RCT (N<50; low quality) examined CMI for individuals with SCI who experienced chronic pain. The CMI group participants were taught mindfulness, mantra meditation, and guided imagery practices. The control group received education on topics related to health and function after SCI. Although outcomes were not statistically significant, the CMI group showed a trend toward improved depressive symptoms (with a large effect size of d>0.8 at day 42 and day 70), and there was a trend for improvement in perceived stress for the control group (with a large effect size of d>0.8 at day 42).[67]

In a fair-quality RCT by Cardenas et al.[81] that assessed a home exercise program for shoulder pain, intention-to-treat analyses revealed improvements in depressive symptoms, as measured by the BDI, as well as several shoulder pain outcomes. Similar improvements in depressive symptoms after an exercise program were found by Sato et al.[49] in a PCT and by Crane et al.[82] in a pre-post study. However, an RCT (low quality) by Gee et al.[48] that examined body-weight support treadmill training and arm cycle ergometry reported no improvements in mood following these interventions.

3.9 We recommend referral to specialized pain management when an individual's pain has plateaued prior to achieving their desired functional goals and if it is leading to a decrease in function, health, participation, or independence.
Risk of Bias: C
Level of Recommendation: Strong

Previously published SCI guidelines[8] suggest consideration of referral to a specialized pain center or clinic if there is persistent pain with insufficient relief, or failure to achieve therapeutic goals. In the non-SCI population, the National Institute for Health and Care Excellence[14] recommends considering a referral to a specialist pain service or a condition-specific service at any stage if there is severe pain; significant pain limitations in lifestyle, daily activities (including sleep disturbance), and participation; or deterioration in the underlying health condition.

A key component of referral for specialized pain management is access to multidisciplinary pain management, particularly for comprehensive pain education, management of yellow flag conditions, reinforcement of self-management techniques, and psychotherapy or psychosocial interventions. Although specialized pain management may be necessary, management of functional limitations will continue to require involvement of the SCI rehabilitation team, and communication between clinicians involved in specialized pain management and SCI rehabilitation is essential.

3.10 We recommend timely and ongoing follow-up care to monitor the changing needs of individuals with SCI and pain. For an individual in the community, this follow-up should be done on an annual basis at minimum.
Risk of Bias: C
Level of Recommendation: Strong

Follow-up care is an important part of the plan of care for individuals with SCI and pain. The domains to be assessed at follow-up include, but are not limited to, medication safety and efficacy, function and mobility, treatment success, and the need for referral to specialized pain management. From the information in CPGs and studies included in our search, we found no evidence regarding a specific time frame regarding follow-up care. The expert panel suggests establishing a follow-up schedule based on the individual needs of the patient; at a minimum, the panel recommends yearly follow-up.

3.11 We recommend that healthcare providers consider weaning treatment for individuals with SCI who have reached a plateau in pain management, including individuals whose pain has resolved.
Risk of Bias: C
Strength of Recommendation: Strong

A plateau in pain management is achieved when pain intensity and functional return to valued activities is balanced and stable, with pain control optimized to the best extent possible. Optimizing analgesic efficacy, optimizing functional status, minimizing adverse effects, and assessing underlying issues that cause and exacerbate pain may require a reduction in treatment, including medication, to the lowest tolerable level. The efficacy and safety of medications and treatments that individuals with SCI continue to receive should be assessed at each follow-up.

Section 4: Opioids

In a meta-analysis, Mei et al.[83] found that opioids were less efficacious and safe when compared with other medications for pain relief, including anticonvulsants, anesthetics, antidepressants, and botulinum toxin A. Significant harm is associated with opioid use after SCI. Respiratory depression related to opioids are a particular concern after SCI, given respiratory insufficiency from SCI, sleep-disordered breathing, and use of respiratory depressant medications.[84] In addition, the concomitant use of sedatives and benzodiazepenes should be avoided given the increased risk of overdose and death.[84,85] Other adverse events associated with opioids include sleep-disordered breathing, constipation, sedation, impaired cognition, overdose, and death.[84]

Although there are various risks associated with opioid use in those with SCI, and limited evidence for benefit, opioid prescription continues to be prevalent after SCI.[85] The panel therefore urges caution in the prescription and use of opioids in the SCI population.

4.1 We recommend that opioids, if necessary, be used for only a short course (e.g., after the initial injury) for musculoskeletal pain. Ideally, the goal is to wean opioids as soon as possible, especially before discharge from inpatient rehabilitation. Initiation of opioids for chronic pain after SCI is not recommended.
Risk of Bias: C
Level of Recommendation: Strong

4.2 We recommend that if opioids are prescribed, short-acting opioids should be used at the lowest dose necessary.
Risk of Bias: C
Level of Recommendation: Strong

Although the use of opioids should be avoided whenever possible, the expert panel recognizes that there are situations, particularly in the acute post-injury phase, in which opioid use is necessary for pain relief and to optimize participation during inpatient rehabilitation. As with any treatment, opioids should be initiated only if potential benefit outweighs risks, and realistic goals for pain relief and improved function should be established.[86] The *VA/DoD Clinical Practice Guideline for the Use of Opioids in the Management of Chronic Pain*[86] specifically identified that pain should be severe, interfering with function and quality of life, and not adequately responding to nonpharmacological and nonopioid pharmacological therapy prior to initiation. Opioid use is relatively contraindicated in individuals with active substance use issues or a history of addiction, as they are at higher risk of opioid use disorder, particularly with long-term use.[87] Among the CPGs and evidence related to SCI, we did not find any articles related to how long opioids should be used.

The *VA/DoD Clinical Practice Guideline for the Use of Opioids in the Management of Chronic Pain*[87] notes that use of opioids beyond 30 days increases the risk for physical dependency and opioid use disorder. In addition, long-term opioid use exposes people to unique risks, including possible problems with drug tolerance and escalation, opioid-induced hyperalgesia, endocrinopathy, and potential for misuse and physical dependency.[88] Therefore, the panel recommends that opioids, if necessary, should be used for only a short period. In the SCI population, this period is most likely to be in the immediate postoperative and possibly the inpatient rehabilitation phases. Ideally, discontinuation of opioids before discharge from inpatient rehabilitation should be the goal. Initiation of opioids for chronic pain after SCI is not recommended, unless there has been an acute change in an individual's health status (e.g., after a surgical procedure).

If opioids are prescribed, the panel recommends using immediate-release opioids rather than extended-release or long-acting opioids, in accordance with the Centers for Disease Control and Prevention (CDC) guidelines on opioid use in a non-SCI population.[86] CDC guidelines on opioid use in a non-SCI population recommend that when clinicians initiate opioids, they should prescribe the lowest effective dose.[86] The CDC guidelines state the following: *"Clinicians should use caution when prescribing opioids at any dosage, should carefully reassess evidence of individual benefits and risks when considering increasing dosage to ≥50 morphine milligram equivalents (MME)/day, and should avoid increasing dosage to ≥90 MME/day or carefully justify a decision to titrate dosage to ≥90 MME/day."*[86] *The VA/DoD Clinical Practice Guideline for*

the Use of Opioids in the Management of Chronic Pain[87] notes the low to moderate evidence supporting an association between the dose of opioids used and the risk of opioid use disorder.

4.3 We recommend continuation of stable doses of opioids in individuals with SCI who have used these medications chronically (i.e., years) for pain after the dose is reduced to its lowest tolerated amount.
Risk of Bias: C
Level of Recommendation: Strong

Although we advise against the use of opioids in the long term, or initiating opioids for chronic pain after SCI, individuals who have already been taking opioids in the long term may continue to require opioids indefinitely. Sudden discontinuation or withdrawal of opioids in these individuals can lead to increased non-prescription opioid use, increased healthcare use, increased mental health crises, increased overdose events, and increased mortality.[89] Although a gradual reduction in dose should be trialed, it should be recognized that discontinuation of the opioid is often not possible, and the dose may still remain above recommended cutoffs (i.e., >90 MME/day) despite reduction. Tapering opioid doses in legacy patients may also require months, if not years, of gradual reduction.

In individuals who require ongoing opioid use, adverse effects such as cognitive impairment, respiratory depression, nausea, vomiting, constipation, dry mouth, dizziness, and drowsiness should be monitored.[84,88]

Section 5: Neuropathic Pain Management

Section 5A: Pharmacological Options

5A.1 We recommend pregabalin or gabapentin for the reduction of NP intensity.
Risk of Bias: B
Level of Recommendation: Strong

Pregabalin and gabapentin belong to the drug class known as anticonvulsants. Pregabalin is absorbed more rapidly than gabapentin, with maximum plasma concentration attained in 1 hour for pregabalin, versus 3-4 hours for gabapentin.[90] In addition, absorption of pregabalin is linear (plasma concentration increases proportionally with increasing dose, and bioavailabilty is greater than or equal to 90% regardless of dose), whereas absorption of gabapentin is nonlinear (bioavailability of gabapentin decreases with increased doses, with reduction in absolute bioavailability from 60% to 33% with dose increases from 900 mg to 3600 mg/day).[90] These medications are commonly prescribed for conditions such as fibromyalgia and NP. Six meta-analyses,[68-70,91-93] 4 systematic reviews,[38,94-96] and 8 RCTs[71-73,96-100] related to the use of pregabalin and/or gabapentin for the management of NP after SCI were identified.

Three meta-analyses[70,91,102] and 1 systematic review[96] studied pregabalin only and found that it improved pain in comparison to placebo. A 2022 meta-analysis by Canavan et al.[91] aimed to assess the effectiveness of several medications, as well as the incidence of adverse events and withdrawal rates in the pharmacological treatment of chronic pain after SCI. Data were combined from 21 studies and effectiveness for NP was found for pregabalin (3 of 3 studies). A meta-analysis and systematic review of multicenter RCTs by Yu et al.[70] assessed the efficacy and safety of pregabalin in managing NP resulting from SCI. After at least 4 weeks of treatment with pregabalin (flexible dose, 150 to 600 mg/day), the analyses showed reduced pain intensity ($p=.0001$), greater proportions of participants achieving >30% ($p<.0001$) and >50% pain relief ($p=.0001$), and reduced anxiety ($p=.05$) and depression ($p=.002$) scores compared with those in the group receiving placebo. A meta-analysis by Parsons et al.[92] and a systematic review by Snedecor et al.[96] reported similar positive findings from pregabalin. Similarly, the RCTs by Min et al.[97] ($N<100$; low quality) and Cardenas et al.[99] ($N>100$; low quality) reported that pregabalin was effective for pain.

Three meta-analyses[68,69,93] compared the use of pregabalin and gabapentin, and the findings support both medications as being effective in managing NP. A meta-analysis by Davari et al.[68] assessed the safety and effectiveness of pregabalin and gabapentin among studies published to December 2018. The meta-analysis demonstrated that both medications were effective for reducing pain, and no significant difference was observed in efficacy and adverse events between the 2 drugs. A meta-analysis by Tong et al.[93] evaluated the relative effectiveness and safety of pregabalin and gabapentin for individuals with SCI-related NP among studies published to August 2020. From the average pain intensity after treatment, the efficacy rank order from highest to lowest was pregabalin, followed by gabapentin, amitriptyline, carbamazepine, and placebo. Mehta et al.[69] performed a systematic review and meta-analysis to assess the effectiveness of gabapentin and pregabalin in alleviating NP intensity, depression, anxiety, and sleep disruption in individuals with SCI, while also examining associated adverse events. Gabapentin and pregabalin demonstrated a significant reduction in the intensity of NP at less than 3 months ($p<.001$) and between 3 and 6 months ($p<.001$) after initiation of treatment. A significant reduction in symptoms of other SCI secondary conditions, including sleep interference ($p<.001$), anxiety ($p<.001$), and depression ($p<.001$) was also shown. Three systematic reviews[38,94,95] support the published meta-analyses and reported strong evidence for the effectiveness of both gabapentin and pregabalin.[38,94,95]

With respect to adverse effects, some research suggests that pregabalin and gabapentin are associated with somnolence and dizziness[69,91,93] Conversely, Yu et al.[70] reported that, when stratified, their meta-analysis showed no difference in primary adverse events (i.e., drowsiness, dizziness, peripheral edema, and dry mouth) between pregabalin and placebo groups ($p>.05$). In addition, Davari et al.[68] found no significant difference between pregabalin and gabapentin for discontinuation due to adverse events. Caution should be exercised when using gabapentinoids and opioids together.[103]

The quality of evidence for gabapentin and pregabalin was rated as moderate due to the presence of multiple meta-analyses and systematic reviews consistently demonstrating positive results on pain intensity with these medications, despite the high risk of bias in the RCTs that were evaluated as part of this CPG.[71-73,97-101]

5A.2 We suggest amitriptyline for the reduction of NP intensity.
Risk of Bias: C
Level of Recommendation: Conditional

Amitriptyline is a TCA that prevents the reuptake of both serotonin and norepinephrine. In an RCT by Agarwal et al.,[104] 147 patients were randomized to receive either 3 weeks of amitriptyline (oral doses of 25 mg daily for 1 week, 50 mg daily for 1 week, 100 mg daily for 1 week) or lamotrigine (oral doses of 25 mg twice daily for 1 week, 50 mg twice daily for 1 week, 100 mg twice daily for 1 week). Medications were increased if no improvement was noted, or there were no adverse events. For both amitriptyline and lamotrigine, mean pain intensity was reduced at 1, 2, and 3 weeks compared with baseline ($p<.001$ for each time point). There was no significant difference in pain improvement between the 2 drugs. The use of amitriptyline is suggested for individuals after SCI and may have an effect on concomitant depression if present. Of note, the risk-of-bias assessment for Agarwal et al.[104] was rated low quality (i.e., high risk of bias), with questionable risk of bias noted for concealed allocation, selective reporting, and blinding of outcome assessment and participants and personnel.

It is suspected but not definitively known whether TCAs other than amitriptyline are effective for the treatment of NP after SCI, as other agents have not been assessed in RCTs.[105-107]

5A.3 We suggest that additional pharmacological management options can be considered for NP after SCI if gabapentin, pregabalin, and/or amitriptyline are trialed without success, or if there are unmanageable side effects. These options may have evidence in other NP conditions, or limited evidence in SCI. Careful consideration and discussion of the limited evidence and potential risks for these medications is important prior to use.
Level of Evidence: C
Strength of Recommendation: Conditional

A conditional recommendation is made for the use of other pharmacological treatments for NP after SCI; the panel acknowledges that for a significant number of individuals, the gabapentinoids and amitriptyline are not effective treatments, and there is a need for guidance in terms of potential pharmacological options that might be helpful. Clinicians should discuss the limited evidence for benefit, and risk of side effects, with individuals who are contemplating these medications after SCI.

Of the pharmacological options assessed by the expert panel, botulinum toxin, lamotrigine, and oxcarbazepine had some evidence of effectiveness. These medications have been suggested for use in other CPGs for NP after SCI, including the CanPainSCI CPG,[10] the German-Speaking Medical Society for Spinal Cord Injury CPG,[8] and the Italian Consensus Conference on Pain in Neurorehabilitation CPG.[11]

An RCT ($N<20$; low quality) by Chun et al.[108] explored the use of localized subcutaneous injections of either botulinum toxin type A (BTX-A) or saline on a single occasion for at-level NP. Patients were followed for 12 weeks and then crossed over to the other treatment. A higher proportion of participants reported a marked change in average pain intensity from baseline to 8 weeks and 12 weeks after BTX-A compared with those receiving a placebo (33% vs. 0% of patients, respectively); however, results were not adequately powered to detect a statistically significant effect. In another RCT ($N=40$; high quality), Han et al.[109] studied individuals with at-level and/or below-level NP after SCI who were randomly divided into either a 1-time 200-unit BTX-A injection group or a placebo (saline) group. Compared with the placebo group, the BTX-A group showed a significant reduction in scores on the visual analog scale (VAS) at 4 weeks ($p=.0027$) and 8 weeks ($p=.0053$) after the injection. Further, at 4 weeks and 8 weeks after injection, 10% and 20% of patients, respectively, reported pain relief of 50% or greater in the BTX-A group vs. only 5% and 10%, respectively, in the placebo group. Compared with those with an American Spinal Injury Association Impairment Scale (AIS) A classification, a significantly greater proportion of individuals with incomplete injuries (AIS B-D) achieved ≥20% pain relief at 4 weeks ($p=.0216$) and 8 weeks ($p=.0098$). The risk-of-bias assessment was good for the study by Han et al.[109] and poor for that by Chun et al.,[108] with high risks of bias regarding

selective reporting and incomplete outcome data and questionable bias for random sequence generation and outcome assessment blinding. In a meta-analysis of 15 studies, Mei et al.[83] found that BTX-A was better than placebo for pain relief and that it showed more efficacy than opioids; however, BTX-A was less effective than anticonvulsants, anesthetics, and antidepressants.

In a low-quality RCT (n=140),[104] lamotrigine was assessed in comparison to amitriptyline. The Short-Form McGill Pain Questionnaire-2 (SFMPQ2) was used to assess pain at baseline, and at 1-, 2-, and 3-week follow-up. For both amitriptyline and lamotrigine, there was significant improvement on mean SFMPQ2 scores at baseline vs. at each follow-up time ($p<0.001$). However, there was no significant difference between groups at baseline vs. week 1 ($p=.799$), week 2 ($p=.819$), or week 3 ($p=.648$). A small RCT[110] (n=22) showed no benefit of lamotrigine for NP across all participants, but there was a significant effect for those with incomplete lesions (n=12). In contrast, among the population in the study by Agarwal and Joshi,[104] 76% were AIS Scale A. The expert panel notes that lamotrigine has a black box warning from the US Food and Drug Administration (FDA) for serious skin rashes, including Stevens-Johnson syndrome (0.08% to 0.3% of adults). The FDA recommends discontinuing lamotrigine at the first sign of a rash, unless the rash is clearly unrelated to the medication.

Oxcarbazepine is an anticonvulsant for which a single crossover RCT[97] (n=55; low quality) has studied its effectiveness in improving NP intensity after SCI. Patients were randomized into receiving either pregabalin or oxcarbazepine and then crossed over to receive the other medication. Further, participants were subdivided into 2 groups: evoked pain present (EPP) and evoked pain absent (EPA). In the EPP group, both medications were significantly effective for all pain characteristics ($p<.05$), except oxcarbazepine for heat hyperalgesia ($p=.336$). Oxcarbazepine was significantly more effective for the EPA group for electrical pain, burning, and pricking than it was for the EPP group ($p<.05$). The difference in the effect of pregabalin between the EPA and EPP groups was not significant for electrical pain, pricking, and numbness ($p>.05$), whereas a much better response was observed for burning in the EPA group ($p=.042$). In the evoked pain categories of allodynia and heat hyperalgesia, pregabalin was significantly more effective than oxcarbazepine ($p<.001$). Although this single study by Min et al.[97] provides evidence of the benefit of oxcarbazepine as a medication for reducing NP after SCI, more studies are required to fully understand its impact. Of note, the risk-of-bias assessment for the study by Min et al.[97] was rated as poor, with high risks noted for concealed allocation and participant and personnel blinding. Clinicians should be aware of the risk of hyponatremia (2-3%) with oxcarbazepine, particularly in the first 3 months of use; this risk can be increased with concomitant use of a selective serotonin reuptake inhibitor.

Numerous other treatments appear in the literature with some suggestion of benefit, but evidence is significantly limited (e.g., single small RCTs, observational studies). These treatments include bumetanide (1 pre-post study, N<20[111]), capsaicin patch (1 RCT, N<20[112]), ziconotide (1 pre-post study, N<20[113]), methylprednisolone (1 case series, N<50[114]), and neurotensin A (1 pre-post study, N<20[115]). One RCT on lithium carbonate compared with placebo (N<50; Yang et al.[116]) demonstrated preliminary evidence of benefit for NP after SCI up to 6 months following initiation of a 6-week course of treatment; however, the expert panel emphasizes the significant adverse effects associated with lithium and discourages its use for NP after SCI.

A treatment option for NP that has received significant attention recently is cannabinoids. One meta-analysis, 1 RCT, and 1 observational study (N>100) examined the use of cannabinoids for the management of NP after SCI. In a meta-analysis, Tsai et al.[117] found that there was no significant difference in pain relief between cannabinoids and placebo in individuals with SCI. A moderate-quality crossover RCT (n=42[118]) demonstrated significantly decreased pain intensity with 2 vaporized cannabis dosages (i.e., 2.9% or 6.7% delta-9-tetrahydrocannabinol) compared with that for placebo within an 8-hour session. No differences were found between dosages. This study was downgraded based on concerns regarding blinding of participants and personnel and blinding of outcome assessments. In 1 observational study (n=353), 63.6% of participants reported that medical cannabis offered "great relief" for their symptoms (including pain, spasms, sleeplessness, and anxiety), whereas 30.20% found that cannabis offered "little relief."[119] Only 6.30% of

subjects reported that medical cannabis use had either made no difference in their condition or symptoms, or had made them worse. Among all respondents, 63.3% indicated that cannabis worked better than prescription medications.

It is important to note that the use of cannabinoids, such as medical marijuana or cannabidiol, for treating NP after SCI in the United States is a subject of ongoing research and debate. Although the CanPainSCI CPG includes recommendations on its possible use, Federal Law in the United States in 2026 classifies marijuana as a Schedule I controlled substance, which makes it illegal at the federal level. In addition, the legal status of cannabinoids varies from state to state. Thus, at this time, no recommendation has been put forth with respect to the use of cannabinoids for treating NP after SCI.

Other pharmacological agents have also been suggested as treatment options in other CPGs for NP after SCI. These agents include duloxetine,[8] venlafaxine,[8] baclofen,[8] intravenous lidocaine/ketamine (short-term benefit),[11] and capsaicin.[8] Although other CPGs have also suggested opioids (e.g., oxycodone, tramadol) as potential treatment options[8,10,11] the chronic use of these medications is discouraged in this CPG (see opioid recommendations 3.12 to 3.14).

The literature shows a lack of benefit in NP for mexiletine (1 RCT; N=11[120]), palmitoylethanolamide (1 RCT; N<100; moderate quality[121]), levetiracetam (1 RCT; N=24; moderate quality[122]), and venlafaxine (1 RCT; N>100; low quality[75]) in studies involving individuals with SCI.

Section 5B: Nonpharmacological Options

5B.1 We suggest considering transcranial direct current stimulation (tDCS) for reducing NP intensity.
Risk of Bias: C
Level of Recommendation: Conditional

tDCS is a noninvasive neuromodulation technique that involves applying a low electrical current to the scalp with the aim of influencing brain activity. It is a relatively simple and safe procedure that has gained attention for its potential to enhance cognitive and motor functions, as well as for its use in various research and clinical applications. Treatment with tDCS alone or in combination with visual illusion has been suggested for NP after SCI in other CPGs.[8,10] Although some studies have demonstrated benefit,[77,123-126] others have not.[61,127,128] Insufficient evidence to conduct a meta-analysis of tDCS on NP following SCI over the primary motor area (M1) was reported by Shen et al.[129] These mixed findings may be attributed to differences in dosage and frequency of tDCS applied, and further evaluation of optimal parameters for tDCS is warranted. The expert panel's suggestion to consider tDCS rests on studies demonstrating some positive effects on NP, along with relatively few side effects (e.g., short-lasting headaches), despite barriers such as limited carryover effects and limitations in access and availability.

5B.2 We suggest considering transcutaneous electrical nerve stimulation (TENS) for reducing NP intensity.
Risk of Bias: C
Level of Recommendation: Conditional

TENS is a noninvasive pain management technique that involves the use of low-voltage electrical currents to alleviate pain. TENS units are portable battery-operated devices that deliver electrical impulses to the body through electrodes placed on the skin. These electrical impulses are designed to stimulate the nerves in a way that can provide relief from various types of pain. The German-Speaking Medical Society for Spinal Cord Injury[8] and CanPainSCI guidelines[10] suggest consideration of TENS as a treatment for NP after SCI.

One meta-analysis[133] and 3 RCTs[65,134,135] were published in the last decade that examined the efficacy of TENS for the management of pain after SCI. A recent meta-analysis by Yang et al.[133] showed that individuals with SCI who received TENS experienced a significantly greater decrease in pain than did those in the control group, as measured by the VAS and the Short-Form McGill Pain Questionnaire.[133] In 2 RCTs (N<100; N<50), TENS was found to significantly reduce pain severity compared with that in a sham intervention.[134,135] In the third RCT, Özkul et al.65 compared the effects of TENS and visual illusion on pain intensity, pain qualities, and ADLs in patients with NP after SCI (N=24). The authors reported that TENS was effective in reducing pain intensity compared with visual illusion overall; however, visual illusion resulted in a significant reduction specifically in hot, sharp, unpleasant, and deep pain types, whereas

TENS did not. Of note, all the RCTs were assessed as having a high risk of bias. Although the benefit of TENS therapy is uncertain and its carryover effects may be limited, the panel's suggestion is based on the growing body of research supporting its potential benefits, noninvasive nature, and low risk of side effects.

5B.3 We recommend considering virtual reality interventions, including virtual walking, for the reduction of NP intensity.
Risk of Bias: C
Level of Recommendation: Conditional

Virtual reality refers to a computer-generated simulation of an environment or experience that can be interacted with and explored by an individual with specialized equipment.[136] In a virtual reality environment, users are typically immersed in a computer-simulated world that can be similar to, or completely different than, the real world. The effect of virtual reality on pain occurs through 2 broad mechanisms: distraction and neuroplasticity.[136] One systematic review,[137] 2 RCTs,[138,139] and 1 secondary analysis of an RCT[138] have examined the efficacy of virtual reality interventions for NP after SCI. Two RCTs by Richardson et al.[139] (N<100; moderate quality) and Jordan and Richardson[138] (N<50; low quality), as well as a secondary analysis by Jordan and Richardson[138] (N<50), reported that virtual walking significantly improved NP after SCI, as measured by the NRS. The systematic review by Chi et al.[137] evaluated these RCTs and other pre-post studies (N=9) and reported a potential for clinically significant analgesic effects of virtual walking interventions.

A PCT (N<50) by Pozeg et al.[140] observed that a body ownership illusion intervention that used virtual reality significantly reduced NP, measured by the VAS for Pain Intensity. Two PCTs (N<100; N>100) evaluated tDCS combined with visual illusion interventions for NP after SCI.[77,125] Both studies found that a combined tDCS and visual illusion intervention resulted in a significant decrease in NP, as measured by the Neuropathic Pain Symptom Inventory, Brief Pain Inventory, and NRS.

Although virtual reality interventions may provide an immediate analgesic effect for SCI-related NP, the long-term effects are unknown.[137] Given this potential for benefit, at least in the short term, the panel's recommendation to consider a virtual reality intervention is based on the notion that this form of therapy can be accessible, with limited adverse effects.

5B.4 We suggest that additional nonpharmacological management options can be considered for pain after SCI. These options may have evidence in other pain conditions, or have only limited evidence in SCI. Careful consideration and discussion of the limited evidence and the potential risks associated with these treatments is important prior to use.
Risk of Bias: C
Level of Recommendation: Conditional

Similar to pharmacological treatment options for NP after SCI, there are multiple nonpharmacological treatment options with limited evidence of effect. Although the evidence to support formal recommendations is lacking, the expert panel recognizes the importance of providing a summary of the evidence reviewed, given the limited treatment options available for managing pain after SCI. Future research to clarify the effect of these interventions in individuals with pain after SCI is important. Note that some studies focused on NP, while others focused on nociceptive pain, or a mixed pain population.

Exercise

One meta-analysis,[141] 1 RCT[48] (N<50; low quality), 1 PCT[49] (N<50), and 2 pre-post studies[50,82] (N<100) that examined the effects of exercise on pain after SCI were reviewed. Multiple different central and peripheral NP conditions were included in the meta-analysis (e.g., multiple sclerosis, Parkinsons, stroke, diabetes, and SCI). The authors recommended exercise programs, such as stretching and strengthening exercises, as treatment for NP in individuals with SCI.[141] An RCT by Gee et al.[48] revealed that arm-cycle ergometry exercise significantly reduced pain after SCI compared with body weight-supported treadmill training. In a PCT by Sato et al.,[49] a single 15-minute session of a wheelchair propulsion exercise was observed to significantly reduce NP among participants with SCI, as measured by the NRS. A pre-post study examined the efficacy of a structured group exercise program on pain after SCI. The findings showed a trend to decreased pain on the Bodily Pain subscale of the 36-Item Short Form Health Survey questionnaire that was not statistically significant.[82] A decrease in pain intensity was also seen in a pre-post study that evaluated a seated double-poling ergometer (N<20).[50]

Biofeedback

One RCT[61] (N<50; low quality) and 3 pre-post studies[142-144] (N<20) investigated the efficacy of biofeedback for NP after SCI. In the RCT, Jensen et al.[61] found that neurofeedback did not result in significant changes in pain intensity pre- to post-session. Three pre-post studies observed that a neurofeedback intervention (a type of biofeedback in which patients are provided with visual and auditory feedback on brain activity) significantly reduced NP after SCI, as measured by the VAS and the NRS.[142-144] For nociceptive pain, 1 RCT (N<20, poor quality) demonstrated that exercise and EMG biofeedback training resulted in significant reduction in shoulder pain post-intervention and at the 6-month follow-up.[145]

Breathing-Controlled Electrical Stimulation

Four RCTs of low quality (2 with N<50; 2 with N<20) investigated the effectiveness of breathing-controlled electrical stimulation (BreEstim) for NP after SCI. Karri et al.[146] found that BreEstim significantly reduced pain compared with that in sham treatment. Similar results were found in 3 other RCTs.[127,146,147]

Transcranial Magnetic Stimulation

We found 3 systematic reviews and 5 RCTs that addressed the effects of repetitive transcranial magnetic stimulation (rTMS) for managing NP after SCI. Overall, evidence for the effectiveness of rTMS in reducing NP after SCI is conflicting. One systematic review[148] and 4 RCTs[149-152] (2 N<20; 2 N<50) found that rTMS significantly reduced pain intensity compared with that in a sham control treatment. In contrast, 1 systematic review[130] and 1 RCT[153] (N<20) did not find any significant differences between rTMS and sham groups for pain intensity after intervention. One meta-analysis by Shen et al.[129] demonstrated that rTMS interventions did not result in significant differences in NP between the intervention group and the sham group at approximately 1 week after intervention, but that they led to significantly greater pain reduction in the intervention groups compared with that in the sham groups between 2 and 6 weeks after intervention.

Motor Imagery

Evidence is conflicting for motor imagery interventions. A systematic review noted significant heterogeneity in the types of interventions provided, outcomes measured, and SCI sample, making it challenging to determine therapeutic effects.[62] RCTs have demonstrated positive results with motor imagery, 2 of moderate quality (N<50)[63,64] and 1 of low quality (N=24).[65]

Mindfulness Meditation

Three RCTs (N<50; low quality) were found that investigated the effects of mindfulness meditation on pain after SCI. Jensen et al.[61] showed that meditation significantly reduced pain after SCI, as measured by the NRS. Hearn et al.[57] examined an online mindfulness training intervention for individuals with SCI and NP. The authors found improvements in pain catastrophizing, pain unpleasantness, depression, and anxiety after intervention.[57] Another RCT[67] showed no statistically significant differences in primary or secondary outcomes from baseline either within or between groups (p>.05) that received a clinical meditation intervention or were an education control group.

Other

Other nonpharmacological therapies that have demonstrated limited evidence of positive effect include the following:

- Acupuncture: 1 RCT (N<50; low quality)[154]
- Anti-inflammatory diet: 1 RCT (N=20; low quality)[155]
- Functional electrical stimulation: 2 pre-post studies (N<20[156]; N=6[157])
- Intermittent normobaric hyperoxia: 1 RCT (N<100; low quality)[158]
- Osteopathic manipulative treatment: 1 RCT (N<50; low quality)[159]
- Seated Tai Chi: 1 pre-post study (N<50)[160]
- Music therapy: 1 pre-post study (N<20)[161]
- Whole-body vibration: 1 secondary analysis of an RCT (N<20)[162]
- Hypnosis: 1 RCT (N<50; low quality)[61]

A number of nonpharmacological therapies have limited evidence of a lack of effect on pain, including the following:

- Exoskeleton: 1 meta-analysis[163]; 1 RCT (N<20; low quality)[164]
- Neuromuscular electrical stimulation: 1 PCT (N<100)[165]
- Transcutaneous spinal direct current stimulation: 1 RCT (N<20; low quality)[132]
- Yoga: 1 RCT (N < 50; low quality)[166]

Nonpharmacological therapies recommended in the German-Speaking Medical Society for Spinal Cord Injury[8] CPG for NP include physical activity, exercise, physiotherapeutic interventions, psychotherapeutic techniques, acupuncture, massage, heat therapy, osteopathy, visual illusion, and motor imagery, as well as TMS.

Section 6: Nociceptive Pain Management

6.1 We recommend that management of nociceptive pain in individuals with SCI include general principles used to manage nociceptive pain in individuals without SCI, although specific treatments and management options may have to be modified depending on the unique considerations and circumstances of the individual with SCI.
Risk of Bias: C
Level of Recommendation: Strong

It is appropriate to offer treatments that have been found to be effective in non-SCI populations to individuals with SCI, particularly if pain is interfering with an individual's functional status and ability to participate in rehabilitation therapies. However, it is important to realize that the needs of the SCI population are unique and that they may require specialized approaches to treatment. For example, neuromuscular impairments may present barriers to some therapeutic strategies, such as targeted strengthening or motor control exercises.

It is particularly important to address musculoskeletal when it interferes with, or has the potential to interfere with, functional mobility, ADLs, and participation in rehabilitation therapies. Regular follow-up care can be helpful in early identification of nociceptive pain prior to interference in these domains.

Pharmacological treatment options for the management of musculoskeletal pain in the non-SCI population (e.g., use of nonsteroidal anti-inflammatory drugs and acetaminophen) would be reasonable to trial for nociceptive pain after SCI. Topical medications (e.g. topical diclofenac or lidocaine) are also reasonable options for musculoskeletal pain. When pain persists following conservative management, interventional therapies (e.g., corticosteroid injection for subacromial bursitis/rotator cuff tendonitis) can be considered.

It should be noted that the evidence specific to SCI for injections to address nociceptive pain is sparse and limited. One RCT[167] (N<50, fair quality) compared blind and ultrasound-guided subacromial bursa injection. Both groups demonstrated significant improvement in pain, although the ultrasound-guided group demonstrated significantly greater pain relief. One pre-post study that examined platelet-rich plasma[168] (N<20), and 1 that examined micro-fragmented adipose tissue injections[169] (N<20) for rotator cuff disease both demonstrated improvement in pain.

6.2 We recommend regular evaluation of the equipment used by individuals with SCI, including ergonomics. Evaluation includes appropriate selection of equipment, adequate training to ensure that proper techniques are used, and ensuring that environmental adaptations are in place.
Risk of Bias: C
Level of Recommendation: Strong

Saunders et al.[170] found that 66% of individuals with SCI reported using at least 1 piece of mobility equipment. Zhao et al.[171] reported that the most commonly used mobility aids include wheelchairs, orthoses, canes, crutches, and walkers. Because of the high use of durable medical equipment by individuals living with SCI to assist with functional mobility and ADLs, it is important to regularly evaluate whether the equipment is still the best fit for the individual. Equipment needs for an individual with SCI may change over time. Appropriate use of equipment that is implemented early may mitigate the development of musculoskeletal pain. Transitioning to equipment that provides additional support, if necessary, can reduce the risk of increasing pain and overuse injury. For example, an ultralightweight manual wheelchair may initially be appropriate for an individual, but this may change with the onset of pain and fatigue in the upper extremities and/or with changes related to aging, leading to the need for power assistance and/or a power wheelchair.

Furthermore, ensuring that proper techniques are used and that needed environmental adaptations are in place allows individuals with SCI to reduce the risk of incurring an overuse injury. Through regular evaluation, a clinician can determine whether a referral to a physical or occupational therapist is needed to review an individual's home environment, determine equipment needs, or provide education on proper techniques to improve joint preservation. In addition, individuals should be educated on the need to seek assistance with new onset of activity-related pain, as may occur while propelling a wheelchair or during transfers.

6.3 We recommend that powered mobility (which could be a power assist device) be offered to full-time manual wheelchair users because of the risk of developing chronic upper limb pain.
Risk of Bias: C
Level of Recommendation: Strong

In a cross-sectional study of individuals with post-traumatic paraplegia, 81% of participants who used a manual wheelchair reported pain.[172] Of these participants, 61% experienced shoulder pain, 33% elbow pain, 43% wrist pain, and 19% shoulder, elbow, and wrist pain. The authors found that individuals who use wheelchairs were commonly diagnosed with rotator cuff tears, epicondylitis, and carpal tunnel syndrome. Similarly, Erhan et al.[173] found that elbow pain was reported by 23% of participants with paraplegia. In a study on manual wheelchair users,[174] the prevalence of shoulder pain was reported to be 59%, and findings of tendinopathy on magnetic resonance imaging was 86% in supraspinatus, 91% in infraspinatus, 75% in subscapularis, and 57% in biceps. The reported prevalence of upper extremity tendon tears in manual wheelchair users was 68%.[174]

The use of power mobility minimizes the risk of developing chronic upper limb pain. Of note, powered mobility does not eliminate pain completely, given the upper extremity load during ADLs and transfers.

Notably, powered mobility may include a range of devices, from a power assist device added to a manual chair to a power wheelchair. It is not always appropriate to transition manual wheelchair users to a power wheelchair, given their environment and the context in which the majority of ADLs are completed. The variety of powered mobility options allows the individual with SCI to determine which powered mobility device optimizes engagement in ADLs and functional mobility while also reducing the risk of chronic upper limb pain.

6.4 We recommend biomechanically optimized seating and positioning to prevent the development of musculoskeletal pain.
Risk of Bias: C
Level of Recommendation: Strong

The goal of a seating system is to provide a means for functional mobility, to support the individual to complete their ADLs as independently as possible, and to support individual postural and biomechanical needs. Kovacs et al.[175] found that 76% of all wheelchair users (with and without SCI) reported pain along the axial spine at any spinal level, including the neck, thorax, and lower back. To reduce the risk of developing nociceptive pain, it is essential to ensure that individuals are properly positioned in their seating system to promote effective biomechanics during mobility.

Because a wheelchair user's individual postural needs change throughout the lifespan and wear and tear on equipment is expected, adjustments should be made to the seating system to ensure that it continues to provide adequate support and facilitates mobility and that it is not contributing to musculoskeletal injury and the development of pain. These maintenance checks and adjustments should ideally be performed by a certified Assistive Technology Professional if possible, with input during therapy visits to ensure that physical and occupational therapists are able to provide input regarding the individual's functional abilities, needs, and risk of developing pain.

6.5 We recommend that a healthcare provider assess wheelchair suitability, skills, and techniques at least yearly to prevent and manage musculoskeletal pain (e.g., shoulder pain).
Risk of Bias: C
Level of Recommendation: Strong

In a narrative review conducted by Mulroy et al.,[176] several recommendations were made for the management of pain in wheelchair users with SCI, including the following:

- Clinicians must consider wheelchair type and the configuration that the individual is using.
- Referral to physical or occupational therapy is recommended for assessment and optimization of the patient's posture, pressure relief techniques, transfer techniques to all surfaces, wheelchair setup, and propulsion, as well as a review of work, home, community, and driving environments.

The PVA guidelines from 2005 on upper limb preservation after SCI[12] provide key recommendations specific to wheelchair use, including the following:

- Routinely assess an individual's function, ergonomics, equipment, and level of pain as part of a periodic health review. Assessment should include an evaluation of transfer and wheelchair propulsion techniques, equipment (wheelchair and transfer device), and current health status.
- Evaluate and discuss the pros and cons of transitioning to use of power assist or a power wheelchair as a way to prevent repetitive injuries.
- Complete a thorough assessment of the patient's environment, obtain the appropriate equipment, and complete modifications to the home, ideally to Americans with Disabilities Act standards.

These recommendations support the need for yearly assessment of wheelchair suitability, skills, and techniques in order to prevent and manage musculoskeletal pain. Clinicians should be aware of, and individuals with SCI educated on, these recommendations to assist in the prevention of nociceptive pain among individuals without a history of pain. Frequent assessments of an individual's wheelchair, ideally at regular therapy visits, is recommended. If pain persists with wheelchair and mobility activities, individuals with SCI should consult with their physician.

Wear and tear from daily use of a seating system warrants the need for a new seating system frame at least every 5 years, and sooner if a wheelchair user has had a significant change in medical status (e.g., weight change). The clinician should inquire about the suitability of the wheelchair at every visit, at least yearly.

6.6 We recommend functional observation (on at least a yearly basis), including assessment of compensatory strategies that an individual may use to minimize pain and discomfort, as this may indicate the potential presence of pain.
Risk of Bias: C
Level of Recommendation: Strong

It is important to closely observe an individual's daily tasks to ensure that they are truly free of pain. For example, individuals may begin to use compensatory techniques when reaching overhead or completing a transfer because of pain in the upper limb. Similarly, observation of functional mobility (e.g., transfers or wheelchair propulsion) can shed light on muscle weakness, imbalance, or fatiguability that can lead to repetitive strain or pain. On observation of these tasks, clinicians (e.g., physicians, physical and/or occupational therapists) can ask further questions regarding these compensatory strategies to gain further insight into the underlying cause. Often, avoidance of pain, and/or pain itself, is the cause for using these compensatory strategies, and so pain may not be present at the time of assessment.

Mulroy et al.[176] recommend a detailed review of ADLs to reveal unique culprits of shoulder injury and allow the clinician to appreciate the impact of shoulder pain on function and quality of life. This type of assessment allows the clinician to identify whether there is a need to refer to physical or occupational therapy for education on proper skills and techniques in order to reduce the risk of developing pain. Using functional movement observation enables the clinician to be preventative, reducing the overall risk of the individual developing a musculoskeletal injury and/or nociceptive pain, and provides the opportunity for early identification of pain.

6.7 We recommend that healthcare providers manage shoulder pain using a prescribed, monitored, gradually progressive exercise program that is tailored to the specific shoulder pathology.
Risk of Bias: C
Level of Recommendation: Strong

The evidence demonstrates that exercise can lead to improvement in shoulder pain. Ten studies were found that examined the effects of exercise on shoulder pain and of these, 9 demonstrated improvement. In a systematic review, Cratsenberg et al.[177] found that exercise interventions were associated with reductions in shoulder pain. One moderate-quality RCT (N<50[81]) found that a home exercise program resulted in significant improvements in the Physical Examination of the Shoulder Scale, both after intervention and at 4-week follow-up. Similarly, 4 pre-post studies found that exercise interventions were effective at improving shoulder pain in individuals with SCI.[178-180] A low-quality RCT reported reductions in the onset of shoulder pain in individuals who participated in various exercise programs at 18 and 36 months compared with those who did not participate in an intervention.[181]

Regarding exercise intensity, 1 cohort study (N<20) by Canori et al.[182] found that although physical activity is associated with chronic pain, this relationship depends on intensity. The authors suggested that moderate levels of physical activity may facilitate activity tolerance, whereas inactivity or maximal amounts of activity may cause more pain. This finding suggested that there is a balance between physical activity and rest in order to control pain.[182]

The exercise program provided to individuals with SCI and shoulder pain should be balanced between supervised, directed exercises and self-directed exercises. Supervised exercises can be conducted through telehealth or virtual platforms. The purpose of having supervised exercises is to ensure that proper technique is being used to prevent worsening shoulder pain due to poor body mechanics; it also allows the therapist to monitor intensity. Therefore, access to advice on the exercise program should be provided to prevent further injury.

6.8 We recommend that a neck or back functional assessment include assessments of acquired structural abnormalities that can predispose the individual to poor posture and the development of back or neck pain.
Risk of Bias: C
Level of Recommendation: Strong

Individuals with SCI may develop postural abnormalities such as kyphosis, scoliosis, or a pelvic tilt (anterior, posterior, or oblique) that can lead to the development of pain.[183-185] Observation of supported vs. unsupported positioning can provide insight into specific impairments or imbalances of postural musculature, which can be targeted in therapy.

Additionally, axial spine pain is common in wheelchair users. In a cross-sectional study of 750 wheelchair users by Kovacs et al, prevalence of spinal pain associated with wheelchair use was 56% for neck pain, 54% for thoracic pain, 45% for low back pain, and 76% for pain at any spinal level.[175] Thus, the other recommendations outlined earlier related to wheelchair prescription are important to consider in the prevention and management of neck and back pain after SCI.

6.9 We suggest that additional management options (e.g., TENS) can be considered for nociceptive pain after SCI. Careful consideration and discussion of the limited evidence and the potential risks associated with these treatments is important prior to use.
Risk of Bias: C
Level of Recommendation: Conditional

There is preliminary and limited evidence for the effectiveness of venlafaxine and TENS for nociceptive pain. Clinicians should discuss the limited evidence for benefit, and the risk of side effects, with individuals who are contemplating these treatments.

A single, moderate-quality RCT (N<100) examined the use of TENS on acupuncture points vs. trigger points to improve myofascial pain after SCI.[76] The stimulation of both acupuncture points and trigger points improved pain intensity; however, acupuncture points were found to offer greater improvements in pain intensity and pain severity. The risk associated with TENS in this population is low and it may be a viable option to consider, although evidence for benefit is very limited for nociceptive pain.

One low-quality RCT (N>100)[74] evaluated venlafaxine for pain in individuals with depression after SCI. In this RCT, venlafaxine resulted in significantly larger reductions in nociceptive pain intensity and pain interference ratings compared with those for placebo. At 12 weeks, 50% of individuals receiving venlafaxine had at least a 50% decrease in pain intensity vs. only 24% for placebo.

Other non-pharmacological management options that may be considered are listed in recommendation 5B.4. The panel emphasizes that a targeted approach to management of nociceptive pain, which considers the underlying musculoskeletal etiology, is optimal.

References

1. Craig A, Tran Y, Guest R, Middleton J. Excessive daytime sleepiness in adults with spinal cord injury and associations with pain catastrophizing and pain intensity. *Spinal Cord.* 2020;58(7):831-839. doi:10.1038/s41393-020-0425-7

2. Rintala DH, Loubser PG, Castro J, Hart KA, Fuhrer MJ. Chronic pain in a community-based sample of men with spinal cord injury: prevalence, severity, and relationship with impairment, disability, handicap, and subjective well-being. *Arch Phys Med Rehabil.* 1998;79(6):604-614. doi:10.1016/s0003-9993(98)90032-6

3. Siddall PJ, McClelland JM, Rutkowski SB, Cousins MJ. A longitudinal study of the prevalence and characteristics of pain in the first 5 years following spinal cord injury. *Pain.* 2003;103(3):249-257. doi:10.1016/S0304-3959(02)00452-9

4. Tran J, Dorstyn DS, Burke AL. Psychosocial aspects of spinal cord injury pain: a meta-analysis. *Spinal Cord.* 2016;54(9):640-648. doi:10.1038/sc.2016.66

5. Sang C, Hulsebosch C. *Spinal Cord Injury Pain.* Academic Press; 2021.

6. Hunt C, Moman R, Peterson A, et al. Prevalence of chronic pain after spinal cord injury: a systematic review and meta-analysis. *Reg Anesth Pain Med.* 2021;46(4):328-336. doi:10.1136/rapm-2020-101960

7. International Association for the Management of Pain. Terminology. Updated 2011. Accessed October 1, 2025. https://www.iasp-pain.org/resources/terminology/

8. Franz S, Schulz B, Wang H, et al. Management of pain in individuals with spinal cord injury: guideline of the German-Speaking Medical Society for Spinal Cord Injury. *Ger Med Sci.* 2019;17:Doc05. doi:10.3205/000271

9. Hadley MN, Walters BC, Aarabi B, et al. Clinical assessment following acute cervical spinal cord injury. *Neurosurgery.* 2013;72(suppl 2):40-53. doi:10.1227/NEU.0b013e318276edda

10. Loh E, Mirkowski M, Agudelo AR, et al. The CanPain SCI clinical practice guidelines for rehabilitation management of neuropathic pain after spinal cord injury: 2021 update. *Spinal Cord.* 2022;60(6):548-566. doi:10.1038/s41393-021-00744-z

11. Paolucci S, Martinuzzi A, Scivoletto G, et al. Assessing and treating pain associated with stroke, multiple sclerosis, cerebral palsy, spinal cord injury and spasticity: evidence and recommendations from the Italian Consensus Conference on Pain in Neurorehabilitation. *Eur J Phys Rehabil Med.* 2016;52(6):827-840.

12. Consortium for Spinal Cord Medicine. *Preservation of Upper Limb Function Following Spinal Cord Injury: A Clinical Practice Guideline for Health-Care Professionals.* Paralyzed Veterans of America; 2005.

13. Bernetti A, Agostini F, de Sire A, et al. Neuropathic pain and rehabilitation: a systematic review of international guidelines. *Diagnostics (Basel).* 2021;11(1):74. doi:10.3390/diagnostics11010074

14. National Institute for Health and Care Excellence. *Neuropathic Pain in Adults: Pharmacological Management in Non-Specialist Settings.* Updated September 2020. Accessed October 1, 2025. https://www.nice.org.uk/guidance/cg173

15. Lin I, Wiles L, Waller R, et al. What does best practice care for musculoskeletal pain look like? Eleven consistent recommendations from high-quality clinical practice guidelines: systematic review. *Br J Sports Med.* 2020;54(2):79-86. doi:10.1136/bjsports-2018-099878

16. Joshi GP, Kehlet H. Postoperative pain management in the era of ERAS: an overview. *Best Pract Res Clin Anaesthesiol.* 2019;33(3):259-267. doi:10.1016/j.bpa.2019.07.016

17. Adriaansen JJ, Post MW, de Groot S, et al. Secondary health conditions in persons with spinal cord injury: a longitudinal study from one to five years post-discharge. *J Rehabil Med.* 2013;45(10):1016-1022. doi:10.2340/16501977-1207

18. Felix ER, Cardenas DD, Bryce TN, et al. Prevalence and impact of neuropathic and nonneuropathic pain in chronic spinal cord injury. *Arch Phys Med Rehabil.* 2022;103(4):729-737. doi:10.1016/j.apmr.2021.06.022

19. Burns AS, Delparte JJ, Ballantyne EC, Boschen KA. Evaluation of an interdisciplinary program for chronic pain after spinal cord injury. *PM R.* 2013;5(10):832-838. doi:10.1016/j.pmrj.2013.05.004

20. Warner FM, Cragg JJ, Jutzeler CR, et al. Progression of neuropathic pain after acute spinal cord injury: a meta-analysis and framework for clinical trials. *J Neurotrauma.* 2019;36(9):1461-1468. doi:10.1089/neu.2018.5960

21. Bombardier CH, Adams LM, Fann JR, Hoffman JM. Depression trajectories during the first year after spinal cord injury. *Arch Phys Med Rehabil.* 2016;97(2):196-203. doi:10.1016/j.apmr.2015.10.083

22. van Gorp S, Kessels AG, Joosten EA, van Kleef M, Patijn J. Pain prevalence and its determinants after spinal cord injury: a systematic review. *Eur J Pain.* 2015;19(1):5-14. doi:10.1002/ejp.522

23. Bryce TN, Biering-Sørensen F, Finnerup NB, et al. International spinal cord injury pain classification: part I. Background and description. March 6-7, 2009. *Spinal Cord.* 2012;50(6):413-417. doi:10.1038/sc.2011.156

24. Bryce TN, Richards JS, Bombardier CH, et al. Screening for neuropathic pain after spinal cord injury with the spinal cord injury pain instrument (SCIPI): a preliminary validation study. *Spinal Cord.* 2014;52(5):407-412. doi:10.1038/sc.2014.21

25. Nielsen SD, Faaborg PM, Christensen P, Krogh K, Finnerup NB. Chronic abdominal pain in long-term spinal cord injury: a follow-up study. *Spinal Cord.* 2017;55(3):290-293. doi:10.1038/sc.2016.124

26. Finnerup NB, Jensen MP, Norrbrink C, et al. A prospective study of pain and psychological functioning following traumatic spinal cord injury. *Spinal Cord.* 2016;54(10):816-821. doi:10.1038/sc.2015.236

27. Mehta S, Orenczuk K, McIntyre A, et al. Neuropathic pain post spinal cord injury part 1: systematic review of physical and behavioral treatment. *Top Spinal Cord Inj Rehabil.* 2013;19(1):61-77. doi:10.1310/sci1901-61

28. Mahnig S, Landmann G, Stockinger L, Opsommer E. Pain assessment according to the International Spinal Cord Injury Pain classification in patients with spinal cord injury referred to a multidisciplinary pain center. *Spinal Cord.* 2016;54(10):809-815. doi:10.1038/sc.2015.219

29. Bélanger LMA, Umedaly HS, Noonan VK, et al. Evaluation of a clinical protocol to assess and diagnose neuropathic pain during acute hospital admission: results from traumatic spinal cord injury. *Clin J Pain.* 2018;34(2):104-112. doi:10.1097/ajp.0000000000000523

30. Khazaeipour Z, Ahmadipour E, Rahimi-Movaghar V, Ahmadipour F, Vaccaro AR, Babakhani B. Association of pain, social support and socioeconomic indicators in patients with spinal cord injury in Iran. *Spinal Cord.* 2017;55(2):180-186. doi:10.1038/sc.2016.160

31. Kumru H, Soler D, Vidal J, Tormos JM, Pascual-Leone A, Valls-Sole J. Evoked potentials and quantitative thermal testing in spinal cord injury patients with chronic neuropathic pain. *Clin Neurophysiol.* 2012;123(3):598-604. doi:10.1016/j.clinph.2011.07.038

32. Majedi H, Safdarian M, Hajiaghababaei M, Vaccaro AR, Rahimi-Movaghar V. Characteristics of neuropathic pain in individuals with chronic spinal cord injury. *Neurosciences (Riyadh).* 2018;23(4):292-300. doi:10.17712/nsj.2018.4.20180223

33. Michailidou C, Marston L, De Souza LH, Sutherland I. A systematic review of the prevalence of musculoskeletal pain, back and low back pain in people with spinal cord injury. *Disabil Rehabil.* 2014;36(9):705-715. doi:10.3109/09638288.2013.808708

34. Zeilig G, Enosh S, Rubin-Asher D, Lehr B, Defrin R. The nature and course of sensory changes following spinal cord injury: predictive properties and implications on the mechanism of central pain. *Brain.* 2012;135(Pt 2):418-430. doi:10.1093/brain/awr270

35. Franz S, Schuld C, Wilder-Smith EP, et al. Spinal Cord Injury Pain Instrument and painDETECT questionnaire: convergent construct validity in individuals with spinal cord injury. *Eur J Pain.* 2017;21(10):1642-1656. doi:10.1002/ejp.1069

36. Widerström-Noga E, Biering-Sørensen F, Bryce TN, et al. The International Spinal Cord Injury Pain Basic Data Set (version 3.0). *Spinal Cord.* 2023;61(10):536-540. doi:10.1038/s41393-023-00919-w

37. Widerström-Noga E, Biering-Sørensen F, Bryce T, et al. The International Spinal Cord Injury Pain Extended Data Set (Version 1.0). *Spinal Cord.* 2016;54(11):1036-1046. doi:10.1038/sc.2016.51

38. Mehta S, McIntyre A, Janzen S, Loh E, Teasell R. Systematic review of pharmacologic treatments of pain after spinal cord injury: an update. *Arch Phys Med Rehabil.* 2016;97(8):1381-1391.e1. doi:10.1016/j.apmr.2015.12.023

39. Meints SM, Edwards RR. Evaluating psychosocial contributions to chronic pain outcomes. *Prog Neuropsychopharmacol Biol Psychiatry.* 2018;87(Pt B):168-182. doi:10.1016/j.pnpbp.2018.01.017

40. Bombardier CH, Azuero CB, Fann JR, Kautz DD, Richards JS, Sabharwal S. Management of mental health disorders, substance use disorders, and suicide in adults with spinal cord injury: clinical practice guideline for healthcare providers. *Top Spinal Cord Inj Rehabil.* 2021;27(2):152-224. doi:10.46292/sci2702-152

41. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. *Acta Psychiatr Scand.* 1983;67(6):361-370. doi:10.1111/j.1600-0447.1983.tb09716.x

42. Kisala PA, Tulsky DS, Kalpakjian CZ, et al. Measuring anxiety after spinal cord injury: Development and psychometric characteristics of the SCI-QOL Anxiety item bank and linkage with GAD-7. *J Spinal Cord Med.* 2015;38(3):315-325. doi:10.1179/2045772315y.0000000029

43. Tulsky DS, Kisala PA, Victorson D, et al. Overview of the Spinal Cord Injury--Quality of Life (SCI-QOL) measurement system. *J Spinal Cord Med.* 2015;38(3):257-269. doi:10.1179/2045772315y.0000000023

44. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med.* 2006;166(10):1092-1097. doi:10.1001/archinte.166.10.1092

45. Abu Mostafa M, Plastow N, Savin-Baden M. The effectiveness of spinal cord injury ADL inpatient education on rehabilitation outcomes: A systematic review and meta-analysis. *Br J Occup Ther.* 2020;83(1):15-28. doi:10.1177/0308022619879019

46. Elmofty DH, Anitescu M, Buvanendran A. Best practices in the treatment of neuropathic pain. *Pain Manag.* 2013;3(6):475-483. doi:10.2217/pmt.13.50

47. Høgholen H, Storhaug A, Kvernrød K, Kostovski E, Viktil KK, Mathiesen L. Use of medicines, adherence and attitudes to medicines among persons with chronic spinal cord injury. *Spinal Cord.* 2018;56(1):35-40. doi:10.1038/sc.2017.95

48. Gee CM, Sinden AR, Krassioukov AV, Martin Ginis KA. The effects of active upper-limb versus passive lower-limb exercise on quality of life among individuals with motor-complete spinal cord injury. *Spinal Cord.* 2022;60(9):805-811. doi:10.1038/s41393-022-00796-9

49. Sato G, Osumi M, Morioka S. Effects of wheelchair propulsion on neuropathic pain and resting electroencephalography after spinal cord injury. *J Rehabil Med.* 2017;49(2):136-143. doi:10.2340/16501977-2185

50. Norrbrink C, Lindberg T, Wahman K, Bjerkefors A. Effects of an exercise programme on musculoskeletal and neuropathic pain after spinal cord injury--results from a seated double-poling ergometer study. *Spinal Cord.* 2012;50(6):457-461. doi:10.1038/sc.2011.160

51. Jensen MP, Turk DC. Contributions of psychology to the understanding and treatment of people with chronic pain: why it matters to ALL psychologists. *Am Psychol.* 2014;69(2):105-118. doi:10.1037/a0035641

52. Alschuler KN, Jensen MP, Sullivan-Singh SJ, Borson S, Smith AE, Molton IR. The association of age, pain, and fatigue with physical functioning and depressive symptoms in persons with spinal cord injury. *J Spinal Cord Med.* 2013;36(5):483-491. doi:10.1179/2045772312Y.0000000072

53. Müller R, Landmann G, Béchir M, et al. Chronic pain, depression and quality of life in individuals with spinal cord injury: mediating role of participation. *J Rehabil Med.* 2017;49(6):489-496. doi:10.2340/16501977-2241

54. Kuzu D, Troost JP, Carlozzi NE, Ehde DM, Molton IR, Kratz AL. How do fluctuations in pain, fatigue, anxiety, depressed mood, and perceived cognitive function relate to same-day social participation in individuals with spinal cord injury? *Arch Phys Med Rehabil.* 2022;103(3):385-393. doi:10.1016/j.apmr.2021.07.809

55. Eccleston C, Fisher E, Craig L, Duggan GB, Rosser BA, Keogh E. Psychological therapies (Internet-delivered) for the management of chronic pain in adults. *Cochrane Database Syst Rev.* 2014;2014(2):CD010152. doi:10.1002/14651858.CD010152.pub2

56. Dear BF, Nicholson Perry K, Siddall P, et al. The Pain Course: exploring the feasibility of an internet-delivered pain management programme for adults with spinal cord injury. *Spinal Cord.* 2018;56(10):931-939. doi:10.1038/s41393-018-0146-3

57. Hearn JH, Finlay KA. Internet-delivered mindfulness for people with depression and chronic pain following spinal cord injury: a randomized, controlled feasibility trial. *Spinal Cord.* 2018;56(8):750-761. doi:10.1038/s41393-018-0090-2

58. Heutink M, Post MWM, Bongers-Janssen HMH, et al. The CONECSI trial: results of a randomized controlled trial of a multidisciplinary cognitive behavioral program for coping with chronic neuropathic pain after spinal cord injury. *Pain.* 2012;153(1):120-128. doi:10.1016/j.pain.2011.09.029

59. Burke D, Lennon O, Blake C, et al. An internet-delivered cognitive behavioural therapy pain management programme for spinal cord injury pain: a randomized controlled trial. *Eur J Pain.* 2019;23(7):1264-1282. doi:10.1002/ejp.1402

60. Li Y, Chien WT, Bressington D. Effects of a coping-oriented supportive programme for people with spinal cord injury during inpatient rehabilitation: a quasi-experimental study. *Spinal Cord.* 2020;58(1):58-69. doi:10.1038/s41393-019-0320-2

61. Jensen MP, Sherlin LH, Askew RL, et al. Effects of non-pharmacological pain treatments on brain states. *Clin Neurophysiol.* 2013;124(10):2016-2024. doi:10.1016/j.clinph.2013.04.009

62. Opsommer E, Chevalley O, Korogod N. Motor imagery for pain and motor function after spinal cord injury: a systematic review. *Spinal Cord.* 2020;58(3):262-274. doi:10.1038/s41393-019-0390-1

63. Kaur J, Ghosh S, Sahani AK, Sinha JK. Mental imagery as a rehabilitative therapy for neuropathic pain in people with spinal cord injury: a randomized controlled trial. *Neurorehabil Neural Repair.* 2020;34(11):1038-1049. doi:10.1177/1545968320962498

64. Lovas J, Tran Y, Middleton J, Bartrop R, Moore N, Craig A. Managing pain and fatigue in people with spinal cord injury: a randomized controlled trial feasibility study examining the efficacy of massage therapy. *Spinal Cord.* 2017;55(2):162-166. doi:10.1038/sc.2016.156

65. Özkul Ç, Kılınç M, Yıldırım SA, Topçuoğlu EY, Akyüz M. Effects of visual illusion and transcutaneous electrical nerve stimulation on neuropathic pain in patients with spinal cord injury: a randomised controlled cross-over trial. *J Back Musculoskelet Rehabil.* 2015;28(4):709-719. doi:10.3233/bmr-140573

66. Müller R, Segerer W, Ronca E, et al. Inducing positive emotions to reduce chronic pain: a randomized controlled trial of positive psychology exercises. *Disabil Rehabil.* 2022;44(12):2691-2704. doi :10.1080/09638288.2020.1850888

67. Zanca JM, Gilchrist C, Ortiz CE, Dyson-Hudson TA. Pilot clinical trial of a clinical meditation and imagery intervention for chronic pain after spinal cord injury. *J Spinal Cord Med.* 2022;45(3):339-353. doi:10.1080/10790268.2021.1970894

68. Davari M, Amani B, Amani B, Khanijahani A, Akbarzadeh A, Shabestan R. Pregabalin and gabapentin in neuropathic pain management after spinal cord injury: a systematic review and meta-analysis. *Korean J Pain.* 2020;33(1):3-12. doi:10.3344/kjp.2020.33.1.3

69. Mehta S, McIntyre A, Dijkers M, Loh E, Teasell RW. Gabapentinoids are effective in decreasing neuropathic pain and other secondary outcomes after spinal cord injury: a meta-analysis. *Arch Phys Med Rehabil.* 2014;95(11):2180-2186. doi:10.1016/j.apmr.2014.06.010

70. Yu X, Liu T, Zhao D, et al. Efficacy and safety of pregabalin in neuropathic pain followed spinal cord injury: a review and meta-analysis of randomized controlled trials. *Clin J Pain.* 2019;35(3):272-278. doi:10.1097/ajp.0000000000000675

71. Kaydok E, Levendoglu F, Ozerbil M, Karahan A. Comparison of the efficacy of gabapentin and pregabalin for neuropathic pain in patients with spinal cord injury: a crossover study. *Acta Medica Mediterranea.* 2014;30(6):1343-1348.

72. Yilmaz B, Yaŝar E, Köroğlu Omaç Ö, Göktepe A, Tan A. Gabapentin vs. pregabalin for the treatment of neuropathic pain in patients with spinal cord injury: a crossover study. *Turk J Phys Med Rehab.* 2015;61:1-5.

73. Rintala DH, Holmes SA, Courtade D, Fiess RN, Tastard LV, Loubser PG. Comparison of the effectiveness of amitriptyline and gabapentin on chronic neuropathic pain in persons with spinal cord injury. *Arch Phys Med Rehabil.* 2007;88(12):1547-1560. doi:10.1016/j.apmr.2007.07.038

74. Richards JS, Bombardier CH, Wilson CS, et al. Efficacy of venlafaxine XR for the treatment of pain in patients with spinal cord injury and major depression: a randomized, controlled trial. *Arch Phys Med Rehabil.* 2015;96(4):680-689. doi:10.1016/j.apmr.2014.11.024

75. Vranken JH, Hollmann MW, van der Vegt MH, Kruis MR, Heesen M, Vos K, Pijl AJ, Dijkgraaf MGW. Duloxetine in patients with central neuropathic pain caused by spinal cord injury or stroke: a randomized, double-blind, placebo-controlled trial. *Pain.* 2011 Feb;152(2):267-273. doi: 10.1016/j.pain.2010.09.005. PMID: 21078545.

76. Chiou YF, Yeh ML, Wang YJ. Transcutaneous electrical nerve stimulation on acupuncture points improves myofascial pain, moods, and sleep quality. *Rehabil Nurs.* 2020;45(4):225-233. doi:10.1097/rnj.0000000000000198

77. Soler D, Moriña D, Kumru H, Vidal J, Navarro X. Transcranial direct current stimulation and visual illusion effect according to sensory phenotypes in patients with spinal cord injury and neuropathic pain. *J Pain.* 2021;22(1):86-96. doi:10.1016/j.jpain.2020.06.004

78. Li L, Huang H, Yu Y, et al. Non-invasive brain stimulation for neuropathic pain after spinal cord injury: a systematic review and network meta-analysis. *Front Neurosci.* 2021;15:800560. doi:10.3389/fnins.2021.800560

79. Yu B, Qiu H, Li J, Zhong C, Li J. Noninvasive brain stimulation does not improve neuropathic pain in individuals with spinal cord injury: evidence From a meta-analysis of 11 randomized controlled trials. *Am J Phys Med Rehabil.* 2020;99(9):811-820. doi:10.1097/phm.0000000000001421

80. Wrigley PJ, Gustin SM, McIndoe LN, Chakiath RJ, Henderson LA, Siddall PJ. Longstanding neuropathic pain after spinal cord injury is refractory to transcranial direct current stimulation: a randomized controlled trial. *Pain.* 2013;154(10):2178-2184. doi:10.1016/j.pain.2013.06.045

81. Cardenas DD, Felix ER, Cowan R, Orell MF, Irwin R. Effects of home exercises on shoulder pain and pathology in chronic spinal cord injury: a randomized controlled trial. *Am J Phys Med Rehabil.* 2020;99(6):504-513. doi:10.1097/phm.0000000000001362

82. Crane DA, Hoffman JM, Reyes MR. Benefits of an exercise wellness program after spinal cord injury. *J Spinal Cord Med.* 2017;40(2):154-158. doi:10.1179/2045772315y.0000000038

83. Mei L, Fengqun M, Zhengyao Z, et al. Efficacy and safety of different drug treatments in patients with spinal-cord injury-related neuropathic pain: a network meta-analysis. *Spinal Cord.* 2022;60(11):943-953. doi:10.1038/s41393-022-00804-y

84. Bryce TN. Opioids should not be prescribed for chronic pain after spinal cord injury. *Spinal Cord Ser Cases.* 2018;466. doi:10.1038/s41394-018-0095-2

85. DiPiro N, Murday D, Corley E, DiPiro T, Krause J. Opioid use among individuals with spinal cord injury: prevalence estimates based on state prescription drug monitoring program data. *Arch Phys Med Rehabil.* 2021;102(5):828-834. doi:10.1016/j.apmr.2020.10.128

86. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain--United States, 2016. *JAMA.* 2016;315(15):1624-1645. doi:10.1001/jama.2016.1464

87. *VA/DoD Clinical Practice Guideline for the Use of Opioids in the Management of Chronic Pain.* Use of Opioids in the Management of Chronic Pain Work Group, US Government Printing Office; 2022.

88. Dworkin RH, O'Connor AB, Backonja M, et al. Pharmacologic management of neuropathic pain: evidence-based recommendations. *Pain.* 2007;132(3):237-251. doi:10.1016/j.pain.2007.08.033

89. Coffin PO, Barreveld AM. Inherited patients taking opioids for chronic pain: considerations for primary care. *N Engl J Med.* 2022;386(7):611-613. doi:10.1056/NEJMp2115244

90. Bockbrader H, Wesche D, Miller R, Chapel S, Janiczek N, Burger P. A comparison of the pharmacokinetics and pharmacodynamics of pregabalin and gabapentin. *Clin Pharmacokinet.* 2010;49(10):661-669. doi:10.2165/11536200-000000000-00000

91. Canavan C, Inoue T, McMahon S, Doody C, Blake C, Fullen BM. The efficacy, adverse events, and withdrawal rates of the pharmacological management of chronic spinal cord injury pain: a systematic review and meta-analysis. *Pain Med.* 2022;23(2):375-395. doi:10.1093/pm/pnab140

92. Parsons B, Argoff CE, Clair A, Emir B. Improvement in pain severity category in clinical trials of pregabalin. *J Pain Res.* 2016;9:779-785. doi:10.2147/jpr.S102696

93. Tong C, Zhengyao Z, Mei L, Dongpo S, Qian H, Fengqun M. Pregabalin and gabapentin in patients with spinal cord injury-related neuropathic pain: a network meta-analysis. *Pain Ther.* 2021;10(2):1497-1509. doi:10.1007/s40122-021-00302-8

94. Asgardoon MH, Jazayeri SB, Behkar A, et al. Pharmacologic therapies of pain in patients with spinal cord injury: a systematic review. *Spinal Cord Ser Cases.* 2022;8(1):65. doi:10.1038/s41394-022-00529-3

95. Guy S, Mehta S, Leff L, Teasell R, Loh E. Anticonvulsant medication use for the management of pain following spinal cord injury: systematic review and effectiveness analysis. *Spinal Cord.* 2014;52(2):89-96. doi:10.1038/sc.2013.146

96. Snedecor SJ, Sudharshan L, Cappelleri JC, et al. Systematic review and comparison of pharmacologic therapies for neuropathic pain associated with spinal cord injury. *J Pain Res.* 2013;6:539-547. doi:10.2147/jpr.S45966

97. Min K, Oh Y, Lee SH, Ryu JS. Symptom-based treatment of neuropathic pain in spinal cord-injured patients: a randomized crossover clinical trial. *Am J Phys Med Rehabil.* 2016;95(5):330-338. doi:10.1097/phm.0000000000000382

98. Levendoglu F, Ogün C, Ozerbil O, Ogün T, Ugurlu H. Gabapentin is a first line drug for the treatment of neuropathic pain in spinal cord injury. *Spine (Phila Pa 1976).* 2004;29(7):743-751. doi:10.1097/01.brs.0000112068.16108.3a

99. Cardenas DD, Nieshoff EC, Suda K, et al. A randomized trial of pregabalin in patients with neuropathic pain due to spinal cord injury. *Neurology.* 2013;80(6):533-539. doi:10.1212/WNL.0b013e318281546b

100. Siddall P, Cousins M, Otte A, Griesing T, Chambers R, TK M. Pregabalin in central neuropathic pain associated with spinal cord injury: a placebo-controlled trial. *Neurology.* 2006;67(10):1792-1800. doi:10.1212/01.wnl.0000244422.45278.ff

101. Vranken JH, Dijkgraaf MG, Kruis MR, van der Vegt MH, Hollmann MW, Heesen M. Pregabalin in patients with central neuropathic pain: a randomized, double-blind, placebo-controlled trial of a flexible-dose regimen. *Pain.* 2008;136(1-2):150-157. doi:10.1016/j.pain.2007.06.033

102. Parsons B, Sanin L, Yang R, Emir B, Juhn M. Efficacy and safety of pregabalin in patients with spinal cord injury: a pooled analysis. *Curr Med Res Opin.* 2013;29(12):1675-1683. doi:10.1185/03007995.2013.834815

103. Kalk N, Chiu C, Sadoughi R, et al. Fatalities associated with gabapentinoids in England (2004-2020). *Br J Clin Pharmacol.* 2022;88(8):3911-3917. doi:10.1111/bcp.15352

104. Agarwal N, Joshi M. Effectiveness of amitriptyline and lamotrigine in traumatic spinal cord injury-induced neuropathic pain: a randomized longitudinal comparative study. *Spinal Cord.* 2017;55(2):126-130. doi:10.1038/sc.2016.123

105. Derry S, Wiffen PJ, Aldington D, Moore RA. Nortriptyline for neuropathic pain in adults. *Cochrane Database Syst Rev.* 2015;1(1):CD011209. doi:10.1002/14651858.CD011209.pub2

106. Gillman PK. Tricyclic antidepressant pharmacology and therapeutic drug interactions updated. *Br J Pharmacol.* 2007;151(6):737-748. doi:10.1038/sj.bjp.0707253

107. Mu A, Weinberg E, Moulin DE, Clarke H. Pharmacologic management of chronic neuropathic pain: review of the Canadian Pain Society consensus statement. *Can Fam Physician.* 2017;63(11):844-852.

108. Chun A, Levy I, Yang A, et al. Treatment of at-level spinal cord injury pain with botulinum toxin A. *Spinal Cord Ser Cases.* 2019;5:77. doi:10.1038/s41394-019-0221-9

109. Han ZA, Song DH, Oh HM, Chung ME. Botulinum toxin type A for neuropathic pain in patients with spinal cord injury. *Ann Neurol.* 2016;79(4):569-578. doi:10.1002/ana.24605

110. Finnerup NB, Sindrup SH, Bach FW, Johannesen IL, Jensen TS. Lamotrigine in spinal cord injury pain: a randomized controlled trial. *Pain.* 2002;96(3):375-383. doi:10.1016/s0304-3959(01)00484-5

111. Nasirinezhad F, Zarepour L, Hadjighassem M, Gharaylou Z, Majedi H, Ramezani F. Analgesic effect of bumetanide on neuropathic pain in patients with spinal cord injury. *Basic Clin Neurosci.* 2021;12(3):409-420. doi:10.32598/bcn.12.3.2049.1

112. Olusanya A, Yearsley A, Brown N, et al. Capsaicin 8% patch for spinal cord injury focal neuropathic pain: a randomized controlled trial. *Pain Med.* 2023;24(1):71-78. doi:10.1093/pm/pnac104

113. Brinzeu A, Berthiller J, Caillet JB, Staquet H, Mertens P. Ziconotide for spinal cord injury-related pain. Eur J Pain. 2019;23(9):1688-1700. doi:10.1002/ejp.1445

114. Li L, Han Y, Li T, Zhou J, Sun C, Xue Y. The analgesic effect of intravenous methylprednisolone on acute neuropathic pain with allodynia due to central cord syndrome: a retrospective study. *J Pain Res.* 2018;11:1231-1238. doi:10.2147/JPR.S160463

115. Sang CN, Barnabe KJ, Kern SE. Phase IA clinical trial evaluating the tolerability, pharmacokinetics, and analgesic efficacy of an intrathecally administered neurotensin A analogue in central neuropathic pain following spinal cord injury. *Clin Pharmacol Drug Dev.* 2016;5(4):250-258. doi:10.1002/cpdd.253

116. Yang ML, Li JJ, So KF, et al. Efficacy and safety of lithium carbonate treatment of chronic spinal cord injuries: a double-blind, randomized, placebo-controlled clinical trial. *Spinal Cord.* 2012;50(2):141-146. doi:10.1038/sc.2011.126

117. Tsai SHL, Lin CR, Shao SC, et al. Cannabinoid use for pain reduction in spinal cord injuries: a meta-analysis of randomized controlled trials. *Front Pharmacol.* 2022;13:866235. doi:10.3389/fphar.2022.866235

118. Wilsey B, Marcotte TD, Deutsch R, Zhao H, Prasad H, Phan A. An exploratory human laboratory experiment evaluating vaporized cannabis in the treatment of neuropathic pain from spinal cord injury and disease. *J Pain.* 2016;17(9):982-1000. doi:10.1016/j.jpain.2016.05.010

119. Stillman M, Capron M, Mallow M, et al. Utilization of medicinal cannabis for pain by individuals with spinal cord injury. *Spinal Cord Ser Cases.* 2019;5:66. doi:10.1038/s41394-019-0208-6

120. Chiou-Tan FY, Tuel SM, Johnson JC, Priebe MM, Hirsh DD, Strayer JR. Effect of mexiletine on spinal cord injury dysesthetic pain. *Am J Phys Med Rehabil.* 1996;75(2):84-87. doi:10.1097/00002060-199603000-00002

121. Andresen SR, Bing J, Hansen RM, et al. Ultramicronized palmitoylethanolamide in spinal cord injury neuropathic pain: a randomized, double-blind, placebo-controlled trial. *Pain.* 2016;157(9):2097-2103. doi:10.1097/j.pain.0000000000000623

122. Finnerup NB, Grydehøj J, Bing J, et al. Levetiracetam in spinal cord injury pain: a randomized controlled trial. *Spinal Cord.* 2009;47(12):861-867. doi:10.1038/sc.2009.55

123. Ngernyam N, Jensen MP, Arayawichanon P, et al. The effects of transcranial direct current stimulation in patients with neuropathic pain from spinal cord injury. *Clin Neurophysiol.* 2015;126(2):382-390. doi:10.1016/j.clinph.2014.05.034

124. Thibaut A, Carvalho S, Morse LR, Zafonte R, Fregni F. Delayed pain decrease following M1 tDCS in spinal cord injury: a randomized controlled clinical trial. *Neurosci Lett.* 2017;658:19-26. doi:10.1016/j.neulet.2017.08.024

125. Kumru H, Soler D, Vidal J, et al. The effects of transcranial direct current stimulation with visual illusion in neuropathic pain due to spinal cord injury: an evoked potentials and quantitative thermal testing study. *Eur J Pain.* 2013;17(1):55-66. doi:10.1002/j.1532-2149.2012.00167.x

126. Yoon EJ, Kim YK, Kim H-R, Kim SE, Lee Y, Shin HI. Transcranial direct current stimulation to lessen neuropathic pain after spinal cord injury: a mechanistic PET study. *Neurorehabil Neural Repair.* 2014;28(3):250-259. doi:10.1177/1545968313507632

127. Li S, Stampas A, Frontera J, Davis M, Li S. Combined transcranial direct current stimulation and breathing-controlled electrical stimulation for management of neuropathic pain after spinal cord injury. *J Rehabil Med.* 2018;50(9):814-820. doi:10.2340/16501977-2379

128. Yeh NC, Yang YR, Huang SF, Ku PH, Wang RY. Effects of transcranial direct current stimulation followed by exercise on neuropathic pain in chronic spinal cord injury: a double-blinded randomized controlled pilot trial. *Spinal Cord.* 2021;59(6):684-692. doi:10.1038/s41393-020-00560-x

129. Shen Z, Li Z, Ke J, et al. Effect of non-invasive brain stimulation on neuropathic pain following spinal cord injury: a systematic review and meta-analysis. *Medicine (Baltimore).* 2020;99(34):e21507. doi:10.1097/md.0000000000021507

130. Boldt I, Eriks-Hoogland I, Brinkhof MW, de Bie R, Joggi D, von Elm E. Non-pharmacological interventions for chronic pain in people with spinal cord injury. *Cochrane Database Syst Rev.* 2014;2014(11):CD009177. doi:10.1002/14651858.CD009177.pub2

131. David M, Moraes AA, Costa MLD, Franco CIF. Transcranial direct current stimulation in the modulation of neuropathic pain: a systematic review. *Neurol Res.* 2018;40(7):555-563. doi:10.1080/01616412.2018.1453190

132. Choi YA, Kim Y, Shin HI. Pilot study of feasibility and effect of anodal transcutaneous spinal direct current stimulation on chronic neuropathic pain after spinal cord injury. *Spinal Cord.* 2019;57(6):461-470. doi:10.1038/s41393-019-0244-x

133. Yang Y, Tang Y, Qin H, Xu J. Efficacy of transcutaneous electrical nerve stimulation in people with pain after spinal cord injury: a meta-analysis. *Spinal Cord.* 2022;60(5):375-381. doi:10.1038/s41393-022-00776-z

134. Bi X, Lv H, Chen BL, Li X, Wang XQ. Effects of transcutaneous electrical nerve stimulation on pain in patients with spinal cord injury: a randomized controlled trial. *J Phys Ther Sci.* 2015;27(1):23-25. doi:10.1589/jpts.27.23

135. Celik EC, Erhan B, Gunduz B, Lakse E. The effect of low-frequency TENS in the treatment of neuropathic pain in patients with spinal cord injury. *Spinal Cord.* 2013;51(4):334-337. doi:10.1038/sc.2012.159

136. Austin PD, Siddall PJ. Virtual reality for the treatment of neuropathic pain in people with spinal cord injuries: a scoping review. *J Spinal Cord Med.* 2021;44(1):8-18. doi:10.1080/10790268.2019.1575554

137. Chi B, Chau B, Yeo E, Ta P. Virtual reality for spinal cord injury-associated neuropathic pain: systematic review. *Ann Phys Rehabil Med.* 2019;62(1):49-57. doi:10.1016/j.rehab.2018.09.006

138. Jordan M, Richardson EJ. Effects of virtual walking treatment on spinal cord injury-related neuropathic pain: pilot results and trends related to location of pain and at-level neuronal hypersensitivity. *Am J Phys Med Rehabil.* 2016;95(5):390-396. doi:10.1097/phm.0000000000000417

139. Richardson EJ, McKinley EC, Rahman A, Klebine P, Redden DT, Richards JS. Effects of virtual walking on spinal cord injury-related neuropathic pain: a randomized, controlled trial. *Rehabil Psychol.* 2019;64(1):13-24. doi:10.1037/rep0000246

140. Pozeg P, Palluel E, Ronchi R, et al. Virtual reality improves embodiment and neuropathic pain caused by spinal cord injury. *Neurology.* 2017;89(18):1894-1903. doi:10.1212/wnl.0000000000004585

141. Zhang YH, Hu HY, Xiong YC, et al. Exercise for neuropathic pain: a systematic review and expert consensus. *Front Med (Lausanne).* 2021;8:756940. doi:10.3389/fmed.2021.756940

142. Al-Taleb MKH, Purcell M, Fraser M, Petric-Gray N, Vuckovic A. Home used, patient self-managed, brain-computer interface for the management of central neuropathic pain post spinal cord injury: usability study. *J Neuroeng Rehabil.* 2019;16(1):128. doi:10.1186/s12984-019-0588-7

143. Hassan MA, Fraser M, Conway BA, Allan DB, Vuckovic A. The mechanism of neurofeedback training for treatment of central neuropathic pain in paraplegia: a pilot study. *BMC Neurol.* 2015;15:200. doi:10.1186/s12883-015-0445-7

144. Vučković A, Altaleb MKH, Fraser M, McGeady C, Purcell M. EEG correlates of self-managed neurofeedback treatment of central neuropathic pain in chronic spinal cord injury. *Front Neurosci.* 2019;13:762. doi:10.3389/fnins.2019.00762

145. Middaugh S, Thomas K, Smith A, McFall T, Klingmueller J. EMG biofeedback and exercise for treatment of cervical and shoulder pain in individuals with a spinal cord injury: a pilot study. *Top Spinal Cord Inj Rehabil.* 2013;19(4):311-323. doi:10.1310/sci1904-311

146. Karri J, Li S, Zhang L, Chen YT, Stampas A, Li S. Neuropathic pain modulation after spinal cord injury by breathing-controlled electrical stimulation (BreEStim) is associated with restoration of autonomic dysfunction. *J Pain Res.* 2018;11:2331-2341. doi:10.2147/jpr.S174475

147. Li S, Davis M, Frontera JE, Li S. A novel nonpharmacological intervention - breathing-controlled electrical stimulation for neuropathic pain management after spinal cord injury - a preliminary study. *J Pain Res.* 2016;9:933-940. doi:10.2147/jpr.S115901

148. Saleh C, Ilia TS, Jaszczuk P, Hund-Georgiadis M, Walter A. Is transcranial magnetic stimulation as treatment for neuropathic pain in patients with spinal cord injury efficient? A systematic review. *Neurol Sci.* 2022;43(5):3007-3018. doi:10.1007/s10072-022-05978-0

149. Jetté F, Côté I, Meziane HB, Mercier C. Effect of single-session repetitive transcranial magnetic stimulation applied over the hand versus leg motor area on pain after spinal cord injury. *Neurorehabil Neural Repair.* 2013;27(7):636-643. doi:10.1177/1545968313484810

150. Nardone R, Höller Y, Langthaler PB, et al. rTMS of the prefrontal cortex has analgesic effects on neuropathic pain in subjects with spinal cord injury. *Spinal Cord.* 2017;55(1):20-25. doi:10.1038/sc.2016.87

151. Sun X, Long H, Zhao C, et al. Analgesia-enhancing effects of repetitive transcranial magnetic stimulation on neuropathic pain after spinal cord injury: an fNIRS study. *Restor Neurol Neurosci.* 2019;37(5):497-507. doi:10.3233/rnn-190934

152. Zhao CG, Sun W, Ju F, et al. Analgesic effects of directed repetitive transcranial magnetic stimulation in acute neuropathic pain after spinal cord injury. *Pain Med.* 2020;21(6):1216-1223. doi:10.1093/pm/pnz290

153. Yılmaz B, Kesikburun S, Yaşar E, Tan AK. The effect of repetitive transcranial magnetic stimulation on refractory neuropathic pain in spinal cord injury. *J Spinal Cord Med.* 2014;37(4):397-400. doi:10.1179/2045772313y.0000000172

154. Estores I, Chen K, Jackson B, Lao L, Gorman PH. Auricular acupuncture for spinal cord injury related neuropathic pain: a pilot controlled clinical trial. *J Spinal Cord Med.* 2017;40(4):432-438. doi:10.1080/10790268.2016.1141489

155. Allison DJ, Thomas A, Beaudry K, Ditor DS. Targeting inflammation as a treatment modality for neuropathic pain in spinal cord injury: a randomized clinical trial. *J Neuroinflammation.* 2016;13(1):152. doi:10.1186/s12974-016-0625-4

156. Calabrò RS, Portaro S, Tomasello P, Porcari B, Balletta T, Naro A. Paving the way for a better management of pain in patients with spinal cord injury: an exploratory study on the use of Functional Electric Stimulation(FES)-cycling. *J Spinal Cord Med.* 2023;46(1):107-117. doi:10.1080/10790268.2021.1961050

157. Sharif H, Gammage K, Chun S, Ditor D. Effects of FES-ambulation training on locomotor function and health-related quality of life in individuals with spinal cord injury. *Top Spinal Cord Inj Rehabil.* 2014;20(1):58-69. doi:10.1310/sci2001-58

158. Gui Y, Li H, Zhao M, Yang Q, Kuang X. Effect of intermittent normobaric hyperoxia for treatment of neuropathic pain in Chinese patients with spinal cord injury. *Spinal Cord.* 2015;53(3):238-242. doi:10.1038/sc.2014.161

159. Arienti C, Daccò S, Piccolo I, Redaelli T. Osteopathic manipulative treatment is effective on pain control associated to spinal cord injury. *Spinal Cord.* 2011;49(4):515-519. doi:10.1038/sc.2010.170

160. Shem K, Karasik D, Carufel P, Kao MC, Zheng P. Seated Tai Chi to alleviate pain and improve quality of life in individuals with spinal cord disorder. *J Spinal Cord Med.* 2016;39(3):353-358. doi:10.1080/10790268.2016.1148895

161. Wood C, Cutshall SM, Lawson DK, et al. Music therapy for anxiety and pain after spinal cord injury: a pilot study. *Glob Adv Health Med.* 2021;10:21649561211058697. doi:10.1177/21649561211058697

162. Wong ML, Widerstrom-Noga E, Field-Fote EC. Effects of whole-body vibration on neuropathic pain and the relationship between pain and spasticity in persons with spinal cord injury. *Spinal Cord.* 2022;60(11):963-970. doi:10.1038/s41393-022-00806-w

163. Fang CY, Tsai JL, Li GS, Lien AS, Chang YJ. Effects of robot-assisted gait training in individuals with spinal cord injury: a meta-analysis. *Biomed Res Int.* 2020;2020:2102785. doi:10.1155/2020/2102785

164. Labruyère R, van Hedel HJ. Strength training versus robot-assisted gait training after incomplete spinal cord injury: a randomized pilot study in patients depending on walking assistance. *J Neuroeng Rehabil.* 2014;11:4. doi:10.1186/1743-0003-11-4

165. Chen FC, Shao HL, Han FL. A pilot study of neuromuscular electrical stimulation for neuropathic pain caused by spinal cord injury. *Medicine (Baltimore).* 2018;97(31):e11658. doi:10.1097/md.0000000000011658

166. Curtis K, Hitzig SL, Bechsgaard G, et al. Evaluation of a specialized yoga program for persons with a spinal cord injury: a pilot randomized controlled trial. *J Pain Res.* 2017;10:999-1017. doi:10.2147/jpr.S130530

167. Azadvari M, Emami-Razavi SZ, Torfi F, Nazar NSB, Malekirad AA. Ultrasound-guided versus blind subacromial bursa corticosteroid injection for paraplegic spinal cord injury patients with rotator cuff tendinopathy: a randomized, single-blind clinical trial. *Int J Neurosci.* 2021;131(5):445-452. doi:10.1080/00207454.2020.1748620

168. Dyson-Hudson TA, Hogaboom NS, Nakamura R, Terry A, Malanga GA. Ultrasound-guided platelet-rich plasma injection for the treatment of recalcitrant rotator cuff disease in wheelchair users with spinal cord injury: a pilot study. *J Spinal Cord Med.* 2022;45(1):42-48. doi:10.1080/10790268.2020.1754676

169. Hogaboom N, Malanga G, Cherian C, Dyson-Hudson T. A pilot study to evaluate micro-fragmented adipose tissue injection under ultrasound guidance for the treatment of refractory rotator cuff disease in wheelchair users with spinal cord injury. *J Spinal Cord Med.* 2021;44(6):886-895. doi:10.1080/10790268.2021.1903140

170. Saunders LL, Krause JS, DiPiro ND, Kraft S, Brotherton S. Ambulation and complications related to assistive devices after spinal cord injury. *J Spinal Cord Med.* 2013;36(6):652-659. doi:10.1179/2045772312y.0000000082

171. Zhao X, Sun G, Jiao G, Lv H. The relationship of fatigue and pain between mobility aid usage and depressive symptomatology in ambulatory individuals with spinal cord injury. *Biomed Res (Aligarh).* 2017;28(2):822-827.

172. Kentar Y, Zastrow R, Bradley H, et al. Prevalence of upper extremity pain in a population of people with paraplegia. *Spinal Cord.* 2018;56(7):695-703. doi:10.1038/s41393-018-0062-6

173. Erhan B, Gündüz B, Bardak AN, et al. Elbow problems in paraplegic spinal cord injured patients: frequency and related risk factors: a preliminary controlled study. *Spinal Cord.* 2013;51(5):406-408. doi:10.1038/sc.2013.13

174. Jahanian O, Van Straaten MG, Goodwin BM, et al. Shoulder magnetic resonance imaging findings in manual wheelchair users with spinal cord injury. *J Spinal Cord Med.* 2022;45(4):564-574. doi:10.1080/10790268.2020.1834774

175. Kovacs FM, Seco J, Royuela A, Barriga A, Zamora J. Prevalence and factors associated with a higher risk of neck and back pain among permanent wheelchair users: a cross-sectional study. *Spinal Cord.* 2018;56(4):392-405. doi:10.1038/s41393-017-0029-z

176. Mulroy SJ, Hafdahl L, Dyson-Hudson T. A primary care provider's guide to shoulder pain after spinal cord injury. *Top Spinal Cord Inj Rehabil.* 2020;26(3):186-196. doi:10.46292/sci2603-186

177. Cratsenberg KA, Deitrick CE, Harrington TK, et al. Effectiveness of exercise programs for management of shoulder pain in manual wheelchair users with spinal cord injury. *J Neurol Phys Ther.* 2015;39(4):197-203. doi:10.1097/npt.0000000000000103

178. Serra-Añó P, Pellicer-Chenoll M, García-Massó X, Morales J, Giner-Pascual M, González LM. Effects of resistance training on strength, pain and shoulder functionality in paraplegics. *Spinal Cord.* 2012;50(11):827-831. doi:10.1038/sc.2012.32

179. Van Straaten MG, Cloud BA, Morrow MM, Ludewig PM, Zhao KD. Effectiveness of home exercise on pain, function, and strength of manual wheelchair users with spinal cord injury: a high-dose shoulder program with telerehabilitation. *Arch Phys Med Rehabil.* 2014;95(10):1810-1817.e2. doi:10.1016/j.apmr.2014.05.004

180. Wilbanks SR, Rogers R, Pool S, Bickel CS. Effects of functional electrical stimulation assisted rowing on aerobic fitness and shoulder pain in manual wheelchair users with spinal cord injury. *J Spinal Cord Med.* 2016;39(6):645-654. doi:10.1179/2045772315y.0000000052

181. Haubert LL, Mulroy SJ, Eberly VJ, Gronley JK, Hatchett PE, Conners SG. Shoulder pain prevention program for manual wheelchair users with paraplegia: a randomized clinical trial. *Top Spinal Cord Inj Rehabil.* 2021;27(4):40-52. doi:10.46292/sci20-00013

182. Canori A, Amiri AM, Thapa-Chhetry B, et al. Relationship between pain, fatigue, and physical activity levels during a technology-based physical activity intervention. *J Spinal Cord Med.* 2021;44(4):549-556. doi:10.1080/10790268.2020.1766889

183. De Gendt EEA, Vercoulen TFG, Joaquim AF, et al. The current status of spinal posttraumatic deformity: a systematic review. *Global Spine J.* 2021;11(8):1266-1280. doi:10.1177/2192568220969153

184. Vaccaro AR, Silber JS. Post-traumatic spinal deformity. *Spine (Phila Pa 1976).* 2001;26(24 suppl):S111-118. doi:10.1097/00007632-200112151-00019

185. Yagi M, Hasegawa A, Takemitsu M, Yato Y, Machida M, Asazuma T. Incidence and the risk factors of spinal deformity in adult patient after spinal cord injury: a single center cohort study. *Eur Spine J.* 2015;24(1):203-208. doi:10.1007/s00586-014-3534-1

Appendices

Appendix A
Key Questions Generated by the Expert Clinical Panel

Section	Key Questions
A	**Prevention of Pain** 1. What are the risk factors for development of neuropathic pain after SCI? 2. What are the risk factors for development of non-neuropathic pain after SCI? 3. What management can be initiated in acute care/rehabilitation/community to prevent the development of pain (neuropathic and non-neuropathic) after SCI? a. Pharmacological b. Nonpharmacological 4. What are the risks for the development of chronic pain, and how can this be prevented?
B	**Screening and Diagnosis of Pain** 5. How is pain after SCI classified? 6. How do I differentiate non-neuropathic and neuropathic pain? 7. If pain develops after SCI, what is the clinical approach to work up and diagnose this pain? a. What are the key components on history and clinical examination to address, including red and yellow flags? b. When should diagnostic testing/investigations be ordered? c. What diagnostic testing/investigations should be ordered? d. What are the differences in clinical approach (if any) in: i. Acute care vs. inpatient rehabilitation vs. outpatient rehabilitation/ community living ii. Traumatic vs. nontraumatic SCI 8. What other comorbid conditions/risk factors that can exacerbate or cause neuropathic/ non-neuropathic pain need to be screened for and/or diagnosed?
C	**Management Options** 9. How should patients be engaged in the management of their pain, i.e., goal setting, initiating, and planning? a. What outcome measures/principles are useful for increasing patient engagement (e.g., Goal Attainment Scale, Patient-Specific Functional Scale)? 10. What are the goals of managing pain after SCI? In addition to pain intensity, what other pain-related or associated outcomes should be addressed with pain management (mood, sleep, etc.)? a. How is the success and effectiveness of overall pain management after SCI assessed and documented? b. How is the effectiveness of individual treatments assessed and/or documented?

	11. In addition to pain-focused treatments, what other comorbid conditions should be managed, and what treatments should be used? a. Mood issues b. Sleep issues c. Other red/yellow flag conditions 12. What are pharmacological and nonpharmacological treatment options for management of neuropathic pain? a. In what order should these treatments be utilized? b. What are differences or considerations (if any) for treatment in: i. Acute care vs. inpatient rehab vs. outpatient rehab/community living ii. Traumatic vs. nontraumatic SCI 13. What are pharmacological and nonpharmacological options for the management of non-neuropathic pain? a. In what order should these treatments be utilized? b. What are differences or considerations (if any) for treatment in: i. Acute care vs. inpatient rehabilitation vs. outpatient rehabilitation/ community living ii. Traumatic vs. nontraumatic SCI 14. Opioid Use (Opioid Use Guidelines) a. When should opioids be used? b. For how long should opioids be used? c. Is there a limit to how high a dose I should prescribe? d. Should functional improvements be considered when determining if an opioid should be continued? e. What adverse effects should be monitored in those using opioids? f. How can I tell if my patient has an opioid use disorder? 15. Combining Treatments a. How long should I continue with one treatment before starting another? b. When should treatments be combined? i. Interactions causing side effects ii. Evidence for interactions that have an additive benefitefit c. When should I cut down or stop treatment?
D	**Follow-up Care** 16. What is an appropriate time frame for follow-up to assess: a. Side effects b. Effectiveness 17. What outcome measures can be used to document effect? a. e.g., Basic Data Set (check SCIRE website for information) 18. How is treatment success defined/evaluated? (See Section C, Item 10, as well) 19. When should referral be made for persistent pain that is not improving (interdisciplinary pain clinic vs. tertiary SCI care)? Expert opinion 20. When is maximal benefit for pain management (function/pain relief) achieved?

	21. When the addition of further treatments is no longer perceived to be beneficial or necessary (stable pain management), what care measures should be continued in terms of: a. Follow-up (by whom? how often?) b. Assessment of medication side effects c. Trial of medication weaning/discontinuation d. Supportive care: what needs to be continued for ongoing care and support of the patient with persistent pain? (e.g., education/counseling, self-management strategies – coping strategies, support groups, other therapies)
E	**Common Pain Presentations** 22. What are common diagnostic considerations and treatment/management options for common non-neuropathic pain presentations? a. Shoulder pain b. Low back pain c. Neck pain d. Myofascial pain e. Postoperative pain i. When is opioid use appropriate? 1. What are the side effects to consider? 2. Are there any potential effects on neurological recovery? ii. Are there other medications that should/could be used to manage postoperative pain? 1. What are the side effects to consider? 2. Are there any potential effects on neurological recovery?
F	**Special Populations** 23. Should pain that develops after traumatic vs. nontraumatic SCI be managed differently? a. In nontraumatic populations, are there any specific considerations regarding management of neuropathic vs. non-neuropathic pain? i. Inflammatory/degenerative/metabolic, etc. b. Young adults c. Polytrauma (e.g., concomitant ABI)
G	**Special Functional Considerations** 24. Return to sports/pain management in the athlete 25. Durable medical equipment use (e.g., manual wheelchair use)

Appendix B
Literature Search Strategy

consortium for SPINAL CORD MEDICINE CLINICAL PRACTICE GUIDELINES

Guidelines - Literature Search Strategy

Databases: CINAHL, Cochrane, EMBASE, MEDLINE, PsycINFO				**Timeframe:** 1980 – July 2022	
Limiters: Human, English language					
Term Category	**Keywords**	**MeSH**	**Embase**	**CINAHL**	**PyscINFO**
Population	Spinal cord Injur* OR SCI Spinal Injur* Quadriplegi* Tetraplegi* Paraplegi* Traumatic SCI OR Traumatic spinal cord injur* Non$traumatic SCI OR non$traumatic spinal cord injur* Spinal cord impaired OR spinal cord lesion OR spinal cord dysfunction OR upper motor neuron OR lower motor neuron	Spinal Cord Injuries Spinal Injuries Paraplegia Quadriplegia	Spinal cord injury Paraplegia Quadriplegia	Spinal cord injuries Spinal injuries Paraplegia Quadriplegia	Spinal cord injuries Paraplegia Quadriplegia
Questions	Prevent* OR reduc* OR minimiz* OR Risk factor* OR contributing factor* OR predisposing factor* OR predictor OR cause OR vulnerability factor OR protective factor OR Screen* OR assessment OR test OR diagnos* OR Investigat* OR Clinical approach OR management OR remediation OR therapy OR training exercise OR Intervention OR treatment OR program OR Principle* OR guideline OR protocol OR best practice* OR patient engagement OR patient participation OR patient involvement OR treatment order OR consideration* OR issue* OR factor* OR follow$up OR discharge OR referral OR care pathway OR	Therapeutics Medicine Patient reported outcome measures Healthcare quality, access, and evaluation Return to sport Equipment and supplies Capacity building Health communication Health workforce Health personnel Health services	Therapy Medicine Patient-reported outcome Health care quality Health care access Return to sport Devices Capacity building Medical information Health work force Health care personnel Health service	Therapeutics Medicine Patient-reported outcomes Quality of healthcare Health care delivery Sports re-entry Equipment and supplies Health facility planning Health personnel Health services	Treatment Treatment process and outcome measures Healthcare services Medical therapeutic devices Health personnel

	Pharmacologic* OR pharm* OR medications OR drug OR narcotic OR non$narcotic OR NSAID OR nonsteroidal anti$inflammatory drug* OR opioid* OR morphine OR tramadol OR alfentanil OR oxycodone OR anticonvulsant* OR gabapentin OR pregabalin OR carbamazepine OR lamotrigine OR levetiracetam OR valproate OR tricyclic antidepressant OR tca OR amitryptiline OR duloxetine OR venlafaxine OR trazodone OR anaesthetic OR lidocaine OR mexiletine OR ketamine OR antispasti* OR baclofen OR phenol OR botulinum toxin OR botox OR cannabinoid*, cannabis OR marijuana OR weed OR tetrahydrocannabinol OR THC OR CBD OR dronabinal OR clonidine OR capsaicin OR lithium OR nitroglycerine OR use disorder OR addiction OR substance use OR substance abuse OR Non$pharmacologic* OR non$pharm* OR complementary OR alternative OR adjunct OR massage OR osteopathy OR acupuncture OR exercise OR exoskeleton OR yoga OR visual illusion OR hypno* OR biofeedback OR cognitive behavioural therapy OR CBT OR mindfulness OR meditat* OR transcranial direct current stimulation OR tdcs OR electrical stimulation OR TCE OR NMES OR FES OR static magnetic field OR electrical nerve stimulation OR transcranial magnetic stimulation OR tms OR diet OR supportive care OR counselling OR psychotherapy OR education OR self$mangement OR self$care OR self$regulation OR self$monitoring OR self$efficacy OR coping OR strategies OR skills OR support OR Dose OR dosage OR dosing Or wean* OR discontinue* OR cessation OR					

	Outcome OR outcome measure* Or efficacy OR impact* OR safety OR benefit OR effect* OR quality OR value OR improv* OR adverse effect* OR side effect* OR negative effect* OR risk OR complication OR functional improvement OR interactions OR heal* OR relief OR control OR Access* OR availability OR barrier* OR obstacle* Or challenge* OR equity OR equality OR diversity OR inclusion OR marginalization OR social justice OR culturally responsive OR Return to sport OR return to activity OR return to performance OR return to play OR Medical equipment OR supplies OR devices				
Pain	Pain OR discomfort OR ache OR neuropathic OR nerve OR non$neuropathic OR nociceptive OR OR neurogenic OR visceral OR allodynia OR hyperalgesi* OR pain (adj5) location OR above level OR at level OR below level OR border zone OR segmental OR head OR neck OR shoulder OR trunk OR abdomen OR back OR low back OR arm OR leg OR lower extrem* OR upper extrem* OR hand OR wrist OR elbow OR musculoskeletal OR mechanical OR central OR myofascial OR post$operative OR quality OR onset OR duration OR characteristic* OR timing OR sever* OR factors OR other OR classification OR unknown OR arthritis OR epicondylitis OR fracture OR muscle spasm OR spastic* OR ischemi* OR compression OR carpal tunnel OR neuralgia OR neuropathy OR fibromyalgia OR complex regional pain syndrome OR cystitis OR irritable bowel syndrome OR IBS OR psychogenic OR catastrophizing OR mood OR sleep	Pain Musculoskeletal pain Somatosensory disorders	Pain Musculoskeletal pain Somatosensory disorder	Pain Somatosensory disorders	Pain Somatosensory disorders

Setting	Acute OR hospital OR ward OR inpatient OR chronic OR outpatient OR Rehabilitation OR rehab OR recovery Community OR primary care OR home	Health facilities	Health care facility	Health facilities	Treatment facilities

Database	Search Terms	# References
Medline	Spinal cord Injur* OR Spinal Injur* OR Spinal Cord Injury OR SCI OR Quadriplegi* OR Tetraplegi* OR Paraplegi* OR Traumatic SCI OR Traumatic spinal cord injur* OR Non$traumatic SCI OR non$traumatic spinal cord injur* Exp Spinal Cord Injuries/ OR Exp Spinal Injuries/ OR exp paraplegia/ or exp quadriplegia AND Prevent* OR reduc* OR minimiz* OR Risk factor* OR contributing factor* OR predisposing factor* OR predictor OR cause OR vulnerability factor OR protective factor OR Screen* OR assessment OR test OR diagnos* OR Investigat* OR Clinical approach OR management OR remediation OR therapy OR training exercise OR Intervention OR treatment OR program OR Principle* OR guideline OR protocol OR best practice* OR patient engagement OR patient participation OR patient involvement OR treatment order OR consideration* OR issue* OR factor* OR follow$up OR discharge OR referral OR care pathway OR Pharmacologic* OR pharm* OR medications OR drug OR narcotic OR non$narcotic OR NSAID OR nonsteroidal anti$inflammatory drug* OR opioid* OR morphine OR tramadol OR alfentanil OR oxycodone OR anticonvulsant* OR gabapentin OR pregabalin OR carbamazepine OR lamotrigine OR levetiracetam OR valproate OR tricyclic antidepressant OR tca OR amitryptiline OR duloxetine OR venlafaxine OR trazodone OR anaesthetic OR lidocaine OR mexiletine OR ketamine OR antispasti* OR baclofen OR phenol OR botulinum toxin OR botox OR cannabinoid*, cannabis OR marijuana OR weed OR tetrahydrocannabinol OR THC OR CBD OR dronabinal OR clonidine OR capsaicin OR lithium OR nitroglycerine OR use disorder OR addiction OR substance use OR substance abuse OR Non$pharmacologic* OR non$pharm* OR complementary OR alternative OR adjunct OR massage OR osteopathy OR acupuncture OR exercise OR exoskeleton OR yoga OR visual illusion OR hypno* OR biofeedback OR cognitive behavioural therapy OR CBT OR mindfulness OR meditat* OR transcranial direct current stimulation OR tdcs OR electrical stimulation OR TCE OR NMES OR FES OR static magnetic field OR electrical nerve stimulation OR transcranial magnetic stimulation OR tms OR diet OR supportive care OR counselling OR psychotherapy OR education OR self$mangement OR self$care OR self$regulation OR self$monitoring OR self$efficacy OR coping OR strategies OR skills OR support OR Dose OR dosage OR dosing Or wean* OR discontinue* OR cessation OR Outcome OR outcome measure* Or efficacy OR impact* OR safety OR benefit OR effect* OR quality OR value OR improv* OR adverse effect* OR side effect* OR negative effect* OR risk OR complication OR functional improvement OR interactions OR heal* OR relief OR control OR Access* OR availability OR barrier* OR obstacle* Or challenge* OR equity OR equality OR diversity OR inclusion OR marginalization OR social justice OR culturally responsive OR Return to sport OR return to activity OR return to performance OR return to play OR Medical equipment OR supplies OR devices Exp Therapeutics/ OR exp medicine/ OR patient reported outcome measures/ OR exp healthcare quality, access, and evaluation/ OR Exp return to sport/ OR equipment and supplies/ OR capacity building/ OR exp health communication/ OR exp health workforce/ OR Exp health personnel/ OR exp health services/ AND Pain OR discomfort OR ache OR neuropathic OR nerve OR non$neuropathic OR nociceptive OR OR neurogenic OR visceral OR allodynia OR hyperalgesi* OR (pain (adj5) location OR above level OR at level OR below level OR border zone OR segmental OR head OR neck OR shoulder OR trunk OR abdomen OR back OR low back OR arm OR leg OR lower extrem* OR upper extrem* OR hand OR wrist OR elbow OR musculoskeletal OR mechanical OR central OR myofascial OR post$operative OR quality OR onset OR duration OR characteristic* OR timing OR sever* OR factors OR other OR classification OR unknown OR arthritis OR epicondylitis OR fracture OR muscle spasm OR spastic* OR ischemi* OR compression OR carpal tunnel OR neuralgia OR neuropathy OR fibromyalgia OR complex regional pain syndrome OR cystitis OR irritable bowel syndrome OR IBS OR psychogenic OR catastrophizing OR mood OR sleep) Exp Pain/ OR exp musculoskeletal pain/ OR exp Somatosensory disorders/ OR Acute OR hospital OR ward OR inpatient OR chronic OR outpatient OR Rehabilitation OR rehab OR recovery OR Community OR primary care OR home Exp Health facilities/	

	Spinal cord Injur* OR Spinal Injur* OR Spinal Cord Injury OR SCI OR Quadriplegi* OR Tetraplegi* OR Paraplegi* Exp Spinal cord injury/ OR exp Paraplegia/ OR exp Quadriplegia/ AND Prevent* OR reduc* OR minimiz* OR Risk factor* OR contributing factor* OR predisposing factor* OR predictor OR cause OR vulnerability factor OR protective factor OR Screen* OR assessment OR test OR diagnos* OR Investigat* OR Clinical approach OR management OR remediation OR therapy OR training exercise OR Intervention OR treatment OR program OR Principle* OR guideline OR protocol OR best practice* OR patient engagement OR patient participation OR patient involvement OR treatment order OR consideration* OR issue* OR factor* OR follow$up OR discharge OR referral OR care pathway OR Pharmacologic* OR pharm* OR medications OR drug OR narcotic OR non$narcotic OR NSAID OR nonsteroidal anti$inflammatory drug* OR opioid* OR morphine OR tramadol OR alfentanil OR oxycodone OR anticonvulsant* OR gabapentin OR pregabalin OR carbamazepine OR lamotrigine OR levetiracetam OR valproate OR tricyclic antidepressant OR tca OR amitryptiline OR duloxetine OR venlafaxine OR trazodone OR anaesthetic OR lidocaine OR mexiletine OR ketamine OR antispasti* OR baclofen OR phenol OR botulinum toxin OR botox OR cannabinoid*, cannabis OR marijuana OR weed OR tetrahydrocannabinol OR THC OR CBD OR dronabinal OR clonidine OR capsaicin OR lithium OR nitroglycerine OR use disorder OR addiction OR substance use OR substance abuse OR Non$pharmacologic* OR non$pharm* OR complementary OR alternative OR adjunct OR massage OR osteopathy OR acupuncture OR exercise OR exoskeleton OR yoga OR visual illusion OR hypno* OR biofeedback OR cognitive behavioural therapy OR CBT OR mindfulness OR meditat* OR transcranial direct current stimulation OR tdcs OR electrical stimulation OR TCE OR NMES OR FES OR static magnetic field OR electrical nerve stimulation OR transcranial magnetic stimulation OR tms OR diet OR supportive care OR counselling OR psychotherapy OR education OR self$mangement OR self$care OR self$regulation OR self$monitoring OR self$efficacy OR coping OR strategies OR skills OR support OR Dose OR dosage OR dosing Or wean* OR discontinue* OR cessation OR Outcome OR outcome measure* Or efficacy OR impact* OR safety OR benefit OR effect* OR quality OR value OR improv* OR adverse effect* OR side effect* OR negative effect* OR risk OR complication OR functional improvement OR interactions OR heal* OR relief OR control OR Access* OR availability OR barrier* OR obstacle* Or challenge* OR equity OR equality OR diversity OR inclusion OR marginalization OR social justice OR culturally responsive OR Return to sport OR return to activity OR return to performance OR return to play OR Medical equipment OR supplies OR devices Exp therapy/ OR exp medicine/ OR exp patient-reported outcome/ OR exp health care quality/ OR exp health care access/ OR exp return to sport/ OR exp devices/ OR exp capacity building/ OR exp medical information/ OR exp health work force/ OR exp health care personnel/ OR exp health service/ AND Pain OR discomfort OR ache OR neuropathic OR nerve OR non$neuropathic OR nociceptive OR OR neurogenic OR visceral OR allodynia OR hyperalgesi* OR (pain (adj5) location OR above level OR at level OR below level OR border zone OR segmental OR head OR neck OR shoulder OR trunk OR abdomen OR back OR low back OR arm OR leg OR lower extrem* OR upper extrem* OR hand OR wrist OR elbow OR musculoskeletal OR mechanical OR central OR myofascial OR post$operative OR quality OR onset OR duration OR characteristic* OR timing OR sever* OR factors OR other OR classification OR unknown OR arthritis OR epicondylitis OR fracture OR muscle spasm OR spastic* OR ischemi* OR compression OR carpal tunnel OR neuralgia OR neuropathy OR fibromyalgia OR complex regional pain syndrome OR cystitis OR irritable bowel syndrome OR IBS OR psychogenic OR catastrophizing OR mood OR sleep) Exp Pain/ OR exp musculoskeletal pain/ OR exp somatosensory disorder/ OR Acute OR hospital OR ward OR inpatient OR chronic OR outpatient OR Rehabilitation OR rehab OR recovery OR Community OR primary care OR home Exp health care facility/	
Cochrane	Spinal cord Injur* OR Spinal Injur* OR Spinal Cord Injury OR SCI OR Quadriplegi* OR Tetraplegi* OR Paraplegi* [mh “spinal cord injuries”] OR [mh “spinal injuries”] OR [MH “paraplegia”] OR [MH “quadriplegia”] AND Prevent* OR reduc* OR minimiz* OR Risk factor* OR contributing factor* OR predisposing factor* OR predictor OR cause OR vulnerability factor OR protective factor OR Screen* OR assessment OR test OR diagnos* OR Investigat* OR Clinical approach OR management OR remediation OR therapy OR training exercise OR Intervention OR treatment OR program OR Principle* OR guideline OR protocol OR best practice* OR patient engagement OR patient participation OR patient involvement OR treatment order OR consideration* OR issue* OR factor* OR follow$up OR discharge OR referral OR care pathway OR Pharmacologic* OR pharm* OR medications OR drug OR narcotic OR non$narcotic OR NSAID OR nonsteroidal anti$inflammatory drug* OR opioid* OR morphine OR tramadol OR alfentanil OR oxycodone OR anticonvulsant* OR gabapentin OR pregabalin OR carbamazepine OR lamotrigine OR levetiracetam OR valproate OR tricyclic antidepressant OR tca OR amitryptiline OR duloxetine OR venlafaxine OR trazodone OR anaesthetic OR lidocaine OR mexiletine OR ketamine OR antispasti* OR baclofen OR phenol OR botulinum toxin OR botox OR cannabinoid*, cannabis OR	

	marijuana OR weed OR tetrahydrocannabinol OR THC OR CBD OR dronabinal OR clonidine OR capsaicin OR lithium OR nitroglycerine OR use disorder OR addiction OR substance use OR substance abuse OR Non$pharmacologic* OR non$pharm* OR complementary OR alternative OR adjunct OR massage OR osteopathy OR acupuncture OR exercise OR exoskeleton OR yoga OR visual illusion OR hypno* OR biofeedback OR cognitive behavioural therapy OR CBT OR mindfulness OR meditat* OR transcranial direct current stimulation OR tdcs OR electrical stimulation OR TCE OR NMES OR FES OR static magnetic field OR electrical nerve stimulation OR transcranial magnetic stimulation OR tms OR diet OR supportive care OR counselling OR psychotherapy OR education OR self$mangement OR self$care OR self$regulation OR self$monitoring OR self$efficacy OR coping OR strategies OR skills OR support OR Dose OR dosage OR dosing Or wean* OR discontinue* OR cessation OR Outcome OR outcome measure* Or efficacy OR impact* OR safety OR benefit OR effect* OR quality OR value OR improv* OR adverse effect* OR side effect* OR negative effect* OR risk OR complication OR functional improvement OR interactions OR heal* OR relief OR control OR Access* OR availability OR barrier* OR obstacle* Or challenge* OR equity OR equality OR diversity OR inclusion OR marginalization OR social justice OR culturally responsive OR Return to sport OR return to activity OR return to performance OR return to play OR Medical equipment OR supplies OR devices MH "Therapeutics+" OR MH "Medicine+" OR MH "Patient-reported outcomes+" OR MH "Quality of healthcare+" OR MH "Health care delivery+" OR MH "Sports re-entry+" OR MH "Equipment and supplies" OR MH "Health facility planning+" OR MH "Health personnel+" OR MH "Health services+" AND Pain OR discomfort OR ache OR neuropathic OR nerve OR non$neuropathic OR nociceptive OR neurogenic OR visceral OR allodynia OR hyperalgesi* OR (pain N5 (location OR above level OR at level OR below level OR border zone OR segmental OR head OR neck OR shoulder OR trunk OR abdomen OR back OR low back OR arm OR leg OR lower extrem* OR upper extrem* OR hand OR wrist OR elbow OR musculoskeletal OR mechanical OR central OR myofascial OR post$operative OR quality OR onset OR duration OR characteristic* OR timing OR sever* OR factors OR other OR classification OR unknown OR arthritis OR epicondylitis OR fracture OR muscle spasm OR spastic* OR ischemi* OR compression OR carpal tunnel OR neuralgia OR neuropathy OR fibromyalgia OR complex regional pain syndrome OR cystitis OR irritable bowel syndrome OR IBS OR psychogenic OR catastrophizing OR mood OR sleep)) MH "Pain+" OR MH "Somatosensory disorders+" OR Acute OR hospital OR ward OR inpatient OR chronic OR outpatient OR Rehabilitation OR rehab OR recovery OR Community OR primary care OR home MH "Health facilities+"	
PsycINFO	Spinal cord Injur* OR Spinal Injur* OR Spinal Cord Injury OR SCI OR Quadriplegi* OR Tetraplegi* OR Paraplegi* Exp Spinal cord injuries/ or exp paraplegia/ or exp quadriplegia/ AND Prevent* OR reduc* OR minimiz* OR Risk factor* OR contributing factor* OR predisposing factor* OR predictor OR cause OR vulnerability factor OR protective factor OR Screen* OR assessment OR test OR diagnos* OR Investigat* OR Clinical approach OR management OR remediation OR therapy OR training exercise OR Intervention OR treatment OR program OR Principle* OR guideline OR protocol OR best practice* OR patient engagement OR patient participation OR patient involvement OR treatment order OR consideration* OR issue* OR factor* OR follow$up OR discharge OR referral OR care pathway OR Pharmacologic* OR pharm* OR medications OR drug OR narcotic OR non$narcotic OR NSAID OR nonsteroidal anti$inflammatory drug* OR opioid* OR morphine OR tramadol OR alfentanil OR oxycodone OR anticonvulsant* OR gabapentin OR pregabalin OR carbamazepine OR lamotrigine OR levetiracetam OR valproate OR tricyclic antidepressant OR tca OR amitryptiline OR duloxetine OR venlafaxine OR trazodone OR anaesthetic OR lidocaine OR mexiletine OR ketamine OR antispasti* OR baclofen OR phenol OR botulinum toxin OR botox OR cannabinoid* OR cannabis OR marijuana OR weed OR tetrahydrocannabinol OR thc OR cbd OR dronabinal OR clonidine OR capsaicin OR lithium OR nitroglycerine OR addiction OR substance$use OR substance abuse OR Non$pharmacologic* OR non$pharm* OR complementary OR alternative OR adjunct OR massage OR osteopathy OR acupuncture OR exercise OR exoskeleton OR yoga OR visual illusion OR hypno* OR biofeedback OR cognitive behavioural therapy OR cbt OR mindfulness OR meditat* OR transcranial direct current stimulation OR tdcs OR electrical stimulation OR tce OR nmes OR fes OR static magnetic field OR electrical nerve stimulation OR transcranial magnetic stimulation OR tms OR diet OR supportive care OR counselling OR psychotherapy OR education OR self$mangement OR self$care OR self$regulation OR self$monitoring OR self$efficacy OR coping OR strategies OR skills OR support OR Dose OR dosage OR dosing OR wean* OR discontinue* OR cessation OR Outcome OR outcome measure* OR efficacy OR impact* OR safety OR benefit OR effect* OR quality OR value OR improv* OR adverse effect* OR side effect* OR negative effect* OR risk OR complication OR functional improvement OR interactions OR heal* OR relief OR control OR Access* OR availability OR barrier* OR obstacle* Or challenge* OR equity OR equality OR diversity OR inclusion OR marginalization OR social justice OR culturally responsive OR Return to sport OR	

	return to activity OR return to performance OR return to play OR Medical equipment OR supplies OR devices Exp treatment/ OR exp treatment process and outcome measures/ OR exp Health care services/ OR Medical therapeutic devices/ OR Exp Health personnel/ AND Pain OR discomfort OR ache OR neuropathic OR nerve OR non$neuropathic OR nociceptive OR neurogenic OR visceral OR allodynia OR hyperalgesi* OR (pain ADJ5 (location OR above level OR at level OR below level OR border zone OR segmental OR head OR neck OR shoulder OR trunk OR abdomen OR back OR low back OR arm OR leg OR lower extrem* OR upper extrem* OR hand OR wrist OR elbow OR musculoskeletal OR mechanical OR central OR myofascial OR post$operative OR quality OR onset OR duration OR characteristic* OR timing OR sever* OR factors OR other OR classification OR unknown OR arthritis OR epicondylitis OR fracture OR muscle spasm OR spastic* OR ischemi* OR compression OR carpal tunnel OR neuralgia OR neuropathy OR fibromyalgia OR complex regional pain syndrome OR cystitis OR irritable bowel syndrome OR IBS OR psychogenic OR catastrophizing OR mood OR sleep)) Exp Pain/ OR exp Somatosensory disorders/ OR Acute OR hospital OR ward OR inpatient OR chronic OR outpatient OR Rehabilitation OR rehab OR recovery OR Community OR primary care OR home Exp Treatment facilities/	

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