Neuropathic Pain Post Spinal Cord Injury Part 2: Systematic Review of Dorsal Root Entry Zone Procedure

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Background: Pharmacotherapy may not sufficiently reduce neuropathic pain in many individuals post spinal cord injury (SCI). The use of alternative therapies such as surgery may be effective in reducing neuropathic pain in these individuals. However, because of the invasive nature of surgery, it is important to examine the evidence for use of this treatment. **Objective:** The purpose of this study was to conduct a systematic review of published literature on the surgical treatment of neuropathic pain after SCI. **Methods:** MEDLINE, CINAHL, EMBASE, and PsycINFO databases were searched for articles in which surgical treatment of pain after SCI was examined. Articles were restricted to the English language. Article selection was conducted by 2 independent reviewers with the following inclusion criteria: the subjects participated in a surgical intervention for neuropathic pain; at least 50% of the subjects had an SCI; at least 3 subjects had an SCI; and a definable intervention involving the dorsal root entry zone (DREZ) procedure was used to reduce pain. Data extracted included study design, study type, subject demographics, inclusion and exclusion criteria, sample size, outcome measures, and study results. Randomized controlled trials (RCTs) were assessed for quality using the Physiotherapy Evidence Database (PEDro) assessment scale. Levels of evidence were assigned to each intervention using a modified Sackett scale. **Results:** Eleven studies met the inclusion criteria. One study provided level 2 evidence, and the rest provided level 4 evidence. The DREZ procedure was shown to be more effective for segmental pain than for diffuse pain after SCI. Further, individuals with conus medullaris level injury were found to have a higher level of neuropathic pain relief than those with cervical, thoracic, or cauda equina injury. **Conclusions:** The studies demonstrated that the DREZ procedure may be effective in reducing segmental pain. Hence, DREZ may be important in treatment of neuropathic pain in individuals resistant to less invasive treatments. Because the studies lacked control conditions and examination of long-term effects, there is a need for larger trials with more stringent conditions. **Key words:** *pain, spinal cord injury, surgical treatment*

Pain is a major cause of distress and disability in persons with spinal cord injury (SCI). It has been shown to lead to social isolation, unemployment, decreased function, decreased quality of life, depression, and even suicide.[1,2] More than 77% of individuals with an SCI indicated that pain interfered with one or more of their daily activities including sleep (40%), exercise (34.9%), and work (33.6%).[2] The International Association for the Study of Pain (IASP) defines neuropathic pain as "pain caused by a lesion or disease of the somatosensory nervous system."[3] After an SCI, individuals often report the onset of chronic neuropathic pain caudal to the level of the lesion or at the same level within the associated spinal cord segment.[4] Dijkers et al[5] reported no difference in the prevalence of pain based on level or completeness.

The reported incidence of neuropathic pain after SCI varies greatly among studies, but between 10% and 30% of patients with SCI experience pain severe enough to interfere with their activities of daily living[6,7] and may require surgical intervention to relieve persistent and refractory pain.[4,8] Unmanageable neuropathic pain occurs more often in individuals with conus medullaris and

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Table 1. Levels of evidence[13]

Level 1	RCTs with a PEDro score ≥ 6
Level 2	RCTs with a PEDro score < 6, cohort and prospective controlled trials
Level 3	Case-control studies
Level 4	Pre-post or postinterventional studies and case series
Level 5	Case reports, clinical consensus, or observational studies

Note: PEDro = Physiotherapy Evidence Database; RCT = randomized controlled trial.

cauda equina lesions where damage also involves the peripheral nerve roots.[8]

When pharmacological and other noninvasive treatments fail to reduce pain, surgical spinal cord stimulation and dorsal root entry zone (DREZ) ablation treatments, such as DREZ lesioning and microsurgical DREZotomy (MDT), can be considered as options for the management of refractory pain.[9] Neurosurgical procedures to reduce neuropathic pain should be reserved for cases in which medical therapies have failed to sufficiently reduce pain.[4] The risks associated with ablative surgeries can be significant for individuals with incomplete neurological deficits; therefore, DREZ ablation is generally only considered a treatment option when neuropathic pain is present after a complete SCI.[8] The MDT procedure targets for ablation the nociceptive fibers in the lateral bundle of the dorsal rootlet, the deafferented neurons of the dorsal horn, and the medial portion of the Lissauer tract.[4,6] This systematic review was conducted to assess the effectiveness of DREZ ablation therapies in reducing neuropathic pain in individuals following SCI.

Methods

Literature search strategy

A systematic review of all relevant literature published from 1980 to December 2011 was conducted using multiple databases (MEDLINE, CINAHL, EMBASE, and PsycINFO). Key words included spinal cord injuries, neuropathic pain, dorsal root entry zone procedure, DREZotomy, and dorsal rhizotomy. Retrieved references were scanned for relevant citations.

Study selection

Studies were selected for analysis if the following criteria were met: (1) at least 50% of the subjects had an SCI; (2) at least 3 subjects had an SCI; (3) the study included individuals with neuropathic pain; and (4) a definable intervention involving the DREZ procedure was used to reduce pain. No study was excluded on the basis of study design. A study was excluded if it provided insufficient details to allow for data synthesis or if it was a nonclinical trial (ie, reviews, epidemiology, or basic sciences research).

Study appraisal

A quality assessment for each study was conducted by 2 reviewers using the Physiotherapy Evidence Database (PEDro) scoring system[10] for randomized controlled trials (RCTs). The Downs and Black (D&B) tool was used in the assessment of non-RCTs. The PEDro tool consists of 11 questions with a maximum score of 10. Higher scores reflect a higher methodological quality rating for that study. In this study, a PEDro score of 5 or lower was used to designate "poor" quality RCTs, which corresponds to a marginally lower score than the approximate mean value over all RCTs in the PEDro database conducted over the latest reported periods (ie, 1995-2002).[11] The D&B tool contains 27 items with a maximum score of 28; higher scores reflect a higher methodological quality of the rated study.[12]

Data synthesis

Studies involving similar interventions were grouped and tabulated. Summary tables were

developed indicating the quality of the study, the type of study, a brief summary of intervention outcomes, and study results. The strength of the evidence for each intervention was rated using a modified Sackett scale[13] (see **Table 1**). Evaluation of the data led us to conclude that a meta-analysis would be inappropriate because of the heterogeneity of the studies, inconsistency in the use of outcome measures, low methodological quality, and insufficient data reporting.

Results

Study size and quality

Eleven studies met the inclusion criteria. One study provided level 2 evidence,[14] and 10 provided level 4 evidence.[4,6-9,15-20] Sample sizes ranged from 6 to 56. Ages of individuals in the studies ranged from 17 to 75 years, with an average age of 39 years. None of the outcome measures were assessed in blinded fashion as individuals simply self-reported pain relief before and after the DREZ procedure.

Study design

One study conducted a prospective controlled trial,[14] 1 utilized a pre-post study design,[9] and 9 studies utilized a case series study design[6-8,15-20] (see **Table 2**). In each study, an intervention for pain was administered to an individual with SCI, and the change in pain was measured; only 1 study compared treated individuals with those in a control group.[14] The study divided individuals into 2 treatment groups: the first 9 patients underwent DREZ microcoagulation with recorded spontaneous neuroelectrical hyperactivity used as a guide, and the second group underwent DREZ microcoagulation with both the recorded spontaneous and evoked hyperactivity used as guides. Individuals were followed up for 6 years after surgery, and pain was measured using the visual analogue scale (VAS).

Four studies examined the microsurgical DREZ treatment (MDT) with Sindou's technique.[6,9,19,20] Sindou's technique for MDT involves selectively destroying nociceptive fibers and hyperactive neurons, which interfere with the neurogenic mechanism causing pain.[20] Chun et al[9] reported on 38 individuals treated with the procedure between 2003 and 2008. These individuals had various types of neuropathic pain including segmental versus diffuse, mechanical versus thermal, or a combination of both, and intermittent versus continuous pain. Previous management with medication had proven unsuccessful. After surgery, individuals were followed up for a period ranging from 19 to 84 months (average of 42 months) to measure the degree of pain relief. At follow-up, individuals were asked to rate the intensity of their pain using the VAS. Pain relief was considered by the authors to be "good" if pain was reduced by more than 75%, "fair" if it was reduced by 25% to 75%, and "poor" if pain was reduced by less than 25%.

Spaic et al[6,20] conducted a pre-post study to assess the effect of MDT on individuals with neuropathic pain. Participants self-reported their pain levels using the VAS at 7 to 12 months[20] and 13 to 50 months after surgery.[6] Sindou et al[19] explored how an MDT intervention might reduce mixed types of pain in individuals with SCI, as measured by changes in the VAS. Between 1980 and 1999, 44 individuals received the DREZ procedure and subsequently rated their pain at 10 days and then at 3 months after surgery; some individuals were also followed up on a long-term basis, for 12 to 240 months after surgery.

In 1 pre-post study, DREZ microcoagulation was performed with a computer-assisted procedure. Investigators followed up 46 individuals with central pain for an average of 44 months after surgery. The authors reported self-rated pain in these individuals.[15]

Five studies involved individuals who underwent a radiofrequency-induced DREZ procedure.[2,7,8,16,18] Friedman and Nashold[7] performed the procedure between 1978 and 1986 on 56 individuals who were experiencing pain associated with an SCI. At follow-up 6 months to 5 years after the procedure, individuals assessed their pain relief as "good" if they were pain free or did not require analgesics or the pain did not interfere with daily activities, "fair" if they only required nonnarcotic analgesics, or "poor" if they still had residual pain that interfered with their daily activities.

Sampson et al[8] reported on 39 individuals with SCI pain of mixed origin who were treated with

radiofrequency-induced DREZ procedures between 1978 and 1992. At follow-up 1 week to 619 weeks later (average of 156 weeks), individuals assessed their pain relief as "good" if they required no analgesics, "fair" if pain was significantly reduced but they still required nonnarcotic analgesics, or "poor" for any other scenario. Similarly, Nashold et al[16] reported on 18 individuals with SCI pain of mixed origin who underwent the DREZ operation in combination with cyst removal. Individuals were asked to use criteria for pain assessment similar to those used by Sampson et al[8] to rate their pain relief on follow-up, an average of 3 years after surgery.

Rath et al[17] examined the effect of radiofrequency-induced DREZ procedures on neuropathic pain in 23 individuals with SCI who underwent the procedure between 1981 and 1997 and who were followed up, on average, for 51 months after surgery. Individuals were asked to self-report their pain relief as "good" if pain was reduced by more than 75%, "fair" if pain was reduced by 25% to 75%, or "poor" if pain was reduced by less than 25%.

Finally, Richter and Seitz[18] examined the impact of radiofrequency-induced DREZ procedures on 10 individuals with cervical and thoracic SCIs who had the procedure performed between 1981 and 1983. Individuals were asked to self-report their pain in the hospital immediately after surgery and at follow-up 5 to 30 months after surgery.

Treatment fidelity

In all 9 studies, a standard microsurgical or radiofrequency-induced DREZ protocol was used. The VAS was used to measure pain relief in 4 studies.[6,9,19,20] In the remaining 5 studies, individuals were asked to self-report the percentage of reduction of pain they had after surgery and whether they still required analgesics.[7,8,16-18] Baseline characteristics to determine variability among individuals were not reported in any of the studies.

Participant characteristics

Most studies did not provide extensive baseline information about the individuals apart from age, gender, cause of injury, and level of injury (**Table 3**). Studies included individuals with injuries to the cervical and thoracic cord, the conus medullaris, and the cauda equina; injuries to the conus medullaris and cauda equina were more common. Six studies included individuals with only neuropathic pain,[6,9,14,15,17,20] and 3 studies included individuals with mixed pain[8,16,19]; in 2 studies the origin of pain was not indicated.[7,18] The presence of neuropathic pain was determined by means of a clinical interview or pain descriptors.

Effectiveness of the DREZ procedure

The DREZ procedure was shown to be effective for many people with SCI, in whom the pain was both mixed and neuropathic in origin (**Table 3**). Good pain relief was described in 3 ways: as a 75% pain reduction, no analgesics needed, and/or lack of hindrance of daily activities from pain after surgery. Overall, good pain relief was achieved for 48% to 100% of all of the study subjects, and fair relief was achieved for 9% to 52% of all of the study subjects. Good pain relief was achieved in 73% to 100% of those with segmental pain, as compared with only 17% to 73% of those with diffuse pain.[7,9,17,19] Spaic et al[6] and Rath et al[17] also found significantly better pain relief among individuals with segmental pain than those with diffuse pain. Individuals with intermittent pain and continuous pain achieved similar rates of good pain relief (78% and 80%, respectively).[9] However, Spaic et al[6] found that significantly better pain relief was reported among individuals with intermittent pain compared with those with continuous pain ($P < .0004$).

Good pain relief was found in 70% to 83% and 50% to 100% of individuals with mechanical (including electric shocks) and combined mechanothermal (including burning) pain, respectively; however, good pain relief was only reported by 0% to 26% of individuals with thermal pain alone.[6,9,19] Good pain relief was achieved in 39% to 100% and 62% to 100% of individuals with complete and incomplete injuries, respectively.[8,19,20] Finally, individuals with injuries at the conus medullaris level reported the highest rates of good pain relief (52%-100%)[6,8,9,19,20] compared with individuals who had injuries at the cervical (67%),[18,19] thoracic (0%-60%),[6,9,19,20] and cauda equina (25%-88%)[6,8,19] levels.

Table 2. Dorsal root entry zone (DREZ) procedure

Study, study type, and scale score	No. of participants, type of pain, and diagnostic tool	Intervention and pain scale	Results
Chun et al, 2011[9]/Korea Pre-Post	N = 38 Pain: Neuropathic Diagnosis: Clinical interview	**Treatment:** MDT was performed according to Sindou's technique. **Pain scale:** VAS	1. Overall, 79% of patients achieved good pain relief, 10.5% fair, and 10.5% poor. 2. Good pain relief was achieved in 82.5% of those with mechanical pain and 100% with combined pain vs 20% with thermal pain. 3. Good pain relief was achieved in those with diffuse pain (73.3%) and segmental pain (82.6%). 4. Good pain relief was achieved in those with intermittent pain (78.2%) and continuous pain (80%).
Falci et al, 2002[14]/USA Prospective controlled trial D&B = 15	N = 41 Pain: Neuropathic Diagnosis: Not stated	**Treatment:** The first 9 patients were placed in group 1 and the next 32 in group 2. Individuals in group 1 underwent DREZ microcoagulation using recorded spontaneous neuroelectrical hyperactivity in DREZ as a guide. The second group underwent DREZ microcoagulation using the above-mentioned recorded spontaneous neuroelectrical hyperactivity in the DREZ as well as recorded evoked hyperactivity during TCS of the DREZ. **Pain Scale:** VAS	1. Seven patients in the first group achieved at least 50% pain relief post treatment, while 5 patients achieved 100%. 2. In the second group, 84% of patients reported 100% pain relief post treatment, while 88% reported at least 50%. 3. In patients in the second group who experienced below-level pain, 81% of patients reported 100% pain relief, while 19% who experienced above-level pain achieved 100% pain relief. 4. The intervention did not result in any deaths. 5. 82% of patients lost partial or complete pinprick sensation in the corresponding DREZ. 6. 68% experienced partial or complete loss of light touch sensation.
Spaic et al, 2002[6]/Yugoslavia (Serbia) Case series	N = 26 Pain: Neuropathic Diagnosis: Not stated	**Treatment:** MDT was performed according to Sindou's technique. **Pain Scale:** VAS	1. Good pain relief was achieved in 70% of those with mechanical pain vs 50% with combined pain vs 0% with thermal pain. 2. Significantly better results were obtained in patients with intermittent pain compared with patients with continuous pain ($P < .0004$). 3. Significantly better results were obtained in patients with segmental pain compared with patients with diffuse pain ($P < .0005$).
Sindou et al,2001[19]/France/Egypt Case series	N = 44 Pain: Mixed Diagnosis: Not stated	**Treatment:** MDT was performed according to Sindou's technique. **Pain scale:** VAS	1. After 3 mo, good pain relief was achieved in 83% of those with electric shock–like pain and 90% with combined pain vs 26% with burning pain. 2. After 3 mo, good pain relief was achieved in 29% of those with diffuse pain and 73% of those with segmental pain. 3. Conus medullaris–injured patients had the greatest pain relief (92%) compared with patients with thoracic cord (25%), cervical cord (67%), or cauda equine (33%) injuries. 4. 100% of patients with incomplete injuries had a good result vs 50% pain relief of those with complete injuries.

Spaic et al, 1999[20]/Yugoslavia (Serbia) Pre-Post	N = 6 Pain: Neuropathic Diagnosis: Not stated	**Treatment:** MDT was performed according to Sindou's technique. **Pain scale:** Self-reported pain relief	1. All patients achieved a good result; 4/6 patients reported 100% pain relief and 2/6 patients reported 80% pain relief. 2. All patients with complete injuries had 100% pain relief; patients with incomplete injuries had 80% pain relief. 3. Patients who had been using pain medication reported no longer needing it.
Rath et al,1997[17]/Germany Case series	N = 23 Pain: Neuropathic Diagnosis: Not stated	**Treatment:** Radiofrequency-induced DREZ procedure **Pain scale:** Self-reported pain relief	1. Overall, 48% of patients achieved good pain relief; 52% had a fair or poor result. 2. Better results were seen for those with "end-zone" (segmental) vs diffuse pain.
Sampson et al,19958/USA Case series	N = 39 Pain: Mixed Diagnosis: not stated	**Treatment:** Radiofrequency-induced DREZ procedure **Pain scale:** Pain relief, as indicated by subsequent treatment and activity levels	1. Overall, 54% of all patients achieved good pain relief, 21% had fair relief, and 26% had poor relief. 2. Of the patients with incomplete injuries, 62% achieved a good result compared with 39% of patients with complete injuries.
Edgar et al, 1993[15]/USA Case series D&B = 7	N = 46 Pain: Neuropathic Diagnosis: Not stated	**Treatment:** Patients that previously received computer-assisted DREZ microcoagulation procedures were followed up. **Pain scale:** Self-reported pain	1. 92% of patients experienced at least 50% pain relief post treatment. 2. 84% experienced 100% pain relief. 3. The procedure did not result in any deaths.
Nashold et al,1990[16]/USA Case series	N = 18 Pain: Mixed Diagnosis: Not stated	**Treatment:** Individuals received DREZ procedures and drainage to remove cysts that had developed 1 yr post injury. **Pain scale:** Pain relief, as indicated by subsequent treatment and activity levels	1. Overall, 78% of patients achieved good pain relief with combined cyst drainage, and 22% achieved fair pain relief.
Friedman & Nashold,1986[17]/USA Case series	N = 56 Pain: Not stated Diagnosis: Not stated	**Treatment:** Radiofrequency-induced DREZ procedure **Pain scale:** Pain relief, as indicated by subsequent productivity levels	1. Overall, 50% of patients achieved good pain relief, 9% fair relief, and 20% poor relief. 2. Better results were obtained in patients with segmental pain (74%) compared with patients with diffuse pain (20%).
Richter & Seitz,1984[18]/Germany Case series	N = 10 Pain: Not stated Diagnosis: Not stated	**Treatment:** Radiofrequency-induced DREZ procedure **Pain scale:** Pain relief, as indicated by subsequent treatment and activity levels	1. Early results (during hospitalization for the DREZ procedure) • All patients with cervical and thoracic injuries reported 75% pain relief; 50% of the patients were totally pain-free (100% pain relief). • One patient with thoracic DREZ lesions reported 50% pain relief; 1 patient reported no pain relief. 2. Late results (5-30 mo post surgery) • Four of 6 treated patients with cervical DREZ lesions had good pain relief (>75%); 2 patients died. • Two treated patients with thoracic DREZ lesions had initial pain recurrence.

Note: MDT = Microsurgical DREZotomy; TCS = transcranial electrical stimulation; VAS = visual analogue scale.

Discussion

Eleven studies were identified that evaluated the effectiveness of the DREZ procedure in reducing neuropathic pain in individuals post SCI. Overall, these studies demonstrated that the DREZ procedure may be effective in reducing pain after SCI. However, because of the limited strength of the evidence each study provided, this conclusion should be viewed with caution. Most of the studies lacked control groups or conditions and were primarily observational convenience samples. Inclusion of control groups for this intervention would be challenging for ethical reasons. However, Falci et al[14] were able to conduct a study involving a standard treatment group, thus allowing for a stronger understanding of how technique and guided technology affect efficacy of the treatment. None of the studies involved blinding of assessors, and many involved reviewing individual charts retrospectively. A significant limitation of examining treatment of level-of-injury pain is that it is difficult to ascertain whether pain is due to the damage to the spinal cord or the root. This has important implications for understanding how effective DREZ treatment may be for the type of pain being reported and its localization.[21]

The type of pain and level of injury had a significant effect on how frequently pain reduction was reported. Most studies indicated that segmental pain was more likely to have "good" pain relief compared with diffuse pain. Further, performing the procedure on the specific injured segmental levels has been previously shown to be efficacious.[22] Therefore, the DREZ procedure appears to be a more effective option for individuals with segmental pain.

On the other hand, 1 study[9] demonstrated that up to 73% of individuals with diffuse pain reported "good" pain reduction. This study involved a modified microsurgical DREZotomy procedure in which all the abnormal rootlets above the injury in an area called the irritative zone were also included. The authors reported that extending the procedure into the irritative zone at least 2 levels above the injury may be more effective in relieving diffuse pain. However, more rigorous controlled trials examining this extended procedure are needed before any definitive conclusions can be made.

Individuals with SCIs involving the conus medullaris and cauda equina region were found to have the highest level of relief in the "good" range (up to 88% and 100%, respectively) when compared with those with cervical or thoracic cord injuries. This suggests that the pain these individuals are experiencing is deafferentation pain. Richter and Seitz,[18] on the other hand, found less favorable results with lower SCIs. However, Richter and Seitz[18] used a maximum coagulation of 50 mA for 10 seconds, whereas Nashold and Ostdahl[23] recommended coagulation of 70 mA for 15 seconds. Furthermore, the authors noted difficulty in localizing the correct region for the DREZ procedure.[18] Therefore, these variations in localization and coagulation dose may have contributed to the less effective results seen in the latter study. Hence, controlled trials examining the effectiveness of DREZ based on the level of SCI are recommended.

Most studies reported that the DREZ procedure resulted in effective long-term pain relief.[8,9,19,20] However, assessment of long-term pain relief and follow-up periods varied among the studies. Only Chun et al[9] reported long-term pain relief determined by a standardized assessment, the VAS. Spaic et al[20] reported that individuals no longer required pain medication 1 year after surgery. Sampson et al[8] and Sindou et al[19] found that 74% and 60% of individuals, respectively, still maintained "good" pain relief at long-term follow up. None of the studies examined participants' improvement in quality of life after surgery or at follow-up. Because pain can negatively affect quality of life, measuring improvements in quality of life in these individuals is integral to evaluating the effectiveness of the DREZ procedure in the future.

Alternative approaches, such as neuromodulation treatments, have been suggested for relieving resistant neuropathic pain post SCI. However, these treatments may require a permanent prosthetic implant, which may have long-term implications for the individual who receives it. Several limitations were encountered during this systematic review. Results from this review were based on published data as required by our

Table 3. Sample characteristics for each study under review including age range, mean age, gender ratio, level of injury, and percentage of sample that achieved good pain relief

	Sample characteristics			
Study	**M/F**	**Age range, years (mean)**	**Level of injury (n)**	**Good relief**
Chun et al[9]	36/2	32-69 (49)	T = 5 CM = 33	60% 82%
Falci et al[14]	36/3	Range unknown (46)	T = 34 L = 7	55% in group 1 88% in group 2
Spaic et al[6]	24/2	24-66 (39)	T = 3 CM = 15 CE = 8	0% 60% 88%
Sindou et al[19]	32/12	Range unknown (46)	C = 3 T = 12 CM = 25 CE = 4	67% 25% 92% 25%
Spaic et al[20]	6/0	25-35 (mean unknown)	CM = 6	100%
Rath et al[17]	19/4	17-74 (47)	T = 21 CE = 2	Results not stratified by level of injury
Sampson et al[8]	31/8	17-66 (29)	CM = 29 CE = 10	52% 60%
Edgar et al[15]	Not stated	Not stated	Not stated	92%
Nashold et al[16]	9/9	25-61 (40)	Levels of injury not stratified	Results not stratified by level of injury
Friedman & Nashold[7]	40/7	27-72 (mean unknown)	Levels of injury not stratified	Results not stratified by level of injury
Richter & Seitz[18]	9/1	17-68 (40)	C = 8 T = 2	67% 0%

Note : C = cervical; CE = cauda equina; CM = conus medullaris; F = female; M = male; T = thoracic.

inclusion criteria. The greatest limitation was the quality of the studies reviewed: all but one provided level 4 evidence. There is a well-known and important publication bias, since studies with positive findings are more likely to be published.

Conclusion

In conclusion, most studies reviewed indicated that the DREZ procedure may be clinically effective in reducing segmental pain or pain from conus medullaris and cauda equina SCIs. New research suggests that the extension of the procedure into the irritative zone results in improved relief of diffuse pain previously thought to be resistant to the DREZ procedure. Larger controlled trials are required to further assess its efficacy. The use of standardized outcome measures of pain and long-term quality of life for participants undergoing the DREZ procedure is integral to evaluating the long-term benefits and risks. Despite the weaknesses of evidence in the current literature, DREZ could be a valuable treatment for neuropathic pain in complex, resistant cases.

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