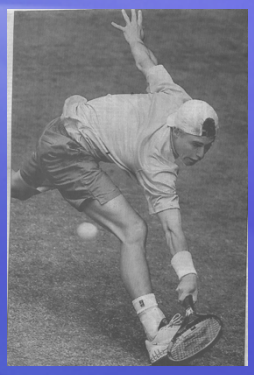
Neurodynamik

Untersuchung, Behandlung des oberen Körperquadranten



Elly Hengeveld
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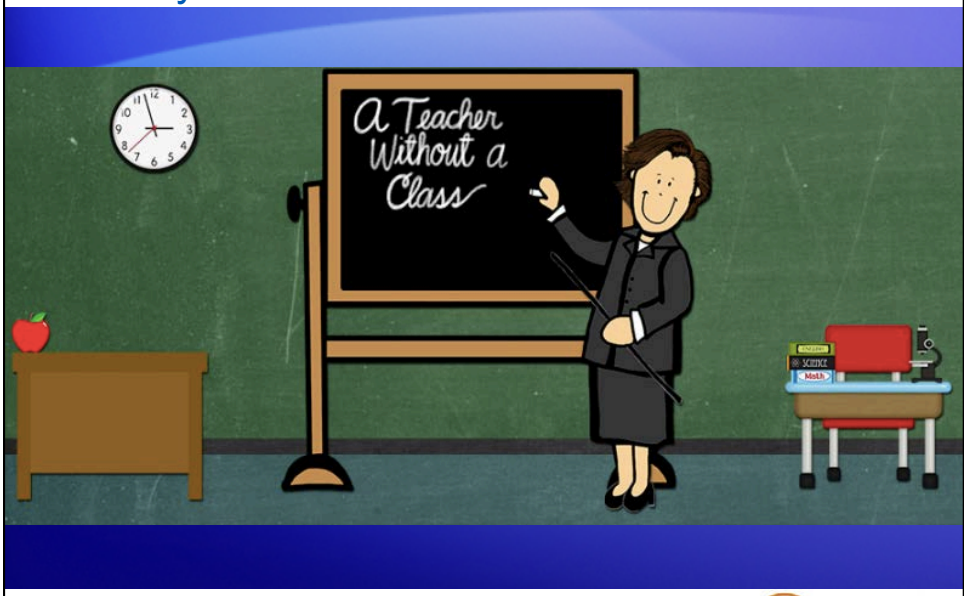
OMT_{svomp}, Senior Teacher IMTA, Clin. Spec $_{MSK/Fisioswiss}$

FisioSwiss – Zentralschweiz 18.5.2017

Neurodynamik des oberen Quadranten

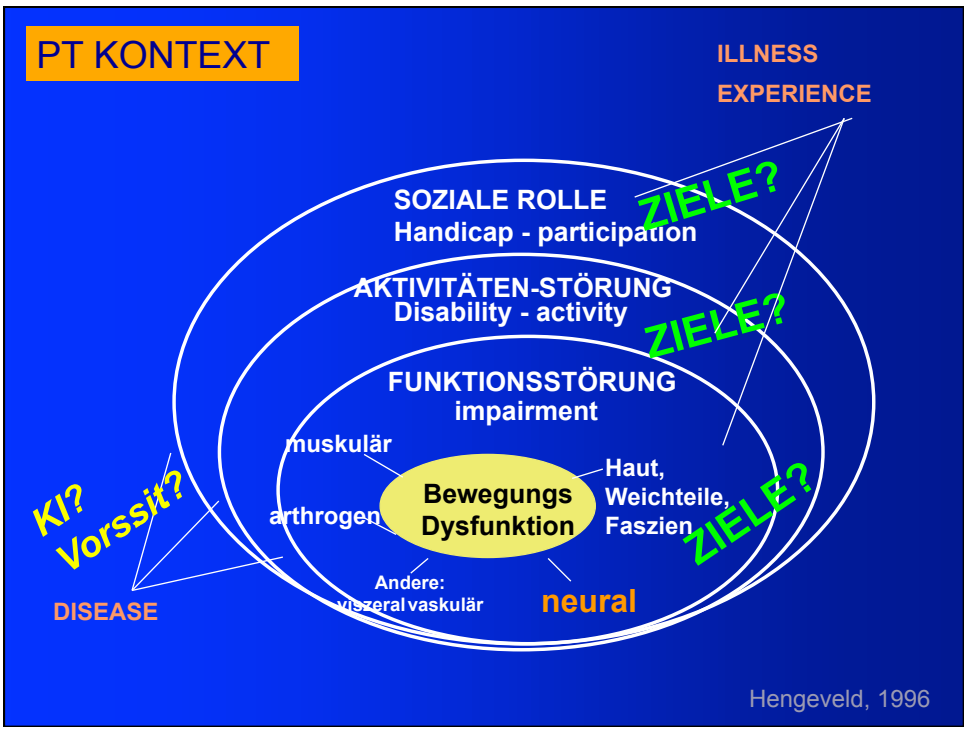
- Einsatzmöglichkeiten, Grenzen in Untersuchung und Behandlung
- Theorie: Anatomie, Biomechanik, Pathophysiologie
- Evidenz: Basiswissenschaftlich, klinische Forschung
- Klinische Beispiele

Neurodynamik des oberen Quadranten



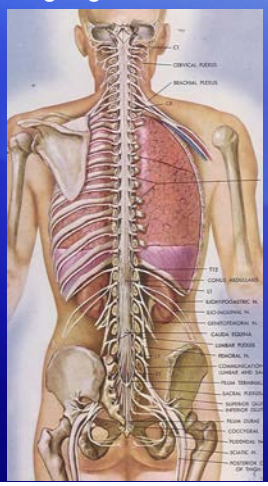
IMTA international maitland teachers association

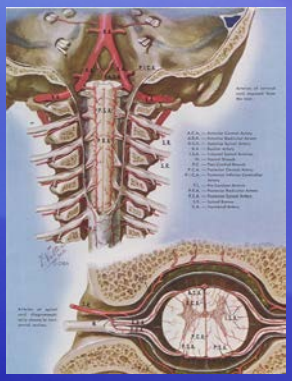
PT KONTEXT



Neurodynamik des oberen Quadranten

- Anatomie:
  auf Bewegung eingestellt – Schutz der Nervenfasern & Anpassung an Körperbewegungen





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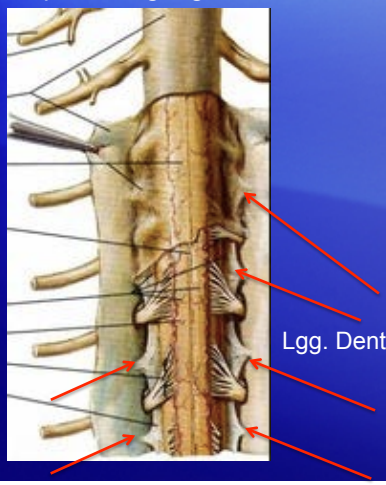
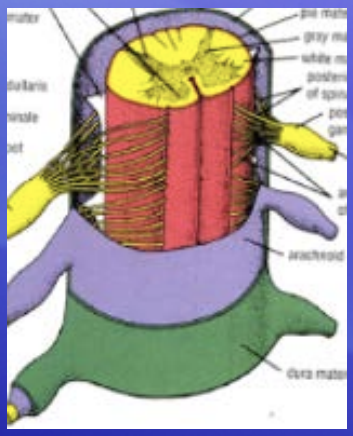


Lgg. Denticulati

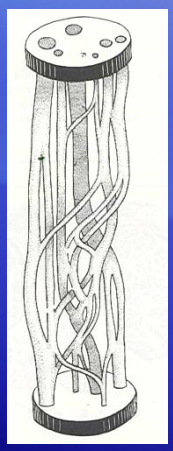


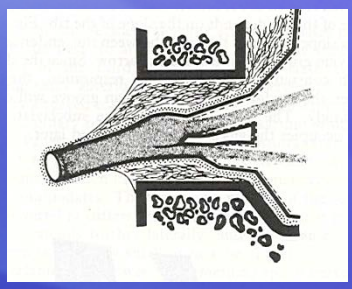
Elly Hengeveld (c) 18.05.2017. FisioSwiss Zentralschweiz

Neurodynamik des oberen Quadranten

- **Anatomie:**
  auf Bewegung eingestellt – Schutz der Nervenfasern & Anpassung an Körperbewegungen

Plexusformation



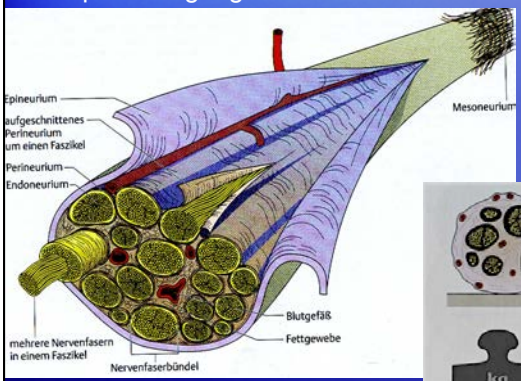


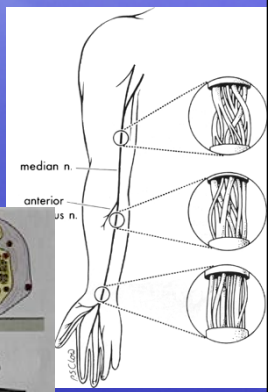
Spinalnerv im IVF

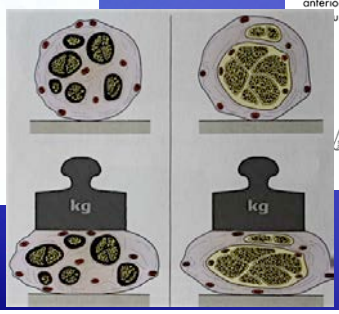
Sunderland, 1975

Neurodynamik des oberen Quadranten

- **Anatomie:**
  auf Bewegung eingestellt – Schutz der Nervenfasern & Anpassung an Körperbewegungen







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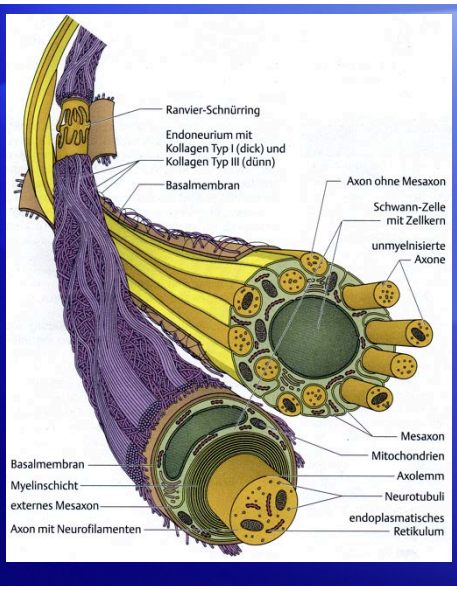
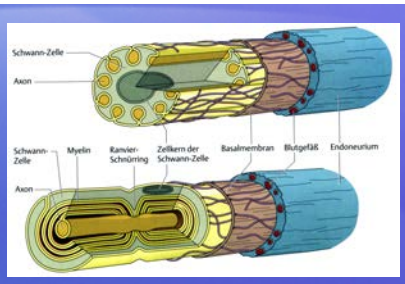
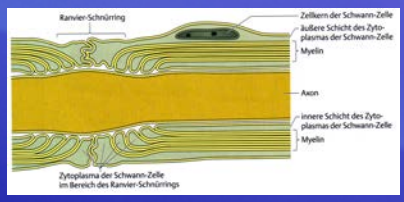
Neurodynamik des oberen Quadranten

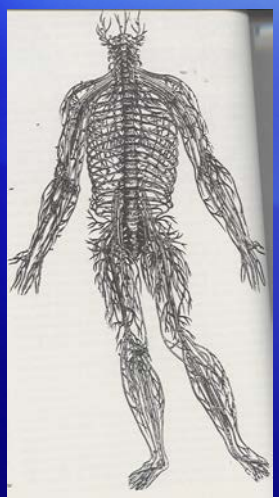


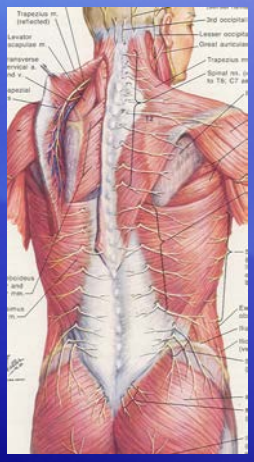


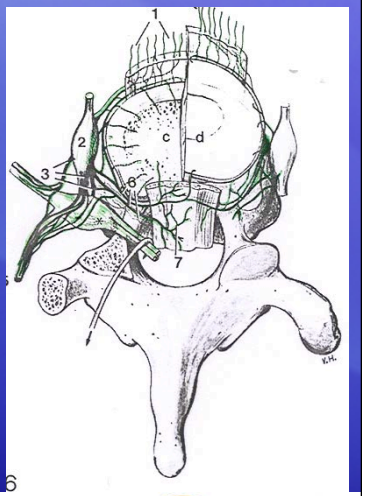


Neurodynamik des oberen Quadranten

- NS ist omnipräsent & Kontinuum (anatomisch, mechnanisch, elektro-physiogisch)

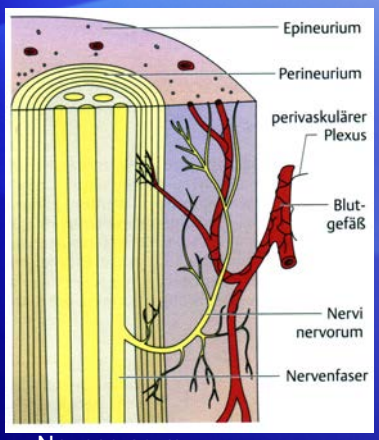




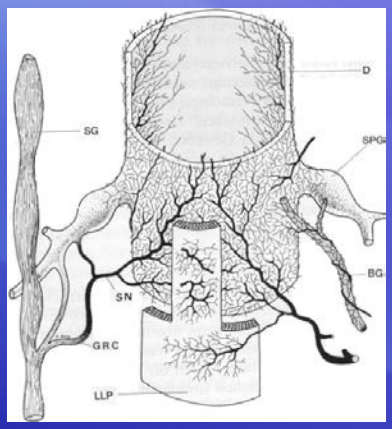


Neurodynamik des oberen Quadranten

- Innervation



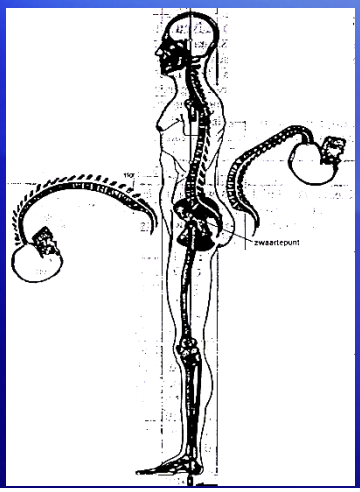
Nn. nervorum
Perivaskulärer Plexus

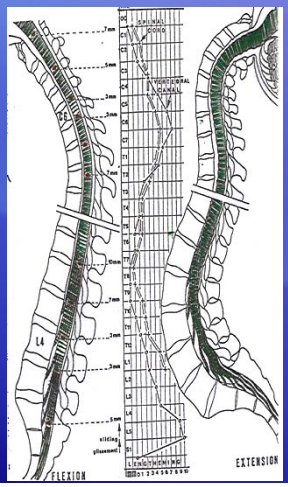


N. sinuvertebralis
(R. meningeus; N. recurrens)

Neurodynamik des oberen Quadranten

- Biomechanik: Nervensystem muss sich an Körperbewegungen anpassen

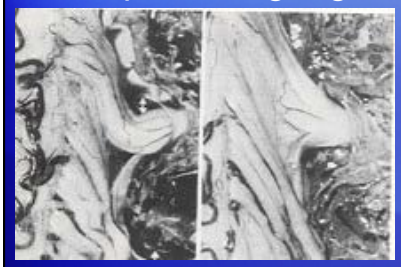


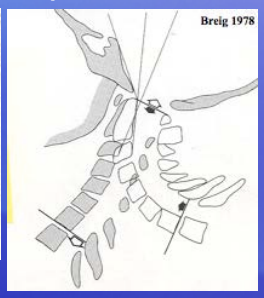


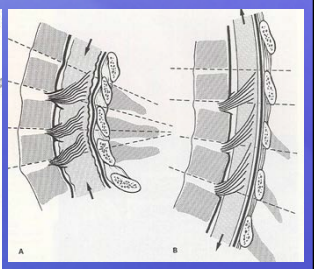
Louis, 1979

Neurodynamik des oberen Quadranten

- Biomechanik: Nervensystem muss sich an Körperbewegungen anpassen



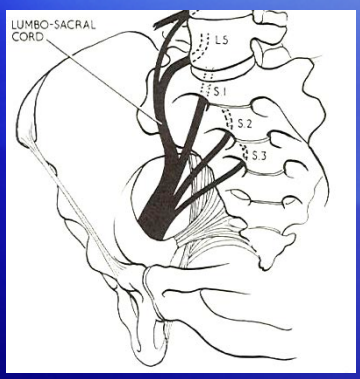




Alf Breig (1978) Adverse Mechanical Tension of the Central Nervous System

Neurodynamik des oberen Quadranten

- Biomechanik: Nervensystem muss sich an Körperbewegungen anpassen



Goddard & Reid, 1965

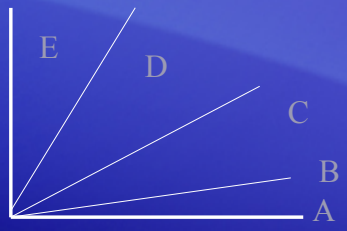
A: Ferse etwa 5 cm: Bew in Foramen Isch. Maj

B: Lumbosacraler Plexus über Ala Sacri

C: etwa 35°: Nervenwurzelbew. In IVF

D: 35°-70°: Nervenwurzelbew. Mehr

E: 70° - 90°: wenig Bew., sondern Spannungszunahme



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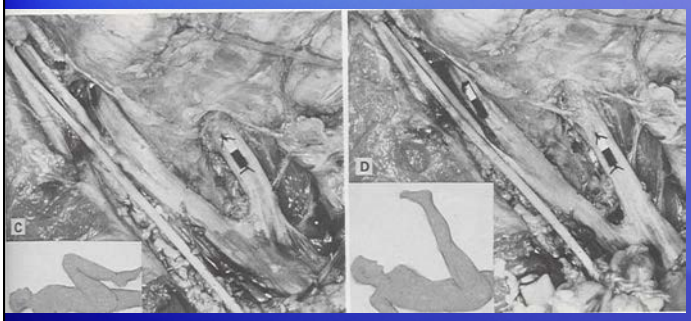
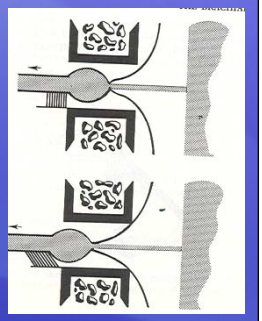


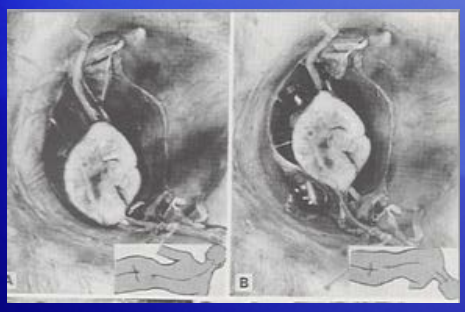
Breig 1978

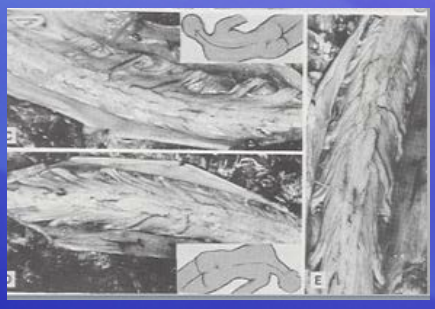


Sunderland, 1975

Neurodynamik des oberen Quadranten

- Biomechanik: Nervensystem muss sich an Körperbewegungen anpassen





Breig 1978

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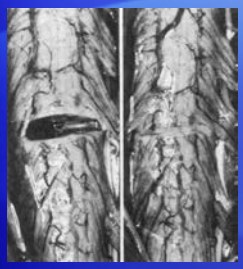
Neurodynamik des oberen Quadranten

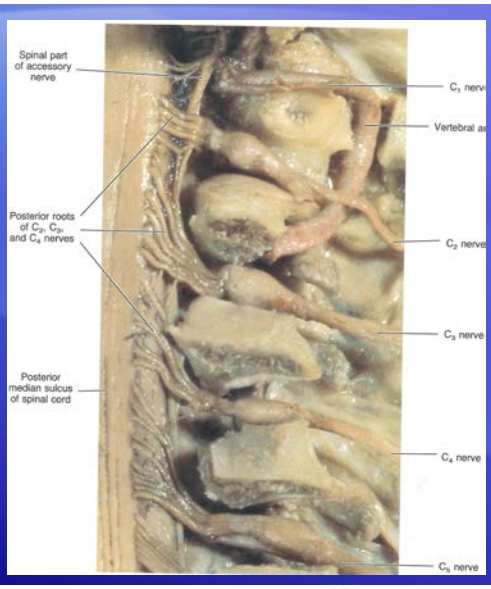
- Biomechanik: Bewegung wird weitergeleitet



Breig 1978

Neurodynamik des oberen Quadranten

- Biomechanik:



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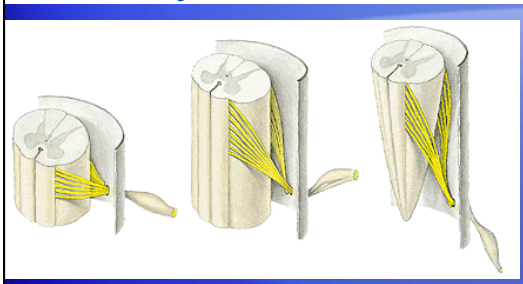


Spinal Ganglien / Ganglion Dorsale

- IVF
- C5-T1: sehr gross
- Zellkörper von sensorischen Neuronen
- Gt vaskularisiert, mit dünnem Zellwand
- Reizbar / verltzlich bei Dehnung in Ext, LF

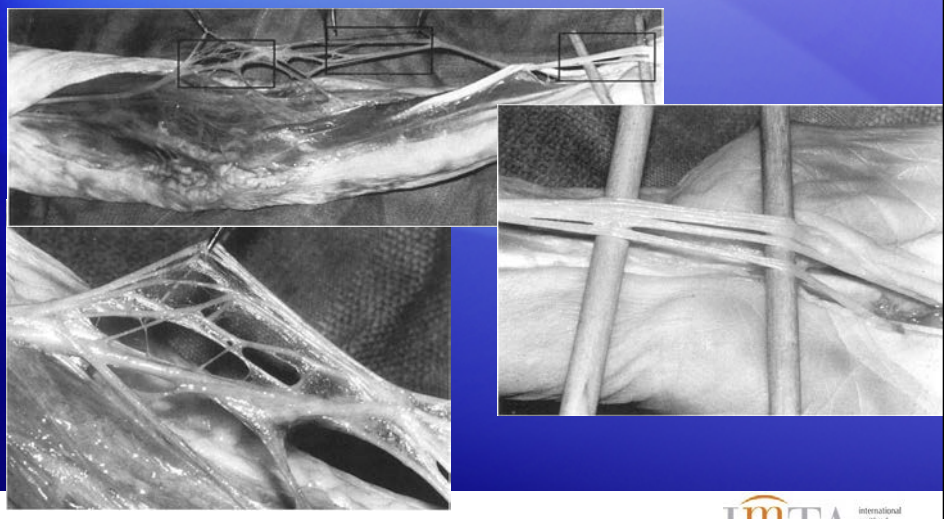
Neurodynamik des oberen Quadranten

- Biomechanik: Nervensystem muss sich an Körperbewegungen anpassen

Elvey R (1978) Brachial Plexus Tension Test n=4

Neurodynamik des oberen Quadranten

- Biomechanik: Nervensystem muss sich an Körperbewegungen anpassen



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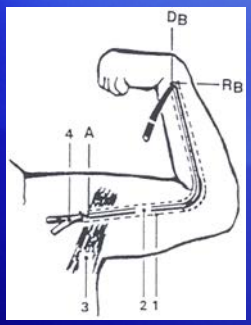

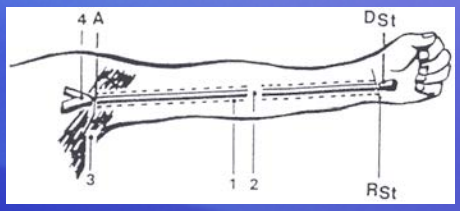

Bett des n. medianus 20% länger von HG und Ellbogen F zu Ext.

Millesi 1986

Elly Hengeveld (c) 18.05.2017. FisioSwiss Zentralschweiz

Neurodynamik des oberen Quadranten

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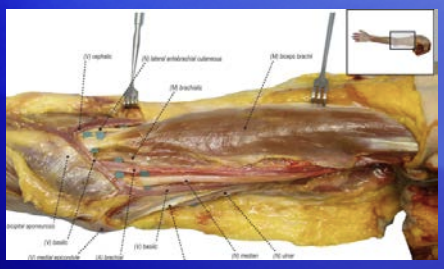


N. medianus:

•Bettlänge zw. Axilla und HG: 100,5mm diff

•Nervenbett ist bei max Ext 4% länger, bei max F: 14.9% kürzer als Nerv selbst

•23%elastische Eigenschaften; 77% entschlängelng und Gleiten in Bezug zu MI

•Bindegewebige Fixation beeinflusst die Dehnbarkeit = Schutz gegen Überdehung

Zöch 1992

Neurodynamik des oberen Quadranten

LONGITUDINAL SLIDING OF MEDIAN NERVE IN UPPER ARM IN RESPONSE TO MOVEMENTS OF LIMB, NECK, AND THORAX*

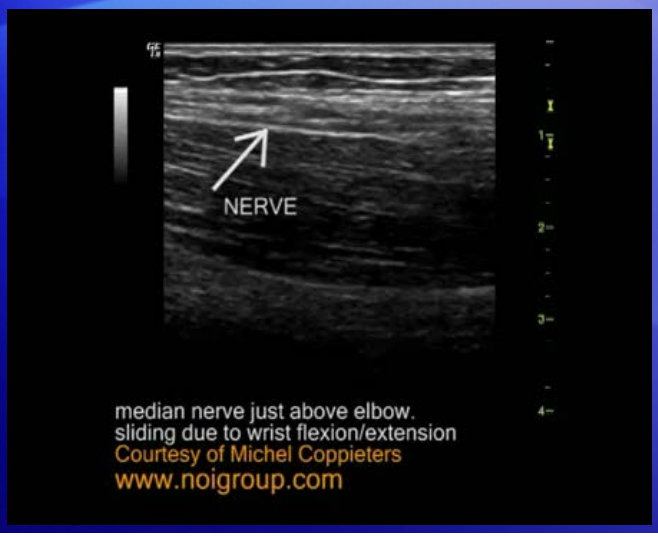
Movement	Direction and amount of nerve sliding: Mean (mm)	Direction and amount of nerve sliding: Range (mm)	Subjects in whom no sliding occurred (no.)
Flex fingers	0.7 ↑	0 – 3.2 ↑	4
Flex fingers and wrist	1.6 ↑	0 – 6.8 ↑	2
Extend fingers and wrist	7.4 ↓	2.8 ↓ –20.5 ↓	0
Pronation of forearm	0.3 ↑	2.2 ↓ – 1.0 ↑	6
Supination of forearm	0.9 ↑	2.8 ↓ – 1.4 ↑	5
Flexion of elbow to 45°	4.3 ↑	0 – 8.6 ↑	1
Neck flexed forwards	0.2 ↑	2.8 ↓ – 2.2 ↑	4
Neck flexed towards nerve	0.4 ↓	2.3 ↑ – 5.1 ↓	6
Neck flexed away from nerve	2.8 ↑	0 – 9.0 ↑	2
Neck rotated towards nerve	0.3 ↑	3.0 ↓ – 5.6 ↑	8
Neck rotated away from nerve	1.1 ↑	5.6 ↓ – 3.0 ↑	6
Neck hyperextended	1.2 ↑	0.5 ↓ – 7.0 ↑	8
Single deep inspiration	4.5 ↑	0 – 8.3 ↑	1

* Data from 15 subjects. ↑ =sliding towards the shoulder, ↓ =sliding towards the elbow.

McLellan & Swash, 1976

Neurodynamik des oberen Quadranten

- Biomechanik



Siehe auch:
Shacklock

Neurodynamik des oberen Quadranten

NS Dynamik

•Anpassen an Bewegungen des Körpers

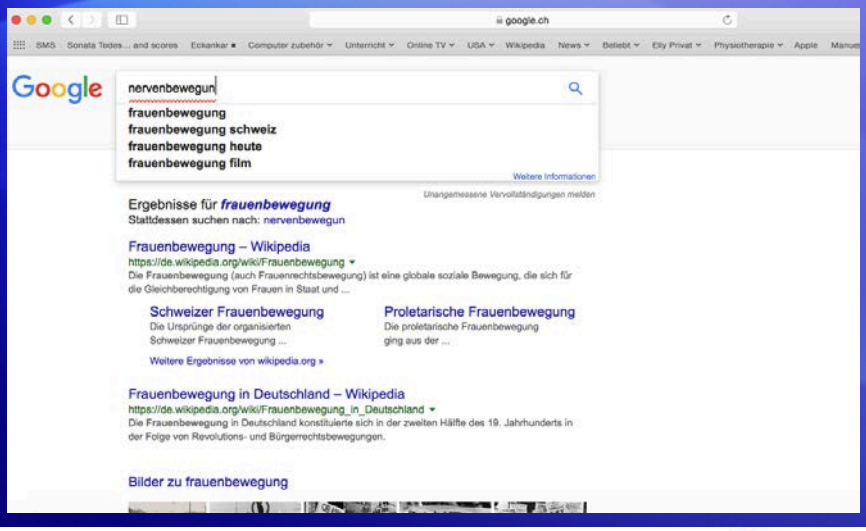
•Schutz gegen Kompression

•Einschränken bestimmter Bewegungen

•Ziel: Impulsleitung erlauben wie dies die Hauptfunktion des NS ist

Neurodynamik des oberen Quadranten

- A propos: Google hat ein Problem.....



Neurodynamik des oberen Quadranten

- Pathophysiologie

Peripher neurogene Schmerzmechanismen & Mechanosensitivität:

- *Nicht* ein einzelner Mechanismus
- Ergebnis einer Serie komplexer Prozesse

Smart, Blake, Doody, 2012

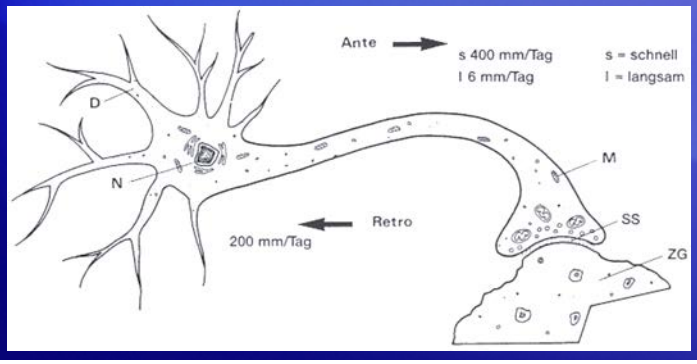
Neurodynamik - Pahtophysiologie

- Kompression,
- Blutzirkulation, Axonplasmatisches Transportsystem
- Sensibilisierung Noziceptoren im Bindegewebe
- Ectopic Excitability
- „Cross Excitation“
- Strukturelle Veränderungen
- Neuro-immunologische Reaktionen

Neurodynamik - Pathophysiologie

Axonale Transportsysteme:

- anterograd schnell: synaptische Vesikel, Neurotransmitter und –peptide, Enzyme
- anterograd langsam: zytoskeletales Material wie Neurofilamente und Microtubuli
- retrograd: Lysosomen, Wachstumsfaktoren



Neurodynamik - Pahtophysiologie

Kompression

Axoplasmatischer Fluss – Reaktion auf Kompression (Lundborg 1970)

- 30 mmHg für 2h → axonale Transport
- 50 mm Hg für 2h → reversibel innerhalb 24 h
- 200 mm Hg für 2 h → reversibel innerhalb 3Tagen
- 400 mm Hg für 2h → reversibel innerhalb 7 Tagen

Diabetische Nerven sind anfälliger auf Kompression

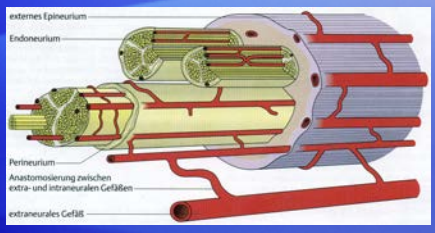
Neurodynamik - Pahtophysiologie

Mögliche Folgen eines gestörten axonalen Transports - „a sick neuron“

- Strukturelle und/oder dynamische Veränderungen des Neurons selber, z.B. in Form eines „Crush-Syndroms“
- Beeinträchtigung der Zellkörper
- Beeinträchtigung der Zielgewebe

Verletzungs- und Entzündungs „anfälligkeit“ Steigt → Entzündungreaktionen intra- und perineural

Neurodynamik – Durchblutung des Nervs

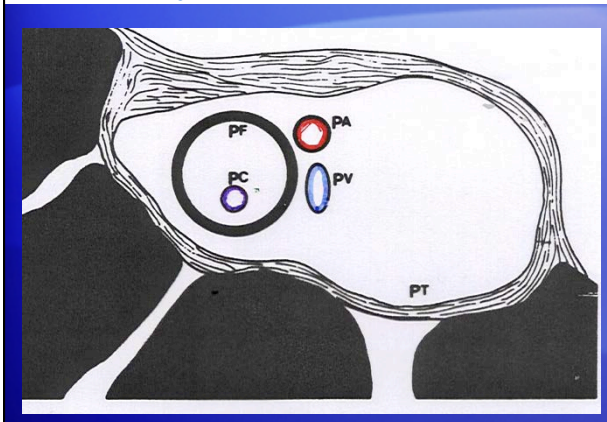


Lunborg, 1970. Intraneuurale Blutzirkulation

Stimulation des sympathischen Grenzstranges führt zur endoneuralen Vasokonstriktion

Rolle der Daueraktivierung des Sympathischen NS bei negativer Stress / mangelnde Erholungsdphysen? (Parasymp. Aktivität)

Neurodynamik des oberen Quadranten

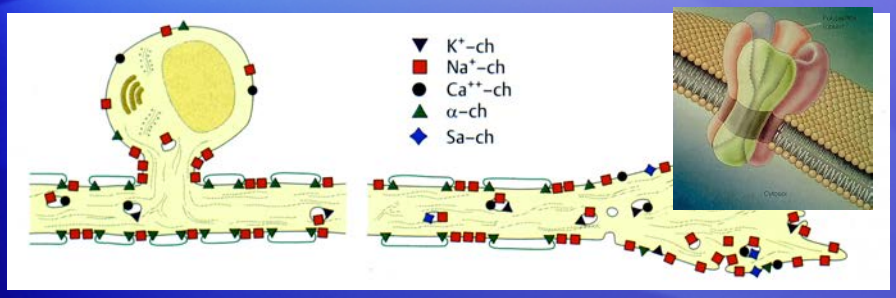


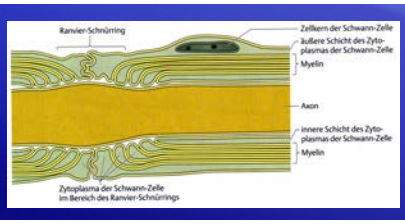
Druckgradienten Sunderland: Pa > Pc (kapill.) > Pf > Pv> Pt

Ischaemie → Hypoxie & Azidose → evt. Fibrosis

Neurodynamik des oberen Quadranten

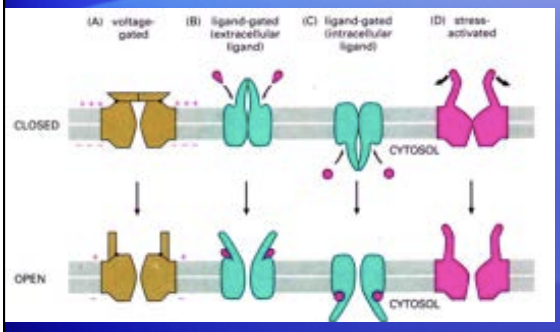
- Ectopic excitability – Ionen Kanäle, Rezeptoren





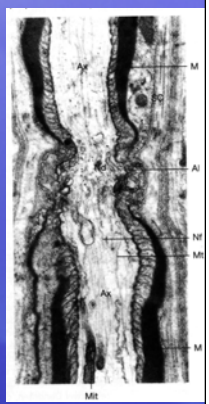
Neurodynamik des oberen Quadranten

- Ectopic excitability – Ionen Kanäle, Rezeptoren



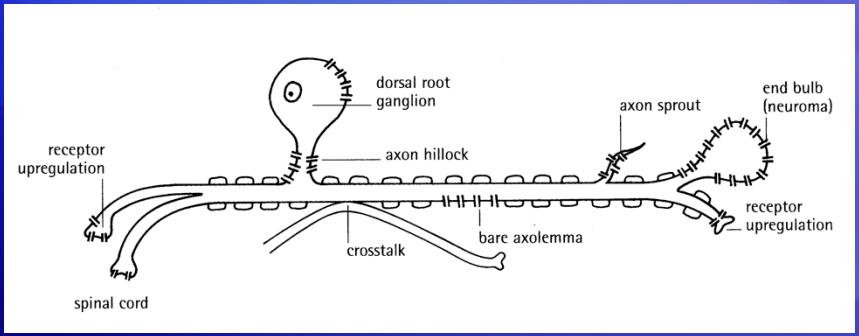
Chemo-, mechano-, thermo-sensibel

→ zB Reaktiv zu chemischen Entzündungsmediatoren (Cytokine; (Nor)Adrenaline), Ischemie, Mechanische Stimuli, Temperatur



Neurodynamik des oberen Quadranten

Abnormale impulsgenerierende Stellen (AIGS): eine Übersicht



Neurodynamik des oberen Quadranten

MANY WAYS TO INJURE A PERIPHERAL NERVE - THE UPPER LIMB

Traditional nerve injury classifications

Most clinicians would have learnt about grades of peripheral nerve injury ranging from the more minor *neurapraxia*, (conduction block with eventual reversal) to *axonotmesis* (axon severed, but connective tissues OK) and *neurotmeses* (neurones severed and connective tissue cut or badly scarred). These categories emerged post WW2 from the work of Sunderland and Seddon. Although we learned them, we rarely used them, unless perhaps you were working in peripheral nerve surgery. Sunderland and other peripheral nerve experts always talked about pre-neurapraxias (Sunderland called them *perverted nerves).* The pre-neurapraxis need a revisit.

A new look at nerve injury classification

Molecular biology has shown us that genetic and environmental forces combine to produce altered kinds and numbers of ion channels at mid axon sites along nerves, creating ectopic discharge – the basis of many syndromes such as carpal tunnel syndrome, tarsal tunnel syndrome and neurogenic tennis elbow. They may react to mechanical, temperature and emotional forces, but still not be picked up on a nerve conduction test. If Sunderland were alive today, I think he would be delighted to see his “perverted nerves” exposed.

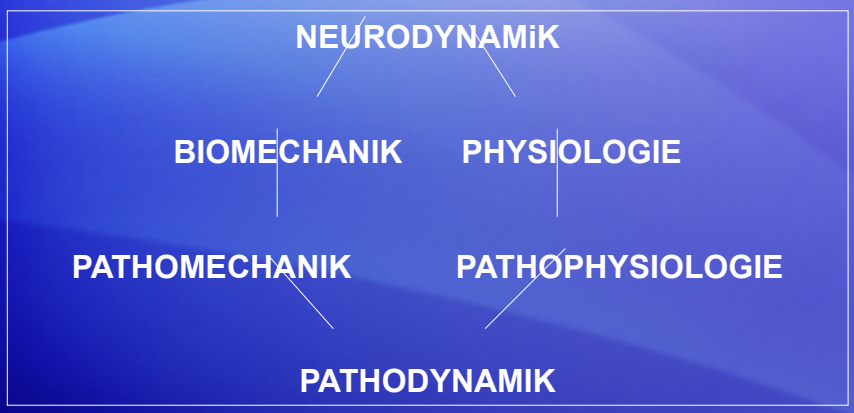
A new view of peripheral nerve injury

Of course, nerves can be severely injured by traction, pinch and rubbing forces. The literature is full of exotic ways of injuring peripheral nerves, including grenade throwing practice (long thoracic), “love bites” (accessory), handcuffs (radial sensory), cycling, taxi driving (ulnar), biceps exercise (musculocutaneous), injections (radial) and simple repetitive wrist flexion and extension (median). A whole range of familial and systemic states will also intervene. Some spider bites can be particularly mean on nerves too.

But a modern view is that it is not only the injuring movements which are critical, but the nerve **owner’s responses and perceptions of the injury**. Recent studies showing increased nerve adrenosensitivity (eg. more sensitive when stressed) and immunoreactivity (eg worse with the flu) with injury suggest the brain plays a big part in the clinical manifestations.

(NOI Newsletter March 2008)

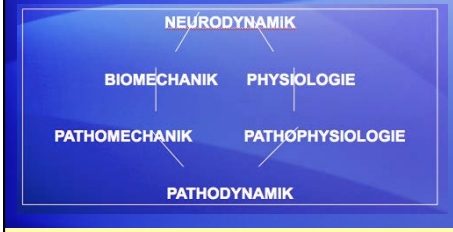
Neurodynamik des oberen Quadranten



Shacklock, 1995

Wieso besteht eine Mechanosensitibilität des neuralen Systems?

Neurodynamik des oberen Quadranten



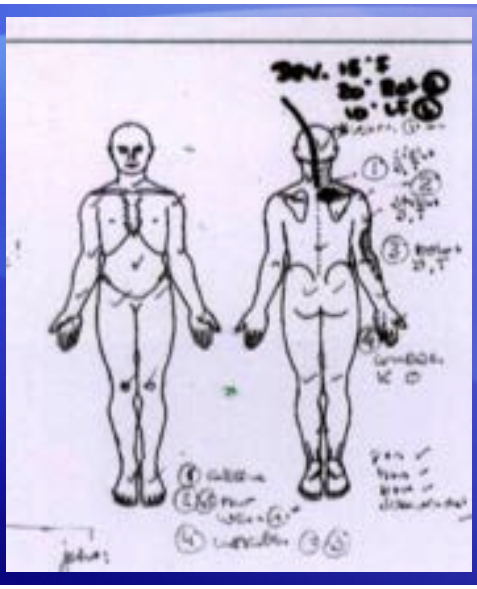
Je mehr pathophysiologische Prozesse vorhanden zu sein schein → zurückhaltendheit in Untersuchung und Behandlung

- **Untersuchen mehr bis Schmerzanfang, nicht zu lange an Bewegungsgrenze**
- **Behandlung: vermehrt auf „Interfaces“ (‚primary crushes‘) gerichtet**

Neurodynamik des oberen Quadranten

- Patientenbeispiele
- Besprechung, Demonstration

Neurodynamik des oberen Quadranten



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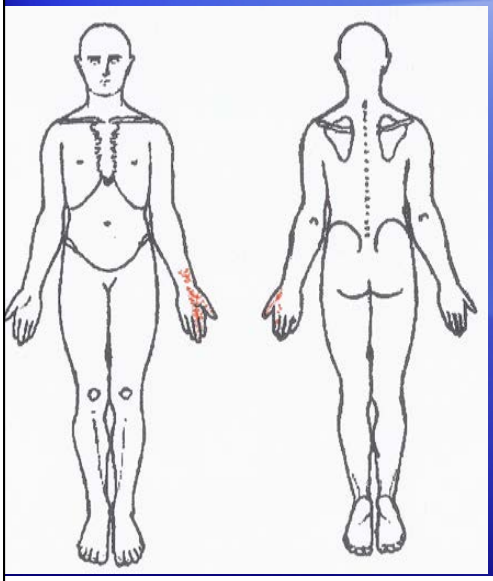

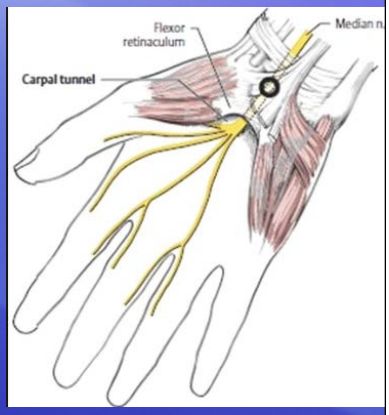

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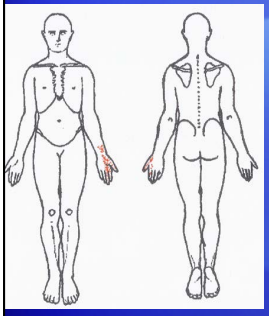


Upton & McComas, 1973

CTS – n=115

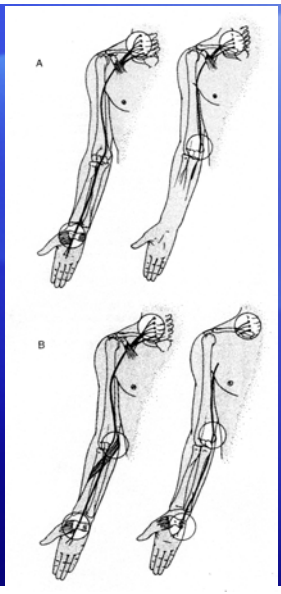
N= 81 auch Nackenprobleme

Circa 40%: nach 1-2 Jahren Symptome an anderer Seite

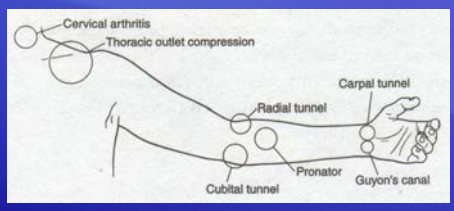
Symptome an einem Nerve → mögliche Ausweitung im Verlauf des Nerves

DOUBLE CRUSH PHÄNOMEN → BEEINTRÄCHRIGUNG PROXIMAL → DISTAL

1973: Axonoplasma?
1990: Mechanisch?
2015: Komplexe physiologische Zusammenhänge



Double- und multiple „crushes“ in der oberen Extremität



Neurodynamik des oberen Quadranten

Neural Mobilization: A Systematic Review of Randomized Controlled Trials with an Analysis of Therapeutic Efficacy

Richard F. Ellis, B. Phty, Post Grad Dip
Wayne A. Hing, PT, PhD

Abstract: Neural mobilization is a treatment modality used in relation to pathologies of the nervous system. It has been suggested that neural mobilization is an effective treatment modality, although support of this suggestion is primarily anecdotal. The purpose of this paper was to provide a systematic review of the literature pertaining to the therapeutic efficacy of neural mobilization. A search to identify randomized controlled trials investigating neural mobilization was conducted using the key words *neural mobilisation/mobilization, nerve mobilisation/mobilization, neural manipulative physical therapy, physical therapy, neural/nerve glide, nerve glide exercises, nerve/neural treatment, nerve/neural stretching, neurodynamics*, and *nerve/neural physiotherapy*. The titles and abstracts of the papers identified were reviewed to select papers specifically detailing neural mobilization as a treatment modality. The PEDro scale, a systematic tool used to critique RCTs and grade methodological quality, was used to assess these trials. Methodological assessment allowed an analysis of research investigating therapeutic efficacy of neural mobilization. Ten randomized clinical trials (discussed in 11 retrieved articles) were identified that discussed the therapeutic effect of neural mobilization. This review highlights the lack in quantity and quality of the available research. Qualitative analysis of these studies revealed that there is only limited evidence to support the use of neural mobilization. Future research needs to re-examine the application of neural mobilization with use of more homogeneous study designs and pathologies; in addition, it should standardize the neural mobilization interventions used in the study.

Keywords: Neural Mobilization, Neurodynamics, Randomized Controlled Trial, Systematic Review, Therapeutic Efficacy.

2008

Neurodynamik des oberen Quadranten

Efficacy of Manual Therapy Including Neurodynamic Techniques for the Treatment of Carpal Tunnel Syndrome: A Randomized Controlled Trial

Tomasz Wolny, PhD,* Edward Saulicz, PhD,* Paweł Linek, PhD,* Michael Shacklock, MPT,† and Andrzej Myśliwiec, PhD‡

ABSTRACT

Objective: The purpose of this randomized trial was to compare the efficacy of manual therapy, including the use of neurodynamic techniques, with electrophysical modalities on patients with mild and moderate carpal tunnel syndrome (CTS).

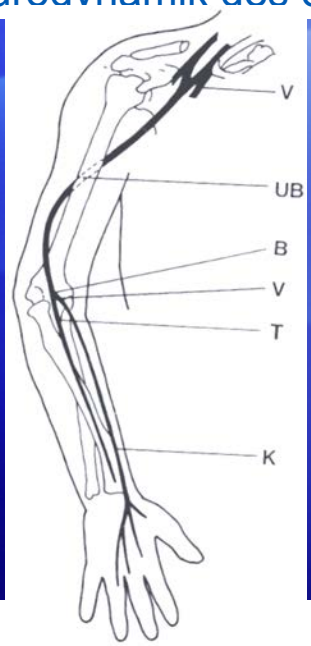
Methods: The study included 140 CTS patients who were randomly assigned to the manual therapy (MT) group, which included the use of neurodynamic techniques, functional massage, and carpal bone mobilization techniques, or to the electrophysical modalities (EM) group, which included laser and ultrasound therapy. Nerve conduction, pain severity, symptom severity, and functional status measured by the Boston Carpal Tunnel Questionnaire were assessed before and after treatment. Therapy was conducted twice weekly and both groups received 20 therapy sessions.

Results: A baseline assessment revealed group differences in sensory conduction of the median nerve ($P < .01$) but not in motor conduction ($P = .82$). Four weeks after the last treatment procedure, nerve conduction was examined again. In the MT group, median nerve sensory conduction velocity increased by 34% and motor conduction velocity by 6% (in both cases, $P < .01$). There was no change in median nerve sensory and motor conduction velocities in the EM. Distal motor latency was decreased ($P < .01$) in both groups. A baseline assessment revealed no group differences in pain severity, symptom severity, or functional status. Immediately after therapy, analysis of variance revealed group differences in pain severity ($P < .01$), with a reduction in pain in both groups (MT: 280%, $P < .01$; EM: 47%, $P < .01$). There were group differences in symptom severity ($P < .01$) and function ($P < .01$) on the Boston Carpal Tunnel Questionnaire. Both groups had an improvement in functional status (MT: 47%, $P < .01$; EM: 9%, $P < .01$) and a reduction in subjective CTS symptoms (MT: 67%, $P < .01$; EM: 15%, $P < .01$).

Conclusion: Both therapies had a positive effect on nerve conduction, pain reduction, functional status, and subjective symptoms in individuals with CTS. However, the results regarding pain reduction, subjective symptoms, and functional status were better in the MT group. (J Manipulative Physiol Ther 2017;xx:1-10)

Key Indexing Terms: *Carpal Tunnel Syndrome; Manual Therapy; Physical Therapy*

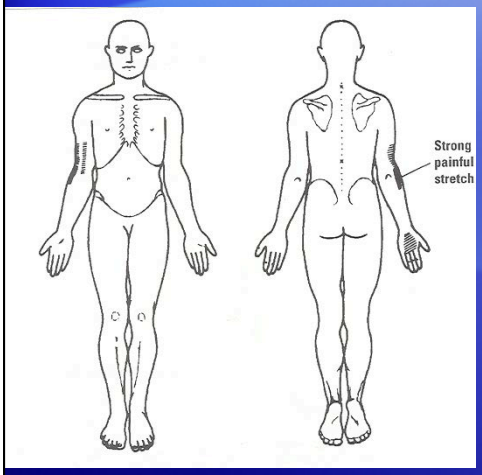
Neurodynamik des oberen Quadranten



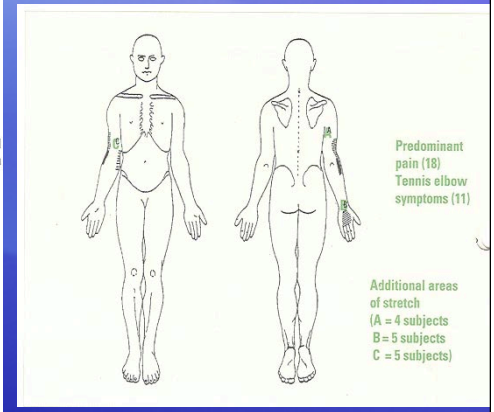
Verletzlichkeit der Nn
(Butler 1995)**:**

- Verzweigung
- Harte Grenzfläche
- Relative Fixation
- Tunnel
- Oberflächliche Lage

Neurodynamik des oberen Quadranten



Jaxley & Jull, 1991

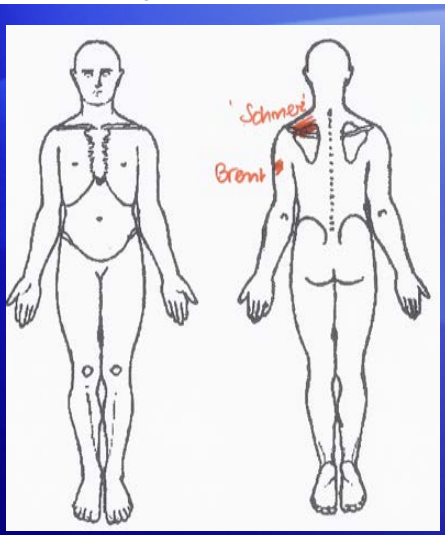


Jaxley & Jull, 1994

Reactions in 18/20 subjects with

IMTA international maitland teachers association

Neurodynamik des oberen Quadranten



IMTA international maitland teachers association

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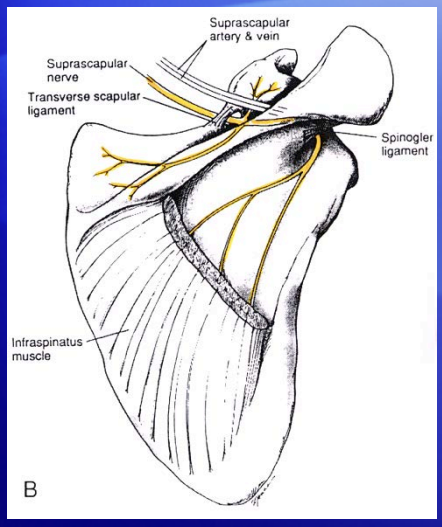

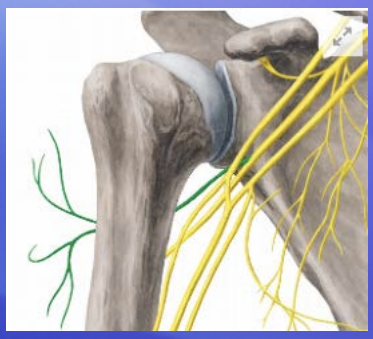

Vorsichtssituationen

- Strukturelle Probleme des Interface
- Hx kurz, verschlechternd
- „Tethered cord“ Syndrom
- Allg. Gesundheit
- Neurologische Defizite – traumatisch / Krankheit

Behandlung

NS ist bereits behandelt worden!

Denk: MOBILISATIONEN!

Behandlungsmöglichkeiten:

- Indirekt: Gelenk / Weichteile → Progression in Positionen mit etwas neuraler Vorspannung
- Direkt:
  - Palpation
  - „Sliders“
  - „Tensioners“ Gebe dem System etwas „Fluchtmöglichkeit“