Schweizer Paraplegiker Zentrum

Navigating neuropathic pain in spinal cord injury: From bench to bedside.

PD. Dr. med Inge Eriks-Hoogland, PhD, PMR
Stv. Chefärztin Paraplegiologie

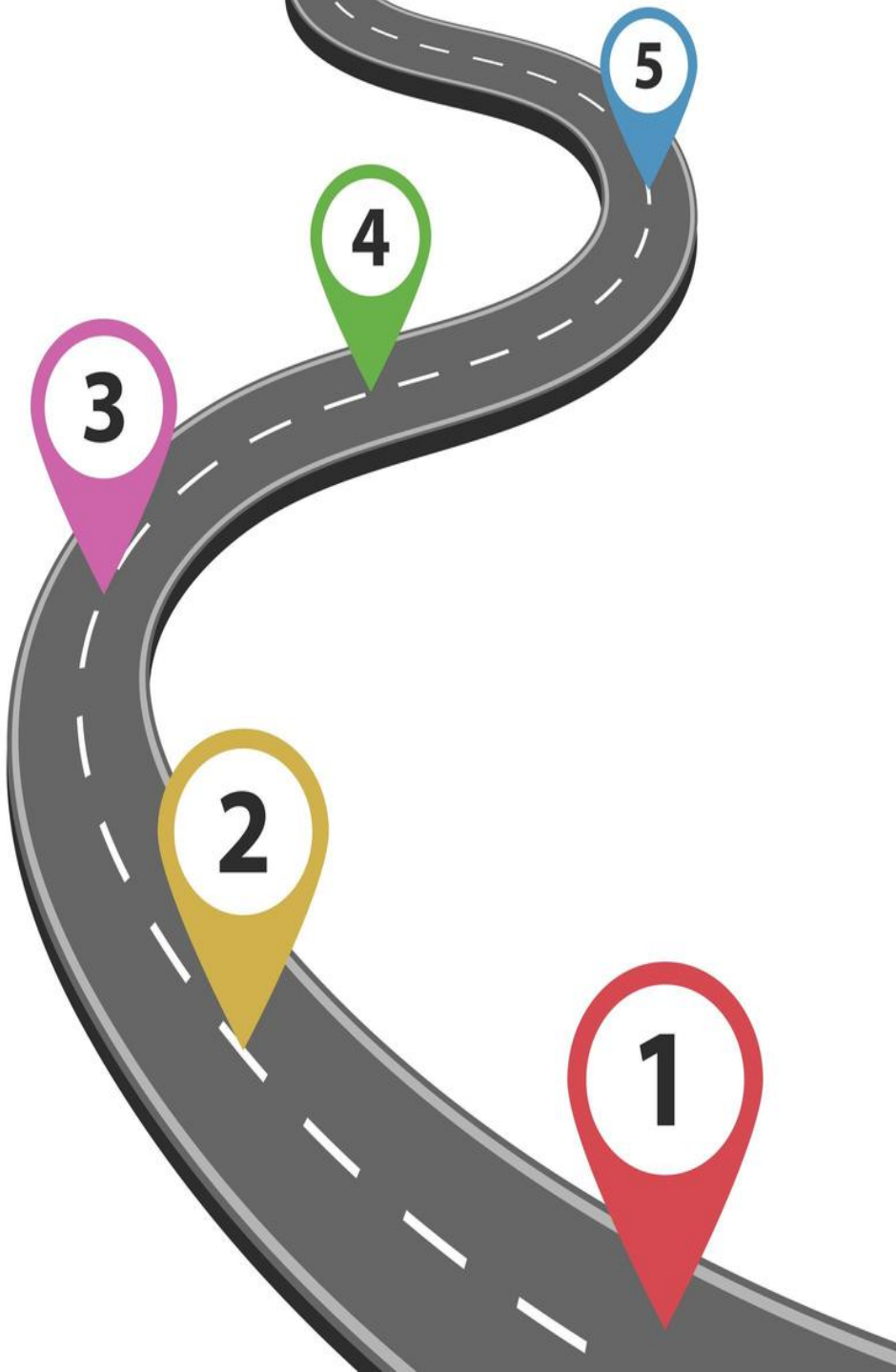
Joint congress: Rehab meets Pain meets Rehab
14. November 2025 11.45-12.15 CEST

reha schweiz
Schweizerische Gesellschaft für Physikalische Medizin und Rehabilitation
Société Suisse de Médecine Physique et Réadaptation
Società Svizzera di Medicina Fisica e Riabilitazione
Swiss Society of Physical Medicine and Rehabilitation

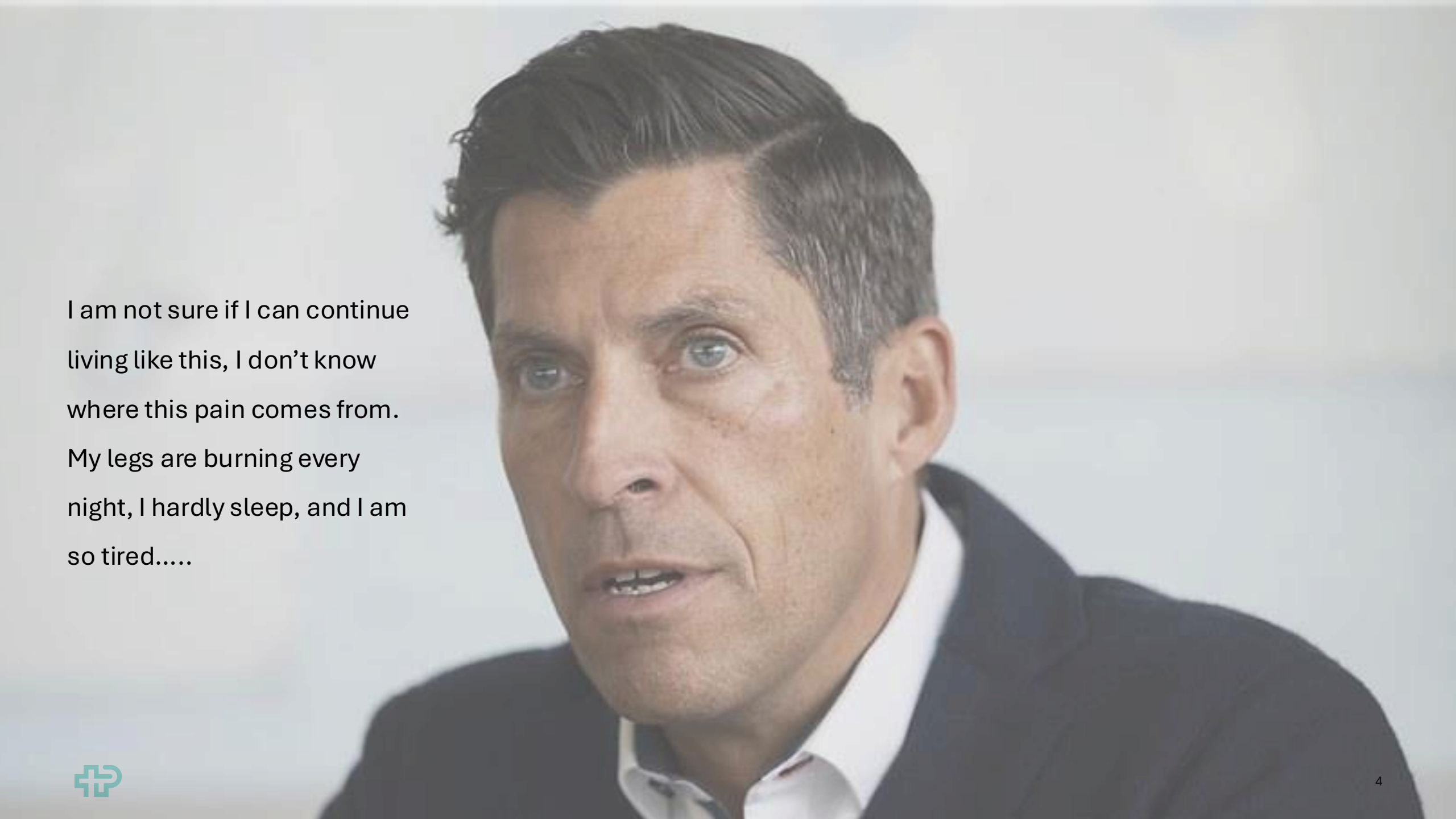
SWISS PAIN SOCIETY

Outline

1. Why this matters
2. Understanding neuropathic pain in SCI
3. Diagnostics in neuropathic pain in SCI
4. Evidence based treatment of neuropathic pain
   - Pharmacological
   - Non-pharmacological
5. Wrap up



1. Why this matters....


I am not sure if I can continue living like this, I don’t know where this pain comes from. My legs are burning every night, I hardly sleep, and I am so tired.....

A typical case

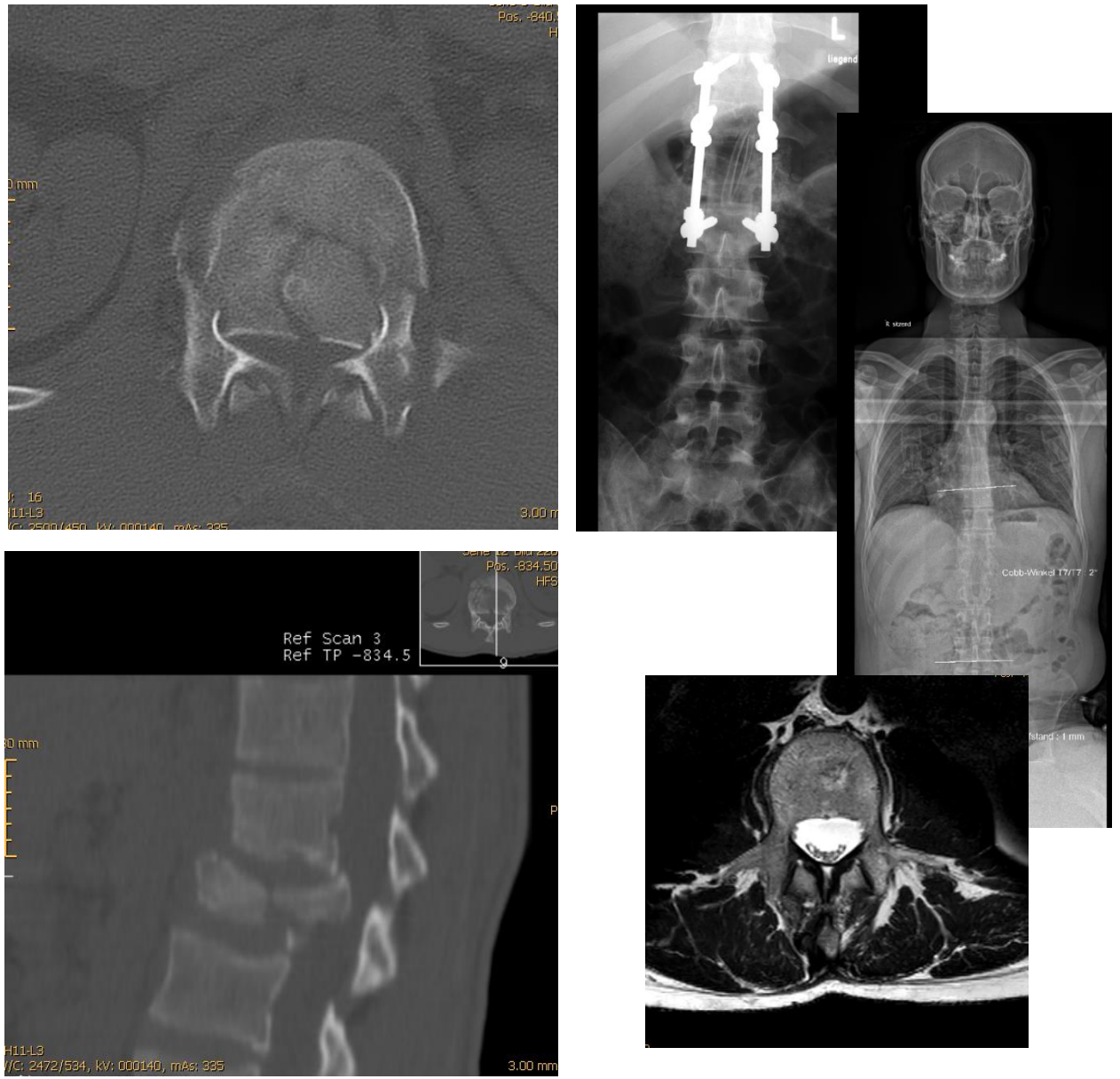
Male, 45 years

Polytrauma:

- Traumatic spinal cord injury T10, AIS A 1999
- Fracture scapula, humerus, elbow and hand
- CIPN

2020: Low back pain

- Removal Osteosynthesismaterial 2020 (Pain)



Annual check-up 2022

Pain in his legs increased

Pain and sensory loss dig 2,3 right

Shoulder pain left

Neck pain

Pain at lesion level increased

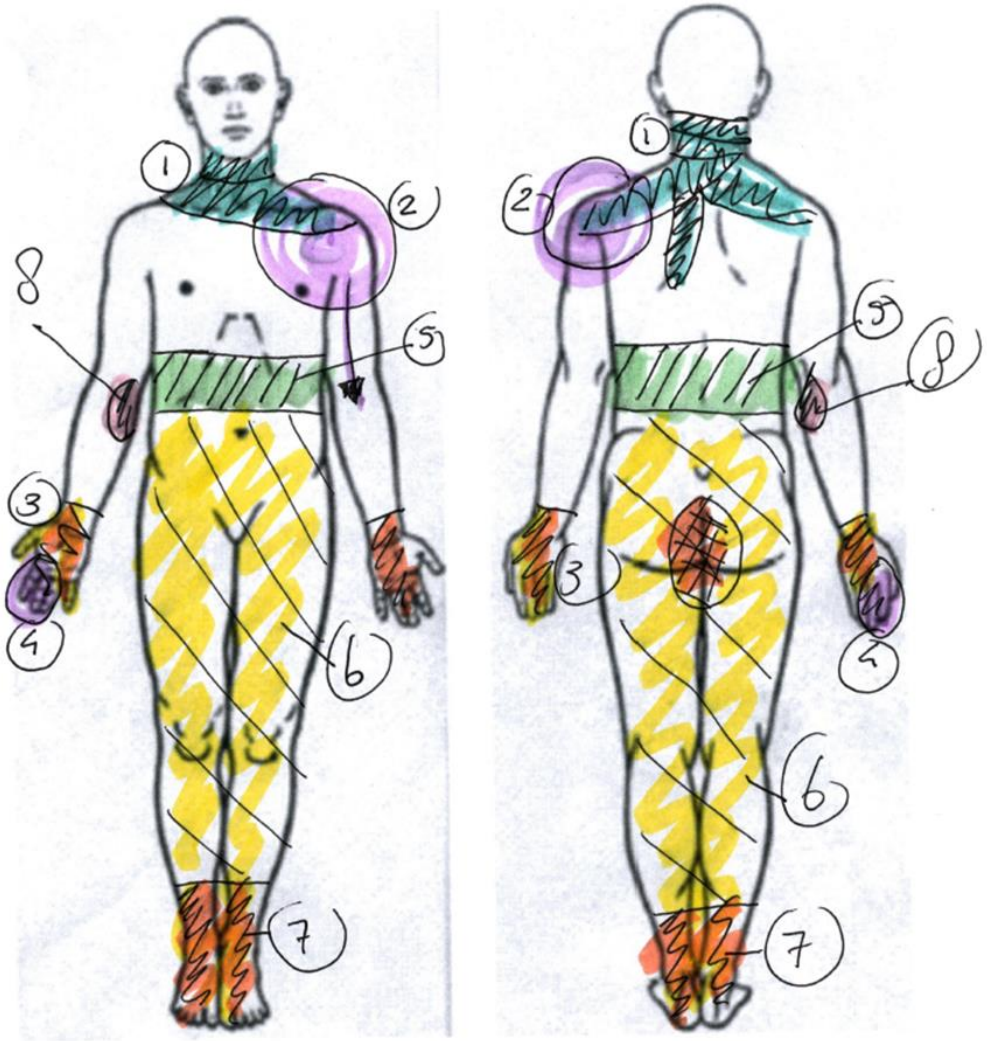
Spasticity increased

Depressive symptoms

Insomnia

Social Isolation

Medication: Betmiga, Toviaz, Folhsamen



Prevalence and severity

Swiss Paraplegic Research

SwiSCI

J Rehabil Med 2016; 48: 197–209

ORIGINAL REPORT

HEALTH CONDITIONS IN PEOPLE WITH SPINAL CORD INJURY: CONTEMPORARY EVIDENCE FROM A POPULATION-BASED COMMUNITY SURVEY IN SWITZERLAND

Martin W. G. Brinkhof, PhD[1,2], Abdul Al-Khodairy, MD[3], Inge Eriks-Hoogland, MD, PhD[1,4], Christine Fekete, PhD[1], Timo Hinrichs, MD[1,5], Margret Hund-Georgiadis, MD[6], Sonja Meier, MSc[1], Anke Scheel-Sailer, MD[2,4], Martin Schubert, MD[7] and Jan D. Reinhardt, PhD[1,2,8], for the SwiSCI Study Group

From the [1]Swiss Paraplegic Research (SPF), Nottwil, [2]Department of Health Sciences and Health Policy, University of Lucerne, Lucerne, [3]Clinique Romande de Réadaptation, Sion, [4]Swiss Paraplegic Center, Nottwil, [5]Division of Sports and Exercise Medicine, Department of Sport, Exercise and Health, University of Basel, [6]REHAB Basel, Basel, [7]Spinal Cord Injury Center, University Hospital Balgrist, Zurich, Switzerland and [8]Institute for Disaster Management and Reconstruction, Sichuan University, Chengdu and Hong Kong Polytechnic University, China

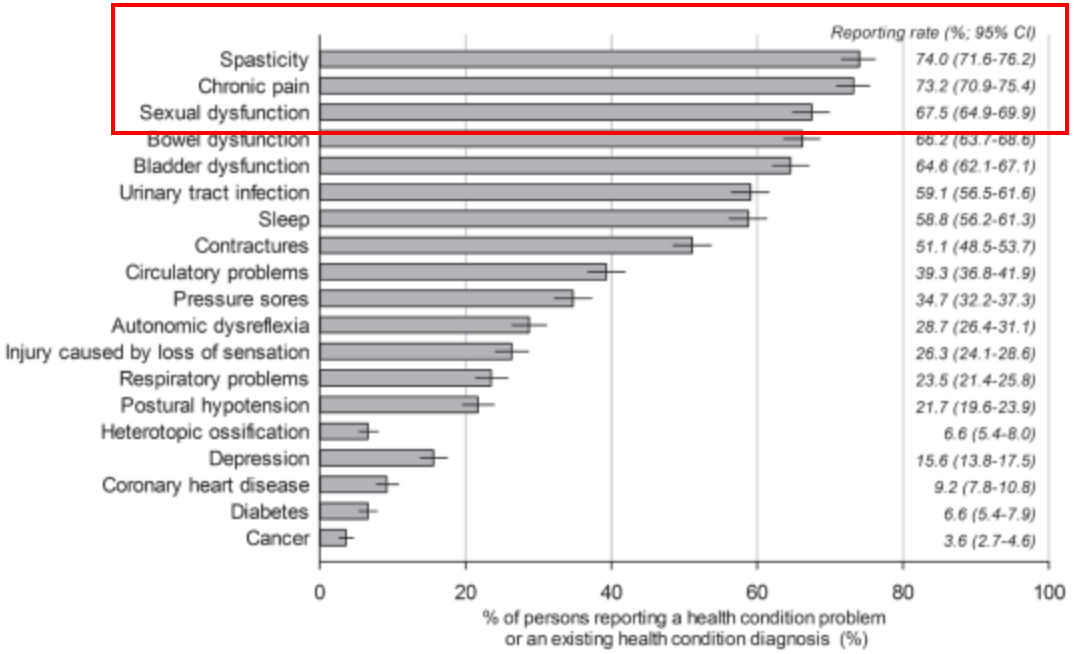


Fig. 1. Prevalence of reported health condition problems and existing diagnoses. 95% CI: 95% confidence interval.

Table I. *Characteristics of study participants (n = 1549)*

Characteristic [*n* missing]	
Gender, *n* (%)	
Male	1,107 (71.5)
Female	442 (28.5)
Age, years, median (IQR)	52 (42–63)
16–30 years	129 (8.3)
31–45 years	377 (24.3)
46–60 years	571 (36.9)
61–75 years	378 (24.4)
≥76 years	94 (6.1)
Years of education [32], median (IQR)	13 (12–15)
Language, *n* (%)	
German	1,105 71.3)
French	376 (24.3)
Italian	68 (4.4)
Aetiology [15], *n* (%)	

	Severity of a health condition problem				
Health condition	*n* [missing]	Not existing or insignificant *n* (%)	Mild or infrequent *n* (%)	Moderate or occasional *n* (%)	Significant or chronic *n* (%)
Spasticity	1,436 [113]	374 (26.0)	319 (22.2)	399 (27.8)	344 (24.0)
Chronic pain	1,445 [104]	387 (26.8)	224 (15.5)	305 (21.1)	529 (36.6)
Sexual dysfunction	1,374 [175]	447 (32.5)	140 (10.2)	188 (13.7)	599 (43.6)
Bowel dysfunction	1,444 [105]	488 (33.8)	347 (24.0)	312 (21.6)	297 (20.6)
Bladder dysfunction	1,427 [122]	505 (35.4)	298 (20.9)	248 (17.4)	376 (26.3)
Urinary tract infection	1,423 [126]	582 (40.9)	262 (18.4)	327 (23.0)	252 (17.7)
Sleep disorders	1,456 [93]	600 (41.2)	303 (20.8)	341 (23.4)	212 (14.6)
Contractures	1,440 [109]	704 (48.9)	227 (15.8)	251 (17.4)	258 (17.9)
Circulatory problems	1,421 [128]	862 (60.6)	278 (19.6)	169 (11.9)	112 (7.9)
Pressure sores	1,386 [163]	905 (65.3)	218 (15.7)	148 (10.7)	115 (8.3)
Autonomic dysreflexia	1,417 [132]	1,010 (71.3)	206 (14.5)	139 (9.8)	62 (4.4)
Injury caused by loss of sensation	1,434 [115]	1,057 (73.7)	228 (15.9)	111 (7.7)	38 (2.7)
Respiratory problems	1,447 [102]	1,107 (76.5)	171 (11.8)	103 (7.1)	66 (4.6)
Postural hypotension	1,412 [137]	1,106 (78.3)	184 (13.0)	93 (6.6)	29 (2.1)
Heterotopic ossification	1,396 [153]	1,304 (93.4)	49 (3.5)	23 (1.7)	20 (1.4)
	Existing health condition diagnosis?				
	n [missing]	No *n* (%)	Yes *n* (%)		
Depression	1,474 [75]	1,244 (84.4)	230 (15.6)		
Coronary heart disease	1,488 [61]	1,351 (90.8)	137 (9.2)		
Diabetes	1,495 [54]	1,397 (93.4)	98 (6.6)		
Cancer	1,488 [61]	1,435 (96.4)	53 (3.6)		

Treatment

Spinal Cord (2021) 59:389–397
https://doi.org/10.1038/s41393-020-00596-z

ISCoS The International Spinal Cord Society

ARTICLE

SwiSCI 360° Perspective—Results from the Swiss SCI Survey 2017

Self-reports of treatment for secondary health conditions: results from a longitudinal community survey in spinal cord injury

Anne Buzzell[1,2] · Kamilla Coutinho Camargos[1,2] · Jonviea D. Chamberlain[3] · Inge Eriks-Hoogland[4] · Kerstin Hug[5] · Xavier Jordan[6] · Martin Schubert[7] · Martin W. G. Brinkhof[1,2]

Table 1 Participant characteristics, stratified by year of survey.

Patient characteristics	2012	2017
Overall sample statistics	*n (%)*	*n (%)*
N individuals	1295 (100.0)	1117 (100.0)
N individuals participating in both surveys	593 (45.8)	593 (53.1)
Paramenters	*n (%)*	*n (%)*
Gender		
Female	369 (28.5)	309 (27.7)
Male	926 (71.5)	808 (72.3)
Age at survey (years)		
16–30	110 (8.5)	45 (4.0)
31–45	327 (25.3)	224 (20.1)
46–60	495 (38.2)	407 (36.4)
61–75	298 (23.0)	355 (31.8)
76+	65 (5.0)	86 (7.7)
Nationality		
Non-Swiss	185 (14.3)	176 (15.8)
Swiss	1110 (85.7)	941 (84.2)
Etiology		
Non-traumatic	193 (14.9)	212 (19.0)
Traumatic	1102 (85.1)	905 (81.0)
Lesion severity		
Paraplegia, incomplete	465 (35.9)	452 (40.5)
Paraplegia, complete	425 (32.8)	324 (29.0)
Tetraplegia, incomplete	261 (20.2)	237 (21.2)
Tetraplegia, complete	144 (11.1)	104 (9.3)

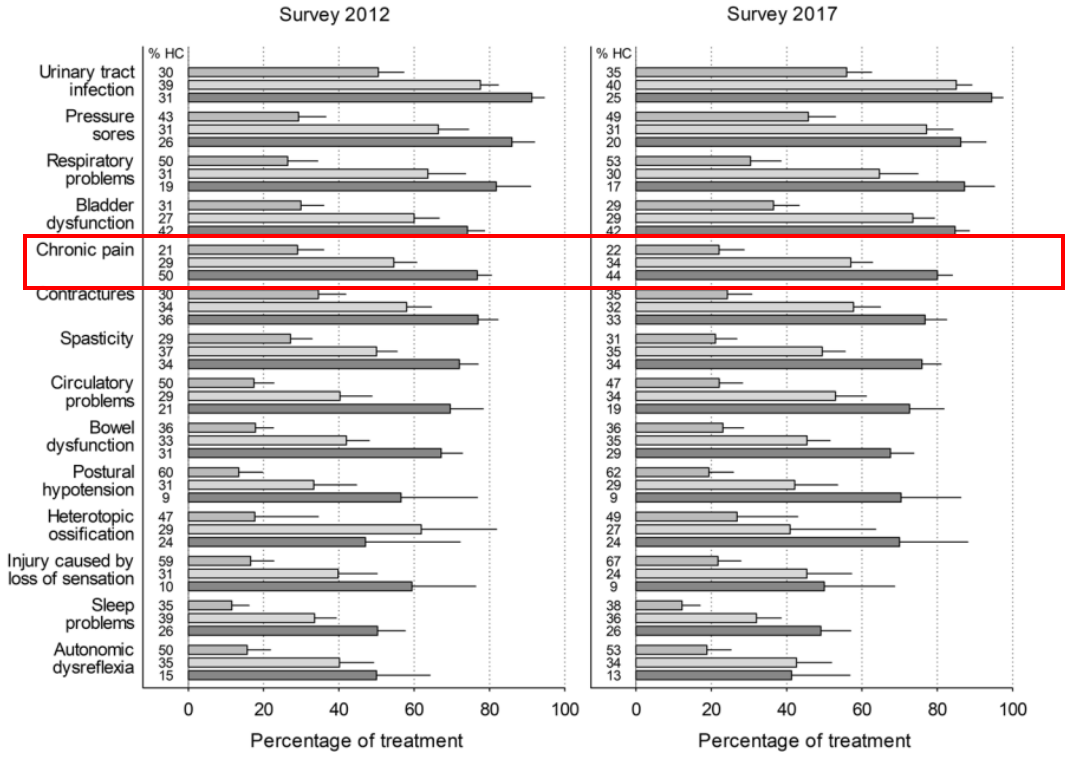


Fig. 1 Percentage of treatment for health conditions across survey year and health condition severity. Percentage of treatment as reported in Survey 2012 and Survey 2017 across health conditions of increasing levels of severity (legend bars, greyscale/color version: white/green = "mild or infrequent"; light grey/yellow = "moderate or occasional"; dark grey/red = "severe or chronic"). Health conditions are positioned in a hierarchically descending order in the percentage of treatment rate within the "severe or chronic" category. Numbers in column label "% HC" indicate the proportional distribution of reported levels of severity within HCs. For numerical detail see supplementary Table S2.

Who develops pain?

Spinal Cord (2017) 55, 346–354

www.nature.com/sc

ORIGINAL ARTICLE

Prevalence and associated factors of pain in the Swiss spinal cord injury population

R Müller[1,2], MWG Brinkhof[1,2], U Arnet[1,2], T Hinrichs[3], G Landmann[4], X Jordan[5] and M Béchir[6] for the SwiSCI Study Group

Table 2 Descriptive statistics for pain parameters, including frequencies, proportions and adjusted proportions (Total $N = 1549$)

Indicator variable	*Frequency* n	*Missing* n (%)	*Proportion (%)* (95% CI)	*Adjusted proportion (%)*[a] (95% CI)
Pain in the past week		26 (1.7)		
Yes	1047		68.7 (66.4–71.0)	68.9 (66.4–71.2)
No	476		31.2 (29.0–33.6)	31.1 (28.8–33.6)
Chronic pain problem in the last 3 months		104 (6.7)		
Significant	529		36.6 (34.6–39.1)	36.9 (34.3–39.5)
Moderate	305		21.1 (19.1–23.3)	21.0 (18.9–23.2)
Mild	224		15.5 (13.7–17.4)	15.6 (13.7–17.6)
No	387		26.8 (24.6–29.1)	26.5 (24.3–28.9)
Mean pain severity[b,c]/mean (s.d.): 5.8 (2.0)		42 (4.0)		
Severe pain (NRS: 7–10)	410		40.8 (37.8–43.9)	40.6 (37.5–43.7)
Moderate pain (NRS: 4–6)	436		43.4 (40.3–46.5)	43.6 (40.4–46.6)
Mild pain (NRS: 1–3)	159		15.8 (13.7–18.2)	15.9 (13.7–18.3)
Type of pain[b,d]/mean (s.d.), range: 2.1 (1.2), 1–7		12 (1.1)		
Musculoskeletal pain	766		71.4 (68.6–74.0)	71.1 (68.2–73.8)
Neuropathic pain beneath lesion level	455		42.4 (39.5–45.4)	41.6 (38.6–44.7)
Visceral pain	276		25.7 (23.2–28.4)	25.3 (22.7–28.1)
Due to spasm	253		23.6 (21.1–26.2)	23.5 (20.1–26.2)
Neuropathic pain at lesion level	214		19.9 (17.7–22.4)	19.8 (17.5–22.4)
Neuropathic pain above lesion level	133		12.4 (10.6–14.5)	12.3 (10.4–14.5)
Other pain type	108		10.0 (8.4–12.0)	10.5 (8.8–12.6)
Pain location[d]/mean (s.d.), range: 3.5 (2.0), 1–12		21 (2.0)		
Back/spine	583		54.3 (51.3–57.3)	54.6 (51.4–57.6)
Shoulder	546		50.9 (47.9–53.9)	50.0 (46.9–53.1)
Neck	463		43.2 (40.2–46.1)	43.2 (40.2–46.3)
Wrist/hands	307		28.6 (26.0–31.4)	28.0 (25.4–30.9)
Ankle joint/foot	266		24.8 (22.3–27.5)	26.0 (23.3–28.8)
Hip(s)	263		24.5 (22.0–27.2)	25.3 (22.7–28.1)
Bottom	255		23.8 (21.3–26.4)	23.8 (21.3–26.6)
Knee(s)	217		20.2 (17.9–22.7)	21.5 (19.0–24.2)
Elbow	138		12.9 (11.0–15.0)	12.5 (10.6–14.6)
No musculoskeletal pain	38		3.5 (2.6–4.8)	3.3 (2.4–4.6)
Other pain location	115		10.7 (9.0–12.7)	11.0 (9.2–13.1)

Abbreviations: CI, confidence interval; NRS, numeric rating scale.
[a]Proportion corrected for non-response.
[b]Proportion and adjusted proportion refers to all individuals who indicated having pain in the past week ($n = 1047$).
[c]Mean pain severity is based on all individuals who indicated having pain in the past week ($n = 1047$).
[d]More than one selection/specification possible.

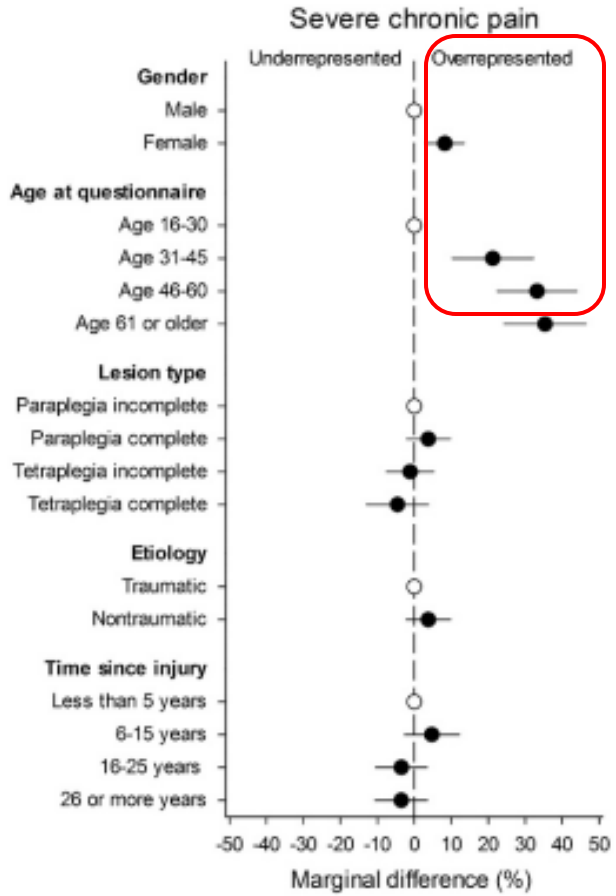
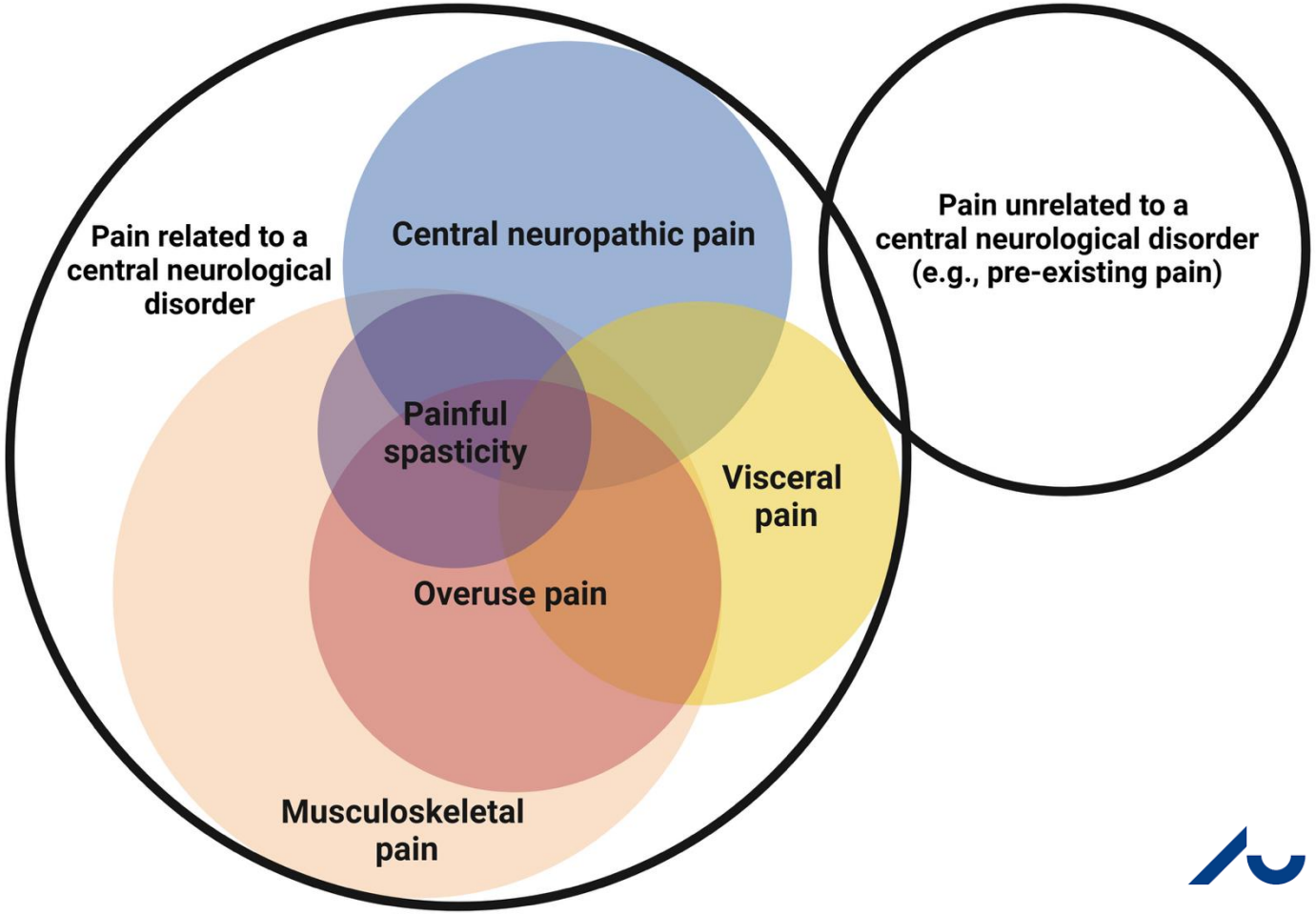


Figure 1 Marginal prediction of the distribution of participants over the ordinal levels of chronic pain for demographic and lesion parameters. Estimates are at mean values for other parameters using the stereotype logistic regression model in Table 3. Open symbols indicate the reference category for each parameter; solid symbols and error bars the percent difference with 95% confidence interval for other parameter classes.

Pain Types after Spinal Cord Injury



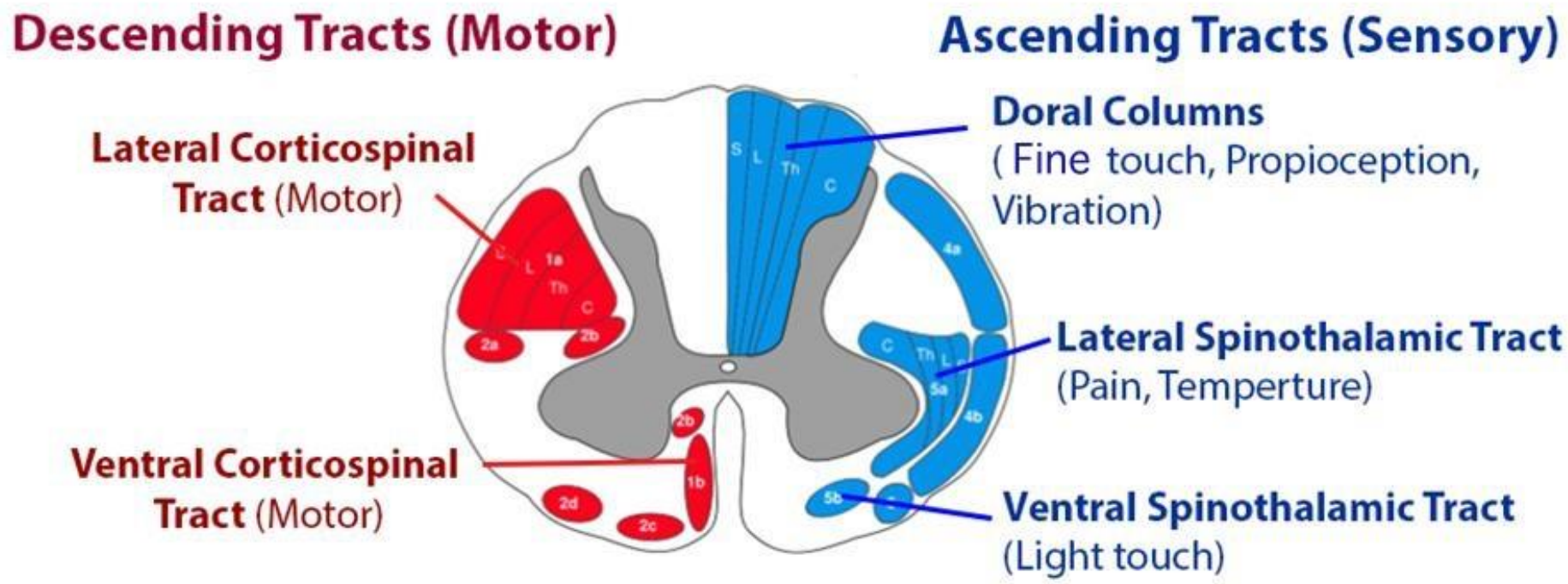
AARHUS UNIVERSITY

Rosner J., Finnerup N., Raj S. Benzon` s Pain Management (in press)

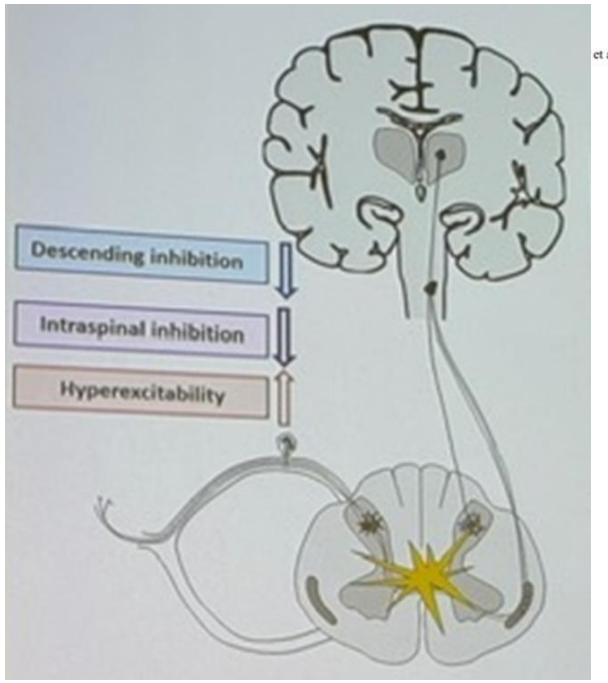
2. Understanding neuropathic pain in Spinal Cord Injury

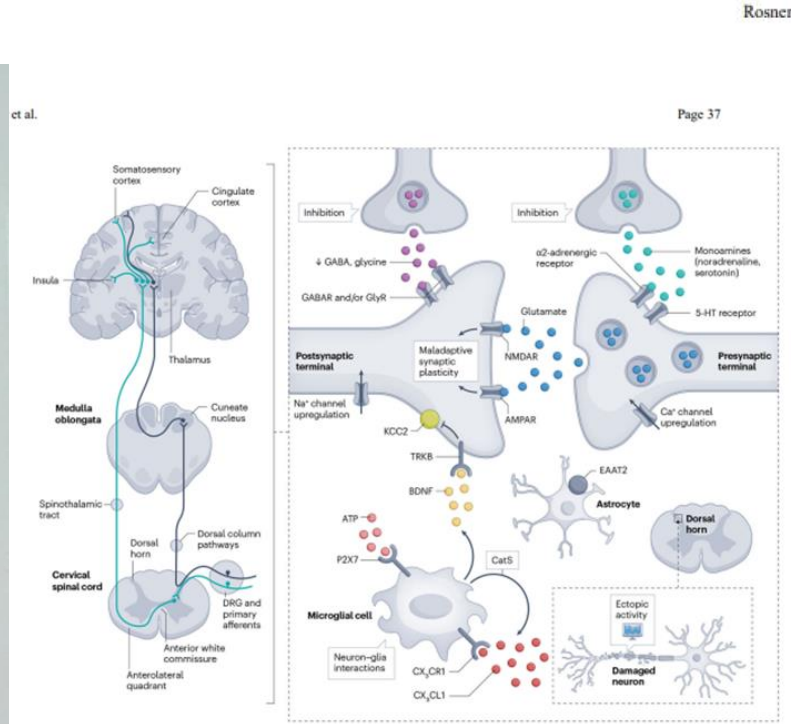
Neuropathic pain after Spinal Cord Injury?

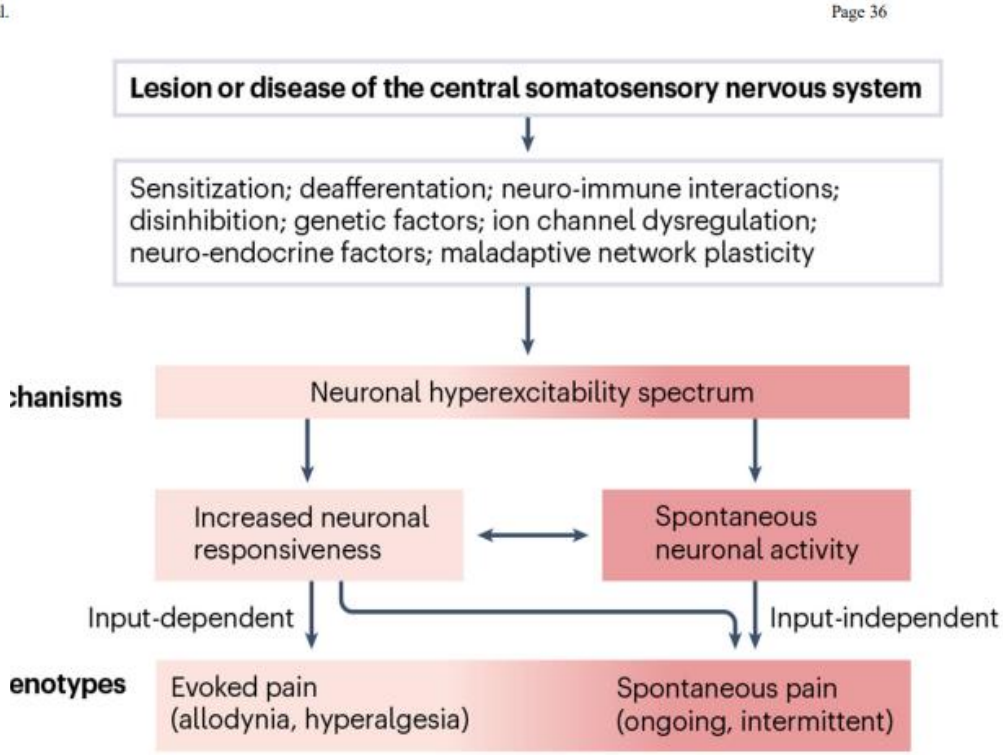
Pain caused by a lesion or disease of the (central) somatosensory nervous system. *IASP Definition*



Mechanism of neuropatic pain





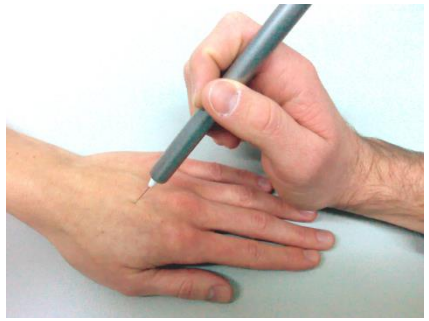


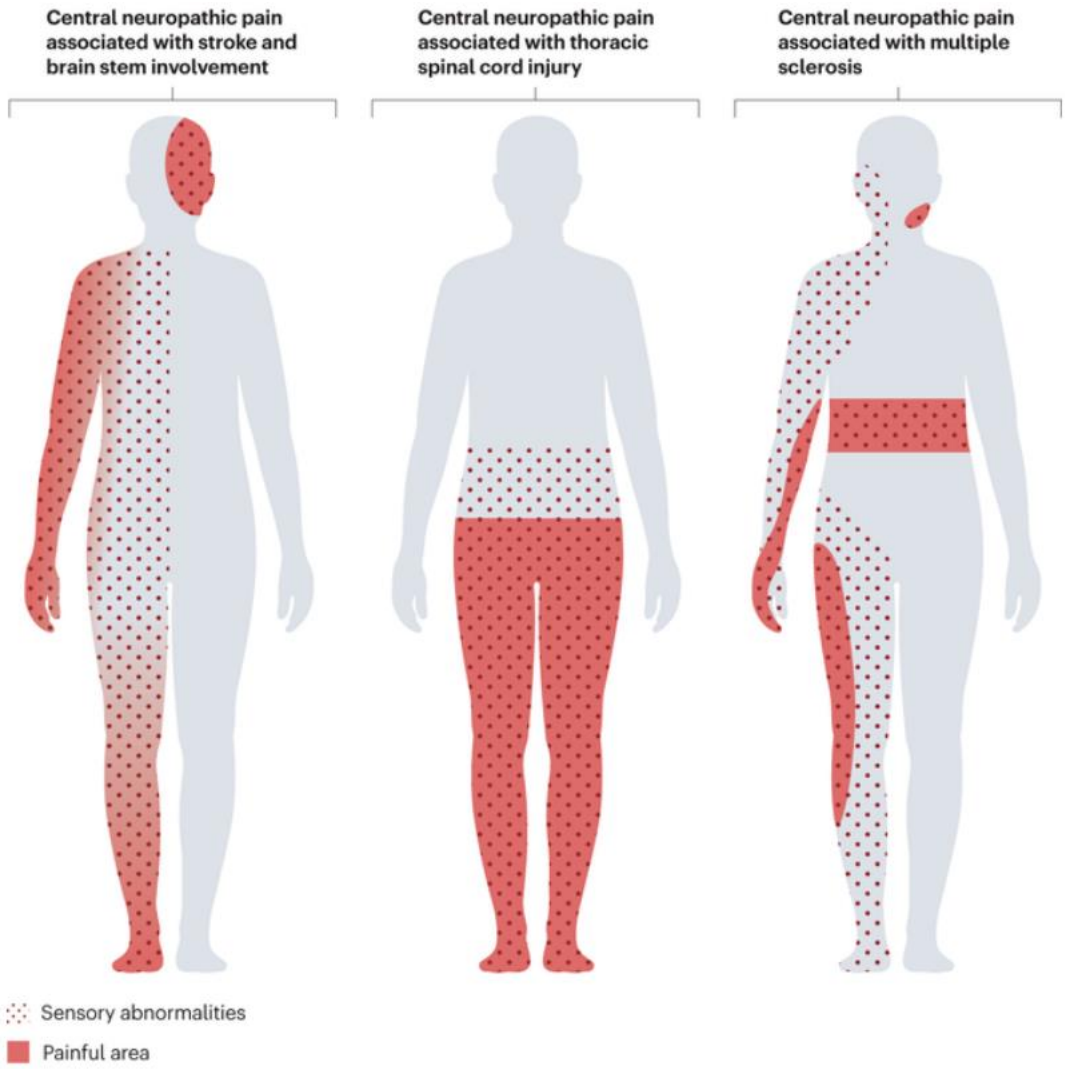
Rosner J, de Andrade DC, Davis KD, Gustin SM, Kramer JLK, Seal RP, Finnerup NB. Central neuropathic pain. Nat Rev Dis Primers. 2023 Dec 21;9(1):73. doi: 10.1038/s41572-023-00484-9. PMID: 38129427; PMCID: PMC11329872.

(Central) Neuropathic Pain

Spontaneous Pain

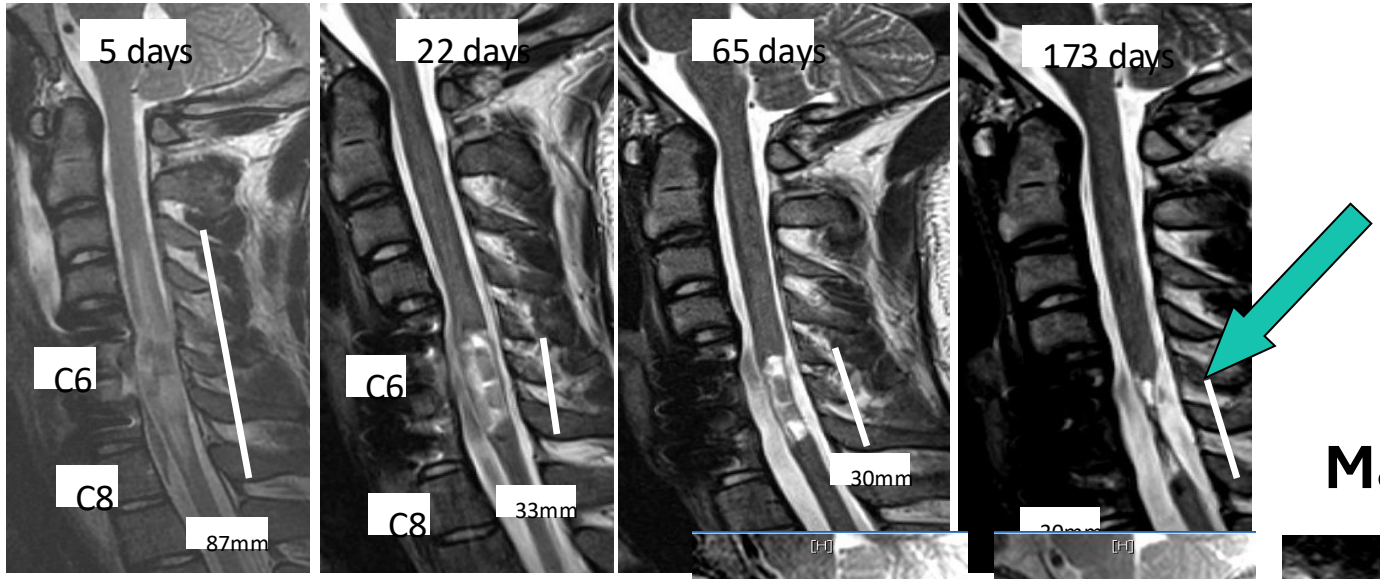
Evoked Pain

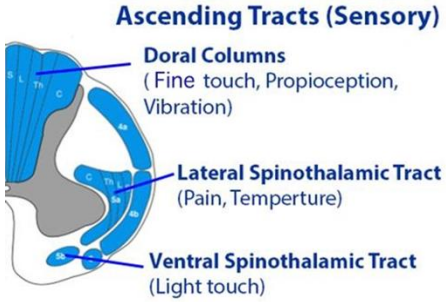




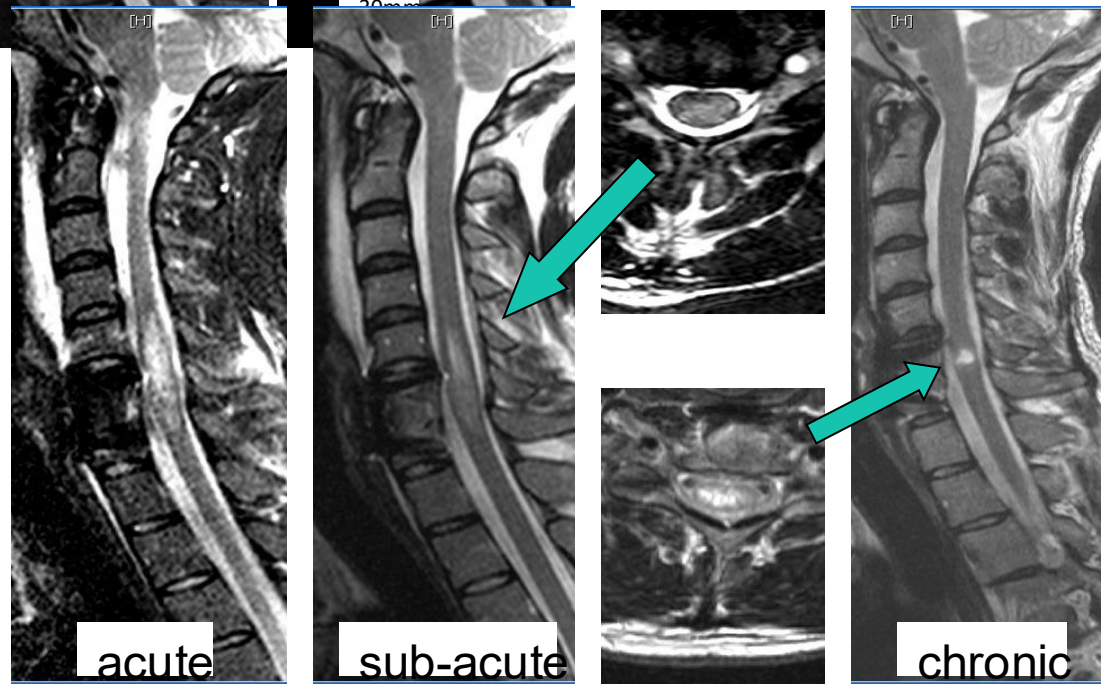
Rosner et al., *Nature Reviews Disease Primers (2023)*

Male 35, Motor Cycle acciddent





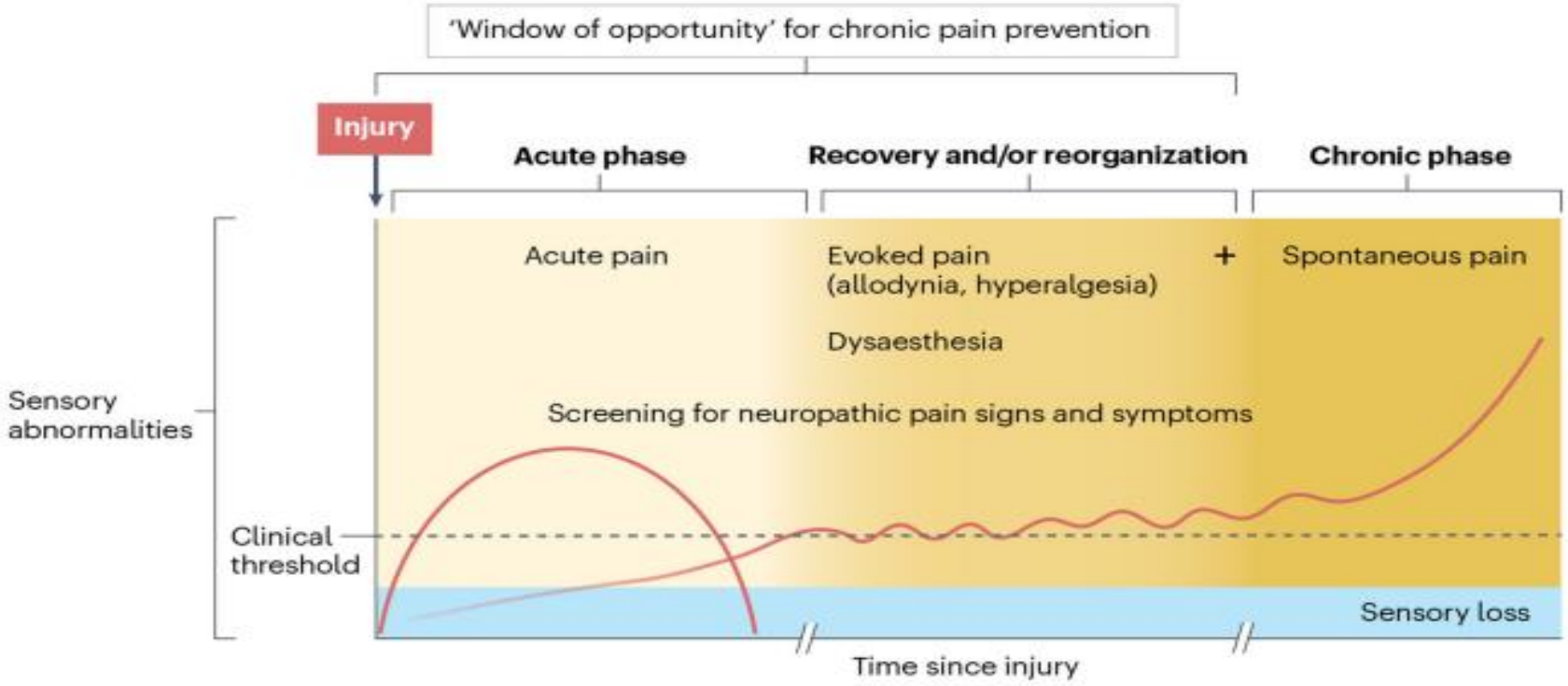
Male 36, Snowboard accident



Balgrist Universitätsklinik

Prof. Dr. med. Dr. rer. nat Patrick Freund

Progression of neuropathic pain after Spinal Cord Injury



Rosner, J., de Andrade, D. C., Davis, K. D., Gustin, S. M., Kramer, J. L. K., Seal, R. P., & Finnerup, N. B. (2023). Central neuropathic pain. Nature reviews. Disease primers, 9(1), 73. https://doi.org/10.1038/s41572-023-00484-9

3. Diagnostics in Spinal Cord Injury related neuropathic pain

Neuropathic pain classification in Spinal Cord Injury

Spinal Cord (2012) 50, 413–417

www.nature.com/sc

ORIGINAL ARTICLE

International Spinal Cord Injury Pain Classification: part I. Background and description

TN Bryce[1], F Biering-Sørensen[2], NB Finnerup[3], DD Cardenas[4], R Defrin[5], T Lundeberg[6], C Norrbrink[7], JS Richards[8], P Siddall[9], T Stripling[10], R-D Treede[11], SG Waxman[12,13], E Widerström-Noga[14], RP Yezierski[15] and M Dijkers[1]

Spinal Cord (2012) 50, 404–412

www.nature.com/sc

ORIGINAL ARTICLE

International Spinal Cord Injury Pain (ISCIP) Classification: Part 2. Initial validation using vignettes

TN Bryce[1], F Biering-Sørensen[2], NB Finnerup[3], DD Cardenas[4], R Defrin[5], E Ivan[1], T Lundeberg[6], C Norrbrink[7], JS Richards[8], P Siddall[9], T Stripling[10], R-D Treede[11], SG Waxman[12], E Widerström-Noga[13], RP Yezierski[14] and M Dijkers[1]

Tier 1: Pain type	Tier 2: Pain subtype	Tier 3: Primary pain source and/or pathology (write or type in)
☐ Nociceptive pain	☐ Musculoskeletal pain	☐ _____ e.g., glenohumeral arthritis, lateral epicondylitis, comminuted femur fracture, quadratus lumborum muscle spasm
	☐ Visceral pain	☐ _____ e.g., myocardial infarction, abdominal pain due to bowel impaction, cholecystitis
	☐ Other nociceptive pain	☐ _____ e.g., autonomic dysreflexia headache, migraine headache, surgical skin incision
☐ Neuropathic pain	☐ At level SCI pain	☐ _____ e.g., spinal cord compression, nerve root compression, cauda equina compression
	☐ Below level SCI pain	☐ _____ e.g., spinal cord ischemia, spinal cord compression
	☐ Other neuropathic pain	☐ _____ e.g., carpal tunnel syndrome, trigeminal neuralgia, diabetic polyneuropathy
☐ Other pain		☐ _____ e.g., fibromyalgia, Complex Regional Pain Syndrome type I, interstitial cystitis, irritable bowel syndrome
☐ Unknown pain		☐ _____

Assessment of neuropathic pain

Spinal Cord (2021) 59:529–537
https://doi.org/10.1038/s41393-021-00616-6

ISCoS The International Spinal Cord Society

ARTICLE

Assessment of neuropathic pain after spinal cord injury using quantitative pain drawings

Jan Rosner[1,2] · Robin Lütolf[1] · Pascal Hostettler[3] · Michael Villiger[4] · Ron Clijsen[5,6] · Erich Hohenauer[5,6,7] · Marco Barbero[5] · Armin Curt[1] · Michèle Hubli[1]

Received: 6 August 2020 / Revised: 17 January 2021 / Accepted: 22 January 2021 / Published online: 16 February 2021

Abstract

Study design Clinimetric cross-sectional cohort study in adults with paraplegic spinal cord injury (SCI) and neuropathic pain (NP).

Objective To assess the reliability of standardized quantitative pain drawings in patients with NP following SCI.

Setting Hospital-based research facility at the Spinal Cord Injury Center, Balgrist University Hospital, Zurich, Switzerland.

Methods Twenty individuals with chronic thoracic spinal cord injury and neuropathic pain were recruited from a national and local SCI registry. A thorough clinical examination and pain assessments were performed. Pain drawings were acquired at subsequent timepoints, 13 days (IQR 7.8–14.8) apart, in order to assess test-retest reliability.

Results The average extent [%] and intensity [NRS 0–10] of spontaneous NP were 11.3% (IQR 4.9–35.8) and 5 (IQR 3–7), respectively. Pain extent showed excellent inter-session reliability (intraclass correlation coefficient 0.96). Sensory loss quantified by light touch and pinprick sensation was associated with larger pain extent ($r_{\text{pinprick}} = -0.47$, $p = 0.04$; $r_{\text{light touch}} = -0.64$, $p < 0.01$).

Conclusion Assessing pain extent using quantitative pain drawings is readily feasible and reliable in human SCI. Relating information of sensory deficits to the presence of pain may provide distinct insights into the interaction of sensory deafferentation and the development of neuropathic pain after SCI.

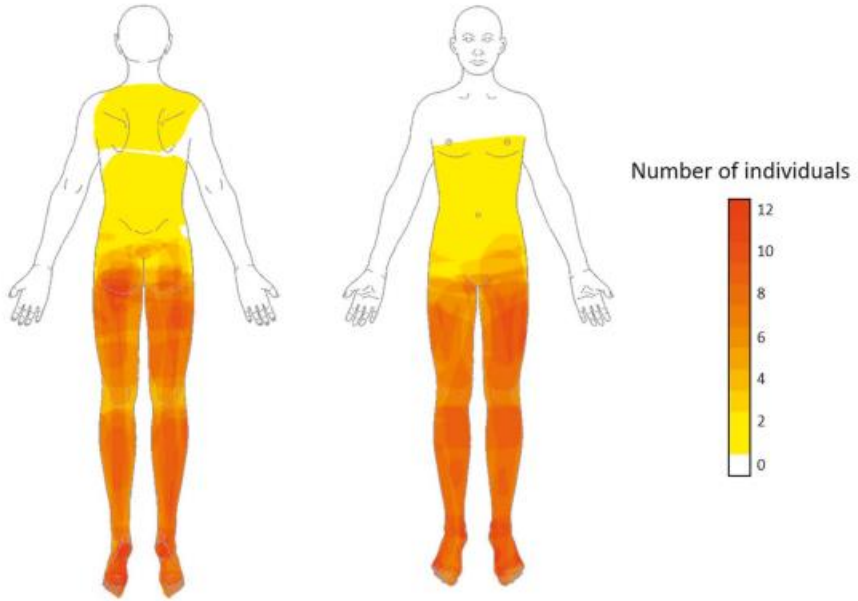


Fig. 2 Average NP distribution across all individuals ($n = 20$). The color bar represents the frequency of NP, with dark colors indicating the most frequently reported areas of pain. Pain was most often reported within the lower limbs corresponding to the L2–L5 and S1 dermatomes.

Grading system for central neuropathic pain

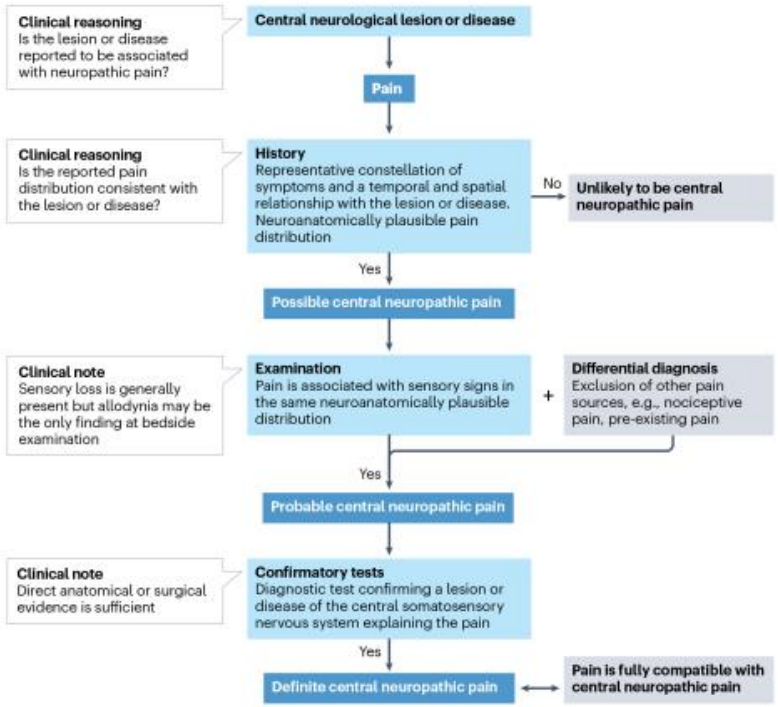


Fig. 5 |. Grading system for central neuropathic pain.
A grading system is used to attain different levels of diagnostic certainty for central neuropathic pain (CNP)[127]. If reported symptoms are temporally associated with the lesion or disease and align with the anticipated neuroanatomical pain pattern, the presence of neuropathic pain is possible. To advance to 'probable', a neurological examination needs to detect somatosensory abnormalities such as loss of sensation or hypersensitivity. Importantly, differential diagnoses such as musculoskeletal pain must be ruled out at this stage. Once a lesion within the central somatosensory nervous system is confirmed and other types of pain excluded, the definite CNP level is reached.

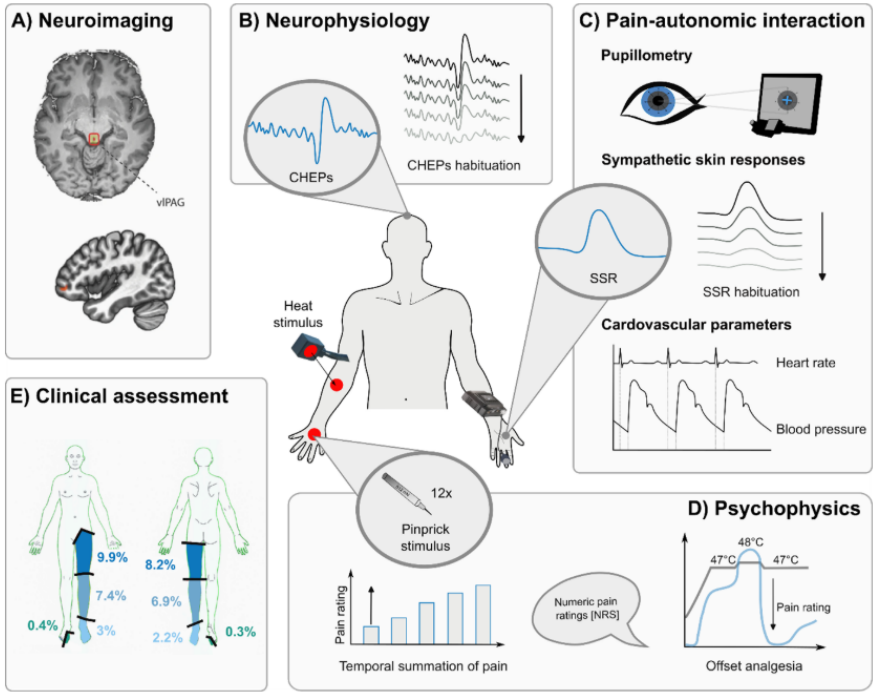
Jan Rosner, Shirvalkar, P., & de Andrade, D. C. (2024). Neuropathic pain - A clinical primer. *International review of neurobiology*, *179*, 41–65. https://doi.org/10.1016/bs.irn.2024.10.014

The role of Neuroimaging and Neurophysiology

Project Lead: PD Dr. Michèle Hubli

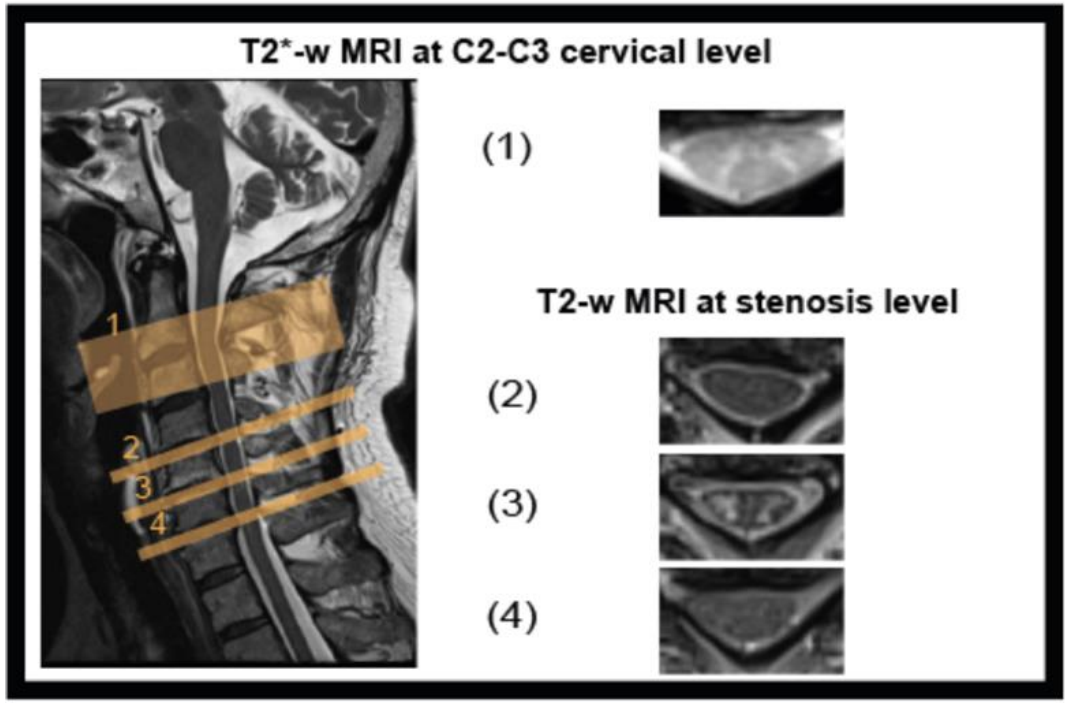
Maladaptive plasticity and sensitization processes within the spinal cord, brainstem and brain are believed to contribute to the development and maintenance of neuropathic pain after SCI. While a variety of subjective tools to assess signs of such sensitization processes exist (i.e., psychophysics), an objective approach is still lacking in humans.

For decades, the structural and functional connection between the nociceptive and autonomic nervous system is known. Hence, this project targets pain-autonomic interaction as a surrogate marker for sensitization at spinal and brain levels. Beyond state-of-the-art pain phenotyping, we test autonomic responses to noxious heat and pinprick stimuli measured by electrodermal activity, blood pressure, heart rate, and pupil dilation.

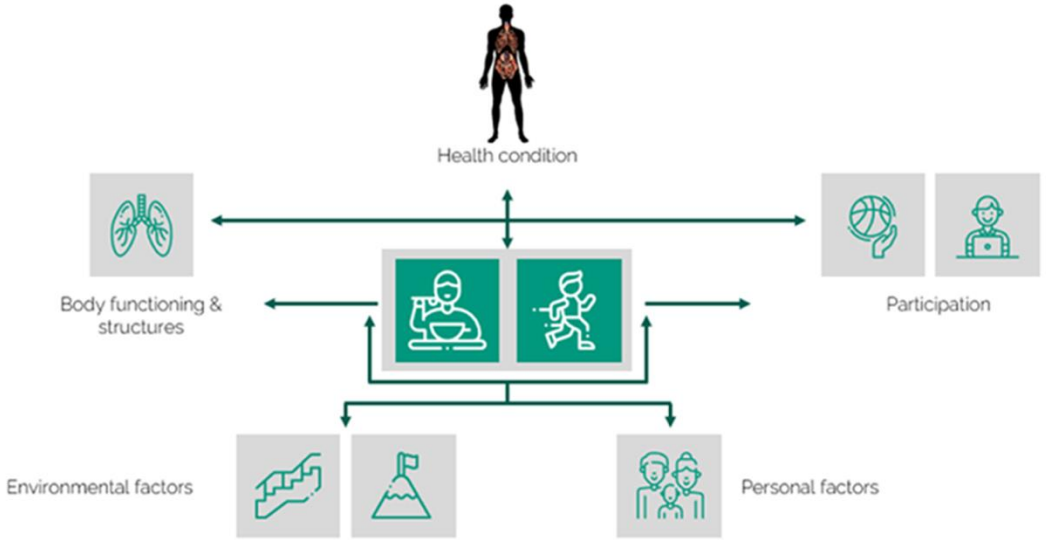


ImagiNg SPInal cord injury and assessing its pREDictive Value - the INSPIRED study -

Project leader: Prof. Dr. Patrick Freund



Pain in a bio-psychosocial context



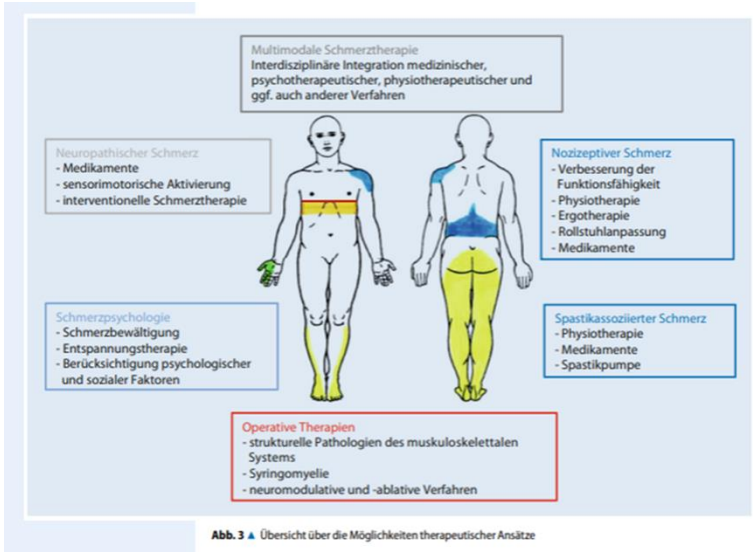


Abb. 3 ▲ Übersicht über die Möglichkeiten therapeutischer Ansätze

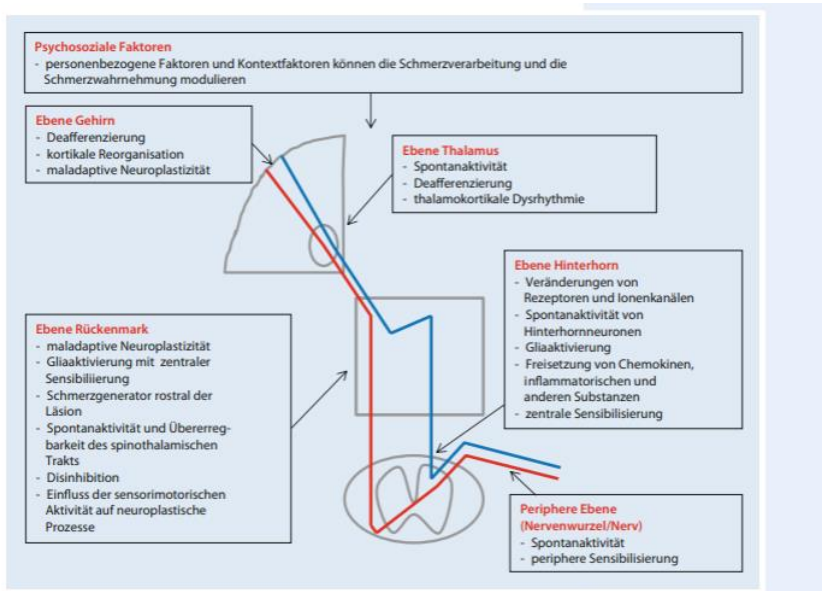
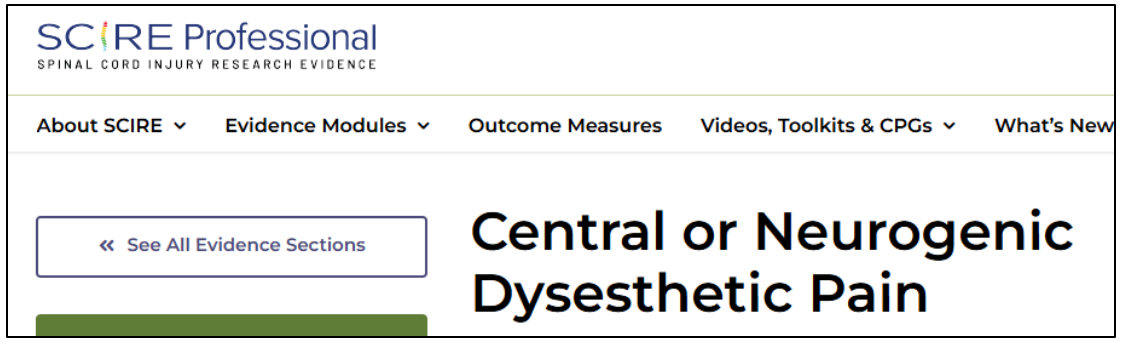


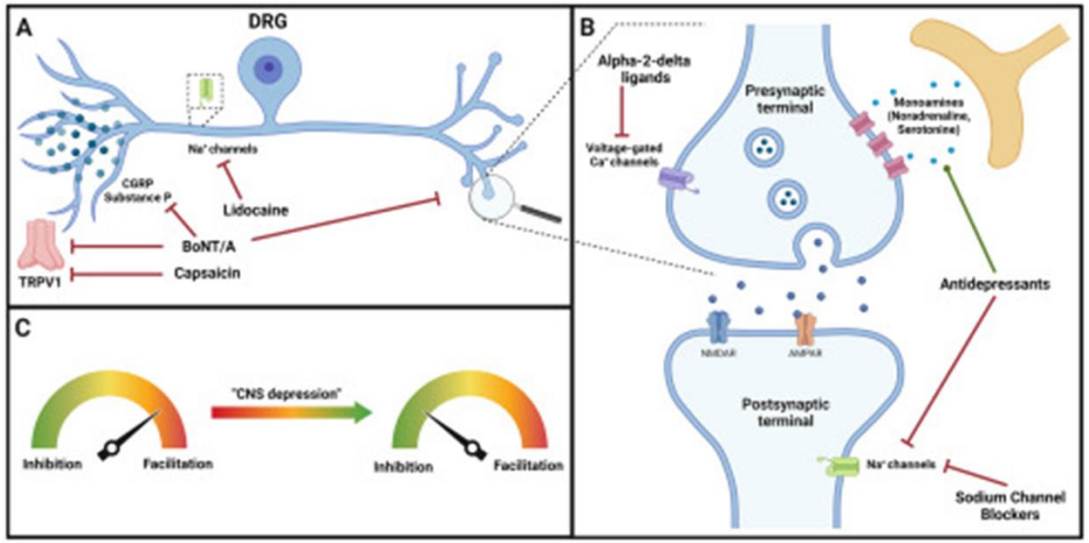
Abb. 2 ▲ Auswahl von Mechanismen, die zur Entstehung von chronischen neuropathischen Schmerzen infolge Rückenmarkläsion beitragen können

4. Treatment of Neuropathic Pain in Spinal Cord Injury

Current guidlines



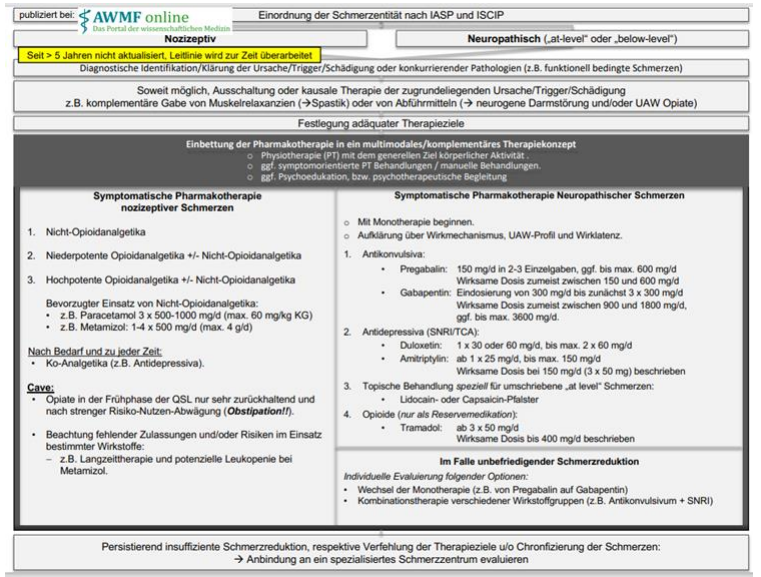
Pharmacological Treatment



ELSEVIER
International Review of Neurobiology
Volume 179, 2024, Pages 403-430

Chapter Twelve - Clinical pharmacology of neuropathic pain

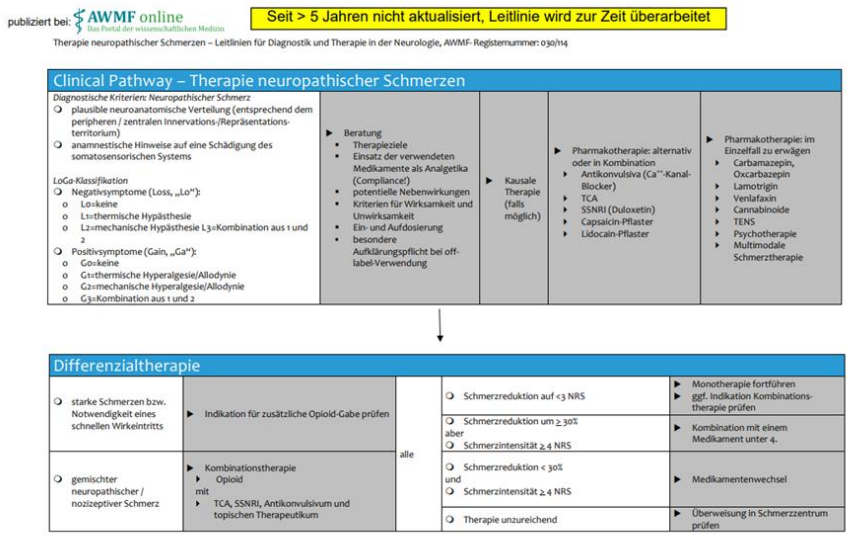
Jan Rosner [a b], Nadine Attal [c], Nanna B. Finnerup [a d]



Richtlijnen database

Review for Dutch Guideline (October 2025)

- 12 RCT's
- Mostly on anti-epileptic medication , anti-depressiva, morfin, lidocain
- Adverse effects



Use and Experienced Effectiveness of Non-Pharmacological Treatments for Chronic Spinal Cord Injury Related Pain

Cross sectional survey (n=371)

78% reported past or current use

of non-pharmacological treatments

Table 3.4: Perceived effect of currently used non-pharmacological treatments

N (%)*	-	+/-	+	++
Conventional treatments				
Massage (n=27)	1 (3.7)	0	21 (77.8)	5 (18.5)
Physiotherapy (n=107)	0	7 (6.7)	62 (59.6)	35 (33.7)
Physical exercise (n=64)	4 (6.3)	3 (4.6)	34 (56.7)	19 (31.7)
TENS (n=10)	0	1 (11.1)	7 (77.8)	1 (11.1)
CAM treatments				
Homeopathy (n=5)	0	0	3 (60.0)	2 (40.0)
Medicinal cannabis (n=8)	0	1 (12.5)	7 (87.5)	0
Non-medicinal cannabis (n=9)	0	1 (11.1)	4 (44.4)	4 (44.4)
Supplements (n=18)	0	8 (53.3)	7 (46.7)	0

Abbreviation: TENS, Transcutaneous Electrical Nerve Stimul tion; CAM, Complementary an Alternative Medicine.

** -: negative effect +/-: no effect, +: moderate effect, ++: good*

Totals differ from table 3.3 as not all participants described perceived effect

Crul et al J Spinal Cord Med. 2024 May 2:1-9.

Research Papers

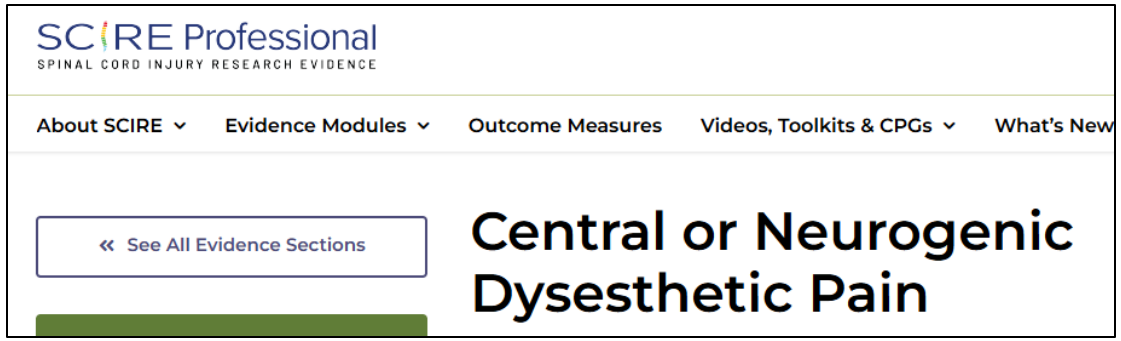
"But I know what works" – patients' experience of spinal cord injury neuropathic pain management

Monika Löfgren & Cecilia Norrbrink

Pages 2139-2147 | Accepted 01 Mar 2012, Published online: 18 Apr 2012

Cite this article https://doi.org/10.3109/09638288.2012.676146

Non-Pharmacological treatment



Movements and exercise

- 4 observational studies (n=7-18)
- No GRADE possible due to lack of comparative studies
- Weak recommendation

Massage and Manipulation

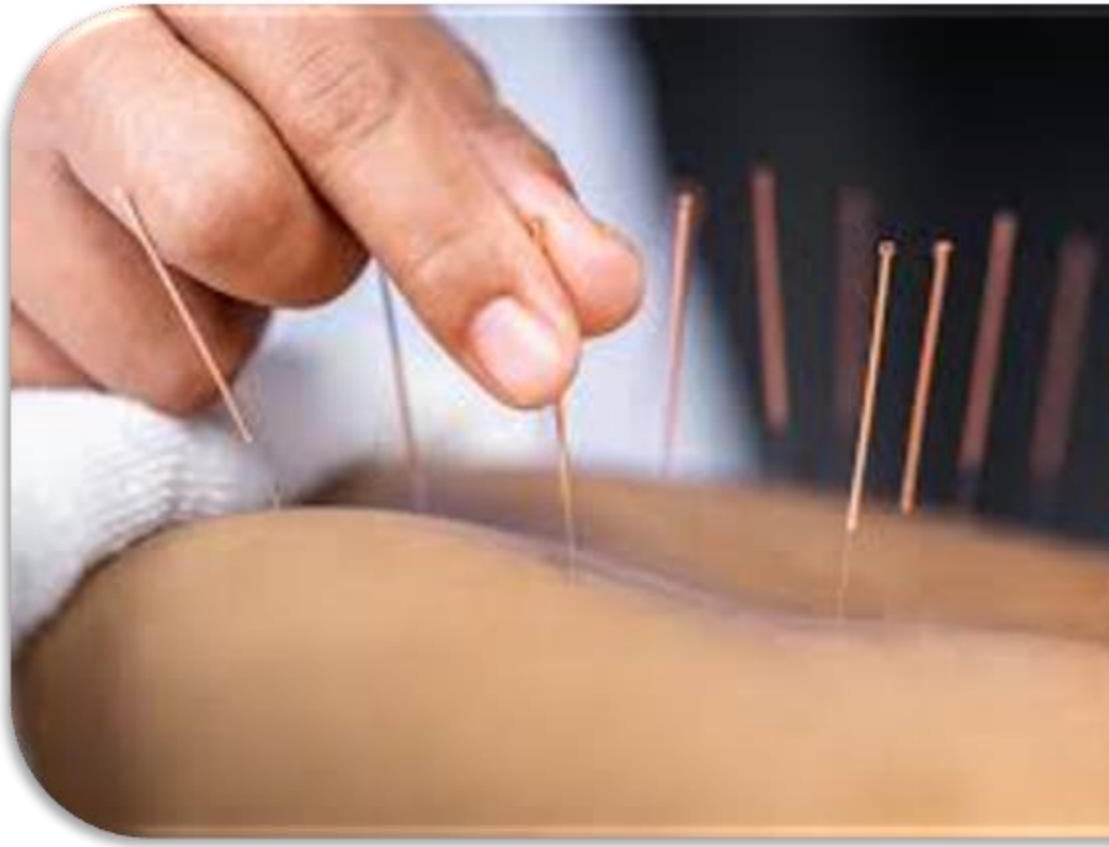
- 2 Studies comparing different treatments, no control group
- Quality of evidence very low
- Neutral recommendation

TENS

- 2 RCT's
- Both clinically relevant difference
- Quality of evidence very low, risk of bias and imprecision
- Neutral recommendation

Acupuncture

- 2 studies comparing with waiting list or massage
- No clinically relevant effect
- Quality of studies very low
- Neutral recommendation



Extended reality

3 studies

Inconsistent results

Quality of evidence very low

(more studies coming)

Neutral recommendation

Psychological treatment

6 RCT’s

Direct + effect pain, after 3 months no effect

Quality of evidence very low

Weak recommendation

Transcranial stimulation

1 RCT & 1 review (8 studies included)

The pooled data show a mean difference of -1.35 (95%CI -2.06 to -0.64) (Figure 1) and a mean difference of -1.34 (95%CI -2.46 to -0.21) in favor of transcranial stimulation (Figure 2). This difference is considered clinically relevant

<u>Neutral recommendation: low quality evidence gives an indication for a possible effect</u>

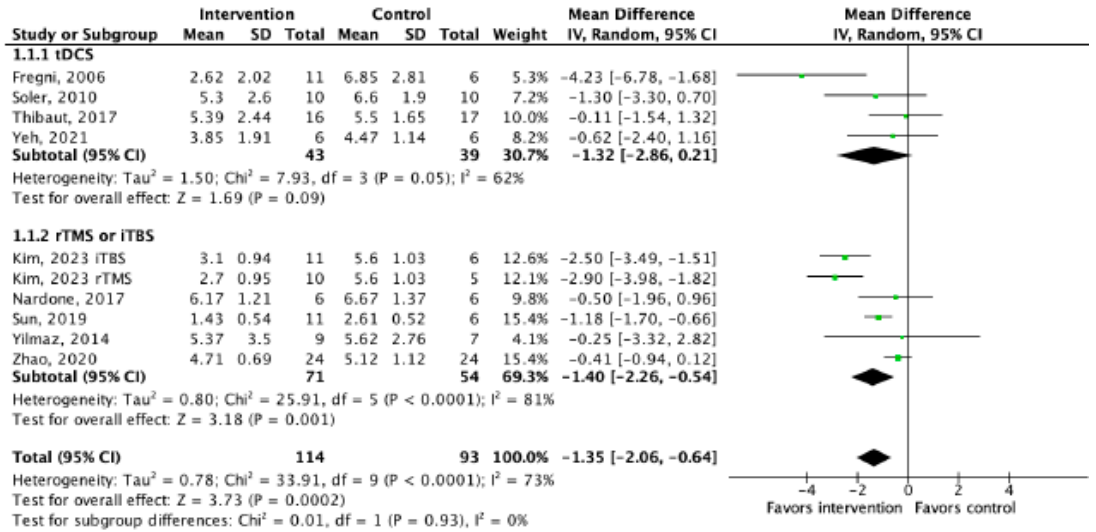


Figure 1: The effect of transcranial stimulation on pain (VAS, NRS) immediately post-intervention.
Z: p-value of the pooled effect; df: degrees of freedom; I2: statistic heterogeneity; CI: confidence interval.

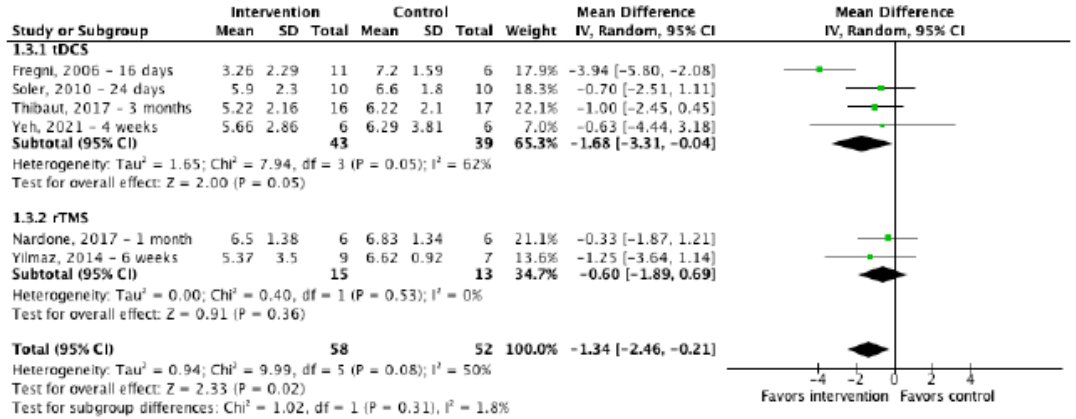


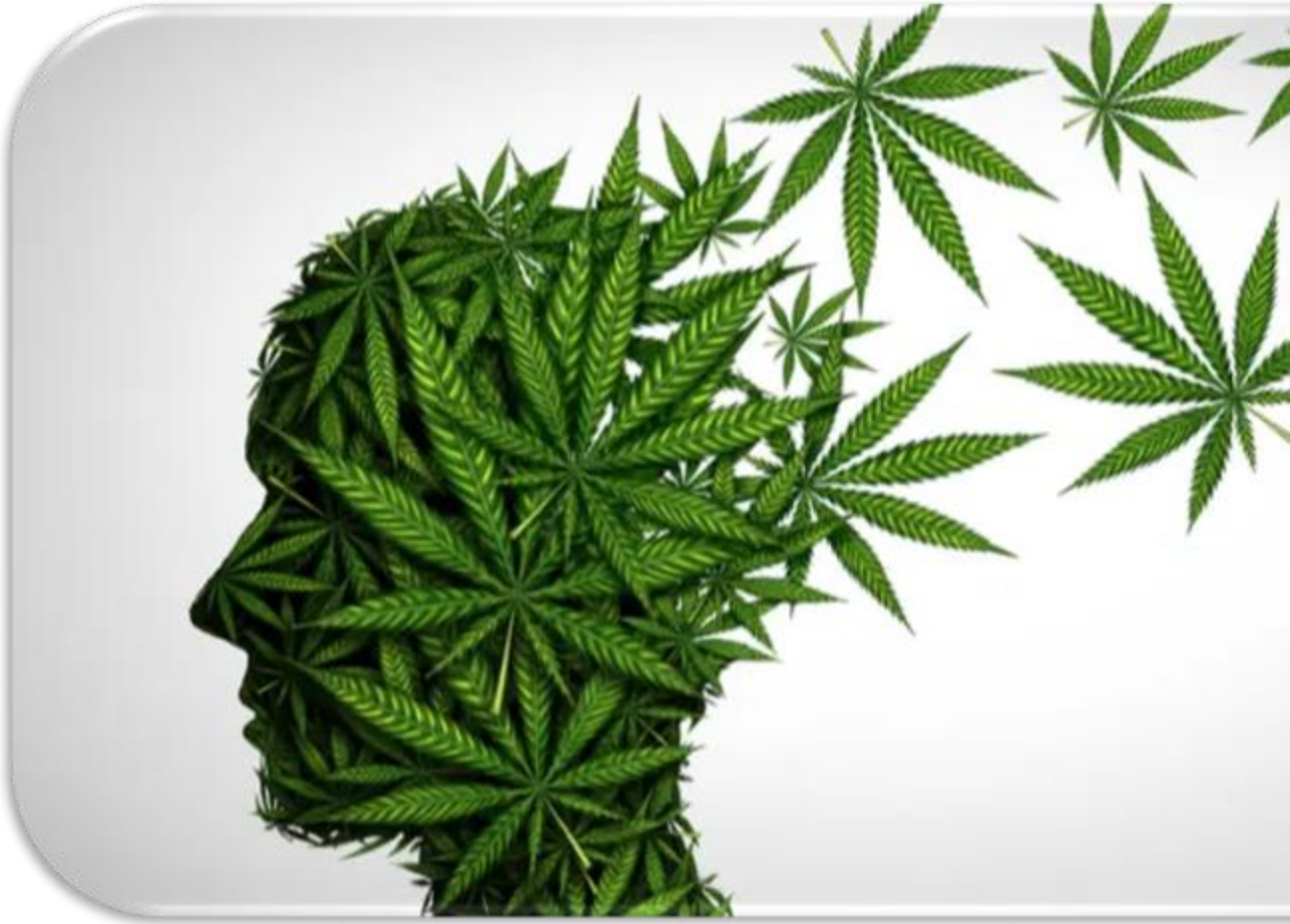
Figure 2: The effect of transcranial stimulation on pain (VAS, NRS) at follow-up (16 days-3 months).
Z: p-value of the pooled effect; df: degrees of freedom; I2: statistic heterogeneity; CI: confidence interval.

Cannabis

No studies

Strong negative recommendation

Therapeutic use in spasticity?



Dorsal Rhizotomy

« See All Evidence Sections

Dorsal Rhizotomy

Conclusion

There is level 2 evidence (from one prospective controlled trial, one pre-post study, and seven case series studies: Falci et al. 2002; Chun et al. 2011; Sindou et al. 2001; Spaic et al. 1999, 2002; Rath et al. 1997; Sampson et al. 1995; Bashold et al. 1990; Friedman & Nashold 1986) to support the use of the DREZ surgical procedure to reduce pain post SCI. It may be that some populations (segmental pain) are more likely to benefit from this procedure.

Broader Evidence

Pharmacotherapy and non-invasive neuromodulation for neuropathic pain: a systematic review and meta-analysis

Nadia Soliman, Xavier Moisset*, Michael C Ferraro, Daniel Ciampi de Andrade, Ralf Baron, Joletta Belton†, David L H Bennett, Margarita Calvo, Patrick Dougherty, Ian Gilron, Aki J Hietaharju, Koichi Hosomi, Peter R Kamerman, Harriet Kemp, Elena K Enax-Krumova, Ewan McNicol, Theodore J Price, Srinivasa N Raja, Andrew S C Rice, Blair H Smith, Fiona Talkington†, Andrea Truini, Jan Vollert, Nadine Attal*, Nanna B Finnerup*, Simon Haroutounian*, NeuPSIG Review Update Study Group*

- Lancet Neurology 2025
- Review and meta-analysis
- 313 RCT's, 40.000 participants
- DM, HIV, Herpes, Stroke.....
- Efficacy, Adverse Effects, Feasibility,
- Accesibility and Costs

15 studies evaluated rTMS at several targets, predominantly the primary motor cortex (12 studies). For rTMS at the primary motor cortex (M1), the combined NNT (six comparisons) was 4·2 (95% CI 2·3–28·3), estimate of effect (14 comparisons) SMD 0·9 (0·4–1·4) and NNH (12 comparisons) was 651·6 (34·7–∞). Removal of an outlier increased the NNT by 36% to 6·6 (3·67–31·97) and decreased SMD by 15% to 0·8 (0·3–1·3; table 1; appendix p 77). There was low certainty of evidence.

	Daily dosages and dose regimen*	Recommendation
Strong recommendation for use		
α2δ-ligands	Gabapentin 1200–3600 mg in three divided doses Gabapentin ER 1200–3600 mg in two divided doses Pregabalin 150–600 mg in two divided doses Mirogabalin 10–30 mg in two divided doses	First line
SNRIs	Duloxetine 60–120 mg once a day Venlafaxine 150–225 mg once a day or in two divided doses	First line
Tricyclic antidepressants†	25–150 mg once a day or in two divided doses	First line
Weak recommendation for use		
Lidocaine 5% plasters‡	1–3 plasters to the painful area for up to 12 h per day	Second line for peripheral neuropathic pain
Capsaicin 8% patches‡	1–4 patches to the painful area for 30–60 min with a minimal application interval of 60 days	Second line for peripheral neuropathic pain
Capsaicin cream‡§	Usually 0·075% one to three times per day	Second line for peripheral neuropathic pain
Botulinum toxin type A‡	50–300 units to the painful area every 3 months	Third line for peripheral neuropathic pain
rTMS (10–20 Hz targeting M1)§	1200–3000 pulses per session	May be used in selected patients
Opioids§¶	Usually <120 mg morphine equivalent in two divided doses Tramadol 200–400 mg in two extended releases or three divided doses	May be used in selected patients

Drugs pertaining to the same drug class are presented in alphabetical order. ER=extended release. NA=not applicable. *Initiate systemic drugs at low doses, titrating slowly. Consult product information for precautions and contraindications. †TCAs are not recommended in older adults because of their anticholinergic and sedative side effects and increased potential risk of falls.[18] An increased risk of sudden cardiac death has been reported for doses over 100 mg/day. ‡Recommended for people living with peripheral neuropathic pain in a localised area, which can be covered by the allowed number of capsaicin 8% patches or lidocaine 5% plasters. This locally applied treatment may be appropriate as first line treatment in vulnerable patients (eg, older adults or people with multiple diseases, or in cases of polypharmacy). §Change from the 2015 recommendations: capsaicin cream, previously inconclusive, is now second-line, particularly if capsaicin 8% patches are not available, with a weak recommendation; tramadol, previously second-line, is now grouped with opioids and recommended as third-line with a weak recommendation; rTMS was not evaluated in 2015. ¶In patients who have not responded to other reasonable treatments, within the shortest possible duration of use.

Table 2: **First-line, second-line, and third-line recommendations for the drugs or drug classes or neuromodulation treatments for neuropathic pain based on the GRADE classification**

Panel: First-line, second-line, and third-line recommendations for the drugs or drug classes or neuromodulation treatments for neuropathic pain with inconclusive recommendations or recommendations against us based on the GRADE classification

Inconclusive evidence for use*
- Carbamazepine–oxcarbazepine†
- Lacosamide
- Lamotrigine
- NMDA
- Selective serotonin reuptake inhibitors
- Transcranial direct current stimulation
- Transcutaneous electrical nerve stimulation
- Spinal cord stimulation
- Topiramate

Recommendations against use
- Cannabinoids
- Valproate
- Levetiracetam
- Mexiletine‡

*The remaining interventions which were assessed as inconclusive due to insufficient evidence are listed in the appendix pp 23–43. †For trigeminal neuralgia, these two drugs are recommended as first-line for long-term carbamazepine (200–1200 mg/day) or oxcarbazepine (300–1800 mg/day) in three divided doses.[15,19] ‡For the treatment of inherited erythromelalgia (300–600 mg/day in three divided doses) this drug may be of benefit.[21]

Implications of all the available evidence

This systematic review underscores the modest efficacy of many pharmacological treatments for neuropathic pain, possibly influenced by the heterogeneity of underlying mechanisms and participant phenotypes in clinical trials. Neuromodulation techniques, emerging as alternatives, demand larger sham-controlled trials to address uncertainties surrounding their long-term efficacy and safety. The recommendations highlight the need for shared decision making, prioritising patient autonomy and preferences when tailoring treatment strategies. Health-care professionals should adapt these guidelines to their specific contexts, accounting for the cost, accessibility, and feasibility of treatments. Further research, including for combination therapies, is necessary to optimise outcomes and improve the quality of life for individuals with neuropathic pain.

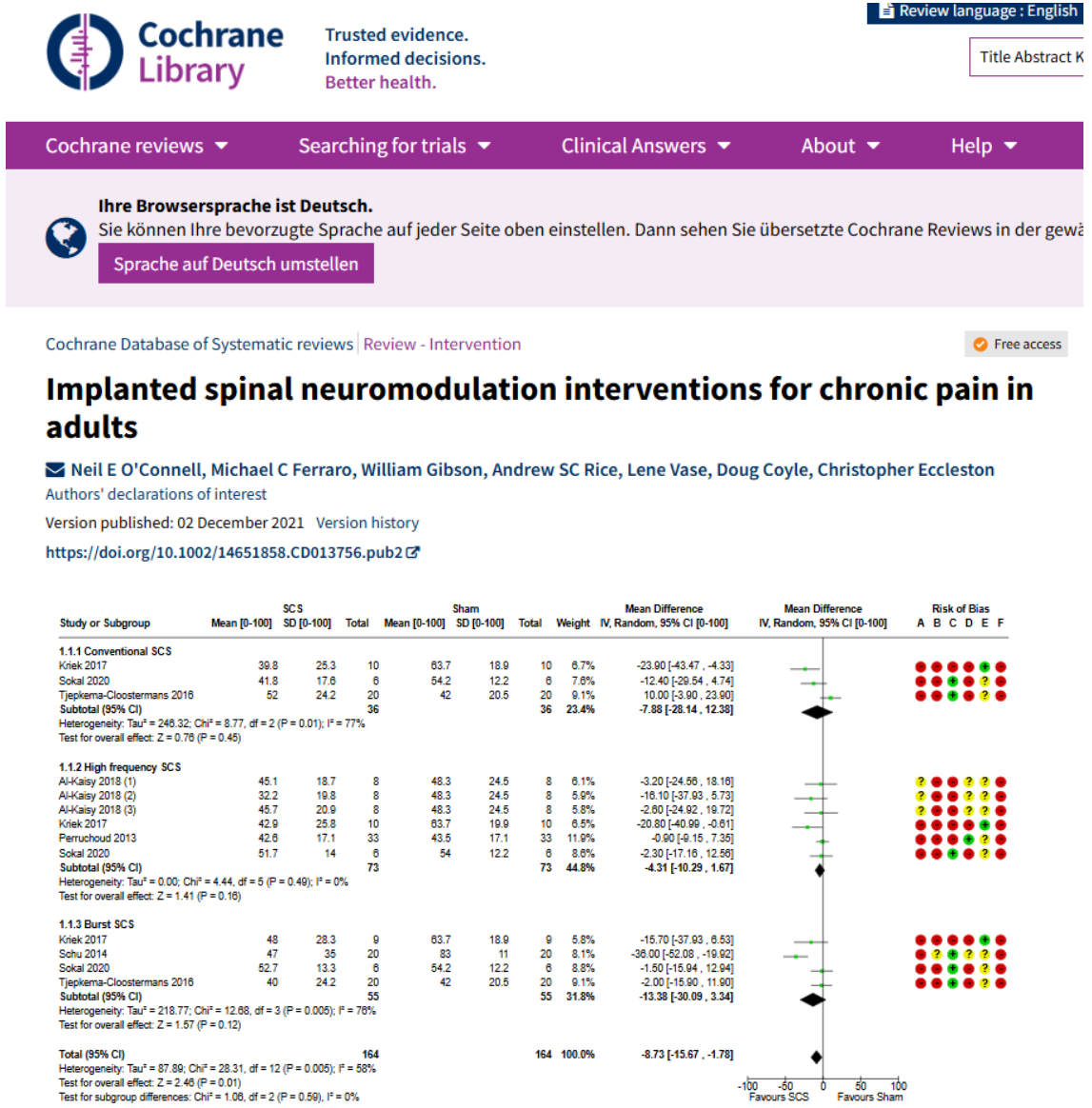
Neuromodulation

15 Studies, 908 participants

High Risk of Bias

Very low evidence that SCS may not provide clinically important benefits,

Adverse Effects!



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Implanted spinal neuromodulation interventions for chronic pain in adults

Neil E O'Connell, Michael C Ferraro, William Gibson, Andrew SC Rice, Lene Vase, Doug Coyle, Christopher Eccleston

Authors' declarations of interest

Version published: 02 December 2021 Version history

https://doi.org/10.1002/14651858.CD013756.pub2

Study or Subgroup	SCS Mean [0-100]	SCS SD [0-100]	SCS Total	Sham Mean [0-100]	Sham SD [0-100]	Sham Total	Weight	Mean Difference IV, Random, 95% CI [0-100]
1.1.1 Conventional SCS								
Kriek 2017	39.8	25.3	10	63.7	18.9	10	6.7%	-23.90 [-43.47 , -4.33]
Sokal 2020	41.8	17.6	6	54.2	12.2	6	7.6%	-12.40 [-29.54 , 4.74]
Tjepkema-Cloostermans 2016	52	24.2	20	42	20.5	20	9.1%	10.00 [-3.90 , 23.90]
Subtotal (95% CI)			36			36	23.4%	**-7.88 [-28.14 , 12.38]**
Heterogeneity: Tau² = 246.32; Chi² = 8.77, df = 2 (P = 0.01); I² = 77%								
Test for overall effect: Z = 0.76 (P = 0.45)								
1.1.2 High frequency SCS								
Al-Kaisy 2018 (1)	45.1	18.7	8	48.3	24.5	8	6.1%	-3.20 [-24.56 , 18.16]
Al-Kaisy 2018 (2)	32.2	19.8	8	48.3	24.5	8	5.9%	-16.10 [-37.93 , 5.73]
Al-Kaisy 2018 (3)	45.7	20.9	8	48.3	24.5	8	5.8%	-2.60 [-24.92 , 19.72]
Kriek 2017	42.9	25.8	10	63.7	19.9	10	6.5%	-20.80 [-40.99 , -0.61]
Perruchoud 2013	42.6	17.1	33	43.5	17.1	33	11.9%	-0.90 [-9.15 , 7.35]
Sokal 2020	51.7	14	6	54	12.2	6	8.6%	-2.30 [-17.16 , 12.56]
Subtotal (95% CI)			73			73	44.8%	**-4.31 [-10.29 , 1.67]**
Heterogeneity: Tau² = 0.00; Chi² = 4.44, df = 5 (P = 0.49); I² = 0%								
Test for overall effect: Z = 1.41 (P = 0.16)								
1.1.3 Burst SCS								
Kriek 2017	48	28.3	9	63.7	18.9	9	5.8%	-15.70 [-37.93 , 6.53]
Schu 2014	47	35	20	83	11	20	8.1%	-36.00 [-52.08 , -19.92]
Sokal 2020	52.7	13.3	6	54.2	12.2	6	8.8%	-1.50 [-15.94 , 12.94]
Tjepkema-Cloostermans 2016	40	24.2	20	42	20.5	20	9.1%	-2.00 [-15.90 , 11.90]
Subtotal (95% CI)			55			55	31.8%	**-13.38 [-30.09 , 3.34]**
Heterogeneity: Tau² = 218.77; Chi² = 12.68, df = 3 (P = 0.005); I² = 76%								
Test for overall effect: Z = 1.57 (P = 0.12)								
Total (95% CI)			164			164	100.0%	**-8.73 [-15.67 , -1.78]**
Heterogeneity: Tau² = 87.89; Chi² = 28.31, df = 12 (P = 0.005); I² = 58%								
Test for overall effect: Z = 2.46 (P = 0.01)								
Test for subgroup differences: Chi² = 1.06, df = 2 (P = 0.59), I² = 0%								

Mean Difference IV, Random, 95% CI [0-100]

-100 -50 0 50 100

Favours SCS Favours Sham

Risk of Bias A B C D E F

Where does this leave us.....

Pharmacological Treatment

- Treatment should be based on reccomendation in guidelines

Non-pharmacological Treatment

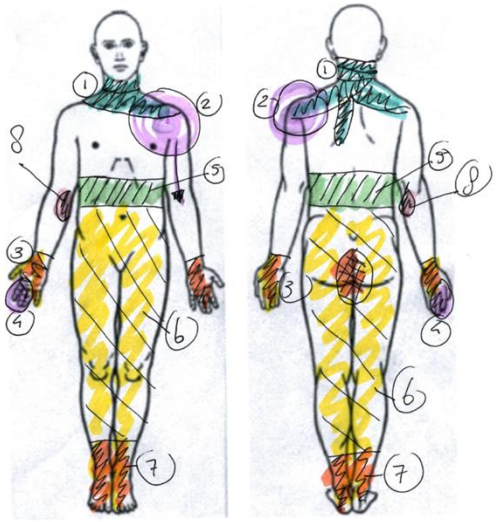
- Very limited evidence of low quality

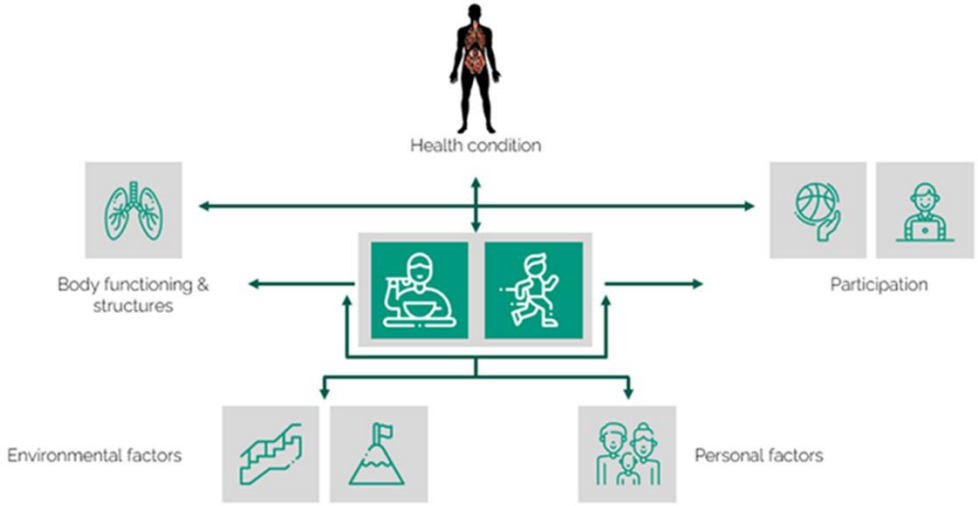
Presicion Medicine:

1. Use guideline where applicable
2. Diagnosis: Phenotyping
3. Diagnosis and treatment within ICF-Framework
4. Shared-desicion making

Our clinical case

- Pain in his legs – spasticity related pain (UTI/Obstipation/Haemorrhoids)
- Spasticity increase – UTI's and obstipation
- Bowel problems – Obstipation, gallstones
- Pain in his right fingers –CTS
- Shoulder pain left – Supraspinatus tendinopathy
- Tired- lack of sleep, anaemia
- Depression- pain/sleep/job
- Trouble sleeping – spasticity/depression/job
- Social Isolation – sleep/depression

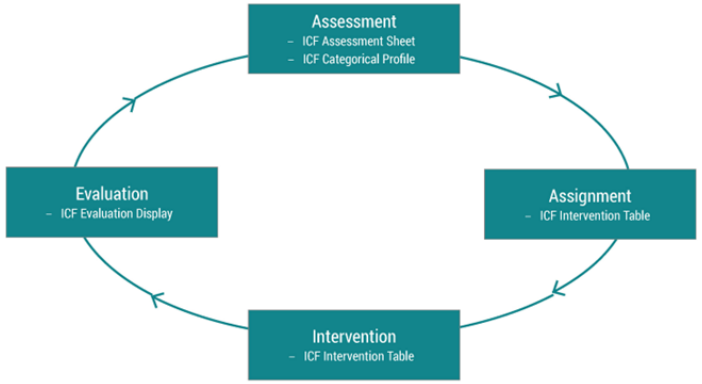




Our clincal case

- Shoulder- Physio and NSAIR
- CTS: Brace
- Spasticity/sleep//neuropathic pain:
  - Optimize bowel management
  - Mydocalm at night for 2 weeks (did not want Gabapentin or antidepressive Medication)
- Depression/Fatigue:
  - Iron suppletion
  - Change Job

Rehab Cycle



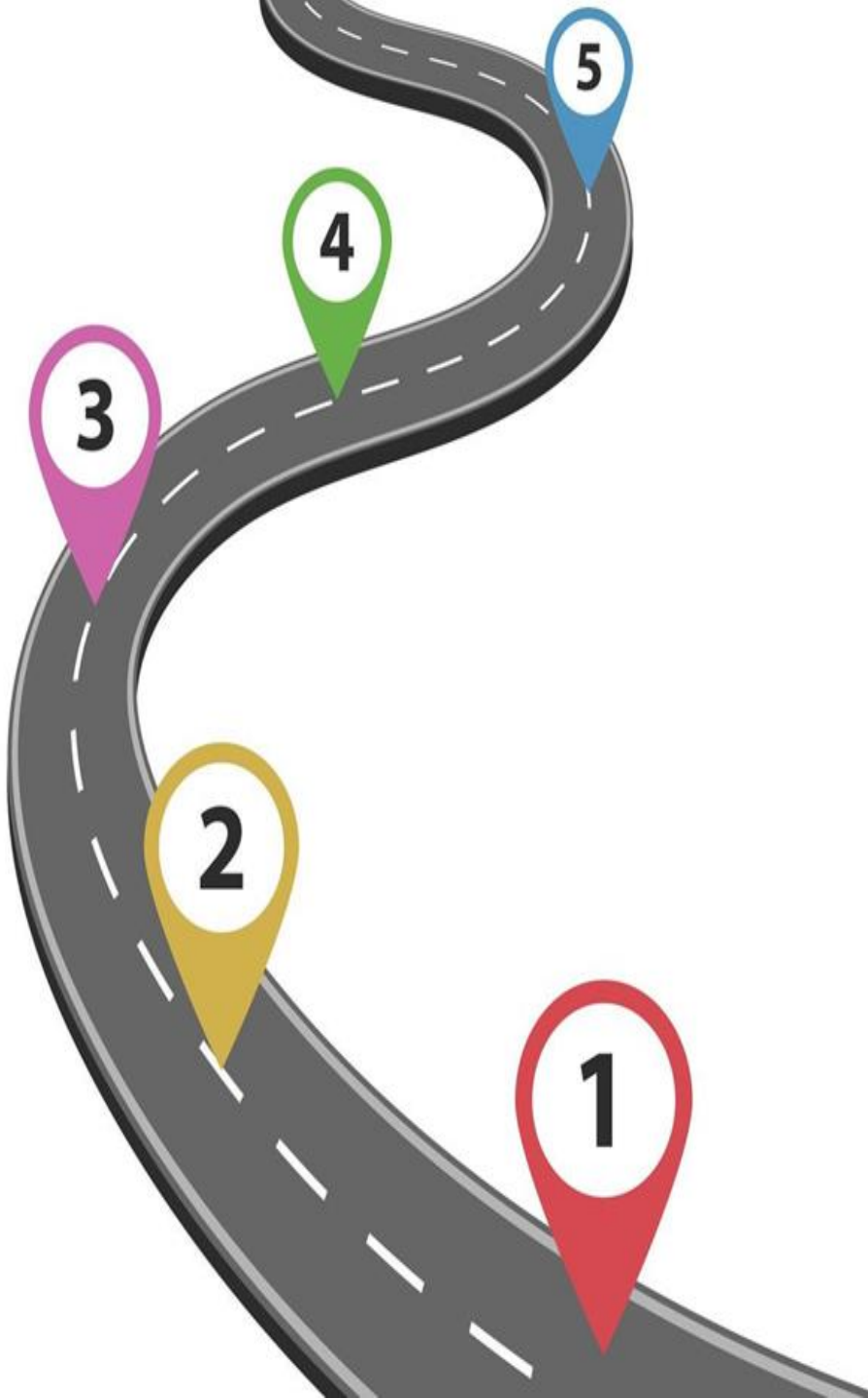
5. Wrap up

1. Epidemiology: Pain in spinal cord injury is frequent but not all pain is neuropathic pain

2. Diagnosis: Key to diagnosis is a good history and clinical examination within the ICF Model

3. Evidence for treatment is low

4. Treatment
   - Personalized medicine in ICF Model
   - Patient centered care
   - Evaluation of treatment with Rehab Cycle



Schweizer Paraplegiker Zentrum

Innovation

Thank you to:







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Dr. med Judith Hattler
Janneke Stolwijk, PhD
Charlotte van Laake, PhD
Prof. Dr. Jan Rosner
Prof. Dr. med. Dr. re. nat. Patrick Freund