Spokane Pain Conference 10/27/17

Neuropathic-Myofascial Pain Syndromes & Intramuscular Stimulation
Trigger Point Dry Needling

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Electrodiagnostic Medicine

2014 University of British Columbia
Chan Gunn Lecturer

2015 Physical Therapy Association of Washington
'Friend of PT Award'

COURSE OBJECTIVES:

1) Understand Types 1-3 Pain and Recognize the High Prevalence of Neuropathic-Myofascial Pain Syndromes: NMPS

2) Recognize the Physical Exam Findings of NMPS

3) Understand the Proper Treatment of NMPS

Disclaimer: No Financial Relationships or Affiliation to Disclose

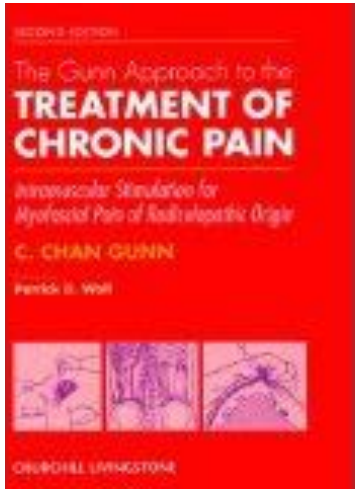
NEUROPATHIC- MYOFASCIAL PAIN

Non-Articular Musculoskeletal Pain Identified by Motor, Sensory & Autonomic Findings including the presence of 'Trigger Points', Myotomally Localized Tender & Shortened Muscle Bands ('Taut Bands') that can *often* be located by palpation and that produce local and/or referred pain, parasthesias, restricted ROM and/or Autonomic Disturbance

"I'm afraid it's your body, Mr. Haskins."

"I'm afraid it's your body, Mr. Haskins."

C.C. Gunn, M.D. and S. Goodman, M.D.



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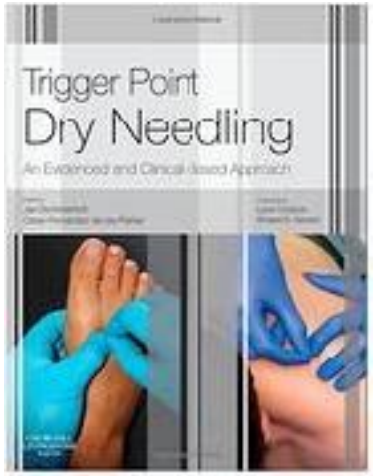
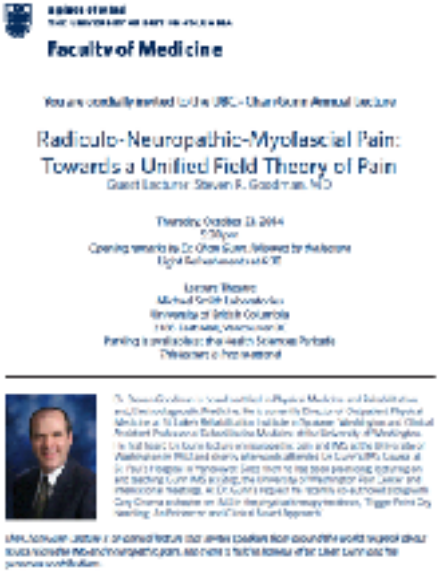


2017 2nd ed.



2014 UBC Chan Gunn Lecturer

International Association for the Study of Pain

"Pain is an unpleasant sensory & emotional experience associated with *actual or potential tissue damage*, or described by the patient in terms of such damage."

Pathophysiological - Temporal

Pain Model

PAIN = THREE Sub-Types:

- **TYPE 1: NOCICEPTION**
  = 'Noxious': Neurophysiologic Specialized Peripheral Receptor/Nerve

- **TYPE 2: INFLAMMATION**
  = 'CHEMICAL'
  Acute Tissue Damage: Trauma, Infxn or Auto-Immune

- **TYPE 3: NEUROPATHIC**
  = Supersensitivity Dysfunction

TEMPORAL PROFILE

- **TYPE 1: Nociception**

  IMMEDIATE!!!

- **TYPE 2: Inflammation**

  Acute!

- **TYPE 3: Neuropathic**

  Chronic!!!!!!!

Descartes Describes Type 1 Nociceptive 'Pain Pathway' in 17th Century

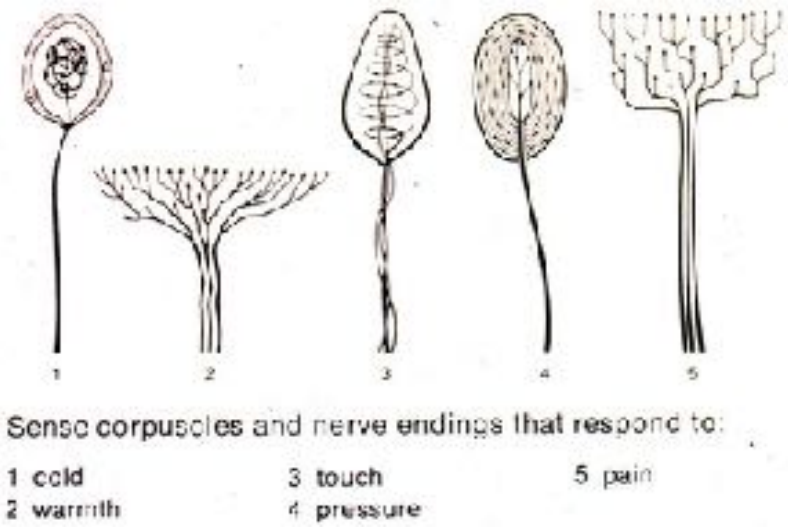
Figure 25. Descartes' (1664) concept of the pain pathway. He writes: "If for
xample fire (A) comes near the foot (B), the minute particles of this fire, which
s you know move with great velocity, have the power to set in motion the
pot of the skin of the foot which they touch, and by this means pulling upon
he delicate thread (cc) which is attached to the spot of the skin, they open up
t the same instant the pore (d e) against which the delicate thread ends, just as
y pulling at one end of a rope one makes to strike at the same instant a bell
hich hangs at the other end."

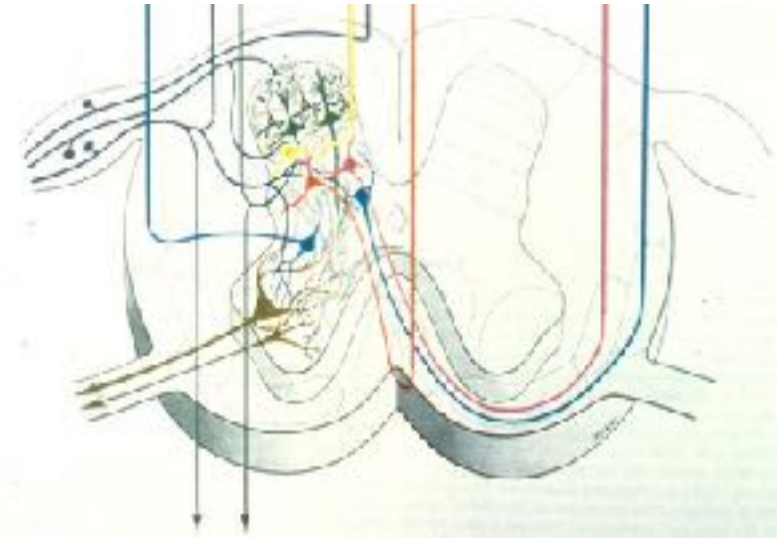
Type 1 PAIN = A-Delta Fibre

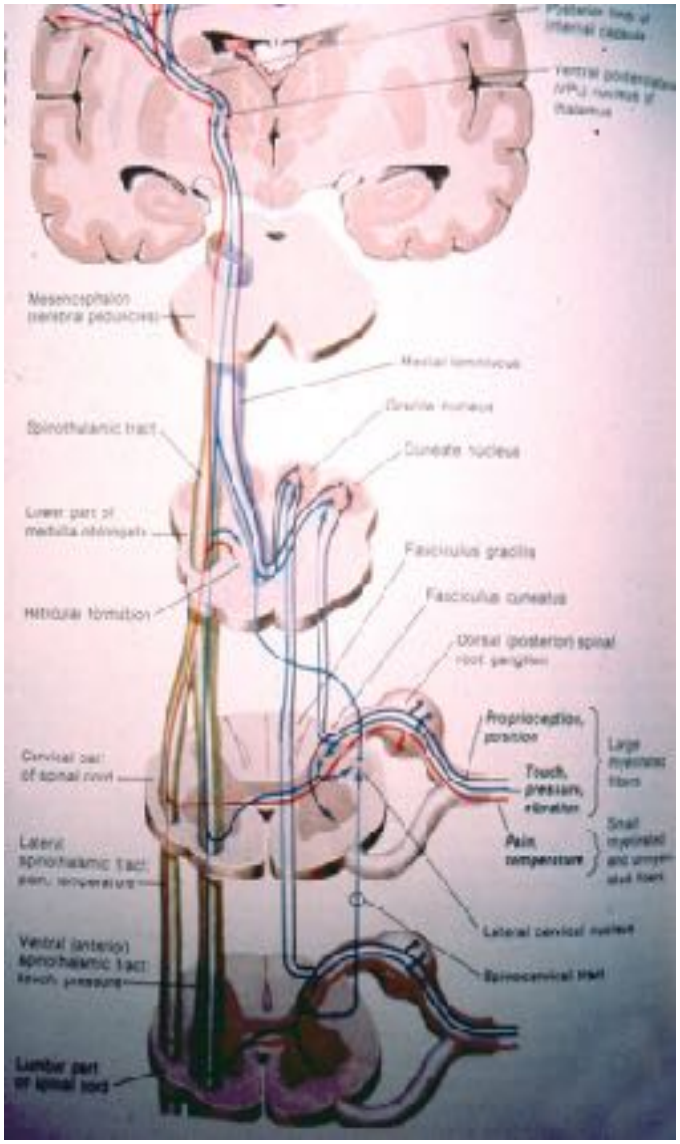
	Fiber Type		Function	Fiber Diameter (μm)	Conduction Velocity (m/s)
Myelinated	A	α	Proprioception; Somatic motor sense	12-20	70-120
		β	Touch, Pressure	5-12	30-70
		γ	Motor to muscle spindles	3-6	15-30
		δ	**Pain, Temperature, Touch**	**2-5**	**12-30**
	B		Preganglionic sympathetics	< 3	3-15
Unmyelinated	C	*Dorsal root*	Pain; Reflex responses	0.4-1.2	0.5-2
		Sympathetic Fibers	Postganglionic sympathetics	0.3-1.3	0.7-2.3

Ganong WF, Review of Medical Physiology 22nd ed. Lange, 2005

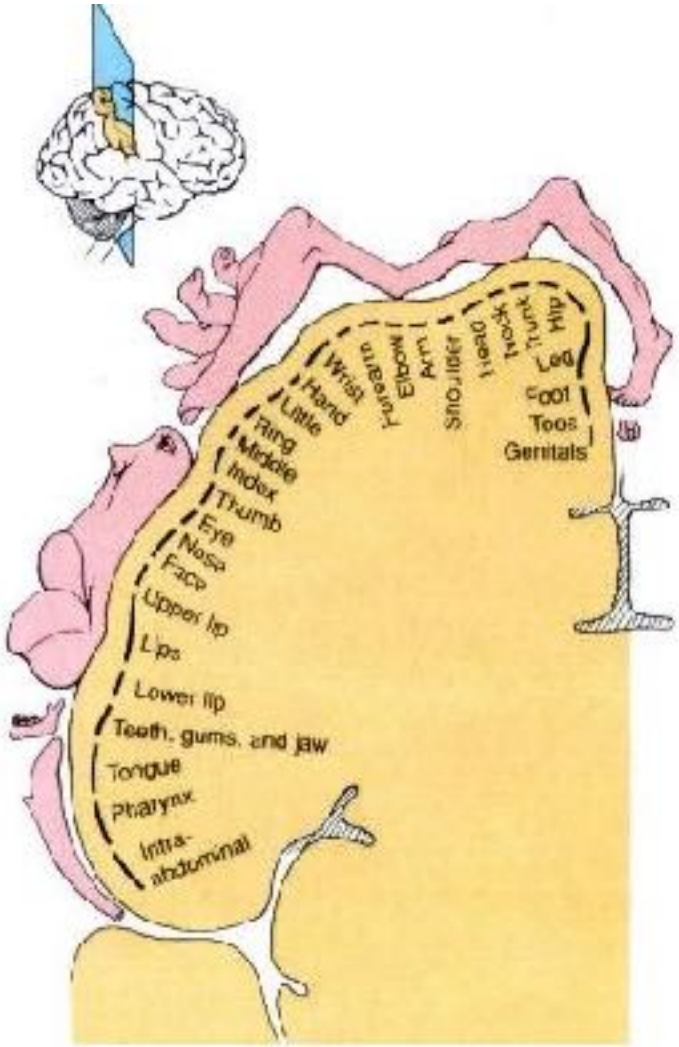
Neuroanatomy A to Z



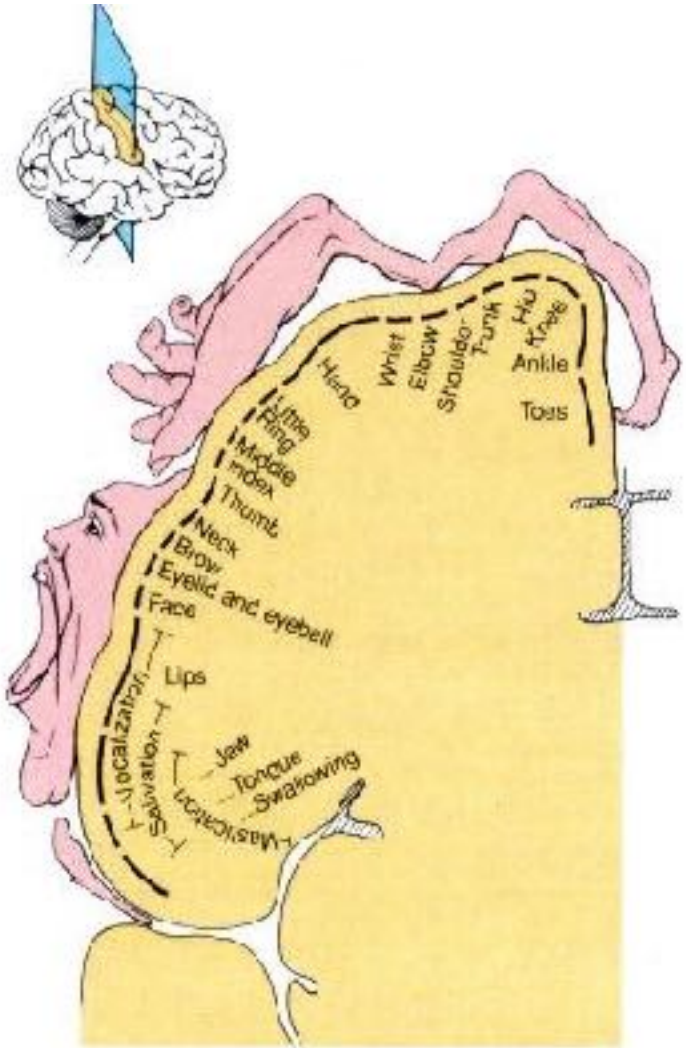




Harry The Homunculus



(a) Somatosensory cortex in right cerebral hemisphere



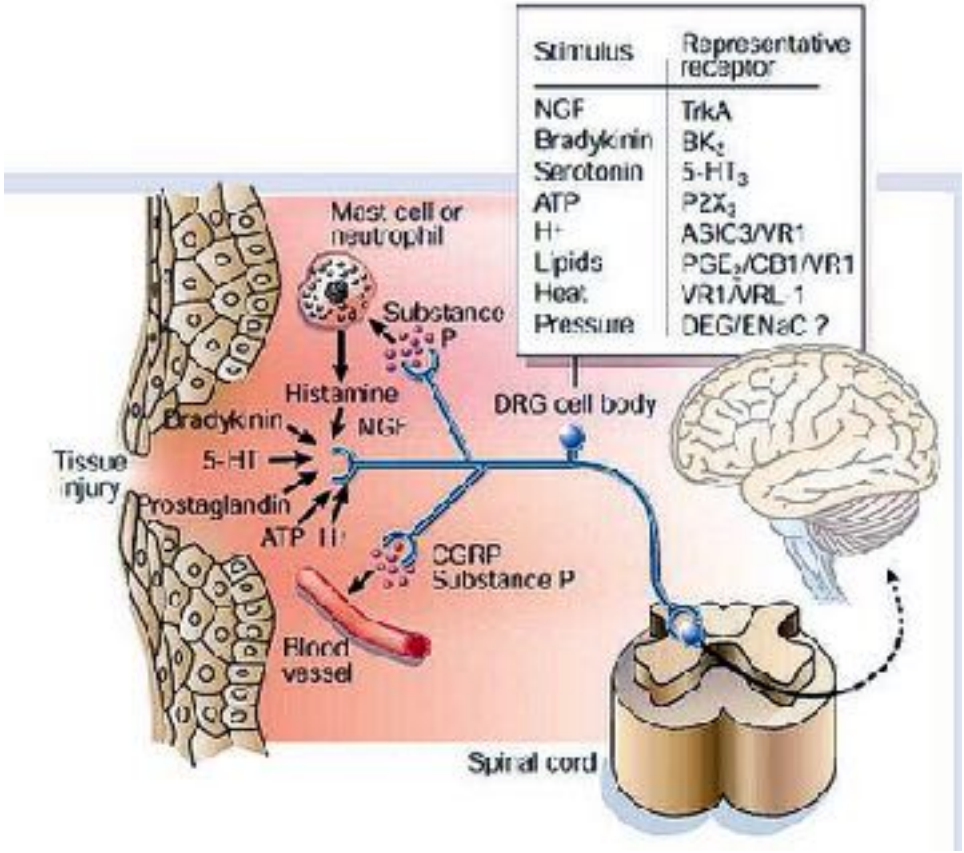
(b) Motor cortex in right cerebral hemisphere

‘Type 1’ Pain: ‘Experimental Pain’ or ‘Monkey Business’ A-Delta Nerve Fiber

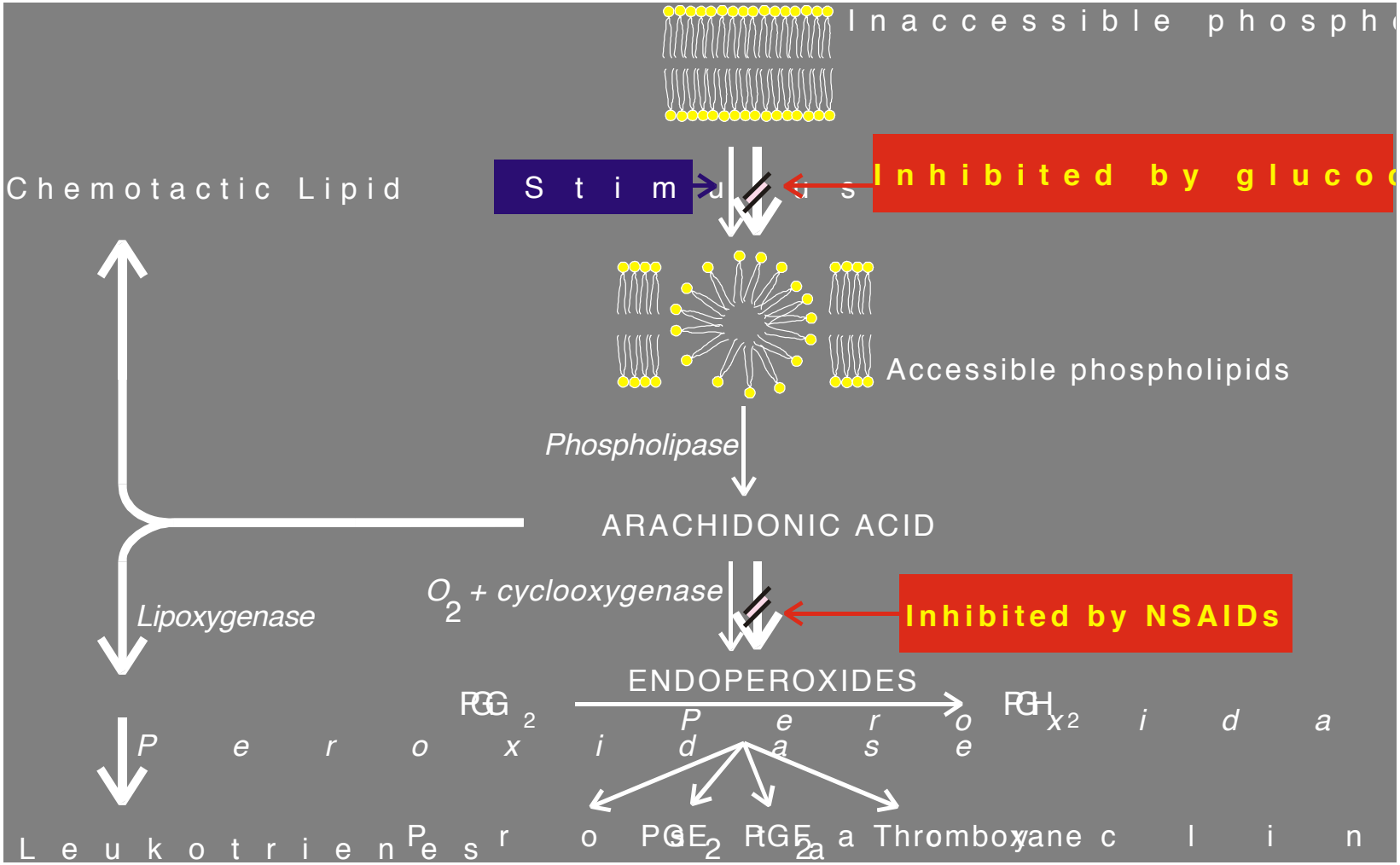
CHARACTERISTICS of TYPES 1- 3 PAIN

	1 NOCI	2 INFLAMMATION	3 NEUROPATHIC
Localization/Locus	Cutaneous Precise Discr.	Poorly localized, vague Visceral/Referred Pattern	Poor/vague Mixed
Onset & Duration	Immediate	Acute	Chronic
Course	On/Off	Protracted	Unremitting
Quality	Sharp	Aching	ALL/MIXED
Intensity	High	Variable	High
Correlation Stim/Resp	“	“	
Behavioral Response	Fight or Flight	Concern Care, Anxiety	Depression

‘Type 2’ Pain: Cellular Damage Trauma or Immune Mediated ‘Chemical’ Inflammation: DOLOR RUBOR CALOR TUMOR



The Inflammatory 'Cascade'



Type 2 PAIN = C Fibre

	Fiber Type	Function	Fiber Diameter (μm)	Conduction Velocity (m/s)
Myelinated	A α	Proprioception; Somatic motor sense	12-20	70-120
	β	Touch, Pressure	5-12	30-70
	γ	Motor to muscle spindles	3-6	15-30
	δ	Pain, Temperature, Touch	2-5	12-30
	B	Preganglionic sympathetics	< 3	3-15
Unmyelinated	**C *Dorsal root***	**Pain; Reflex responses**	**0.4-1.2**	**0.5-2**
	Sympathetic Fibers	**Postganglionic sympathetics**	**0.3-1.3**	**0.7-2.3**

Ganong WF, Review of Medical Physiology 22nd ed. Lange, 2005

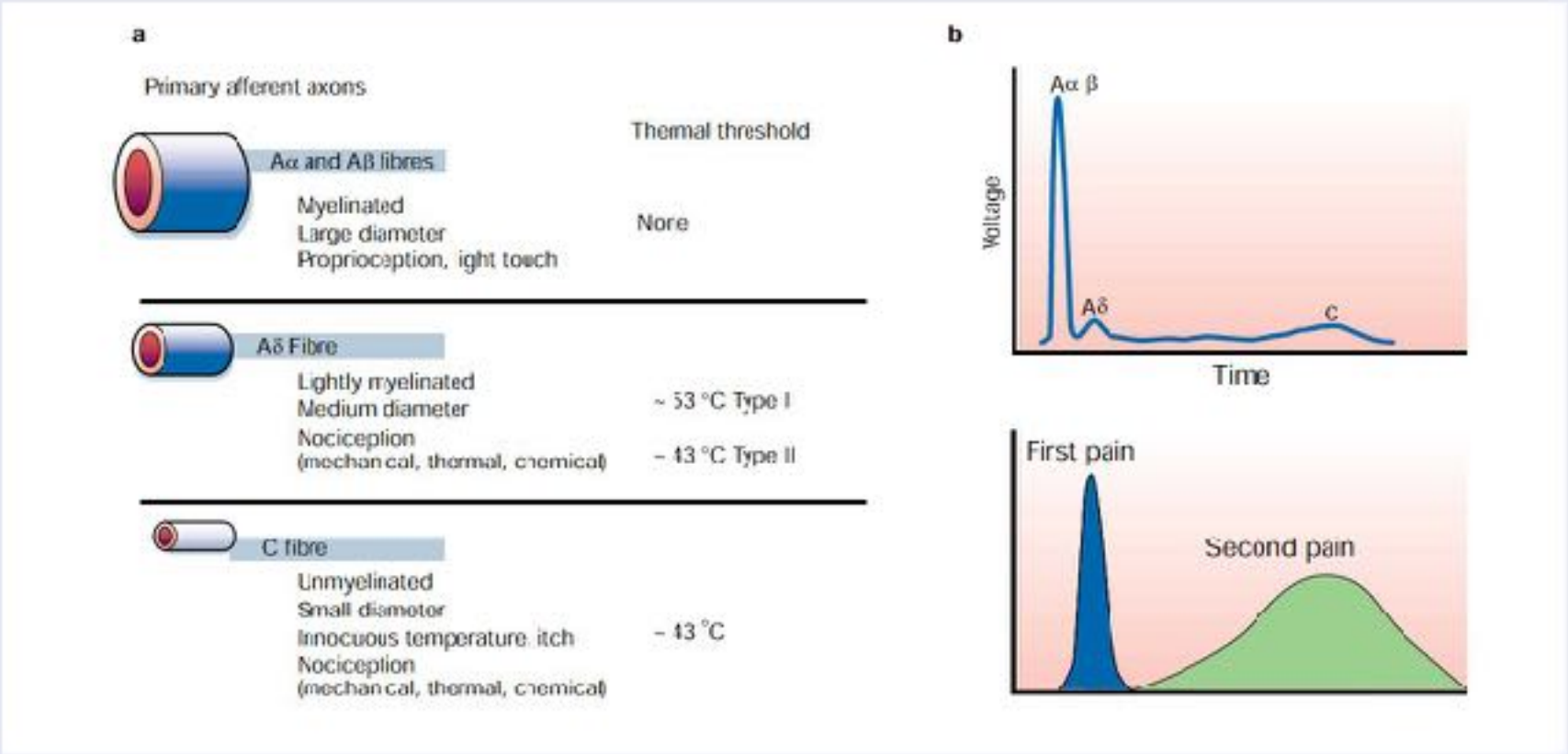


Figure 1 Different nociceptors detect different types of pain. **a**, Peripheral nerves include small-diameter (Aδ) and medium- to large-diameter (Aα, β) myelinated afferent fibres, as well as small-diameter unmyelinated afferent fibres (C). **b**, The fact that conduction velocity is directly related to fibre diameter is highlighted in the compound action potential recording from a peripheral nerve. Most nociceptors are either Aδ or C fibres, and their different conduction velocities (6–25 and ~1.0 m s^{-1}, respectively) account for the first (fast) and second (slow) pain responses to injury. Panel **b** adapted from ref. 75.

Total Body TYPE 2 PAIN

The Dinosaur Has ‘Tough Skin’

No A-Delta Fibres (Only Mammals Have)

Must Create Tissue Damage To Cause PAIN

CHARACTERISTICS of TYPES 1- 3 PAIN

	1 NOCI	2 INFLAMMATION	3 NEUROPATHIC
Localization/Locus	Cutaneous Precise Discr.	Poorly localized, vague Visceral/Referred Pattern	Poor/vague Mixed
Onset & Duration	Immediate	Acute	Chronic
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Correlation Stim/Resp	“	“	
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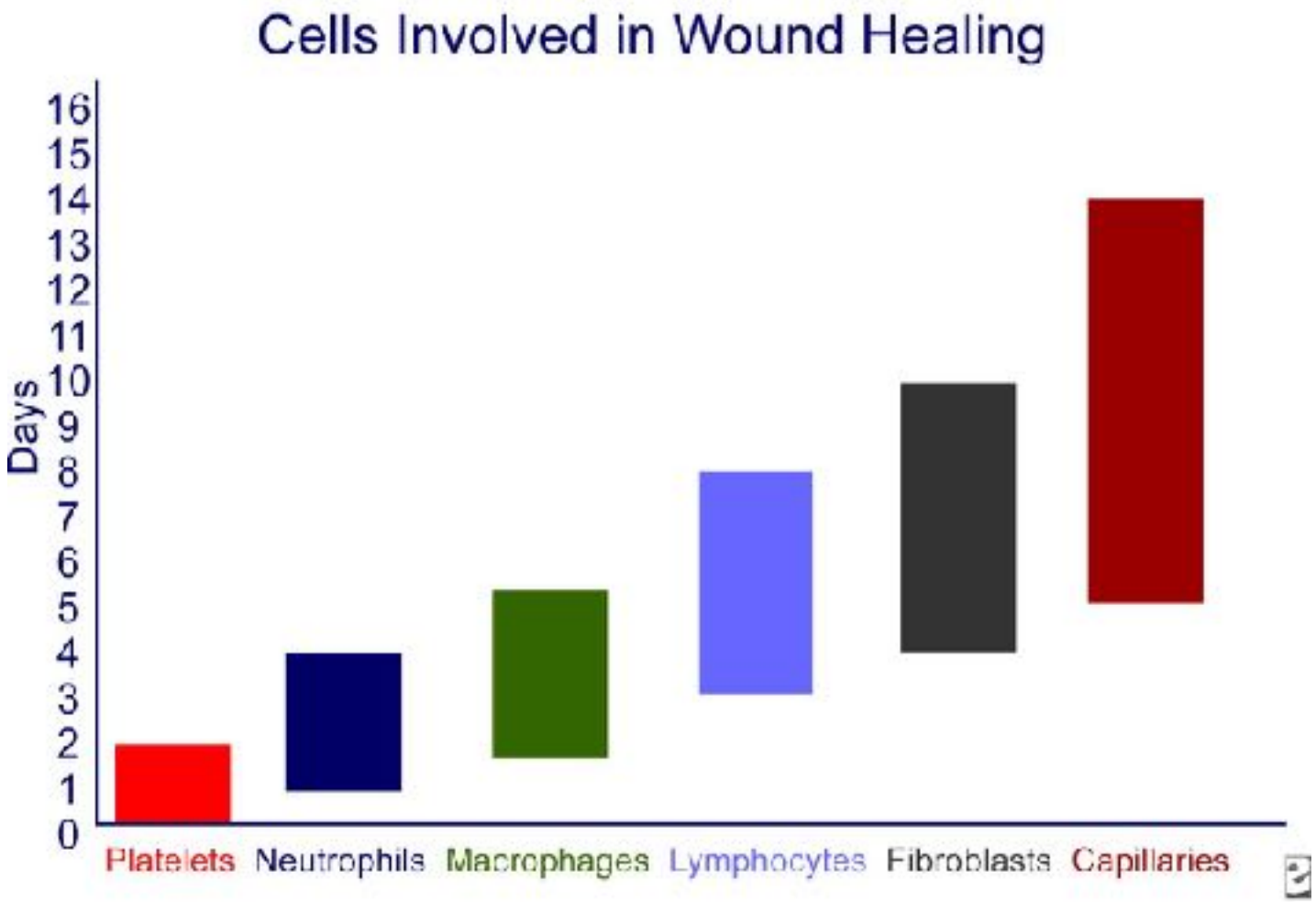

Cells Involved in Wound Healing
Days
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Platelets
Neutrophils
Macrophages
Lymphocytes
Fibroblasts
Capillaries

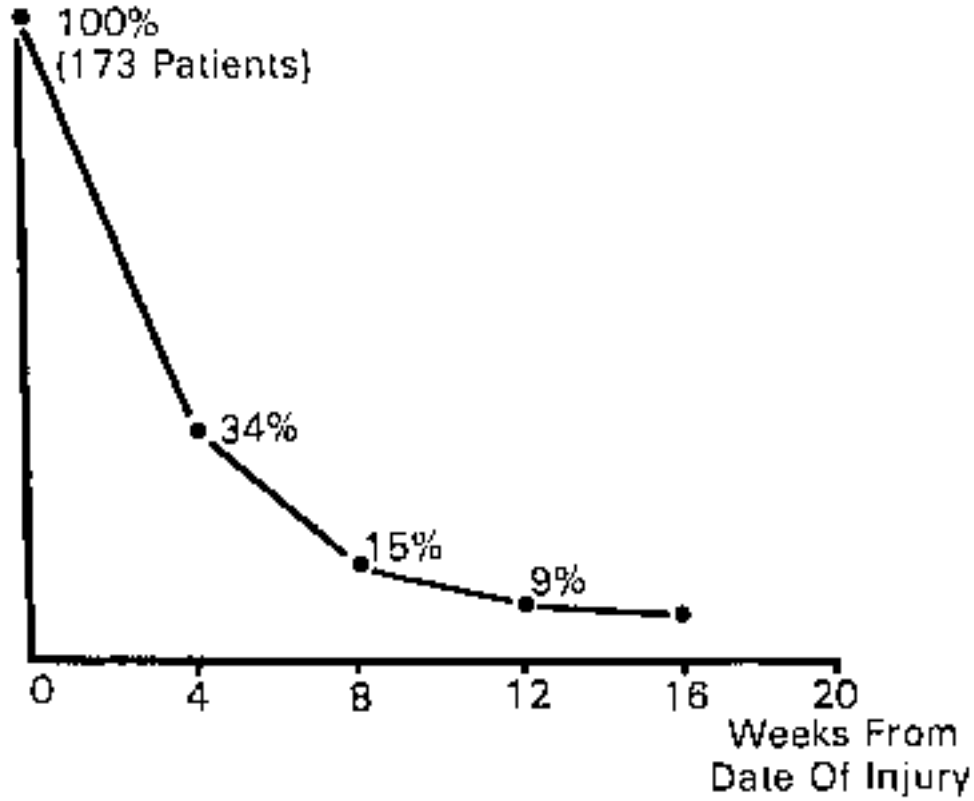
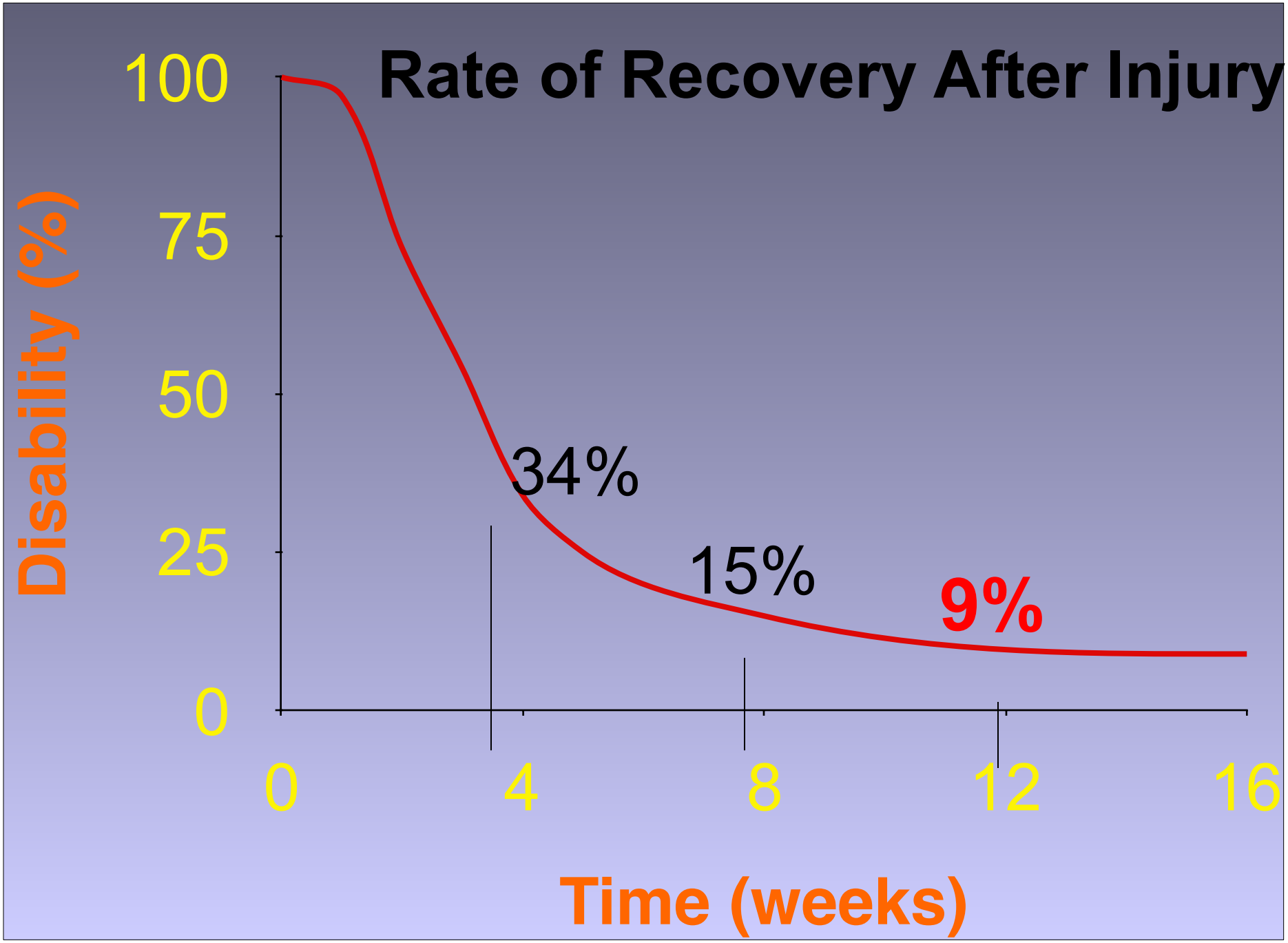
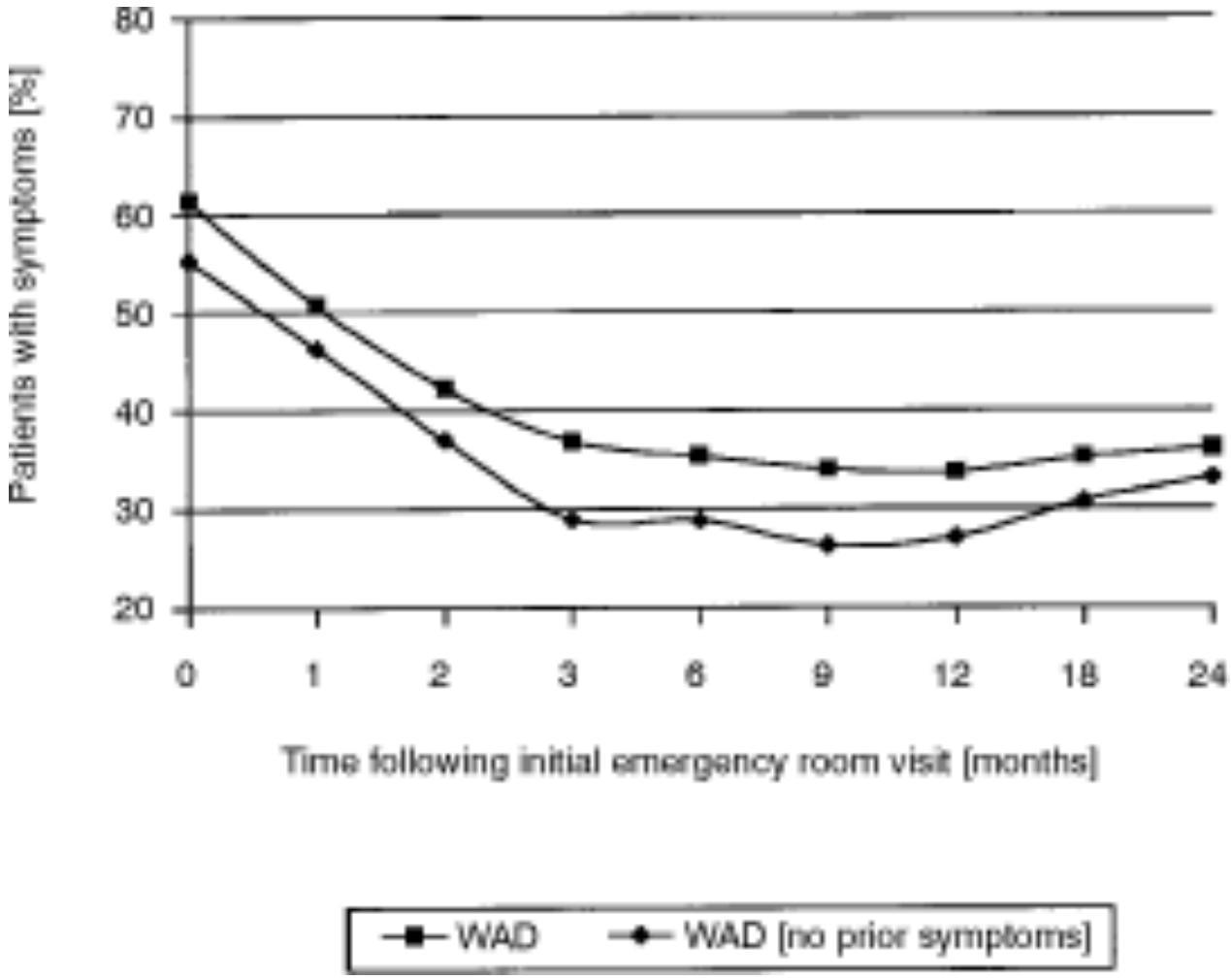


Fig 1. The natural history of low-back injury. A survey of 173 patients in 1975 showed that most (85%) are recovered by the eighth week regardless of the modality of treatment. After the 12th week there remains a resistant group of less than 10% in whom progress is extremely slow.

Gunn CC, Milbrandt WE. Dry needling of muscle motor points for chronic low back pain. A randomized clinical trial with longterm follow-up. Spine 1980;5:279-29


Rate of Recovery After Injury
Disability (%)
100
75
50
25
0
34%
15%
9%
0
4
8
12
16
Time (weeks)


Patients with symptoms [%]
80
70
60
50
40
30
20
0
1
2
3
6
9
12
18
24
Time following initial emergency room visit [months]
WAD
WAD [no prior symptoms]

- **TYPE 1: ‘NOCICEPTION’ = NOXIOUS Peripheral Receptor/Nerve**

- **TYPE 2: INFLAMMATION = ‘CHEMICAL’**

  Acute Tissue Damage, Infection or Auto-Immune

- **TYPE 3: NEUROPATHIC = Supersensitivity Dysfunction**

International Association for the Study of Pain

Definition of Neuropathic Pain:

"Pain arising as a direct consequence of a lesion or disease affecting the somatosensory system"

‘Neuro’- pathy = Nerve - disease

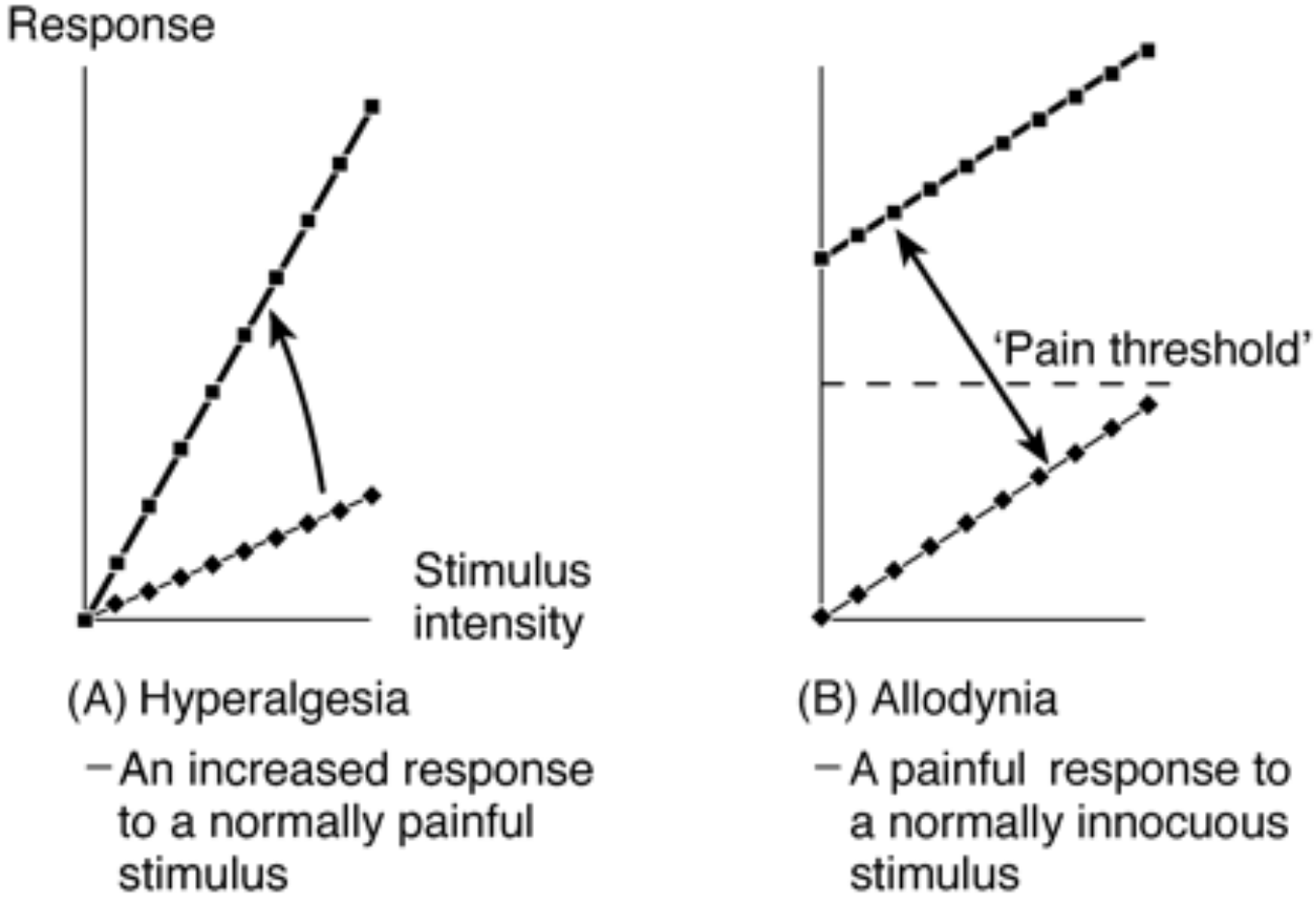
D

Nerves ‘Gone Wild’ (erratically):

- **Ectopic d/c: nerve and muscle fibers become receptive to chemical transmitters along length**
- **Ephaptic transmission = ‘CROSS TALK’ *NON-SYNAPTIC* NERVE TRANSMISSION**
- **Neural sprouting in both afferent & efferent fibers**
- **‘Short circuits’: sensory/motor/autonomic**

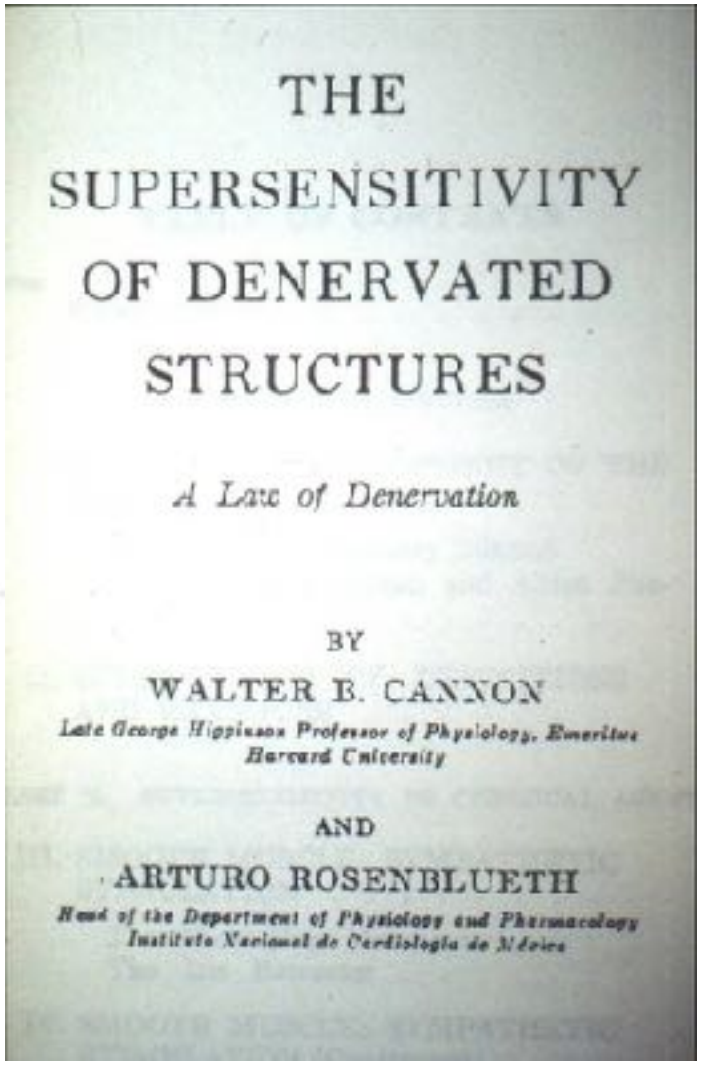
Peripheral effect	Central effects
• Ectopic and spontaneous discharge • Ephaptic conduction • Alterations in ion channel expression • Collateral sprouting of primary afferent neurones • Sprouting of sympathetic neurones into the DRG • Nociceptor sensitization	• Central sensitization • Spinal reorganization • Cortical reorganization • Charges in inhibitory pathways

British Journal of Anesthesia
Vol. 87, No. 1 12-26 2001
Mechanisms of Neuropathic Pain



British Journal of Anaesthesia
Vol. 87, No. 1 12-26 2001
Mechanisms of Neuropathic Pain

Cannon and Rosenblueth's
'Law of Denervation Supersensitivity'



THE
SUPERSENSITIVITY
OF DENERVATED
STRUCTURES

A Law of Denervation

BY

WALTER B. CANNON

Late George Higginson Professor of Physiology, Emeritus
Harvard University

AND

ARTURO ROSENBLUETH

Head of the Department of Physiology and Pharmacology
Instituto Nacional de Cardiología de México

"When in a series of efferent neurons a unit is destroyed, an increased irritability to chemical agents develops in the isolated structure or structures, the effect being maximal in the part directly denervated."

Walter Cannon, Ph.D, M.D.

Mt. Cannon

Glacier National Park

Montana

(1871-1945) was an American disciple of Sherrington, and Higginson Professor & Chairman of the Department of Physiology @ Harvard 1906-1945.

- **'Fight-or-Flight' Response**
- **'Homeostasis' (Claude Bernard)**

ALSO

- **'Law of Denervation Supersensitivity'**

ALL STRUCTURES RESPOND TO MOTOR DENERVATION by DEVELOPING ‘SUPERSENSITIVITY’

- Skeletal Muscle
- Smooth Muscle
- Spinal Neurons
- Sympathetic Ganglia
- Sweat Glands
- Adrenal Glands
- Brain Cells

Neuropathic Response

D

Four Types of Supersensitivity described by Cannon

- **Superduration of response:**
  amplitude of response unchanged but duration prolonged

- **Hyperexcitability of stimulus:**
  lower threshold of stimulus

- **Increased Susceptibility of stimulus:**
  decreased stimulus = response of normal amplitude

- **Superreactivity of tissue**
  augmented response of tissue

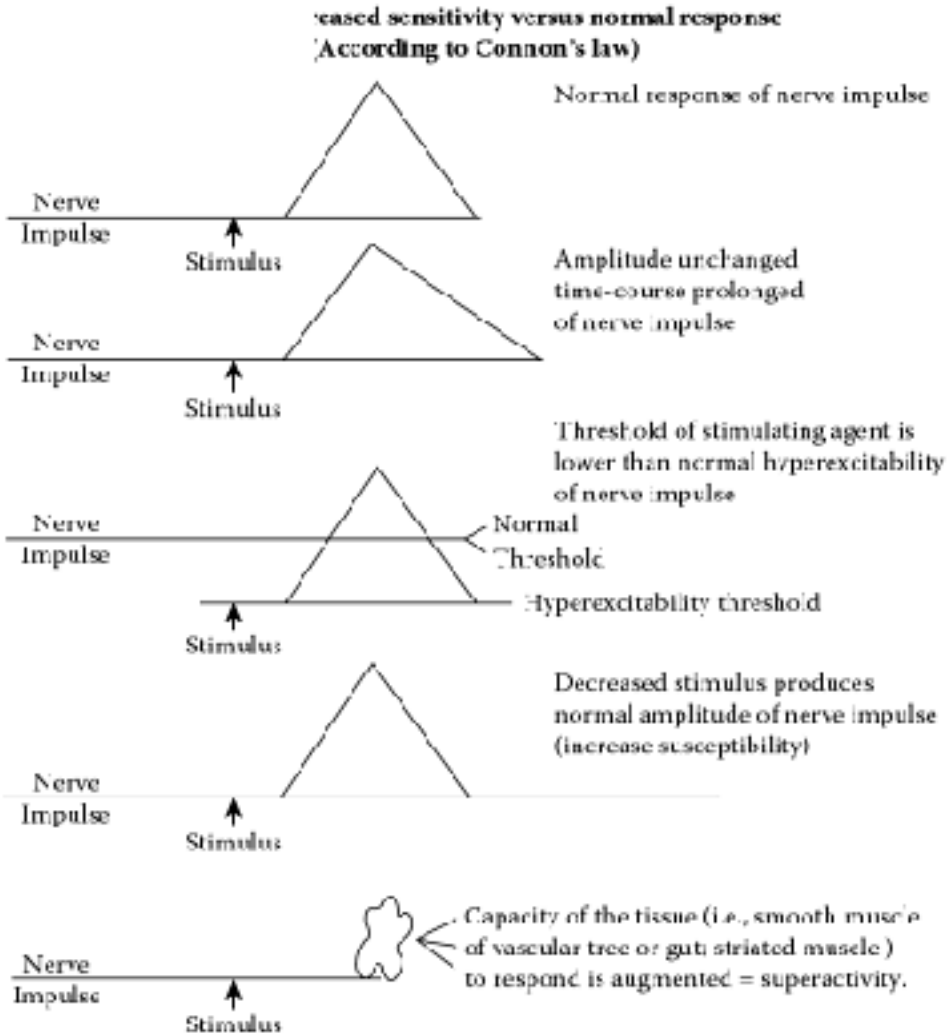
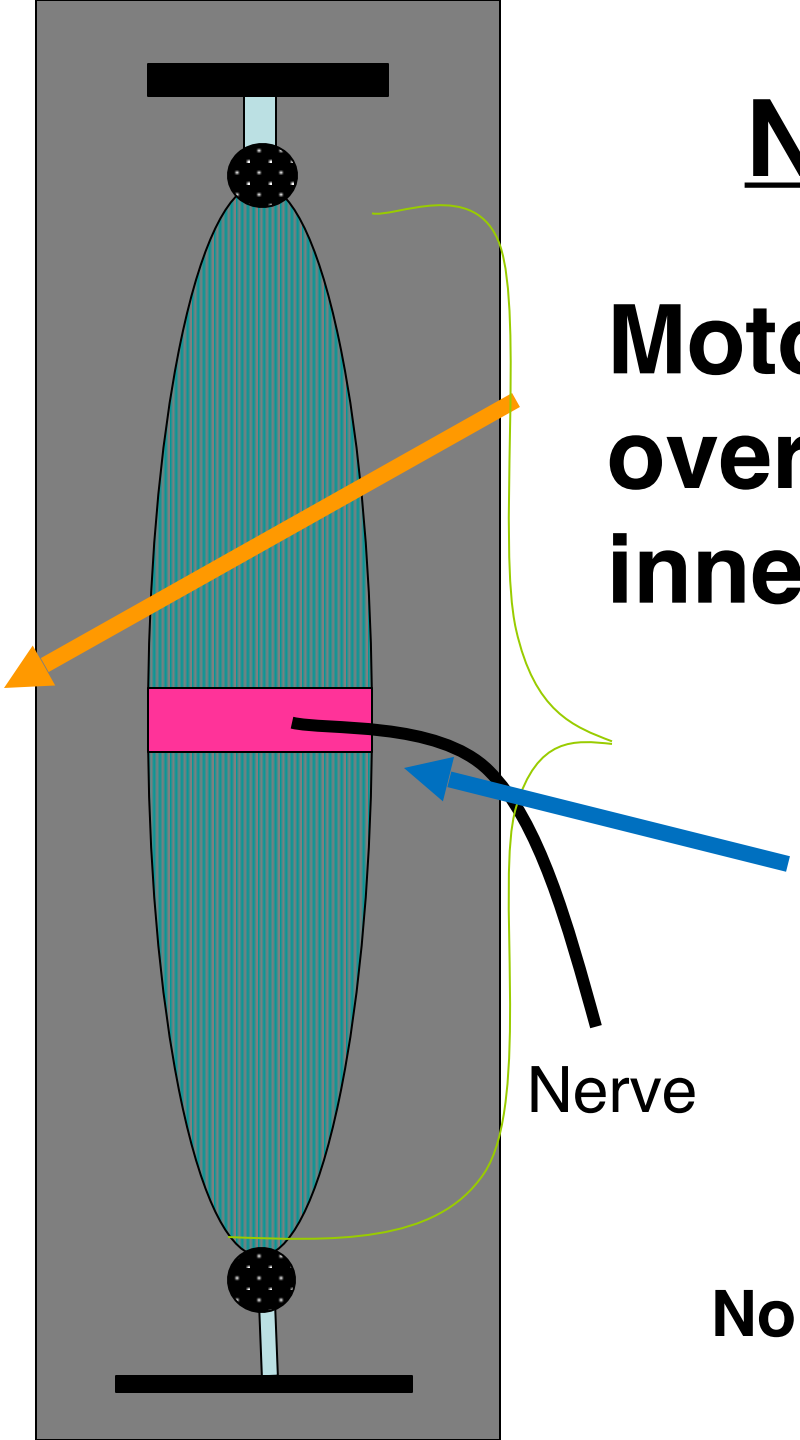


FIGURE 2.12 Types of increased Sensitivity according to the law of denervation leading to hypersensitivity to environmental responses (molds, terpenes, bacteria, viruses, neurotransmitters, foods, toxic and nontoxic chemicals). (EHC-Dallas.)



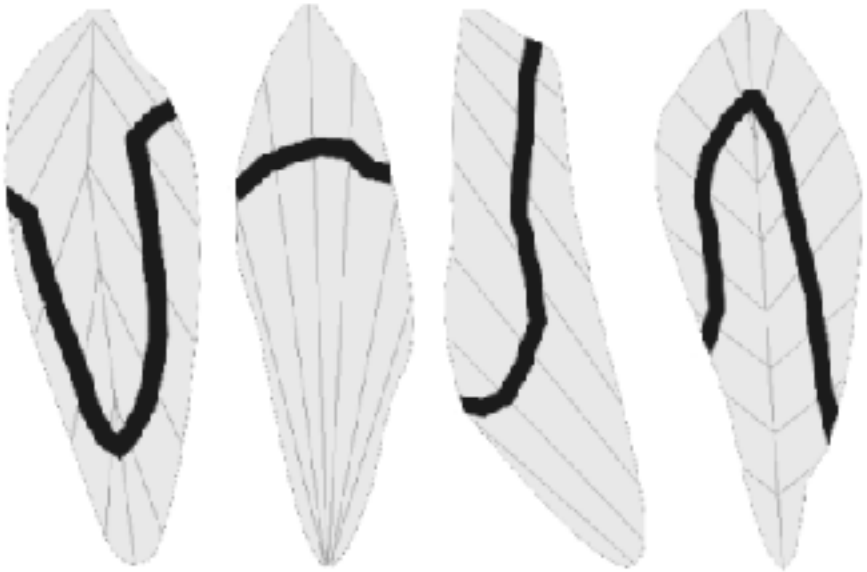
Normal Muscle

Motor Point on skin over zone of innervation

Acetylcholine acts only at receptors within a narrow zone of innervation

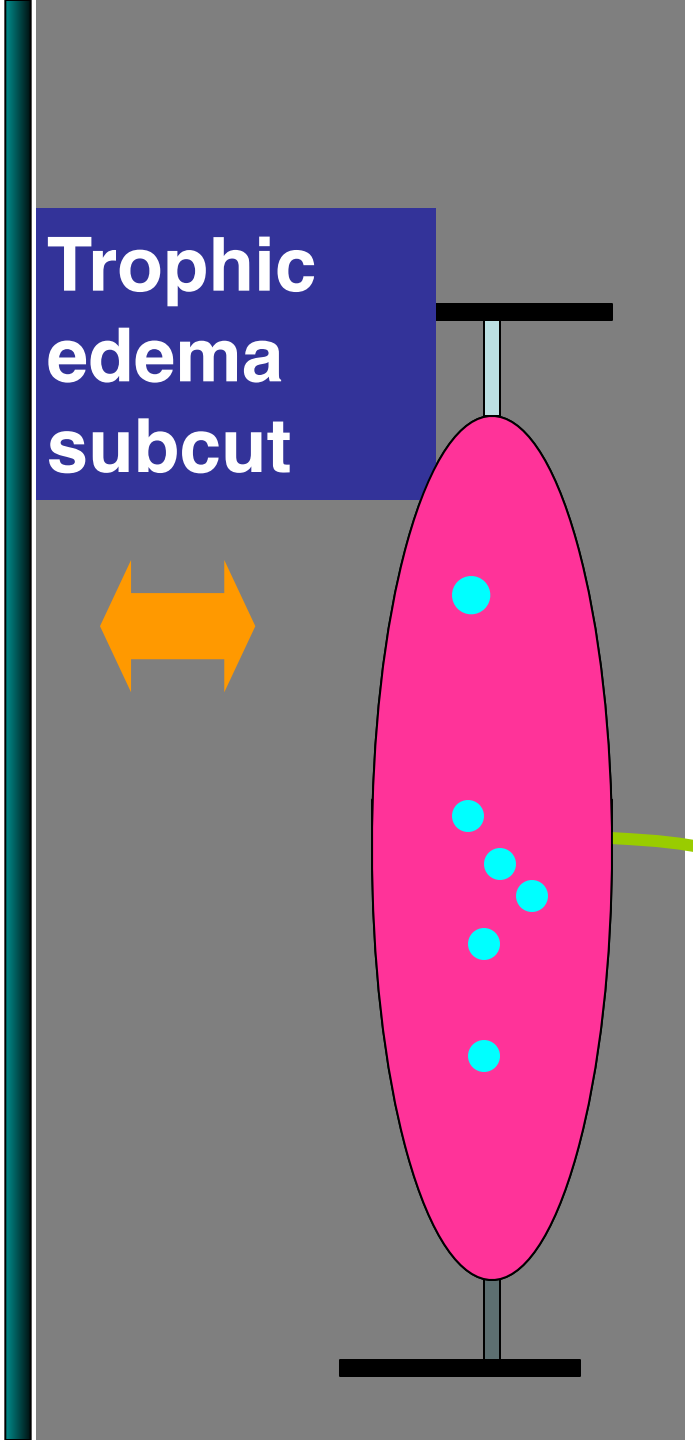
Normal subcutaneous tissue

Distribution zones of motor end plates (black lines) traced by positivity of acetylcholinesterase in human lower limb muscles



Topographical localization of motor endplates in cryosections of whole human muscles. Muscle and Nerve 1984 May;7(4): 287-93. Aquilonius, SM, et. al.

Neuropathic Muscle



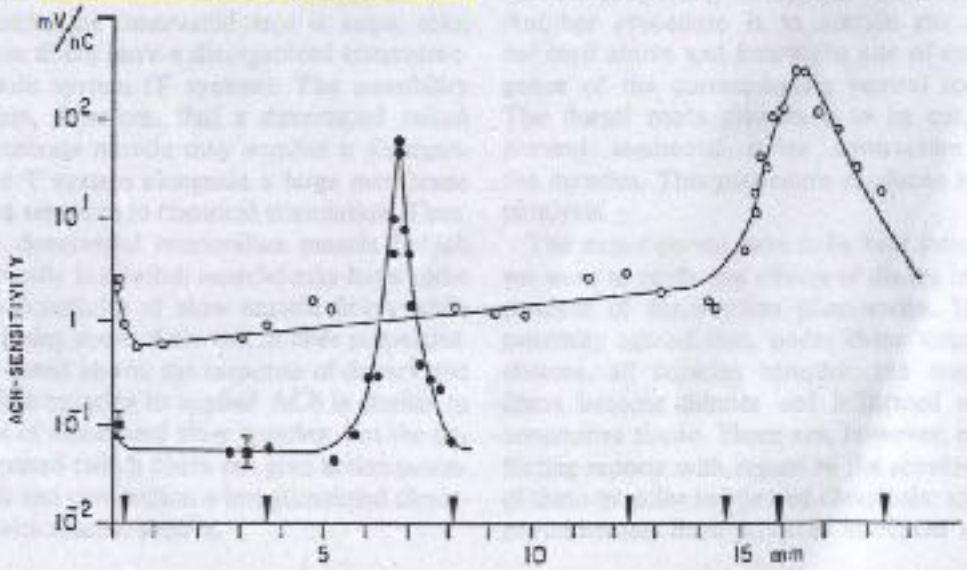
In neuropathy, Acetylcholine can act at extra-junctional "hotspots" that are present throughout the muscle

1 mmol vs. 1000 mmol

Neuropathic = Sick Nerve

Acetylcholine Sensitivity Along Muscle Membrane After Denervation

Fig. 25—2.—Distribution of sensitivity to ACh applied iontophoretically along a frog muscle fiber 58 days after denervation (open circles) and along a fiber in the opposite, control muscle (dots). Distance is measured from the muscle-tendon junctions. Triangles on the abscissa indicate successive positions of the intracellular recording electrode. Squares and bars denote mean sensitivity ± S.E.M. of 10 fibers in control muscle. In normal muscle, the highest sensitivity to ACh occurs at about 7 mm (the end-plate region). In the denervated muscle, there is almost uniform sensitivity to ACh except for an increase at the muscle-tendon junction, at about 16 mm. ACh sensitivity is expressed in threshold millivolts of depolarization per nanocoulomb of applied current ejecting ACh. (From Miledi, R.: Induction of Receptors, in Monger, J. L., and DeReuck, A. V. S. [eds.]: Enzymes and Drug Action [Boston: Little, Brown and Company, 1962].)



Eyzaguirre C, Fidone SJ 1975 Physiology of the nervous system. Chicago, Year Book Medical Publishers. 2nd ed.

Cannon and Rosenblueth
investigated complete denervation

Intact motor/efferent nerve provides not only a stimulatory but an inhibitory/stabilizing AND nourishing effect, or 'trophic factor'

'Trophic' effect on end-organ so that

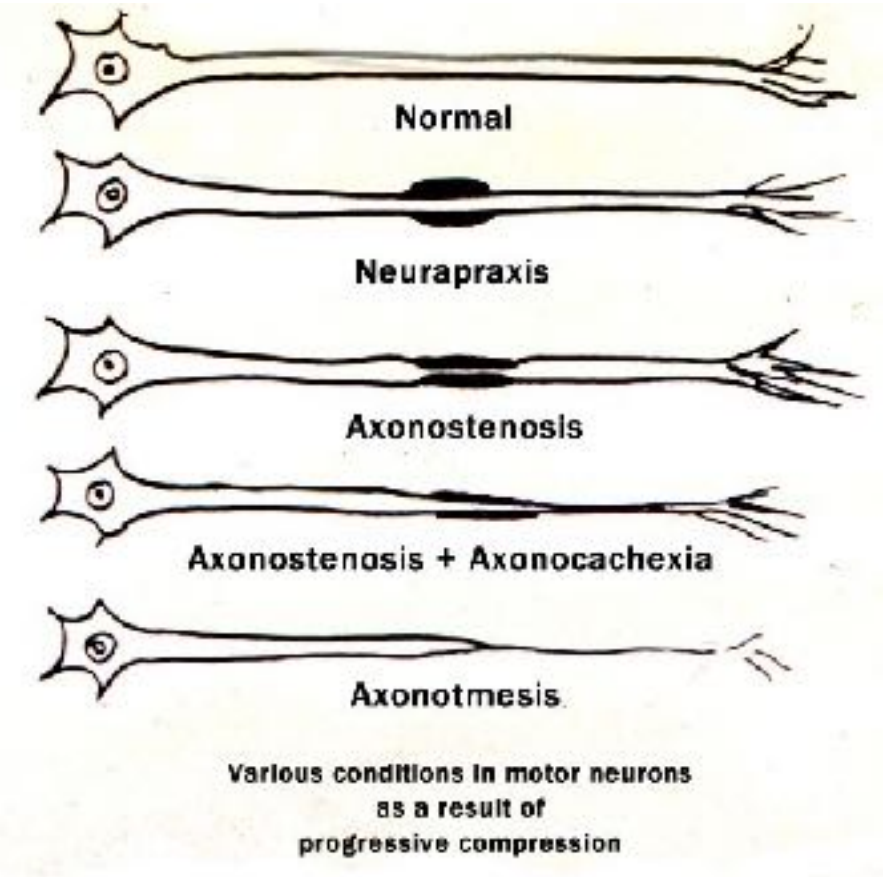
DE-NERVATION → *A*-TROPHY

NOW KNOWN: Any measure which blocks the flow of motor impulses and deprives the effector organ of excitatory input for a period of time can cause

Neuropathic DYS-FXN → *DYS*-TROPHY

Altered electrochemical state: SUPERSENSITIVITY

Various Degrees of Compression to Motor Neurons



CANNON:
DENERVATION > 'A'-TROPHY

'PARTIAL DENERVATION', or
NEUROPATHY > 'DYS'-TROPHY

Neuropathic Supersensitivity > PAIN
Home Security Alarm Triggers on Sunrise and Cat ‘Burglars’

Type 1

Type 2

Type 3

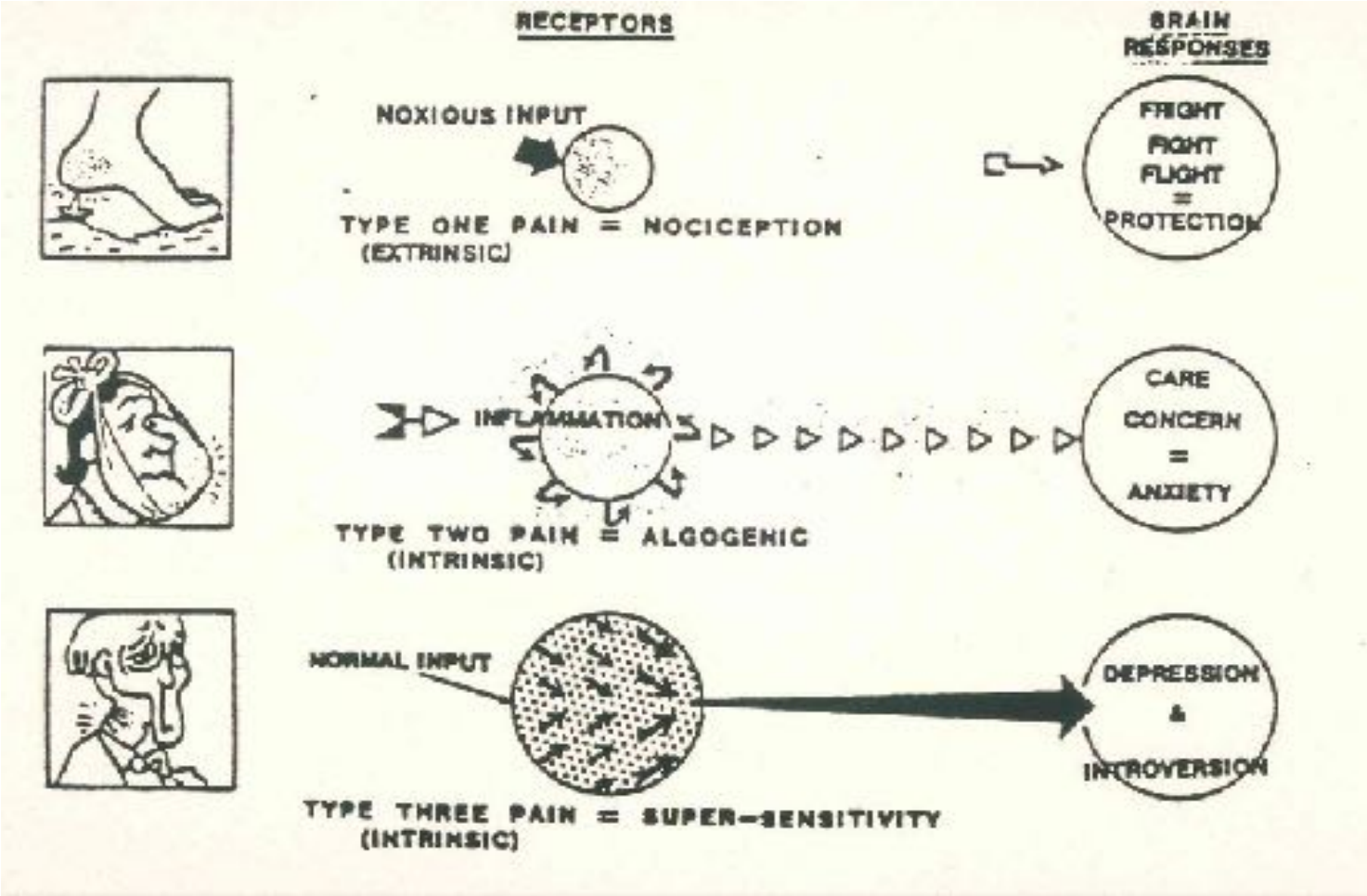


Table 1 Traditional aetiological classification of Neuropathic Pain

An estimate of the prevalence, in the USA (population 270 million) is given in brackets after each example cited

Trauma: phantom limb (50), spinal cord injury (120).
Ischaemic injury: central pain (30), painful diabetic neuropathy (600).
Infection/inflammation: post-herpetic neuralgia (500), HIV (15).
Cancer: invasion/compression of neural structures (200).
Drugs: vinca alkaloids.
Compression: sciatica (2100), trigeminal neuralgia (15).
Unknown: trigeminal neuralgia, MS (51).

British Journal of Anaesthesia, 2001, Vol. 87, No. 1 12-26 © 2001
Mechanisms of neuropathic pain
D. Bridges[1,2], S. W. N. Thompson[3] and A. S. C. Rice[1] ***[1]Pain Research, Department of Anaesthetics, Imperial College School of Medicine, Chelsea and Westminster Hospital Campus, London W2 1NY, UK***

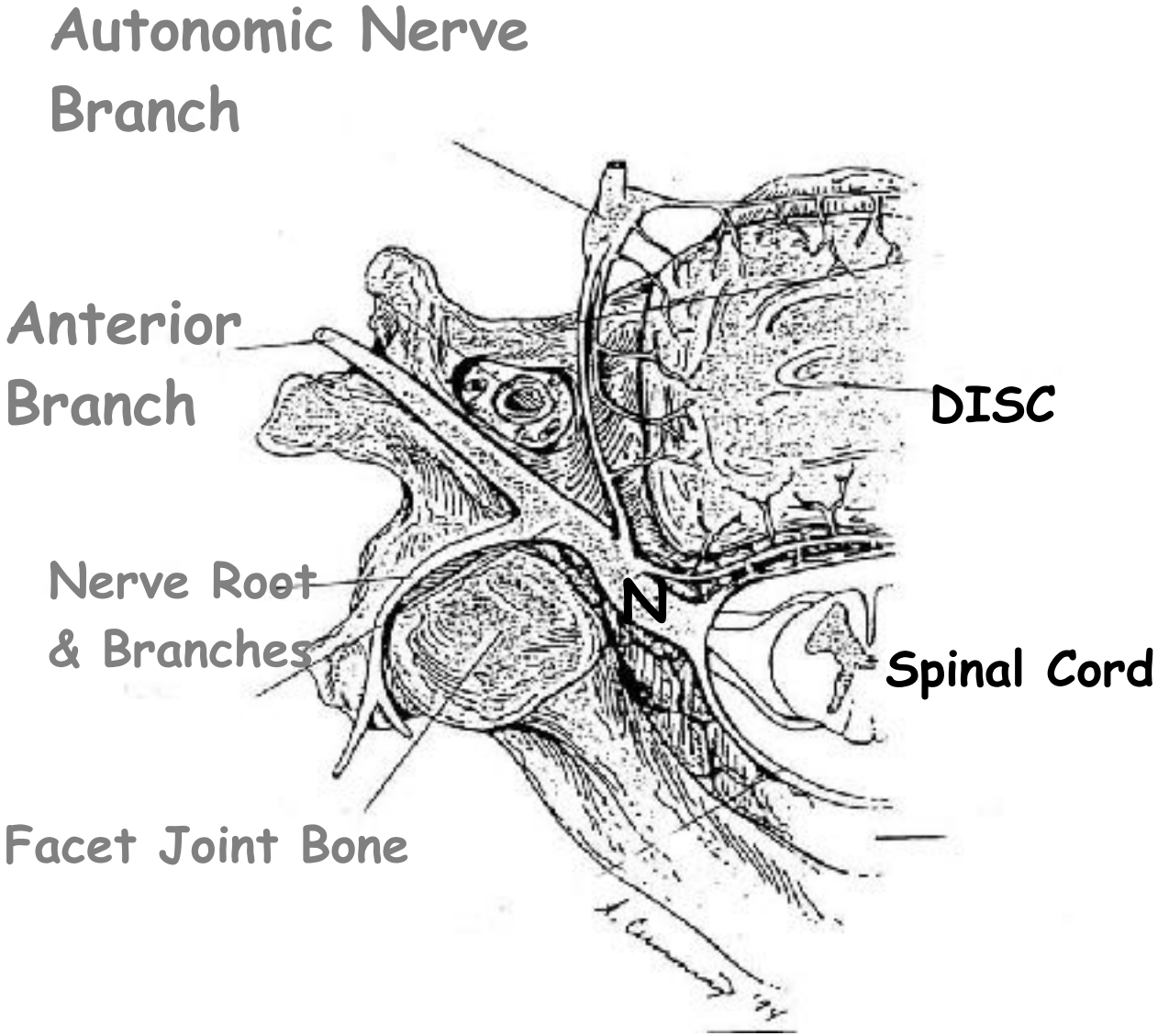
Most Common Cause of Nerve Injury

Spondylosis = Spinal Degeneration

- Nerve Root Vulnerable to Mechanical Trauma = Radiculo-pathy, or Radiculo-Neuropathy

- I.V.F. Narrow & Congested
- S.N.R. lacks Epineurium and Perineurium
- Tethered by Dura Mater
- Tethered by Various Ligaments

Axial View of Disc & Spinal Nerve Root



CORONAL VIEW NEURAL FORAMINA

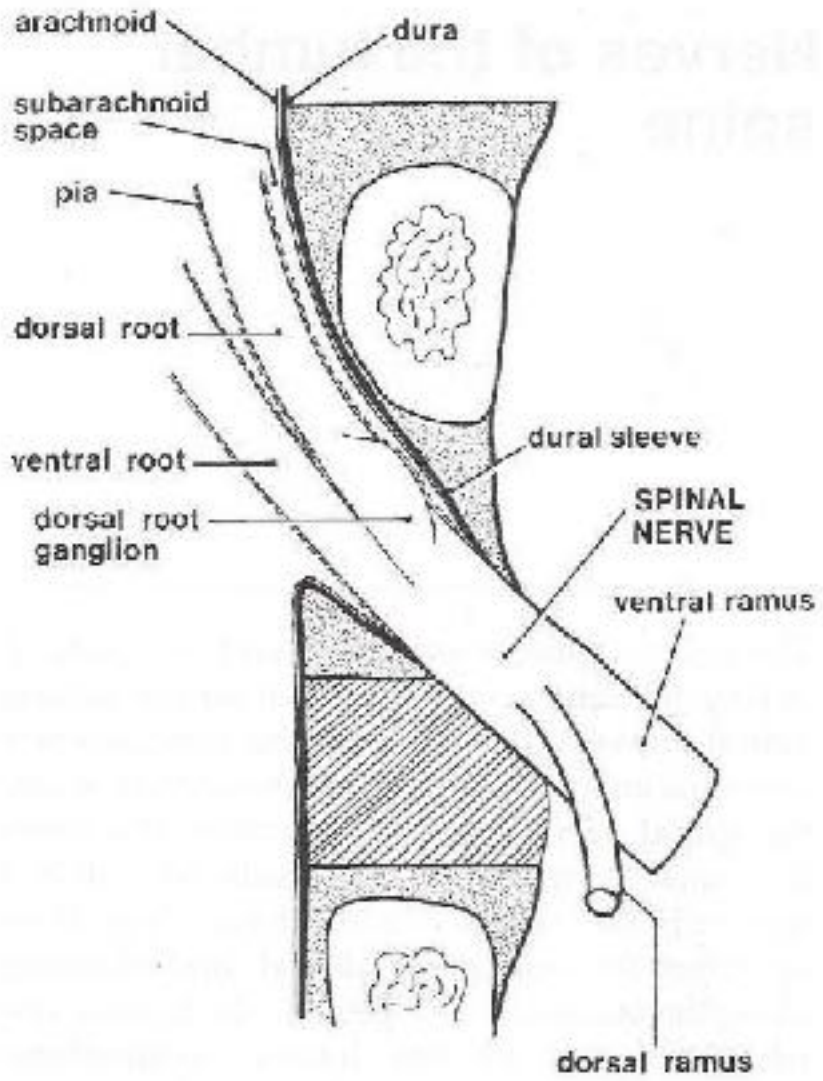
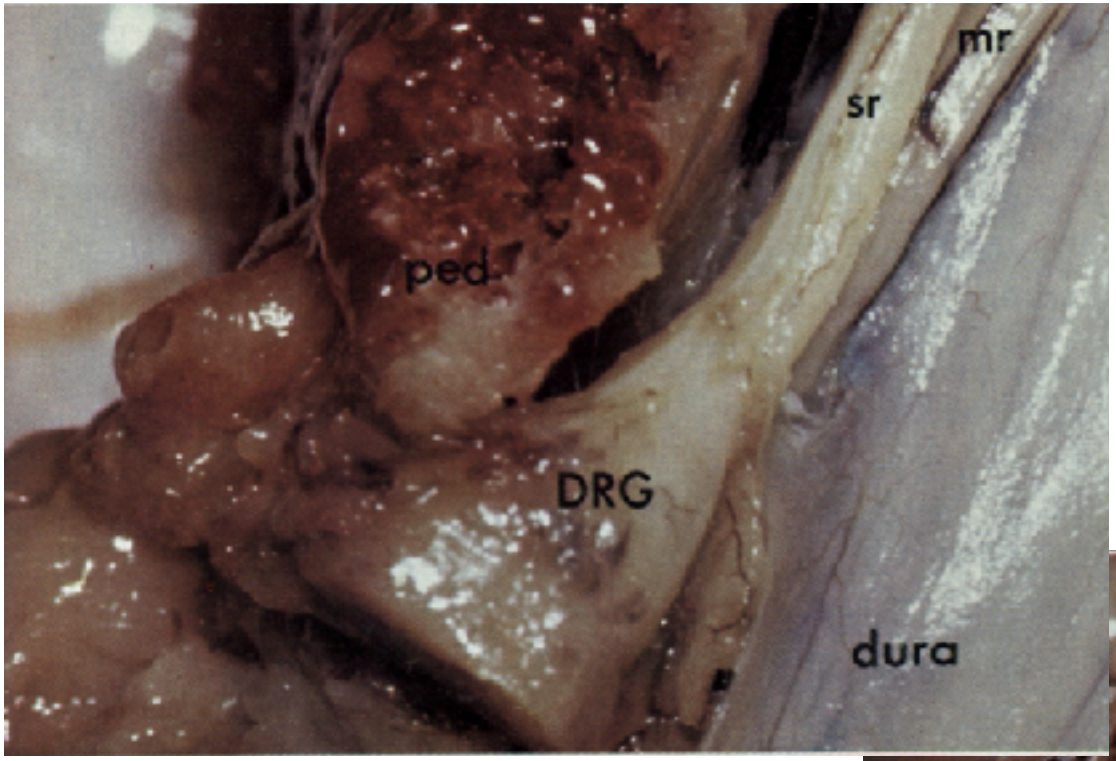
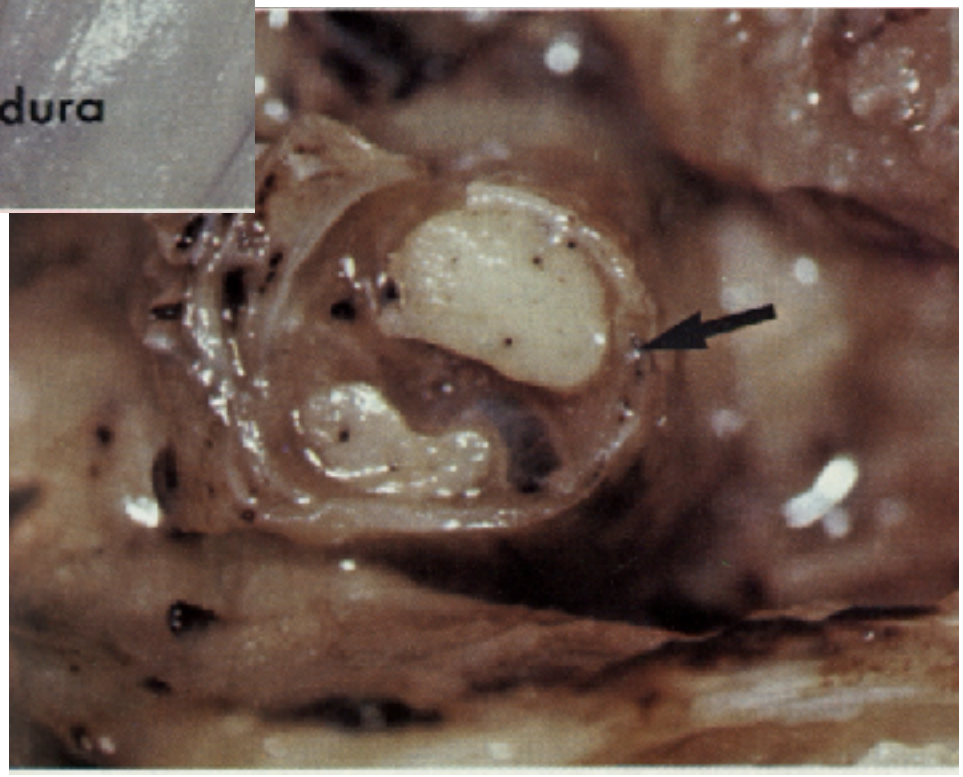


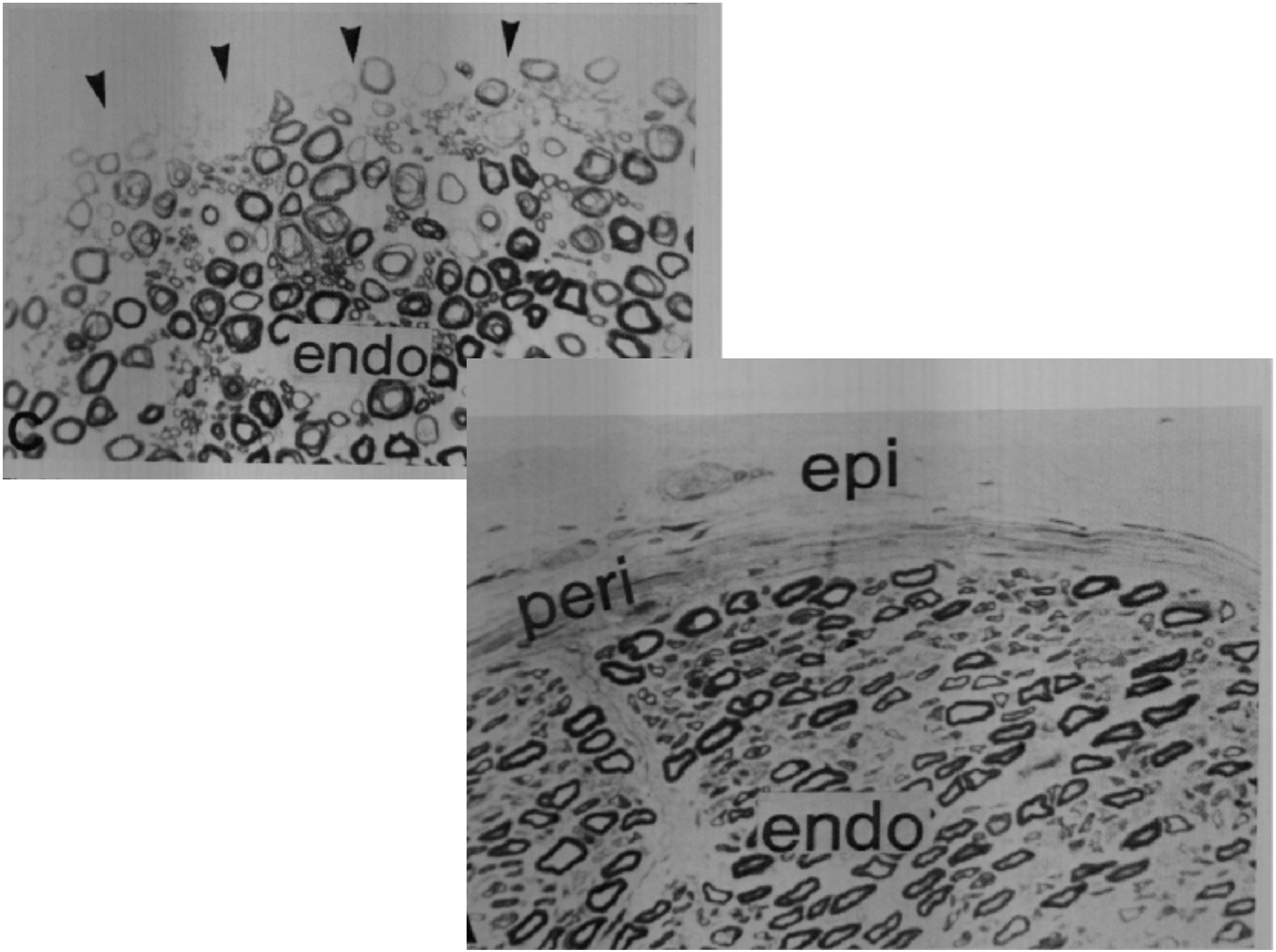
Figure 10.1 A sketch of a lumbar spinal nerve, its roots and meningeal coverings. The nerve roots are invested by pia mater, and covered by arachnoid and dura as far as the spinal nerve. The dura of the dural sac is prolonged around the roots as their dural sleeve, which blends with the epineurium of the spinal nerve.

Spinal Nerve Roots Lack Protection of Perineurium and Epineurium of Spinal/ Peripheral Nerve

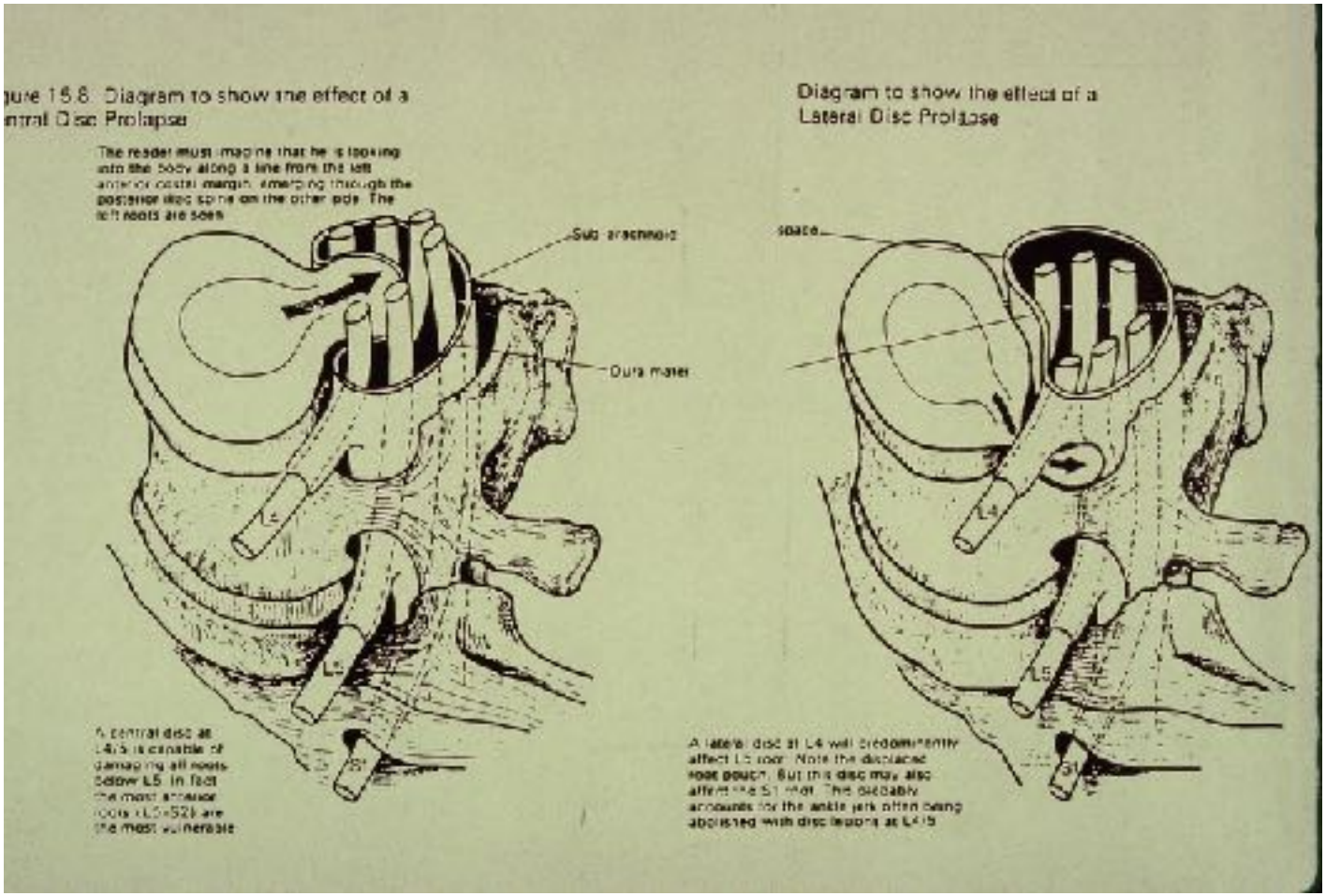
Bogduk, N. Clinical Anatomy of the Lumbar Spine and Sacrum, 3rd ed, p.128


mr
sr
ped
DRG
dura

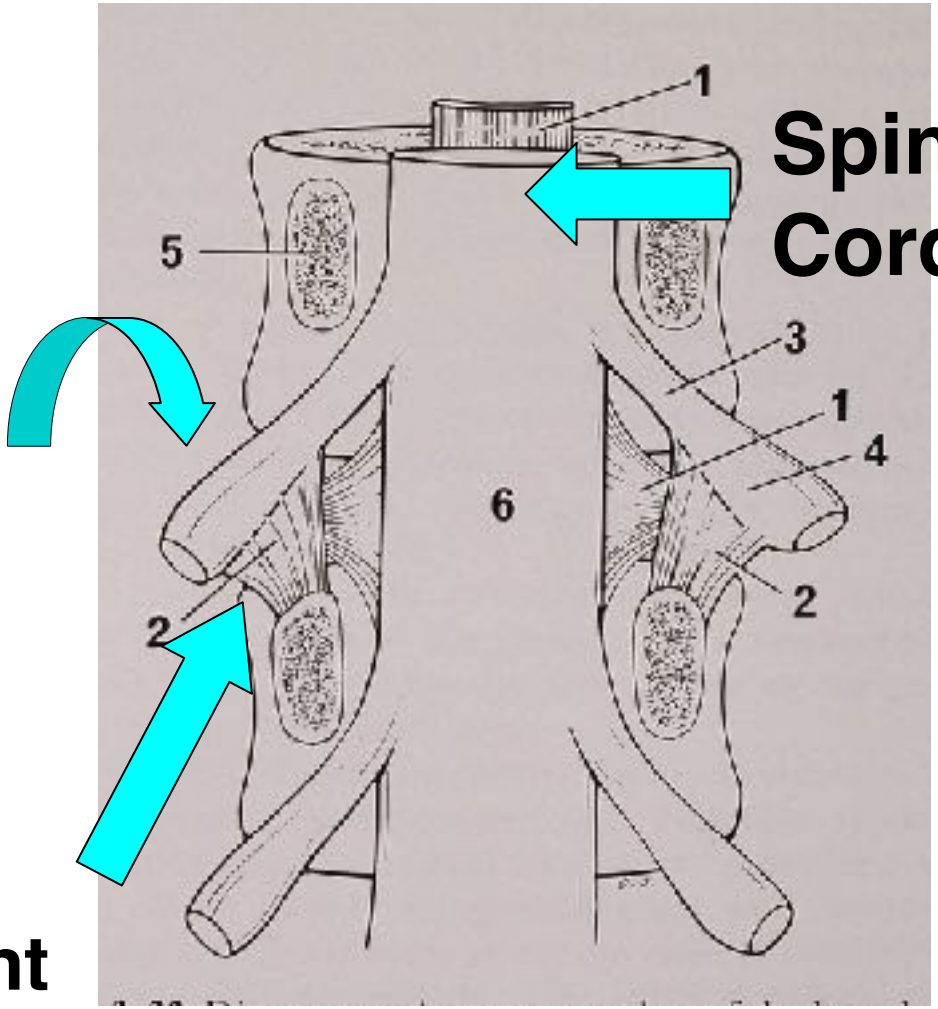



endo
epi
peri
endo

Dura Mater Tethers Nerve Root



Lateral Root & Other Ligaments



Spinal Cord

Spinal Nerve Root

Lateral Ligament

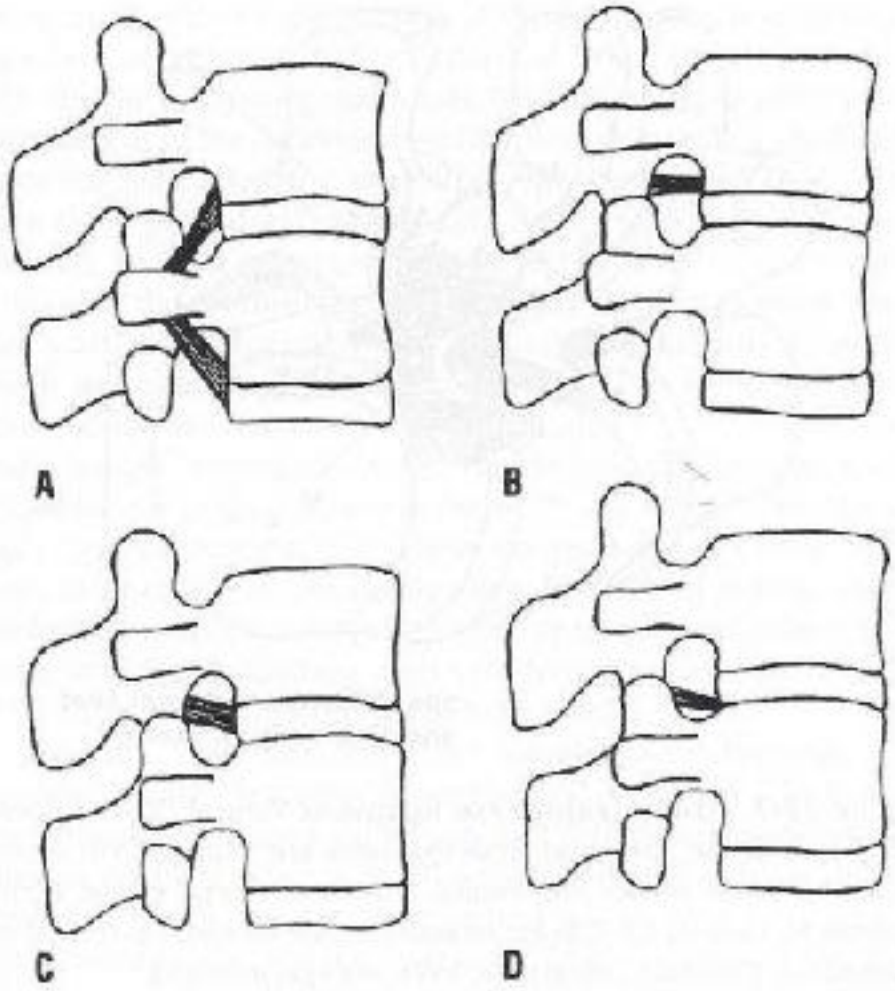


Figure 18-9. Transforaminal ligaments. The various transforaminal ligaments are shown. It is possible for these structures to limit the spinal nerve to a small region of the intervertebral foramen. (**A**) Superior and inferior corporotransverse ligaments. (**B**) Superior transforaminal ligament. (**C**) Middle transforaminal ligament. (**D**) Inferior transforaminal ligament. (From Bogduk N, Twomey LT: Clinical Anatomy of the Lumbar Spine, 2nd ed. Melbourne, Churchill Livingstone, 1991, with permission.)

Dumitru, D. Electrodiagnostic Medicine, 2nd ed. Hanley & Belfus,2002, p.720

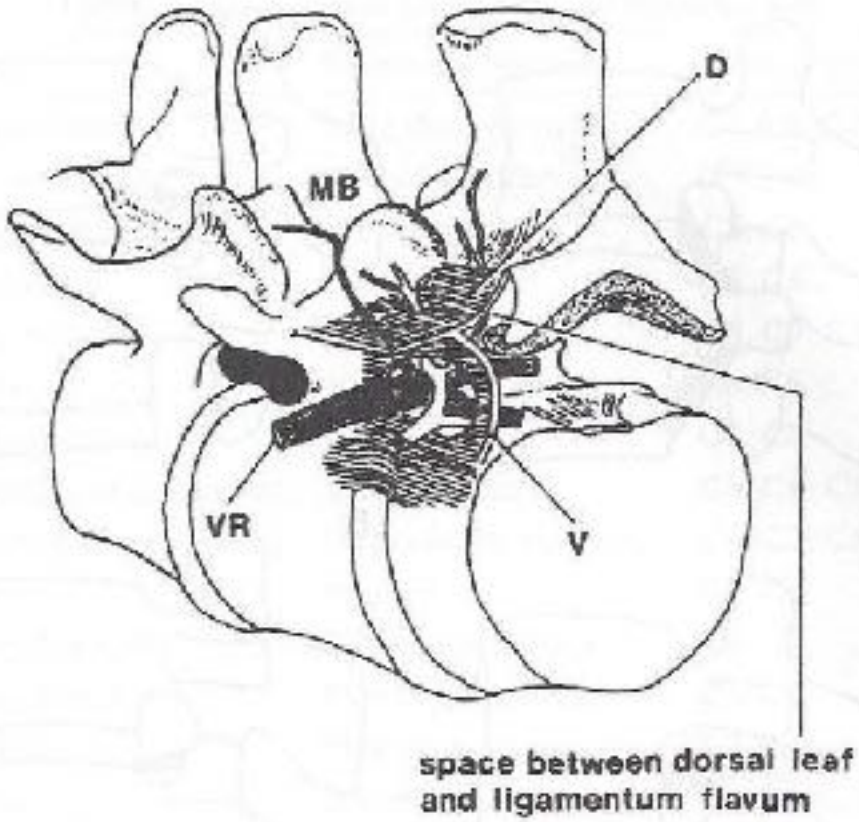


Figure 18-7. **Intertransverse ligament.** Ventral (V) and dorsal (D) leaves of the intertransverse ligaments are depicted. VR: ventral ramus of spinal nerve; MB: medial branch of dorsal ramus. (From Bogduk N, Twomey LT: Clinical Anatomy of the Lumbar Spine, 2nd ed. Melbourne, Churchill Livingstone, 1991, with permission.)

Dumitru, D. Electrodiagnostic Medicine, 2nd ed. Hanley & Belfus, 2002, p.719

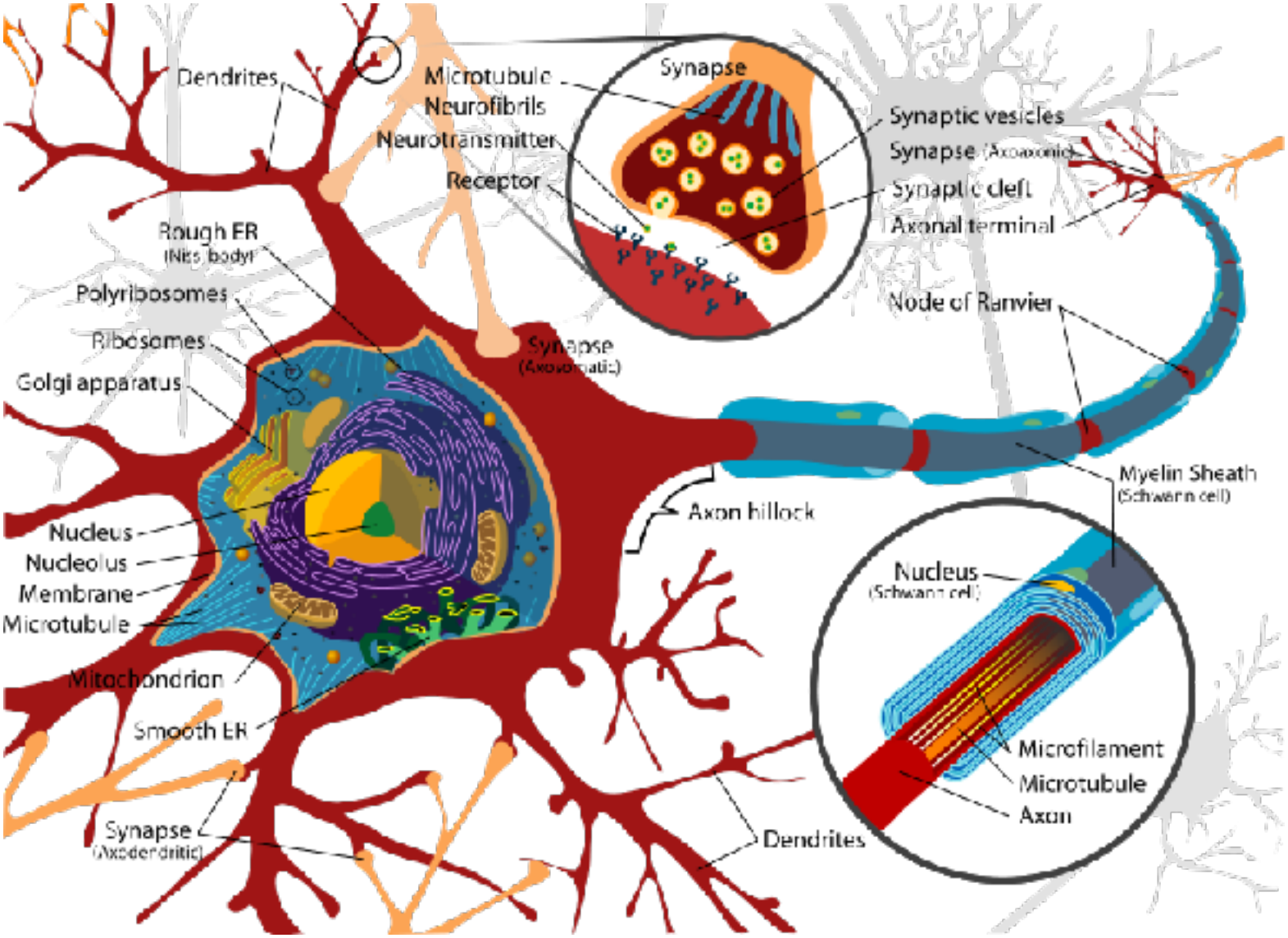
The Segmental Dorsal Ramus as a Common Cause of Chronic & Recurrent LBP.

Electromyogr Clin Neurophysiol 1992, 32(10-11): 507-510 Sihvonen, T.

Medial Branch of Posterior Ramus Supplies Multifidi Muscles & Passes Through Mamillo-Accessory Ligament

Figure 18-8. **Posterior primary ramus.** Medial branch of the posterior primary ramus running beneath the mamillo-accessory ligament. This is a possible site for neural entrapment, particularly when this ligamentous structure ossifies in elderly individuals. zj: zygapophyseal joint; tp: transverse process; mp: mamillary process; mal: mamillo-accessory ligament; mb: medial branch; ap: accessory process. (From Bogduk N, Wilson AS, Tyunan W: The human lumbar dorsal rami. J Anat 1982; 134:383–397, with permission.)

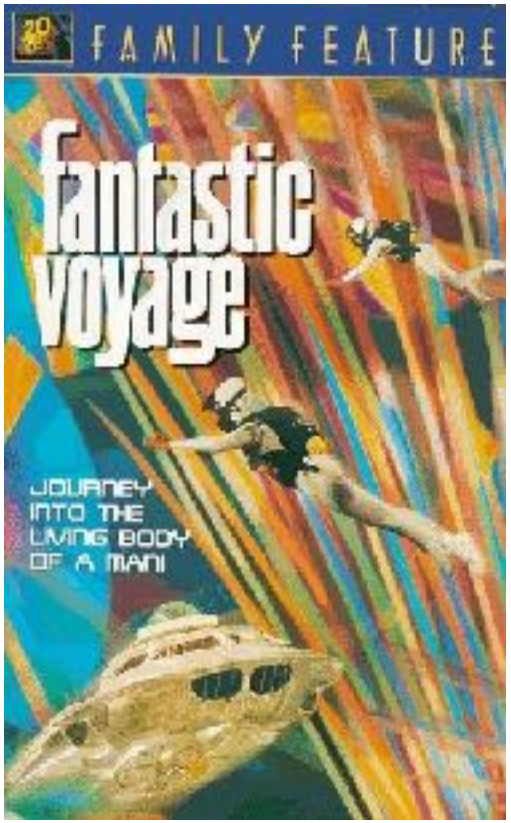
Dumitru, D. Electrodiagnostic Medicine, 2nd ed. Hanley & Belfus,2002, p.719

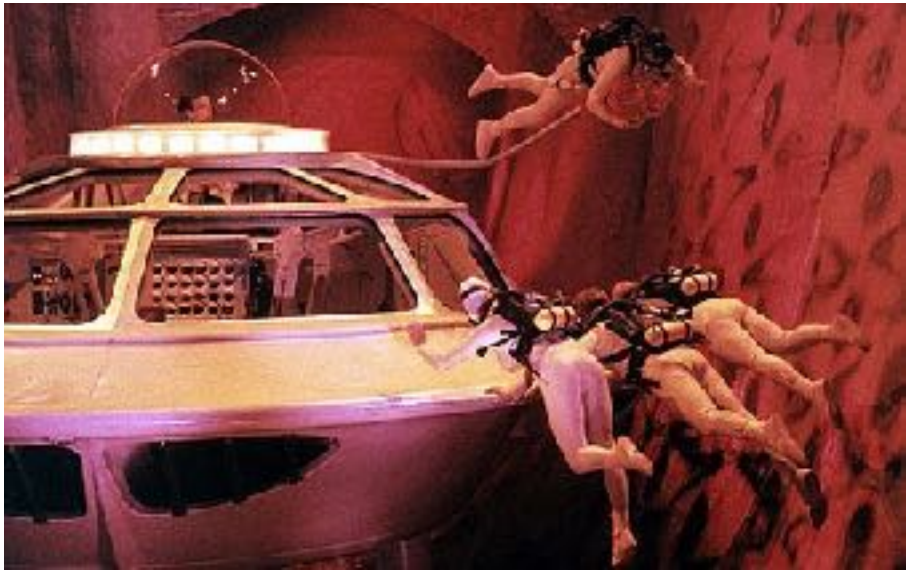

Dendrites
Microtubule
Neurofibrils
Neurotransmitter
Receptor
Synapse
Synaptic vesicles
Synapse (Axoaxonic)
Synaptic cleft
Axonal terminal
Rough ER
(Nissl body)
Polyribosomes
Ribosomes
Golgi apparatus
Synapse
(Axosomatic)
Node of Ranvier
Myelin Sheath
(Schwann cell)
Axon hillock
Nucleus
Nucleolus
Membrane
Microtubule
Mitochondrion
Smooth ER
Synapse
(Axodendritic)
Dendrites
Nucleus
(Schwann cell)
Microfilament
Microtubule
Axon

Electrochemical 'Highway'

- Cytoplasm contains proteins, enzymes, neurotransmitters, charged +/- ions
- Axoplasmic flow ➡ stream of cytoplasm,
  motor proteins,
  charged ions
- Electrical Properties: Resting membrane potential, action potential, DC, semicond currents
- Trophic factor : combination of axoplasmic flow and electro-chemical stimulus

TROPH = Nourish


FAMILY FEATURE
fantastic voyage
JOURNEY INTO THE LIVING BODY OF A MAN!



1966

Spondylosis, or Spinal 'Wear & Tear' >>>>>

RADICULOPATHY & RADICULO-(*NEURO*)PATHY

- Nerve &/or vascular compression, angulation, torsion and traction can impede axoplasmic flow and alter electrical properties
- Spinal Nerve Roots >> Suceptible >> Peripheral nerve

10mm Hg pressure x 10-15 minutes >
50% in Compound Nerve Action Potential
1975 Sharpless

15% stretch > conduction block
1984 Rydevik

9 degrees axial rotation produces
myelographic filling defect at L5 w/2x 20%
physiological stretch
1983 Farfan

- Spondylosis > 'Injury Pool' of Sick Nerves

‘Susceptibility of Spinal Roots to Compression Block’

1975 Sharpless

10mm Hg pressure x 10-15 minutes > 50% in Compound Nerve Action Potential

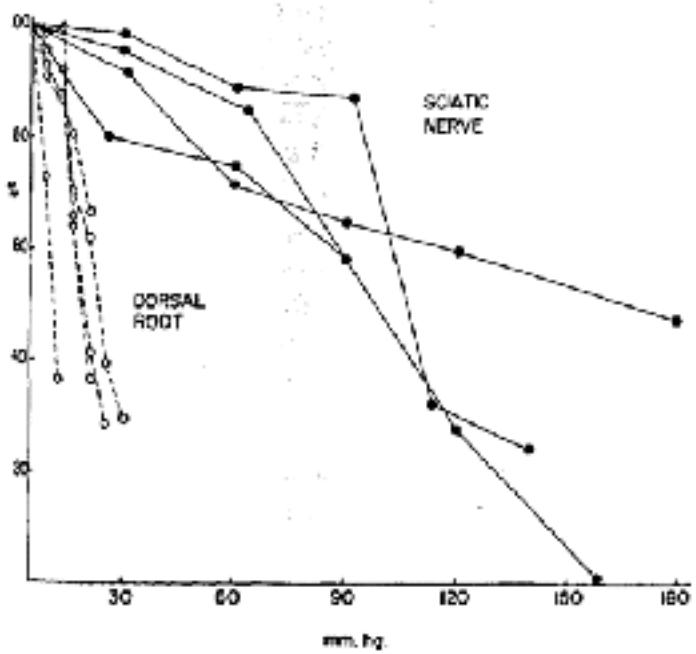


Fig. 2. Susceptibility of spinal roots to compression block. Compound action potentials integrated and expressed as percent of initial value. Pressures applied for 3 minutes only.

CONCLUSIONS

1. Dorsal roots are far more susceptible to compression block than peripheral (sciatic) nerve. When pressure is applied for 3 minutes followed by 3-minute recovery periods, 100 mm. Hg. must be applied to sciatic nerve to achieve the same conduction block that can be produced in spinal roots by 20 mm. Hg.

2. As little as 10 mm. Hg. pressure, maintained for 15–30 minutes, reduces the compound action potentials of dorsal roots to about half of their initial values. With such small pressures, nearly complete recovery occurs in about 30 minutes.

It is difficult to appreciate the significance of the minute pressures capable of affecting root conduction. It seems doubtful that the most skillful and deft surgeon could touch a spinal root or the balloon of our compression apparatus with his gloved forefinger without producing a pressure increment of at least 5 mm. Hg. One may well consider what happens to the spinal roots when they are manipulated by the far less dextrous electrophysiologist.

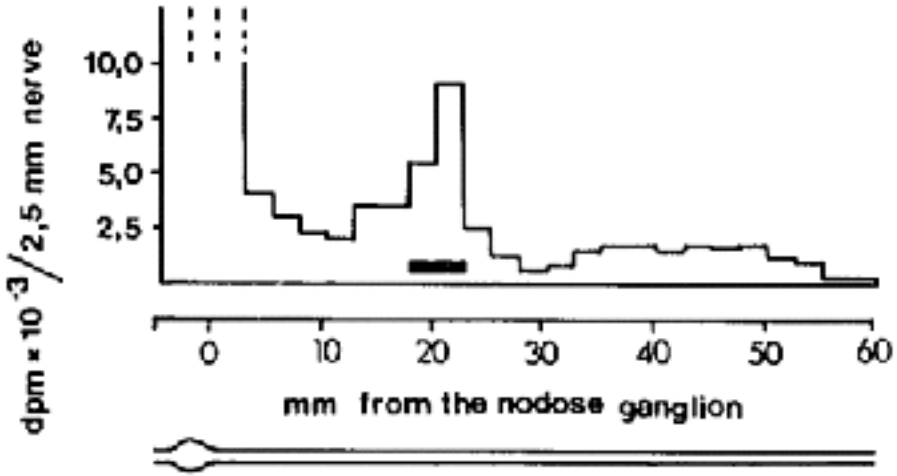


Fig 5. Diagram that illustrates block of axonal transport induced by compression. The rabbit vagus nerve was compressed by means of a small inflatable cuff. The cuff was applied around the nerve, which thereby was compressed at controlled pressure.[39] Radioactively labelled amino acid (^{3}H-leucine) was injected into the nodose ganglion of the nerve. These aminoacids then are incorporated into the proteins, which are synthesized in the ganglion, and then transported down the axon at a speed of about 400 mm/24 hours. The nerve is

>15% stretch =

- **intraneural blood flow blocked**
- **electrical conduction block**

Rydevik SPINE 1984

ganglia. Their axons may be more than 100 cm in length. This is a remarkable distance in view of the size of the nerve cell body, which is around 100 μm. If we transfer these dimensions to a larger scale, a nerve cell body of 100 cm in diameter would have an axon with a diameter of about 10 cm and with a length in the range of 10 km.

(ONLY!!!) 9 degrees axial rotation produces myelographic filling defect at L5
w/2x normal 20% physiological stretch on nerve root

1983 Farfan

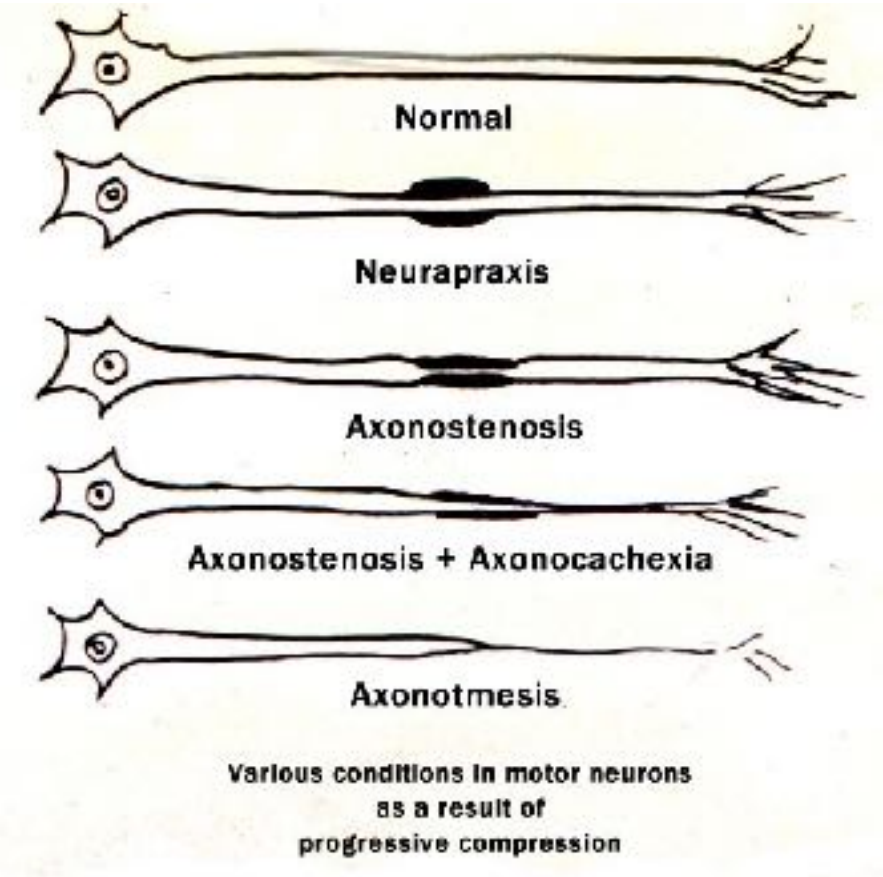
Wall Street Journal
Soccer 'Header' Impact Likened to Hard Punch 2/16/13

Force Absorbed

K.E.= ½ mv2

20 mph = 4 x 10 mph
30 mph = 9 x 10 mph
40 mph = 16 x 10 mph
50 mph = 25 x 10 mph

Various Degrees of Compression to Motor Neurons

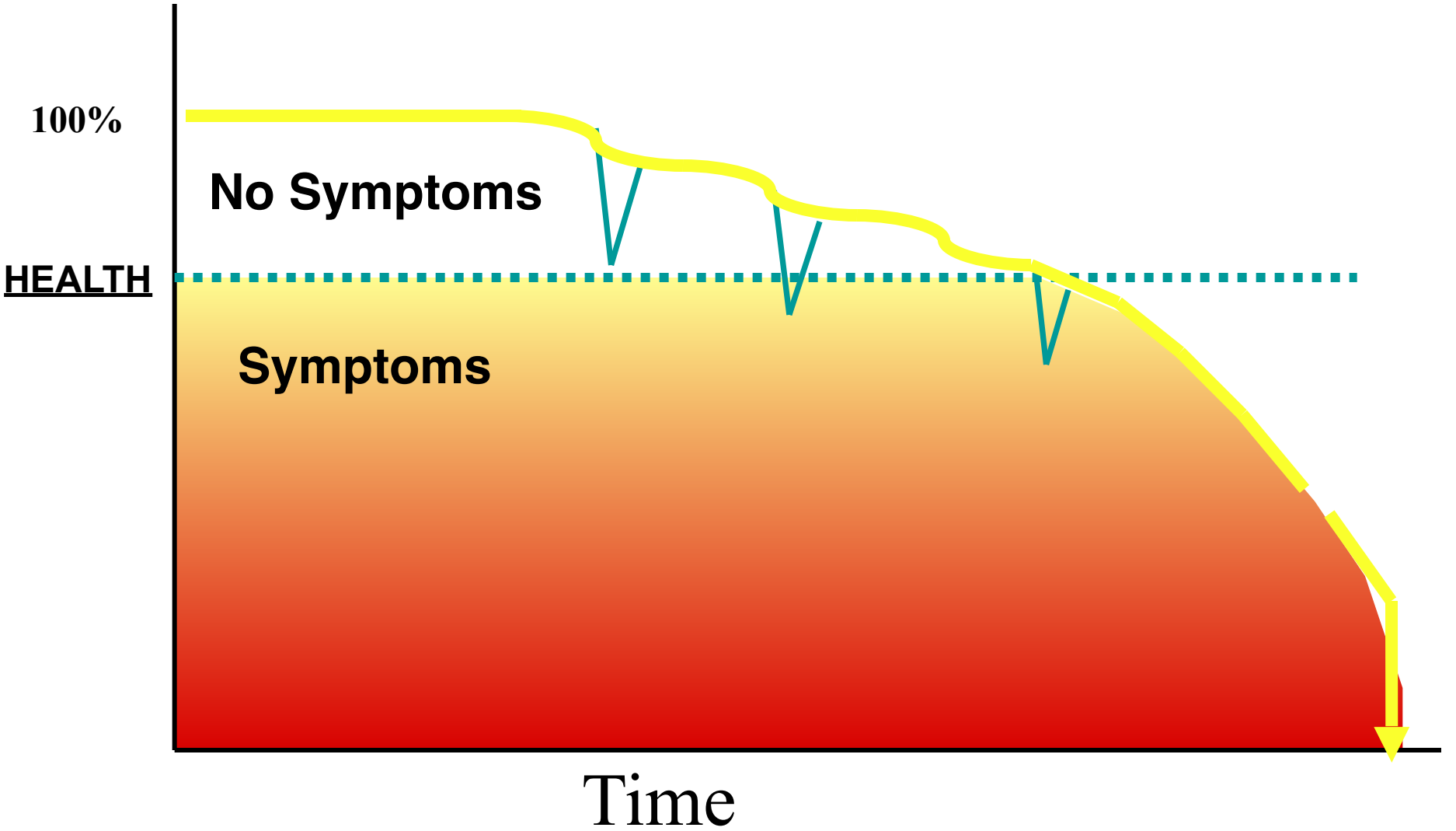


CANNON:
DENERVATION > 'A'-TROPHY

'PARTIAL DENERVATION', or
NEUROPATHY > 'DYS'-TROPHY

SPONDYLOSIS:

‘Pool of Injured Nerves’ That Accumulate Over Time



-2 meters

Large Diameter Nerve Fibers More Susceptible Compression > Small Diameter Fibers

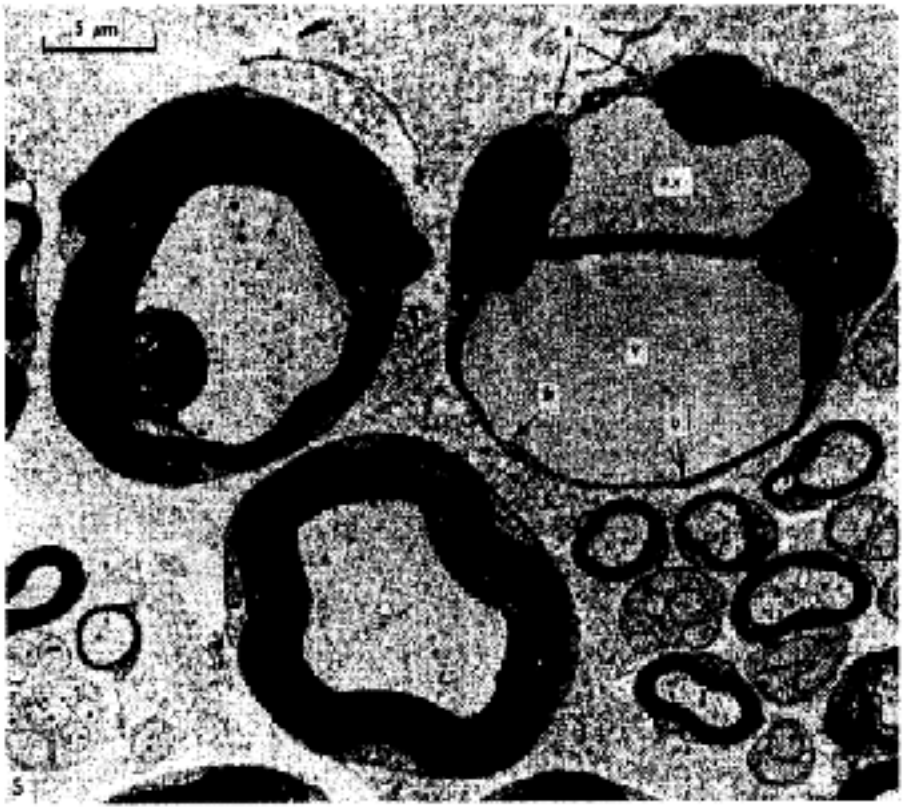
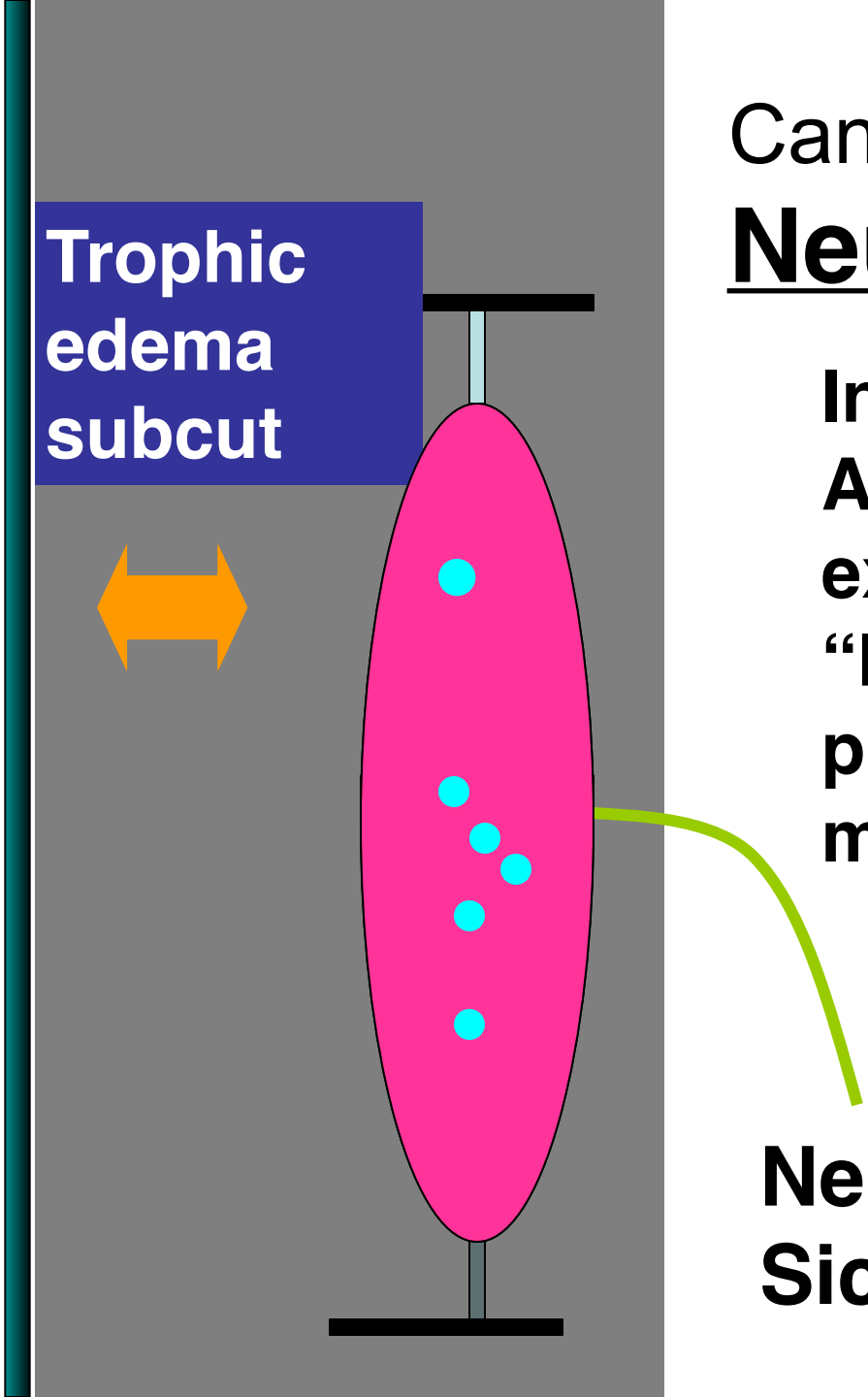


Fig. 5. Transverse section from a nerve, 18 hours after compression, to show myelin rupture and oedema. The fibre on the left shows partial rupture of myelin lamellae. The fibre on the right shows rupture of the whole thickness of the myelin sheath at *a*, the axon (*ax*) being separated from the basement membrane by a thin Schwann cell process. A collection of homogeneous material (*v*) has split the myelin sheath with rupture of the outer lamellae at *b*. Small myelinated and unmyelinated fibres appear normal.

Large Myelinated Fibers

	Fiber Type		Function	Fiber Diameter (μm)	Conduction Velocity (m/s)
Myelinated	**A**	**α**	**Proprioception; Somatic motor**	**12-20**	**70-120**
		β	Touch, Pressure	5-12	30-70
		γ	Motor to muscle spindles	3-6	15-30
		δ	Pain, Temperature, Touch	2-5	12-30
	B		Preganglionic sympathetics	< 3	3-15
Unmyelinated	C	*Dorsal root*	Pain; Reflex responses	0.4-1.2	0.5-2
		Sympathetic C Fibers	Postganglionic sympathetics	0.3-1.3	0.7-2.3

Ganong WF, Review of Medical Physiology 22nd ed. Lange, 2005



Cannon's Law &

Neuropathic Muscle

In neuropathy, Acetylcholine can act at extra-junctional "hotspots" that are present throughout the muscle

Neuropathic = Sick Nerve

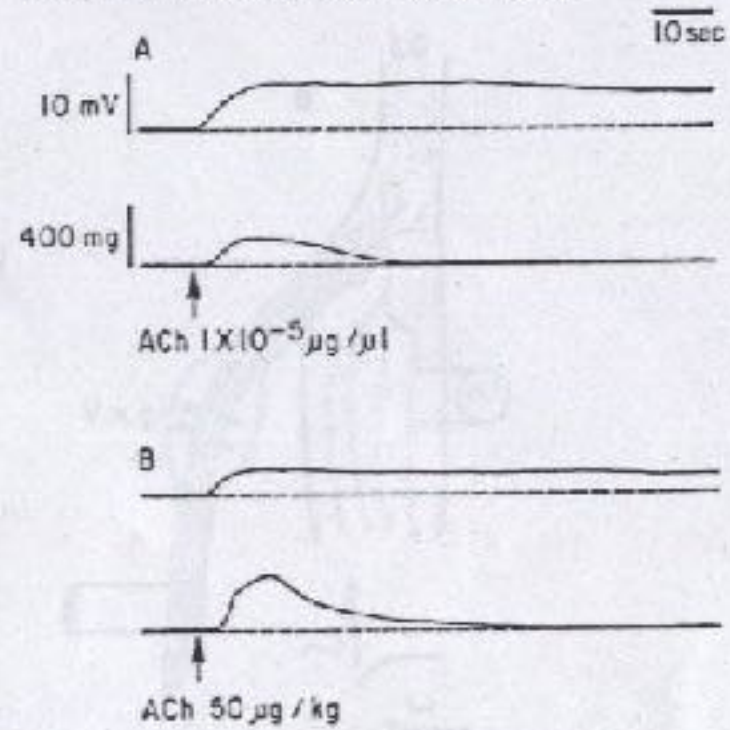
Muscle CONTRACTURE vs. Muscle CONTRACTION

ACh slowly depolarizes muscle membrane, and this induces electromechanical coupling, with the consequent SLOW development of *TENSION* WITHOUT action potentials = 'Silent' electrically

CONTRACT-URE is the evoked shortening of a muscle fiber in the ABSENCE of action potentials

Eyzaguirre C, Fidone SJ 1975 Physiology of the nervous system. Chicago, Year Book Medical Publishers. 2nd ed.

Fig. 25–3. — Effects of ACh on denervated muscle; anterior gracilis of a rat denervated 24 days before the experiment. In **A** and **B** the upper traces represent depolarization recorded by a small electrode (about 1 μ) applied to the surface of the muscle; the lower traces represent the tension developed by the muscle. In **A**, a small drop (1 μl) of ACh applied to the muscle surface in the vicinity of the recording electrode elicits muscle depolarization (upper trace) and development of tension (lower trace). In **B**, similar effects are induced by an intra-arterial injection of ACh. (Drawn from Turkanis, S. A.: *Pharmacological and Physiological Properties of Denervated Mammalian Skeletal Muscle* [University of Utah thesis, 1967].)



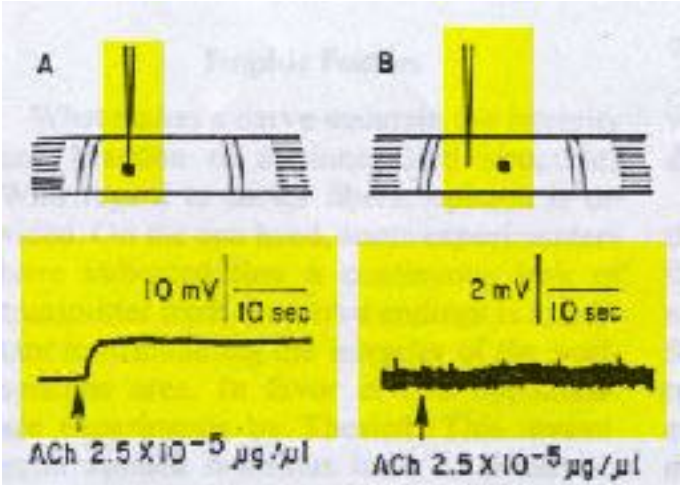
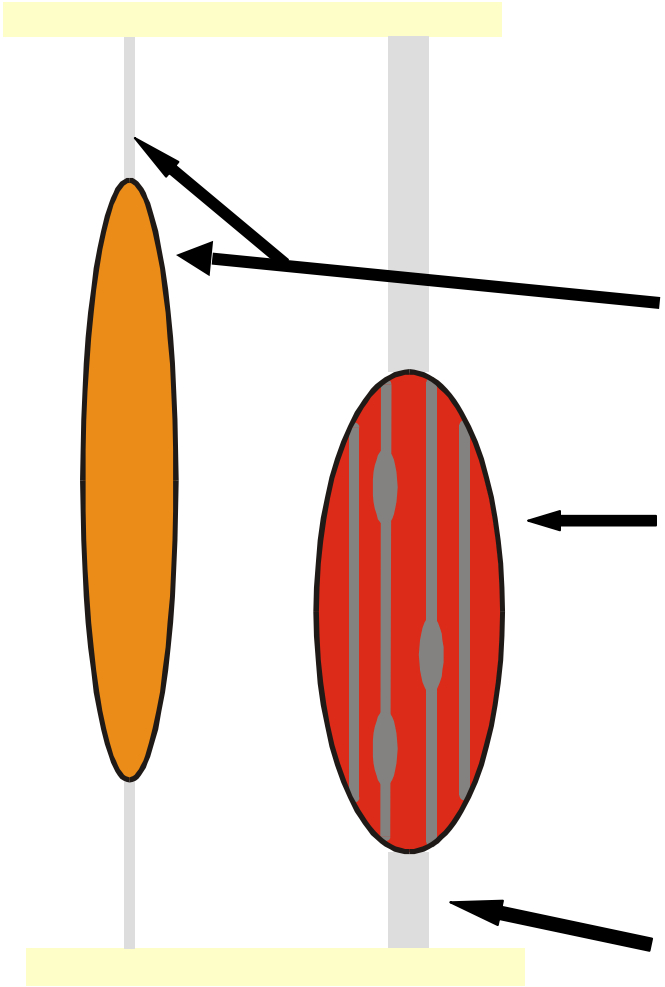


Fig. 25–4.—Local nature of ACh-induced contracture. Muscle tension is not presented in these records, although it occurred concomitantly with the recorded depolarization. **A** and **B**, diagrammatic representation of the experiment. The anterior gracilis end-plate zones are contained within each pair of curves. In **A**, a microdrop (1 µl) of ACh is applied in the vicinity of the recording microelectrode. This elicits depolarization of the area (shown below the diagram) and development of tension (not illustrated). In **B**, the microdrop of ACh is applied at some distance (3 mm) from the recording microelectrode. The depolarization occurring in the vicinity of the microdrop is not recorded by the electrode, as shown in the trace below the muscle diagram. Muscle tension developed in **B**, but this is not illustrated. (Drawn from Turkanis, S. A.: *Pharmacological and Physiological Properties of Denervated Mammalian Skeletal Muscle* [University of Utah thesis, 1967].)

Local Nature of Ach-Induced Contracture

Leads to Focal Taut Bands with ↑ MUSCLE TENSION

Neuropathic Muscle = Shortened Muscle



Normal Muscle & Tendon

Muscle Contracture

- Taut Bands
  Spasm, Decreased ROM
- Altered Biochemistry >
  Myalgic Hyperalgesia
  Referred Pain
- Tension on Tendons =
  Tendonosis, -opathy

The Trigger Point

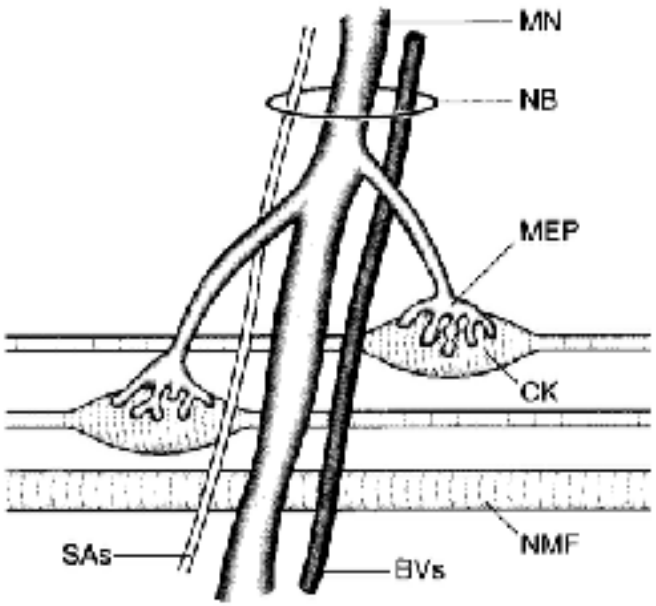
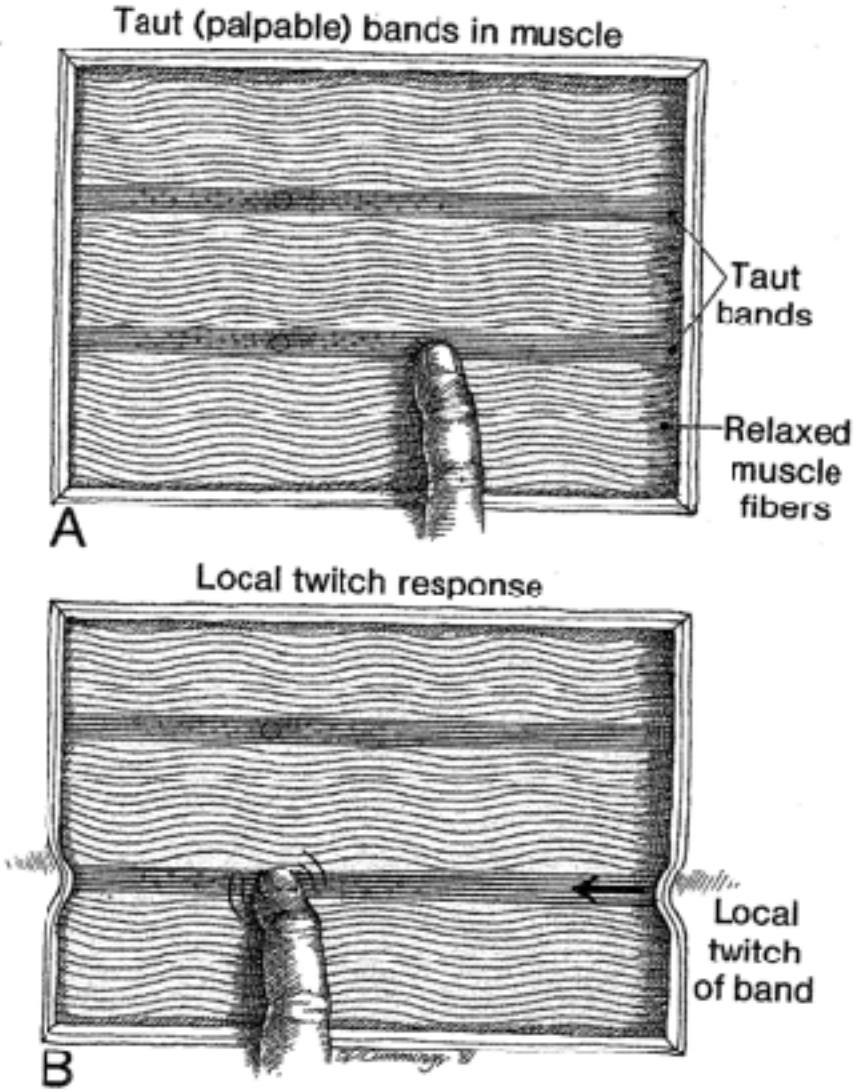
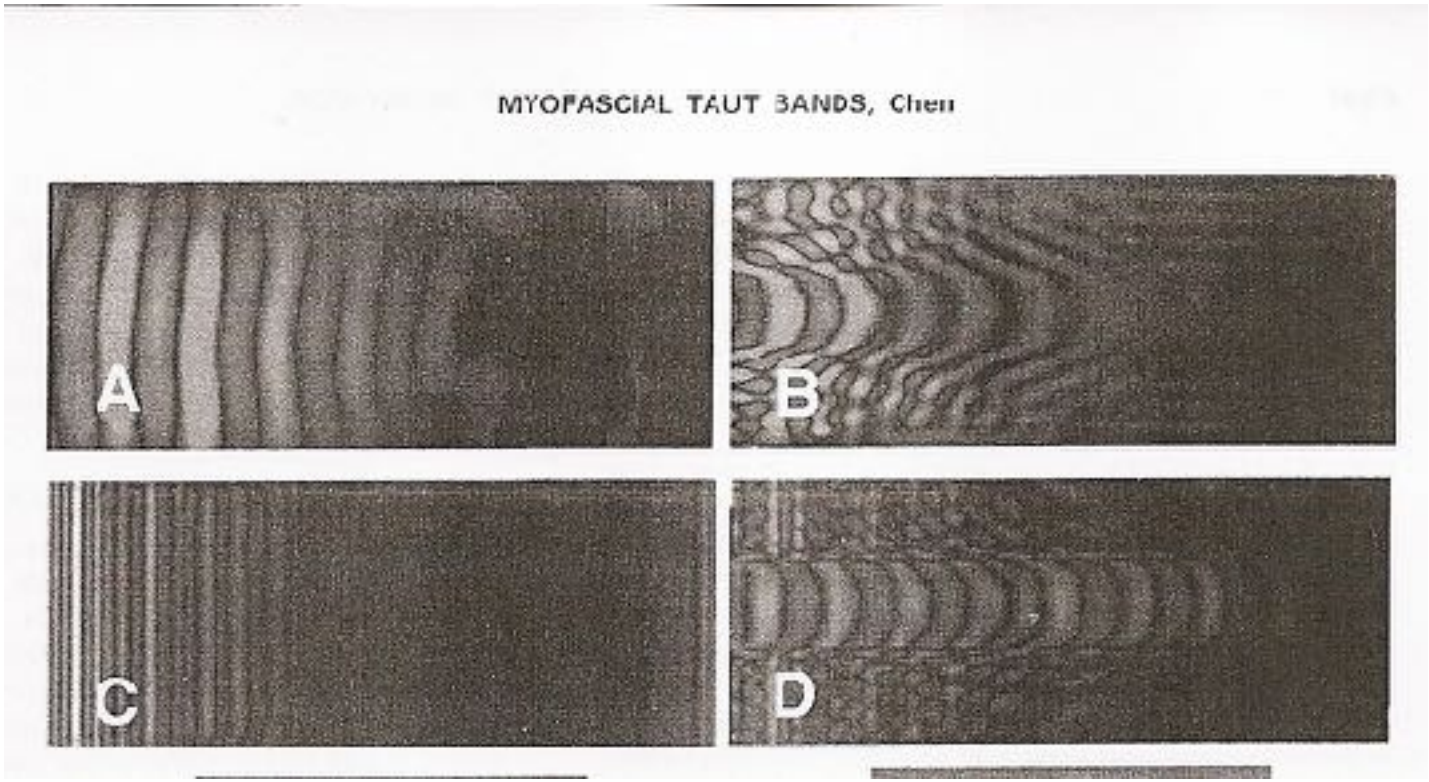


Figure 4.2 Diagrammatic representation of part of a myofascial trigger point showing two motor endplates (MEPs) and juxtapositional contraction knots (CKs); also a neurovascular bundle (NB) containing motor nerves (MNs), nociceptive and proprioceptive sensory afferents (SAs) and blood vessels (BVs) with closely associated sympathetic fibres. Note: in normal muscle fibre (NMF) the sarcomeres are of equal length. In a muscle fibre containing a contraction knot there is shortening of the sarcomeres at that site and compensatory lengthening of them on either side.



Baldry, PE. Myofascial Pain and Fibromyalgia – A Clinical Guide to Diagnosis and Management. Churchill Livingstone

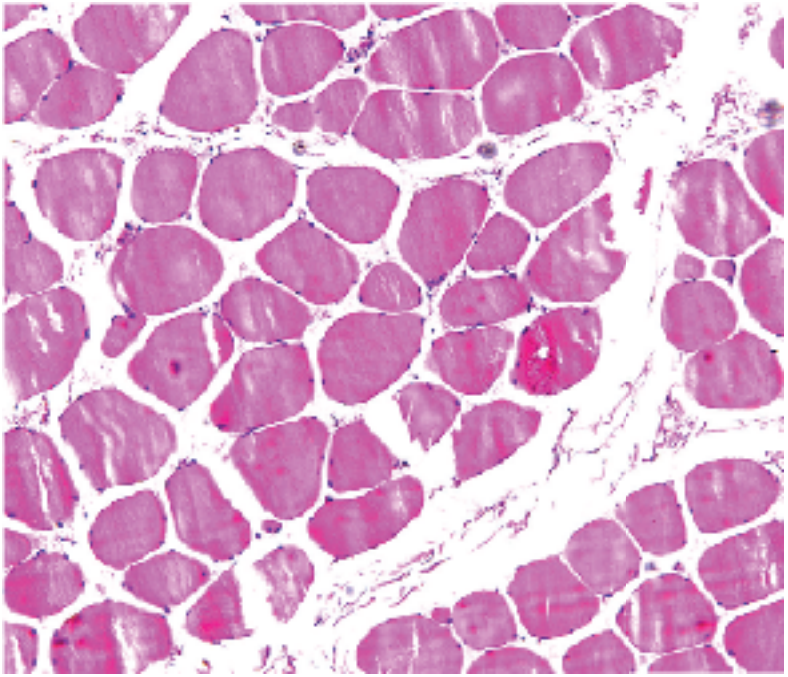


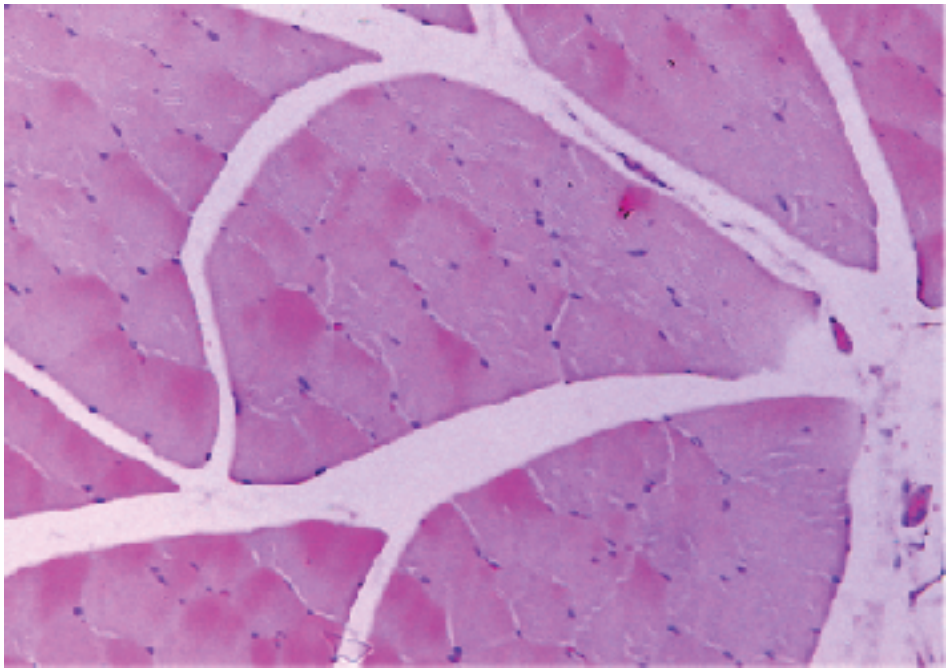
Identification & Quantification of Myofascial Taut Bands with Magnetic Resonance Elastography

Archives of Physical Medicine & Rehabilitation

Chen, Q., et.al. Vol 88 December 2007 p.1658-1661

Morphological findings of representative skeletal muscles with nontaut and taut bands. (a) Biceps femoris with a nontaut band; (b) Biceps femoris with a taut band (H&E staining, scale bar = 5 μm)

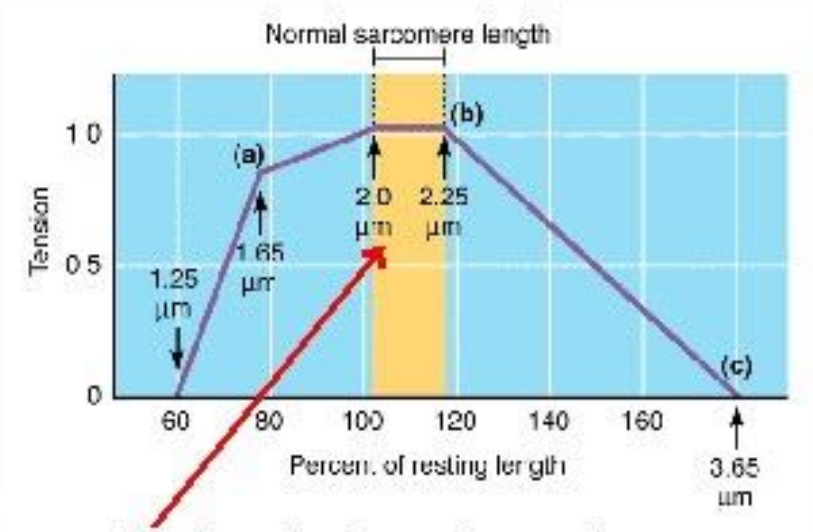




Hsieh YL, et. al. Dry needling at myofascial trigger spots of rabbit skeletal muscles modulates the biochemicals associated with pain, inflammation, and hypoxia. Evid Based Complement Alternat Med. 2012

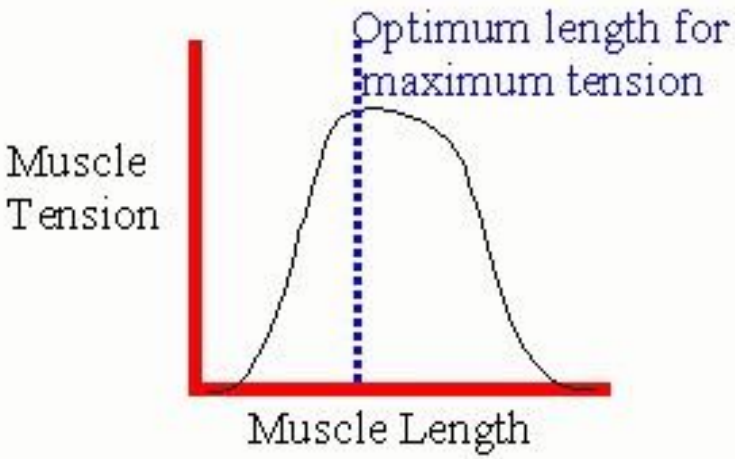
Relationship of Tension to Muscle Length.

The Sarcomere



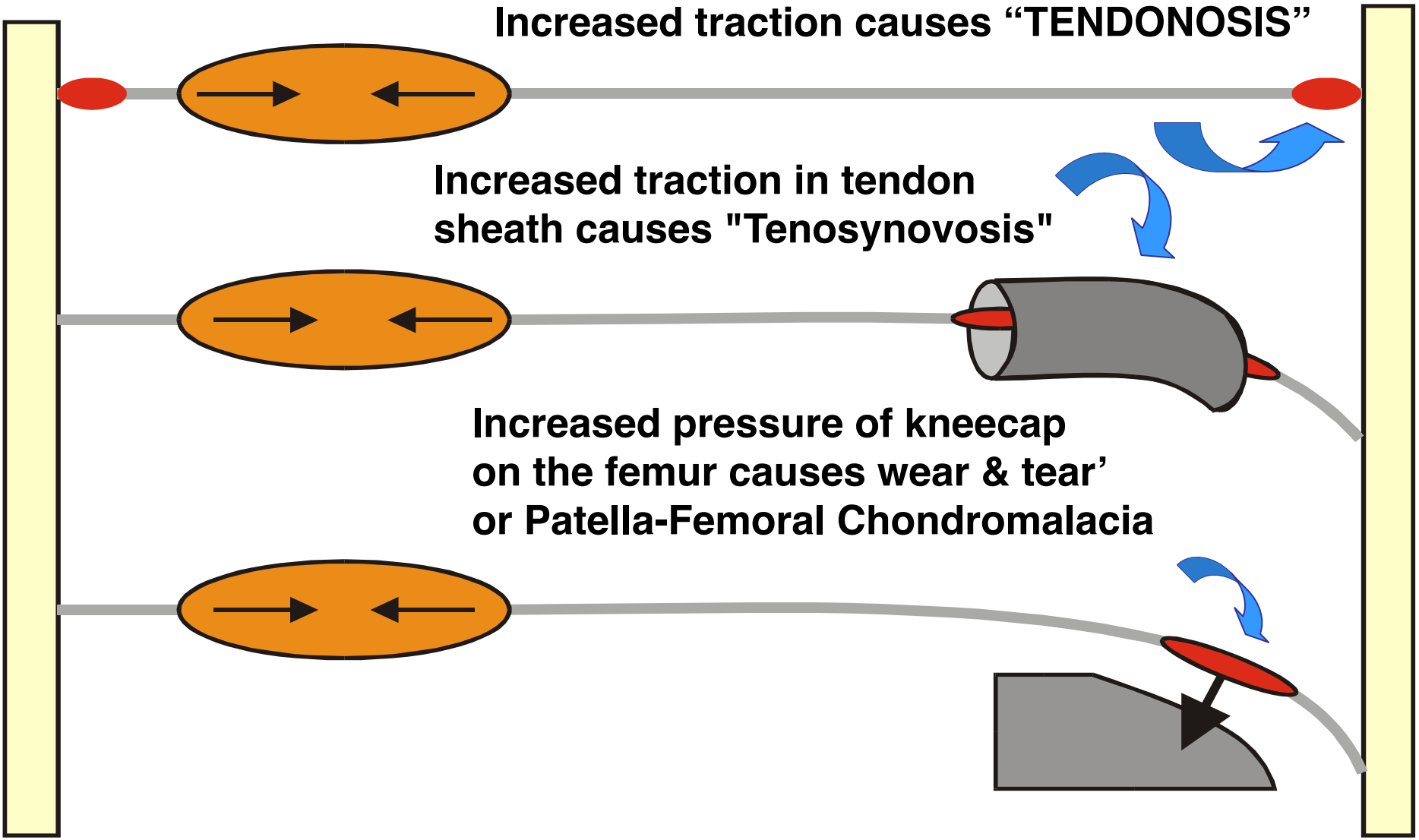
At this length there is maximum overlap of myofilaments producing maximum number of crossbridges and maximum amount of tension.

Whole Muscle

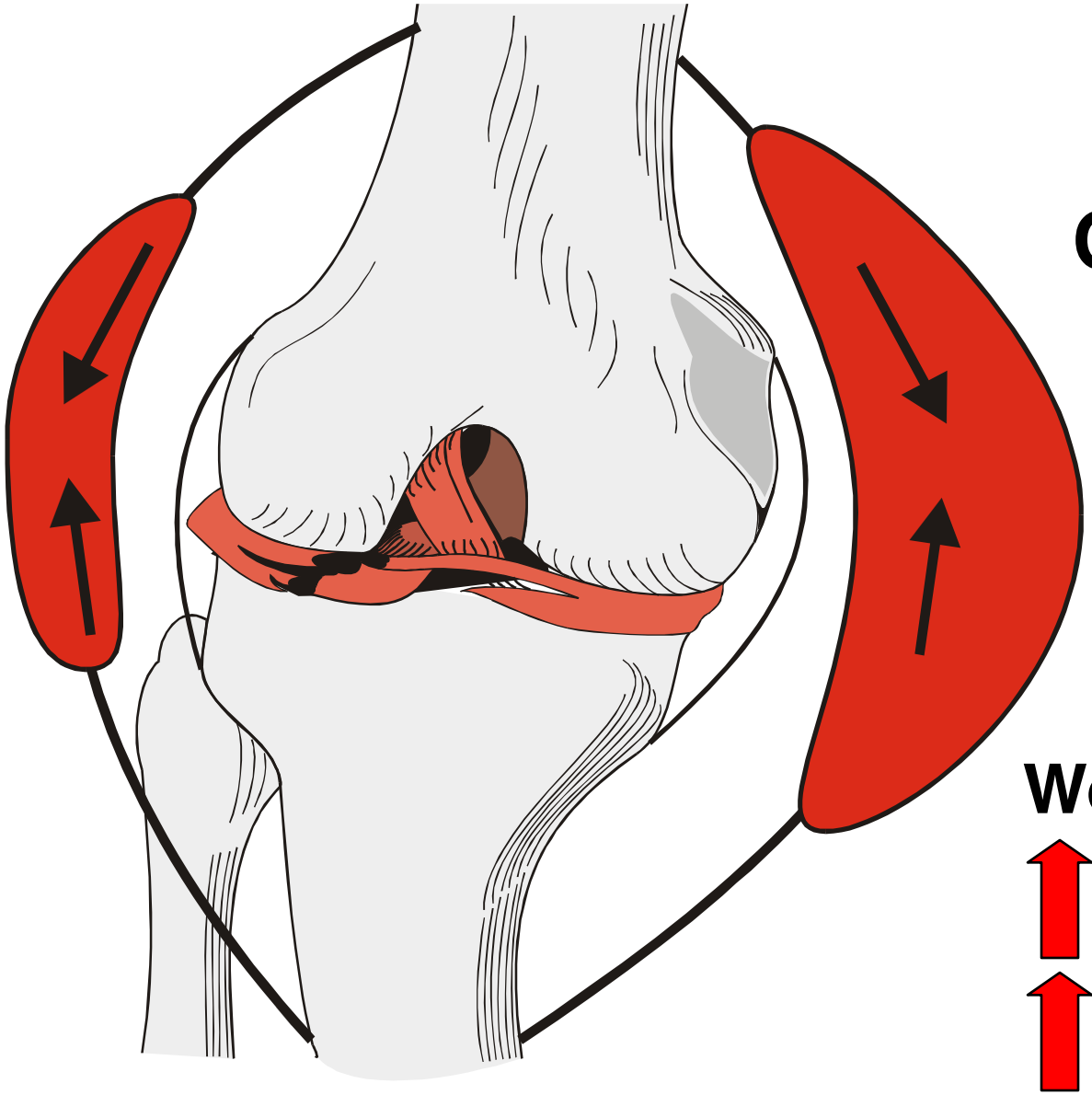


This applies to the entire muscle as well as to indivual sarcomeres.

Secondary Effects of Short Muscle Syndrome



Shortened Muscle



Arthralgia &

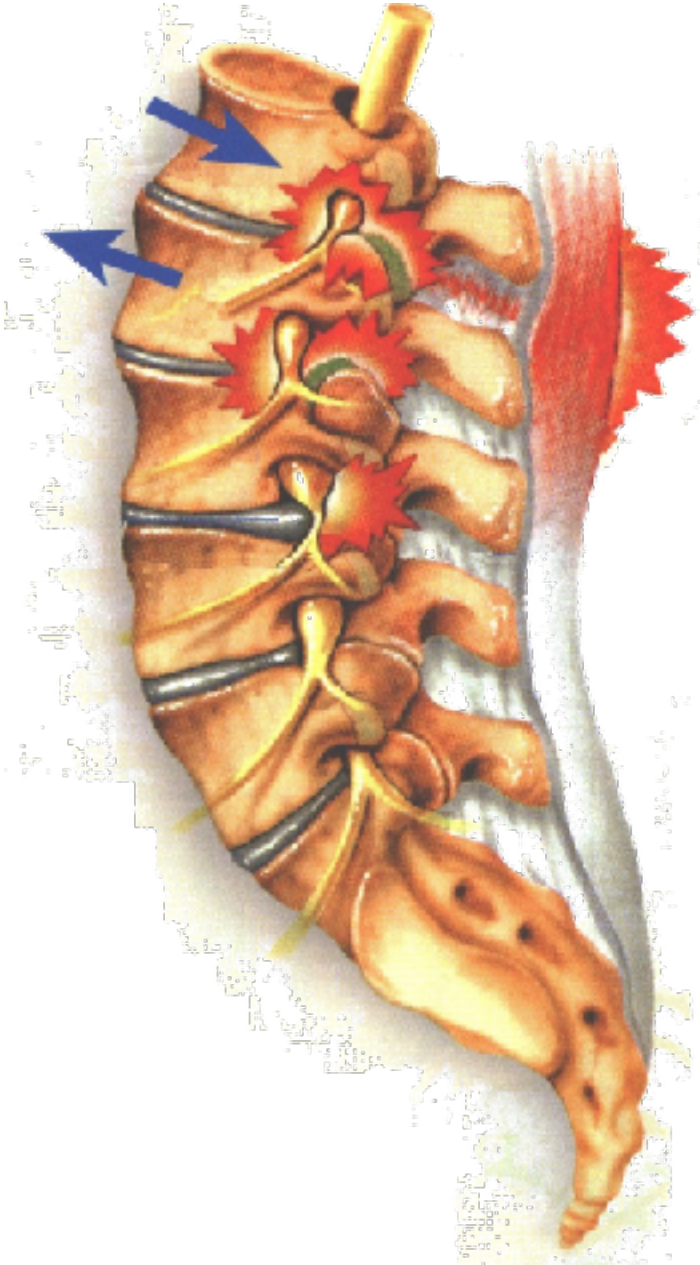
Osteoarthritis

Wolf's Law:

Tension

Bone = 'Spurs'

Paraspinal Muscle Shortening



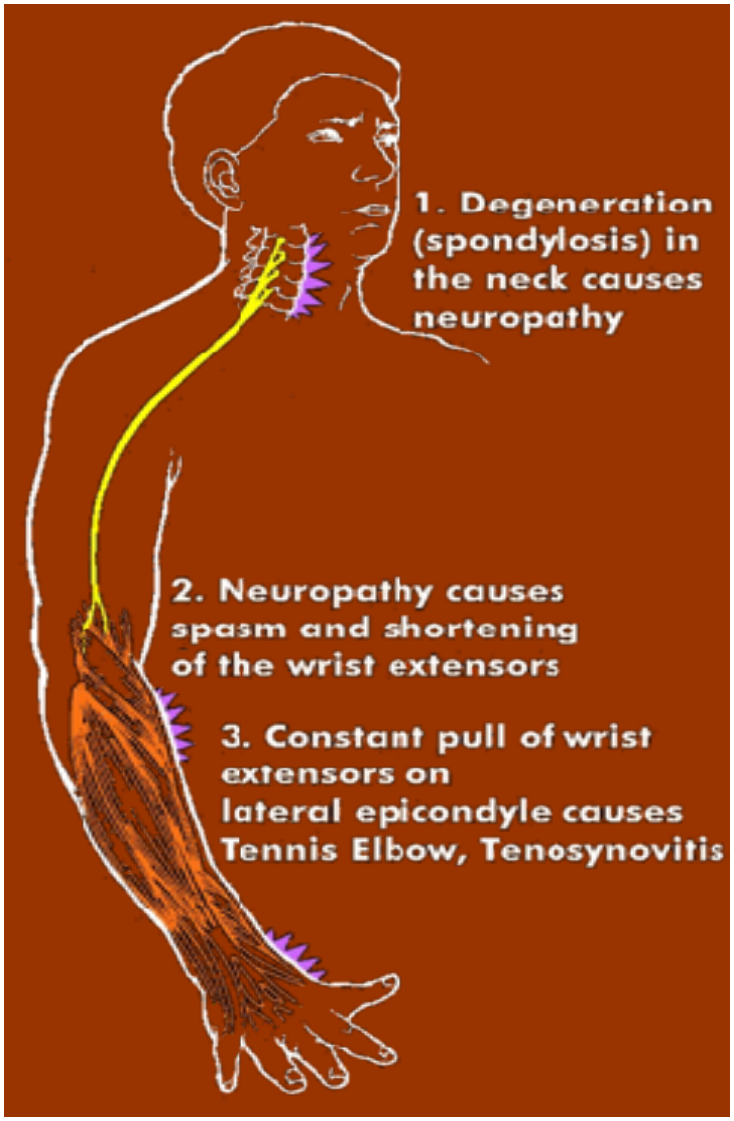
Shortened muscles between vertebrae increase pressure on disc, nerve and facet joints

Spondylosis > Neuropathy > Muscle Shortening > Tendinosis Syndromes

Spinal Wear & Tear ➔ Radiculo-Neuropathy

Neuropathy ➔ Muscle Shortening

Shortening ➔ ⬆ Tension on Tendon = Tendinosis



‘SHORTENED MUSCLE’ SYNDROMES

SHORTENED MUSCLE	SYNDROME
Gluteal, Pyriformis Hamstring	Pseudo’ Sciatica, Gluteal/Ischial Bursitis, Pyriformis Syndrome
Supra - Infraspinatus, Teres Major, Subscap	Rotator Cuff Tendonosis, Impingement
Extensor Carpi Radialis Longus and Brevis	Lateral Epicondylosis Tennis Elbow
Quadriceps, Adductors	Patella-Chondromalacia Runner’s Knee, Medial Knee Pain
Gastroc-soleus	Achilles Tendonosis
Neck & Back Muscles	Cervicalgia, Lumbar Pain Facet Syndrome
Intrinsic Foot	Plantar Fasciitis, Heel Pain
TFL, Iliotibial Band	IT-Band, Knee Pain

Tenodono**pathy** NOT Tendo**nitis**

Khan KM, Cook JL, Bonar F, Harcourt P, Åstrom M Histopathology of common tendonopathies. Update and implications for clinical management. Sports Med 1999 27: 393-408

Khan KM, Cook JL, Kannus P, Maffulli N, Bonar SF. Time to abandon the "tendonitis" myth: painful overuse tendon conditions have a non-inflammatory pathology. BMJ 2002 324: 626-27

Fredberg U, Stengaard-Pedersen K. Chronic tendinopathy tissue pathology, pain mechanisms, and etiology with a special focus on inflammation. Scand J Med Sci Sports 2008 18: 3–15

Jonsson P, Alfredson H, Sunding K, Fahlstrom M, Cook J. New regimen for eccentric calf-muscle training in patients with chronic insertional Achilles tendinopathy: results of a pilot study. Br J Sports Med 2008 42:746–49

Allison GT, Purdam C. Eccentric loading for Achilles tendinopathy – strengthening or stretching? Br J Sports Med 2009 43:276-79

Myofascial Pain is a Type of Neuropathic Pain
'Evidence of Neuroaxonal Degeneration in MFPS'
Chang, CW. 2008, Europ Jrnal of Pain

Table 1
Values of mean consecutive difference (MCD) obtained in patients with myofascial pain syndrome (MPS) and normal controls

Muscles	Subject numbers	MCD (μs)	HNL MCD (μs)	Abnormal MCD (%)
Normal controls	16			
Trapezius	8	32.9 ± 7.1^{a}	47.1	0
Levator scapulae	8	36.2 ± 6.4^{b}	49.0	0
MPS patients	23			
Trapezius	15	61.5 ± 11.1^{a}		74.3
Levator scapulae	8	59.2 ± 10.9^{b}		70.7

Values are mean ± SD.
HNL: highest normal limit.
For comparison of values with the same letter: $^{a,b}p < 0.01$ by Student's t-tests.

Electrophysiologic Evidence of Spinal Accessory Neuropathy in Patients With Cervical Myofascial Pain Syndrome

Chang, et. al. Arch Phys Med Rehabil Vol 92, June 2011

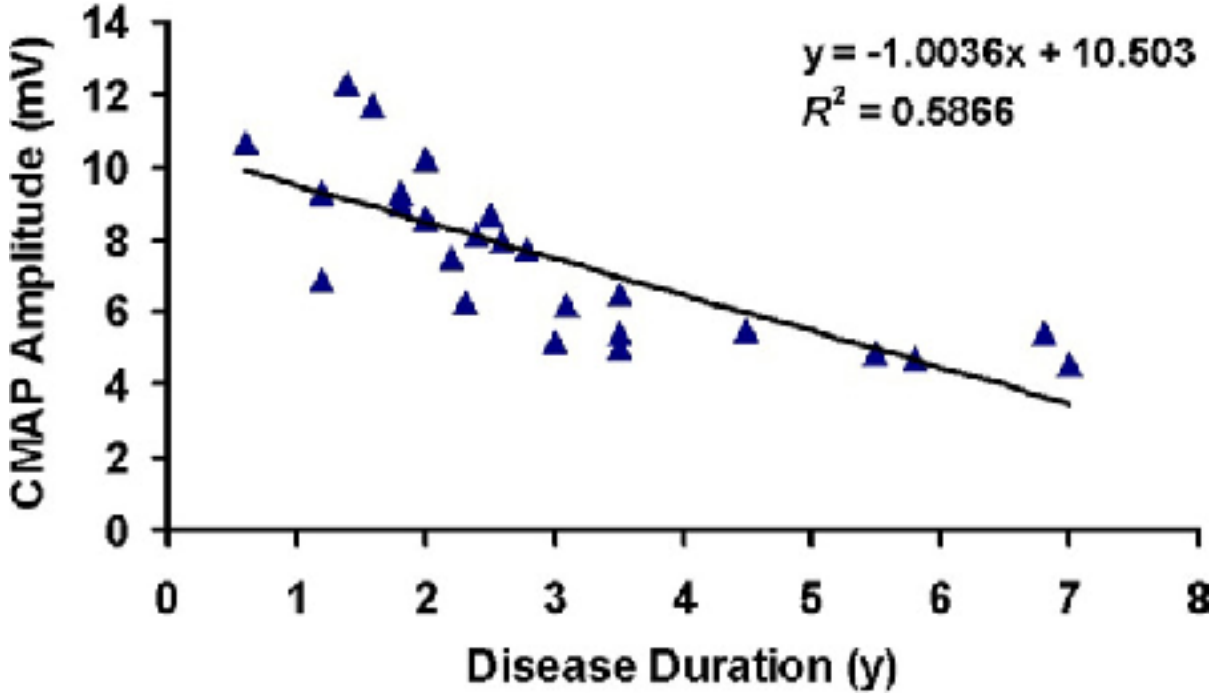


Fig 2. Relation between CMAP amplitude and disease duration in patients with cervical MFPS.

Radiculopathy: 3 Divisions of Nerve Root

- **Motor nerve: c/o stiffness; muscle fiber contracture/taut bands, spasm, decreased joint ROM; tendinosis syndromes**

- **Sensory nerve: c/o parasthesias; allodynia, myalgic hyperalgesia = tender points**

- **Autonomic nerve: smooth muscle contracture > neurogenic or trophic edema**
- **vasonstriction > cool to touch**

  sudomotor > hyperhidrosis

  pilomotor > gooseflesh, hair loss

Neuroanatomy explains association of MFPS and Autonomically mediated symptoms

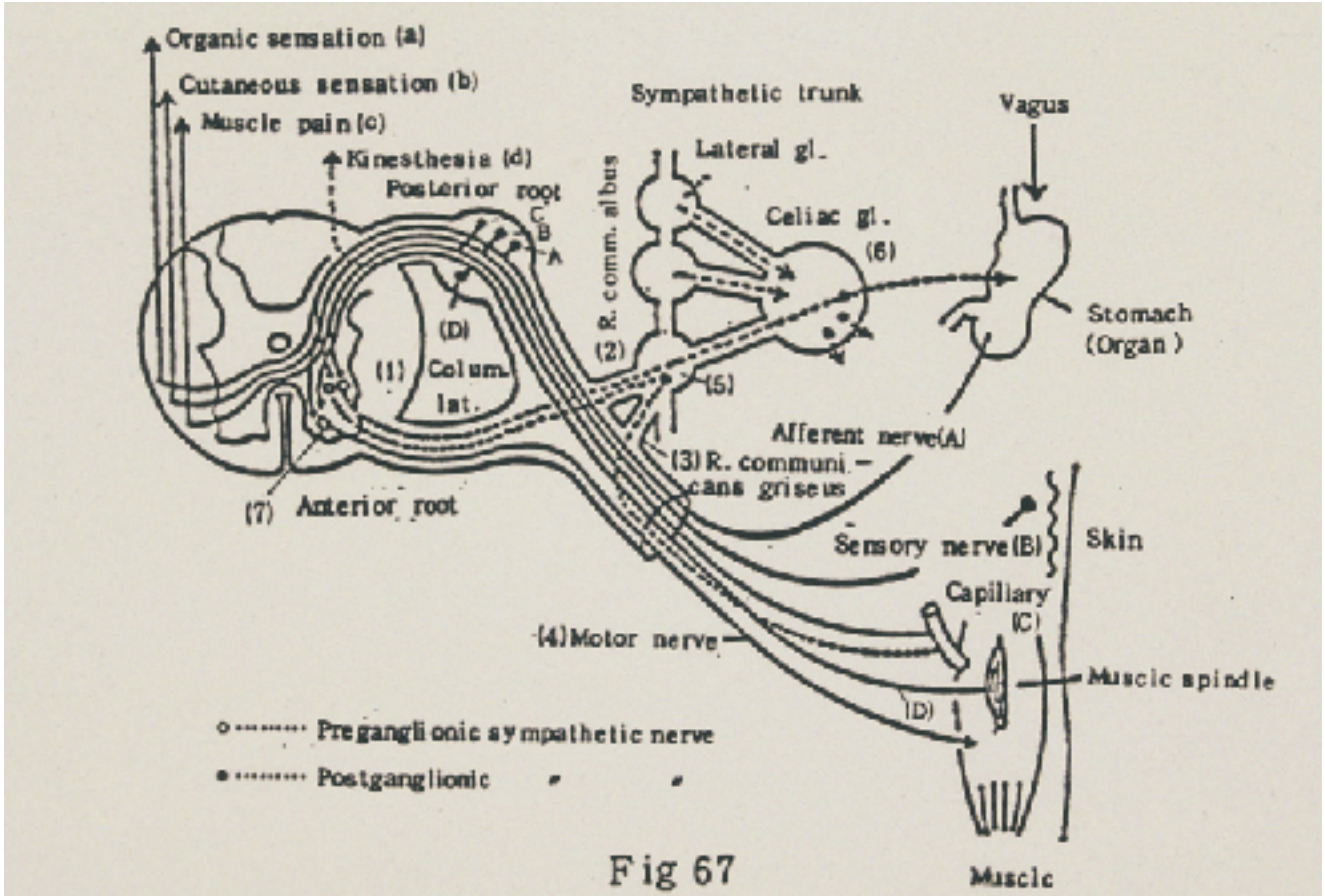


Fig 67

Relationship between the internal organs and the muscles, showing neuronal connections

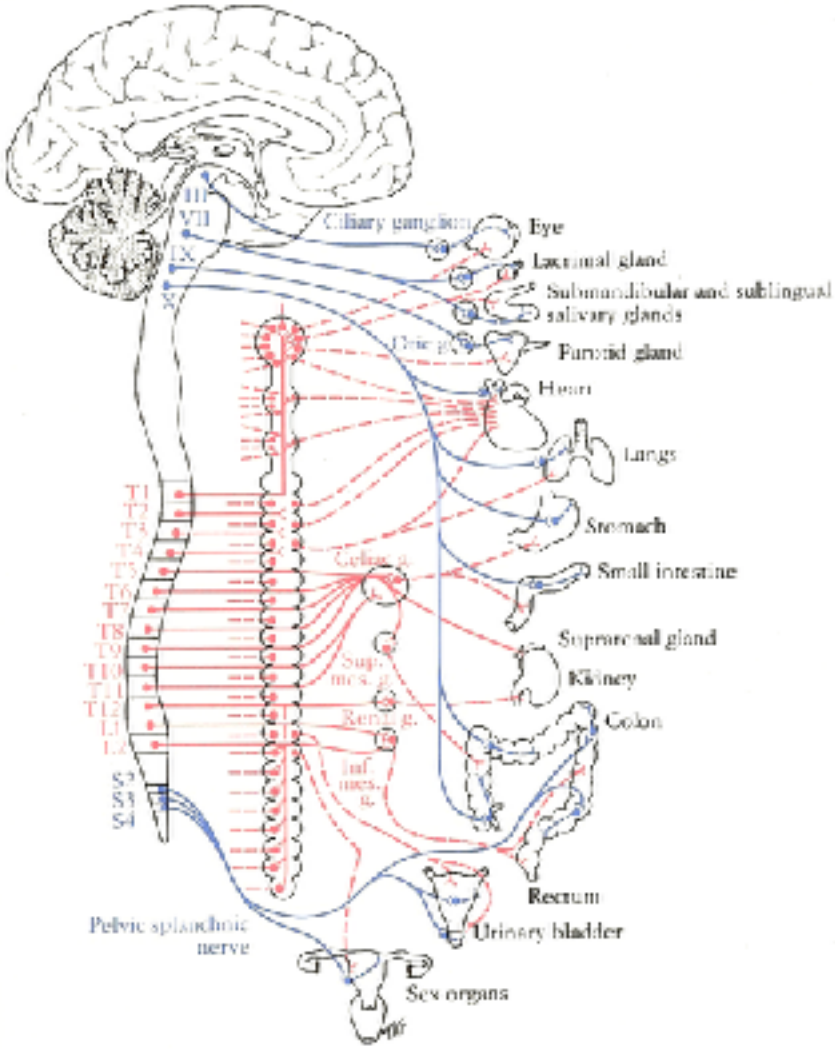


Fig. 29-2. Efferent part of autonomic nervous system. Preganglionic parasympathetic fibers are shown in solid blue, postganglionic parasympathetic fibers in interrupted blue. Preganglionic sympathetic fibers are shown in solid red, postganglionic sympathetic fibers in interrupted red.

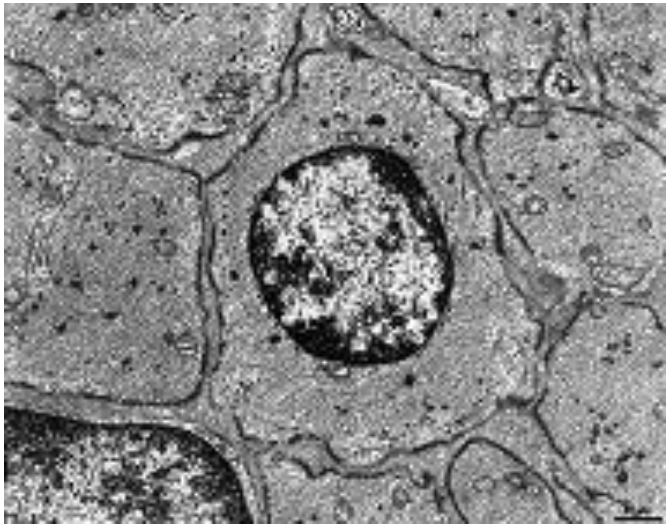
Autonomic Neuropathy > Neurogenic Edema: Peau d'Orange' Effect

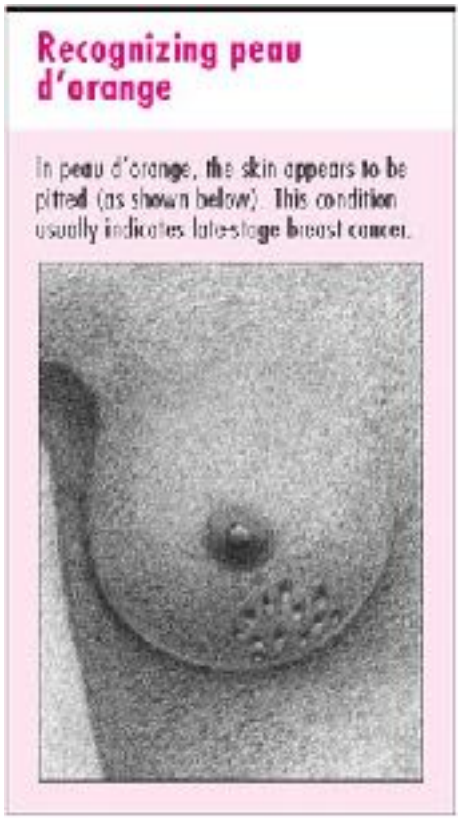
- **Smooth muscle cells (vascular & lymphatic)**

Supersensitive to Ach ➡ Contracture

➡ ⬆ **opening of cell gap**

➡ **leakage = 'Trophic' Edema**





A Novel Microanalytical Technique for Assaying Soft Tissue Demonstrates Significant Quantitative Biochemical Differences in 3 Clinically Distinct Groups: Normal, Latent, and Active. 2003

Jay P. Shah, MD National Institutes of Health

This technique recovered extremely small quantities (0.5L) of very small substances (molecular weight, 100kd) directly from soft tissue.

There were significant differences in the levels of pH, substance P, CGRP, bradykinin, norepinephrine, TNF, and IL-1 in those subjects with an active MTrP (symptoms, MTrP present) compared with subjects with a latent MTrP (no symptoms, MTrP present) and normal subjects (no symptoms, no MTrP).

Neuropathy ➡ Dystrophic Muscle Histopathology

- Golgowsky and Wallraff: waxy degen., agglom. nucclei, fatty infiltration
- Miehlke et al: Groups 1-4 Symp./Findings #3,4 ~ dystrophic nuclear changes, esp. near blood vessels, fibre degen., fat/conn. tissue
- Fassbender: swollen mitochondria, moth-eaten filaments, necrosis, dissolution of elements, inc. mucopolysaccharides = ischemia or Etoh

Rachlin ES. Myofascial Pain and Fibromyalgia – Trigger Point Management. Mosby, 1994

NEUROPATHIC- MYOFASCIAL PAIN

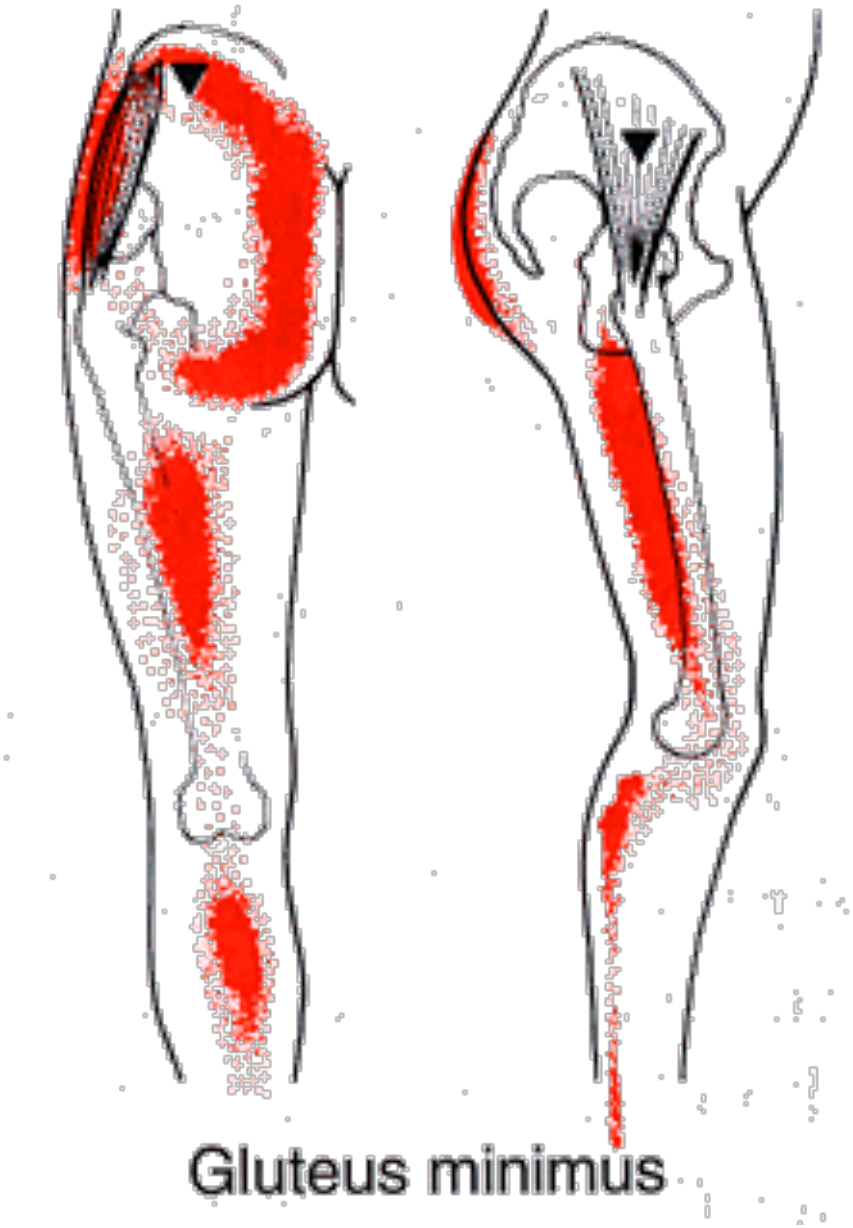
Non-Articular Musculoskeletal Pain Identified by Motor, Sensory & Autonomic Findings including the presence of 'Trigger Points', Myotomally Localized Tender & Shortened Muscle Bands ('Taut Bands') that can *often* be located by palpation and that produce local and/or referred pain, parasthesias, restricted ROM and/or Autonomic Disturbance

DIAGNOSIS of NEUROPATHIC-MYOFASCIAL PAIN SYNDROME

“Your test results were negative – get lost!”

“When all else fails, examine the patient.”

Dean Naughton



ENIGMATIC

Myotomal NOT = Dermatomal

- **Referred Pain Experienced Remotely From Source & Partially**

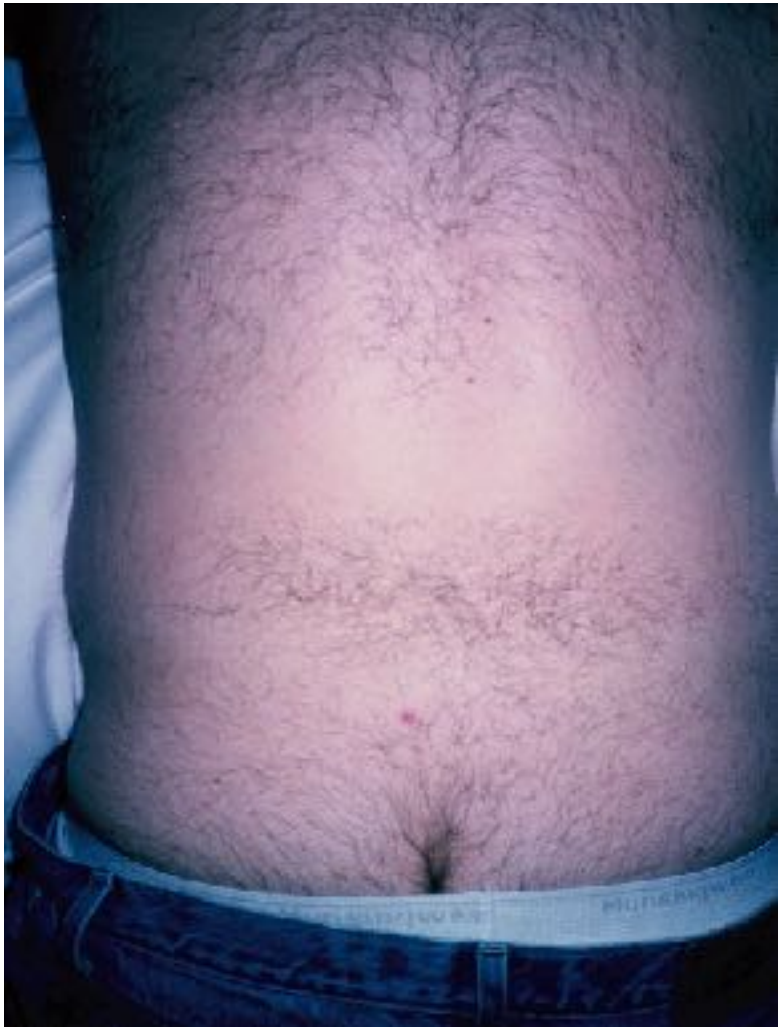
- **Multiple Trigger Point Can Refer to Same Location**

- **Travell & Simons Myofascial Trigger Points**

Autonomic Neuropathy
Exaggerated Pilomotor Reflex

Bilateral C4-C5 Dermatomal Hair Loss

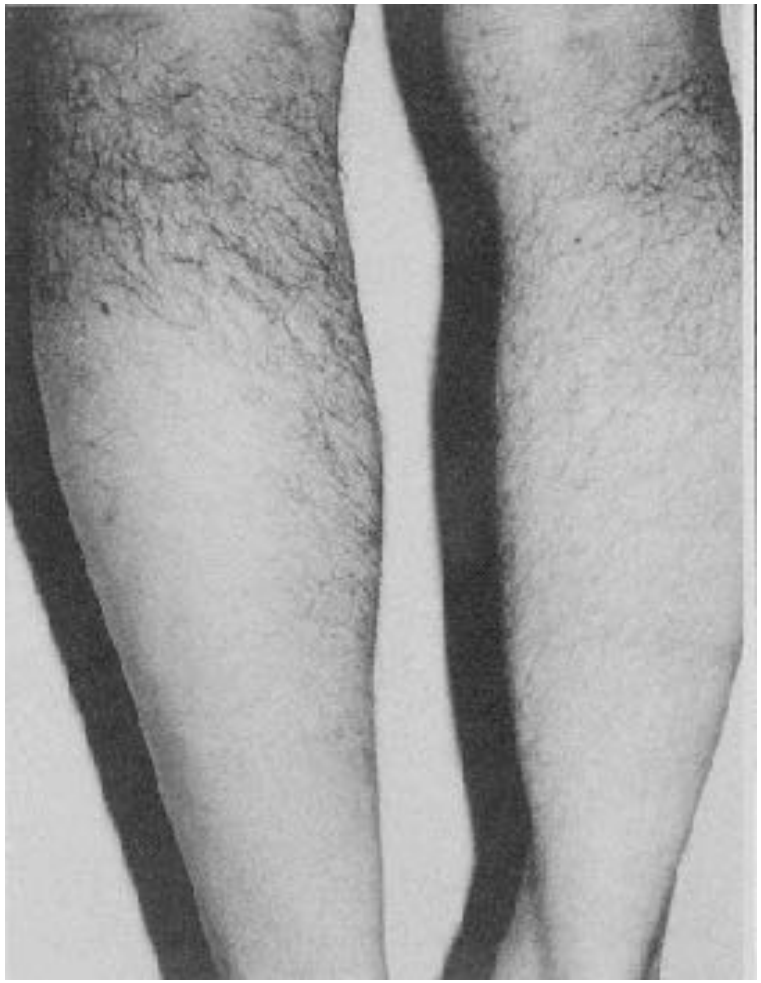
L2-L3 Dermatomal Hair Loss



Right L2-L3 Dermatomal Hair Loss

Dermatomal Hairloss Secondary to Bilateral L5 Radiculo-Neuropathy

Dermatomal Hairloss Secondary to S1 Radiculo-Neuropathy



Muscle Contracture with Shortening > Postural deviation

MUSCLE SHORTENING ➡ DECREASED RANGE of MOTION

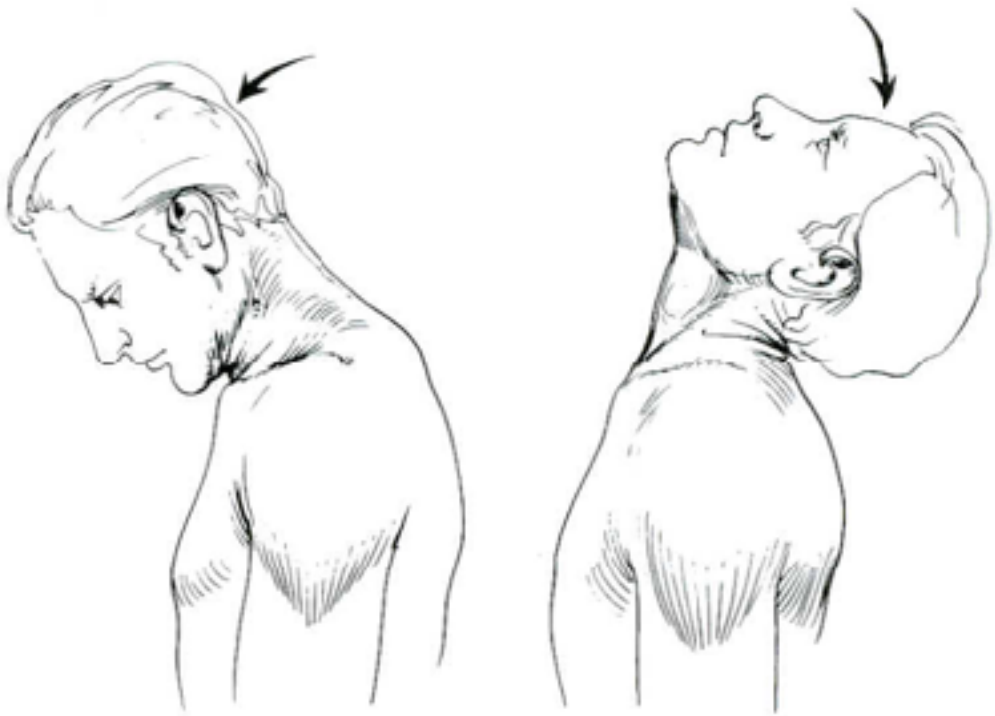
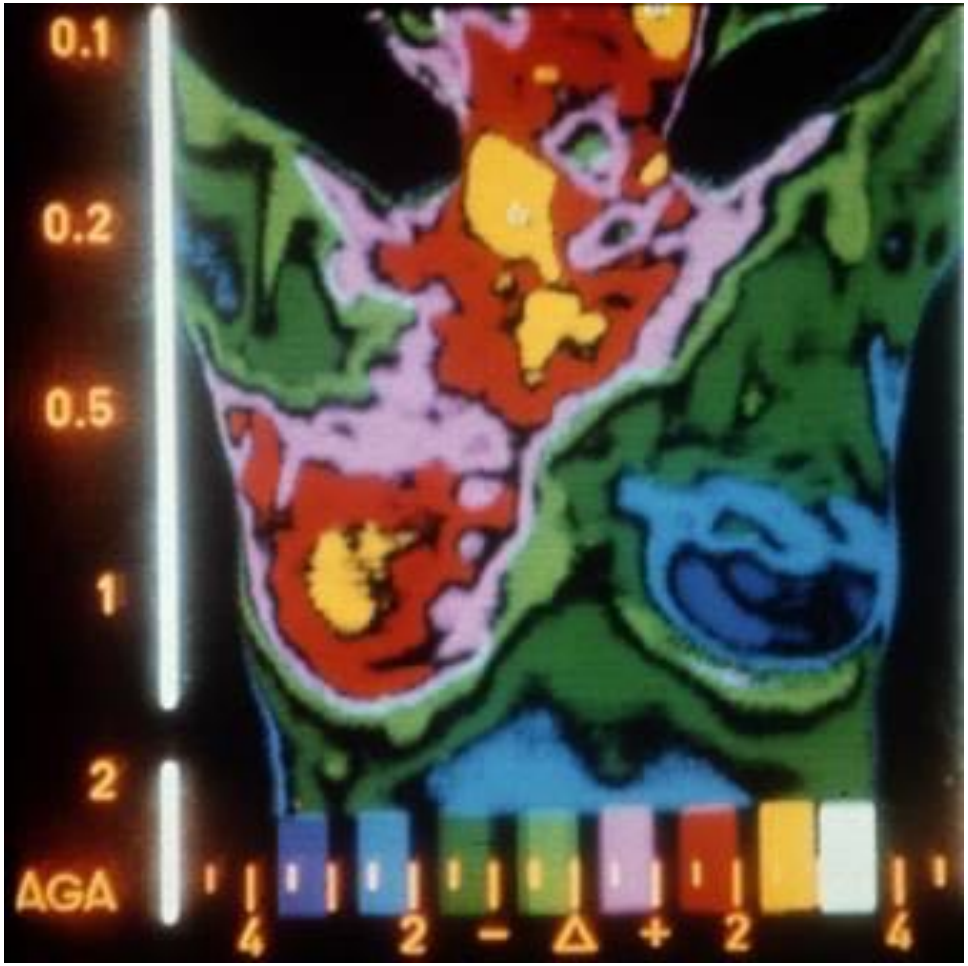
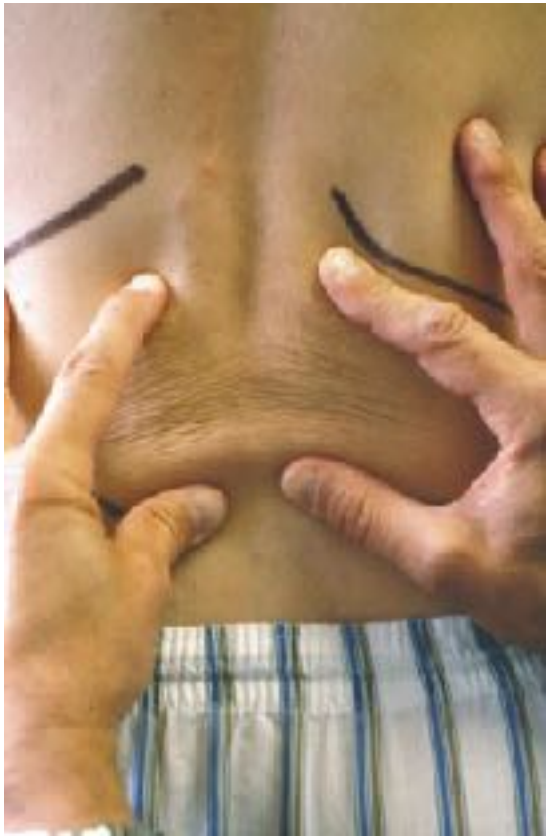


Fig. 24. Left. Normal range of neck flexion. **Right.** Normal range of neck extension.

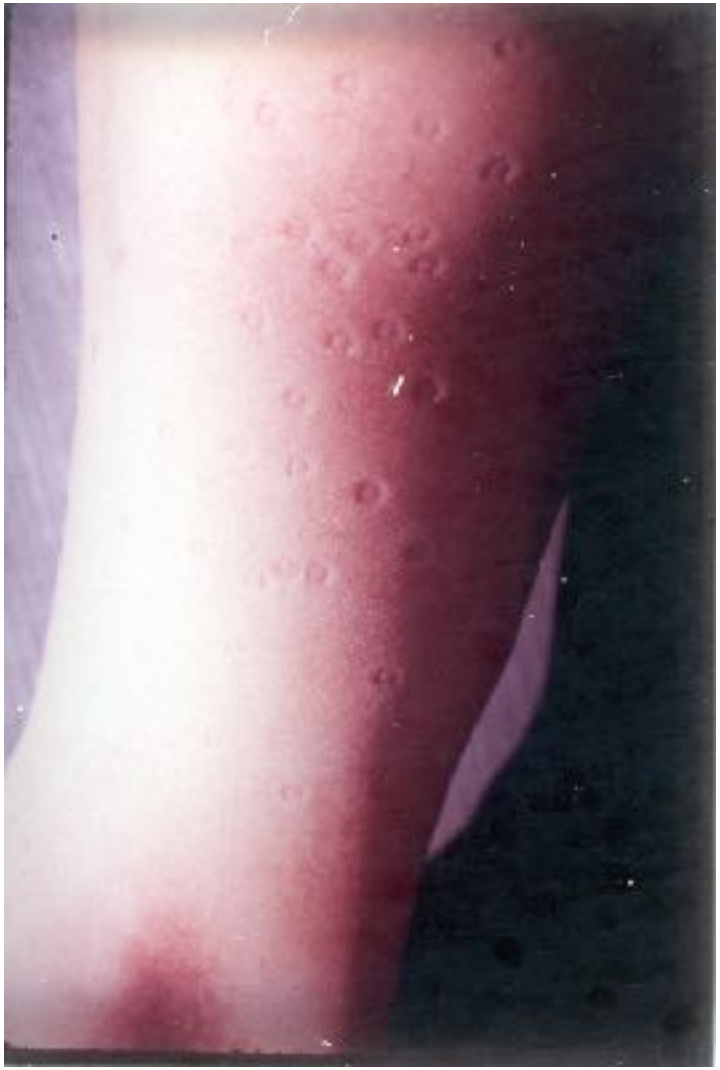
Neuropathy → Vasoconstriction: Cool to Touch Segmentally



LYMPHATIC & VASCULAR SMOOTH MUSCLE CONTRACTURE → TROPHIC EDEMA



Trophic Edema in the Lower Inner Leg



Cervical Edema + DDD = ‘Turkey Neck’

The Trigger Point

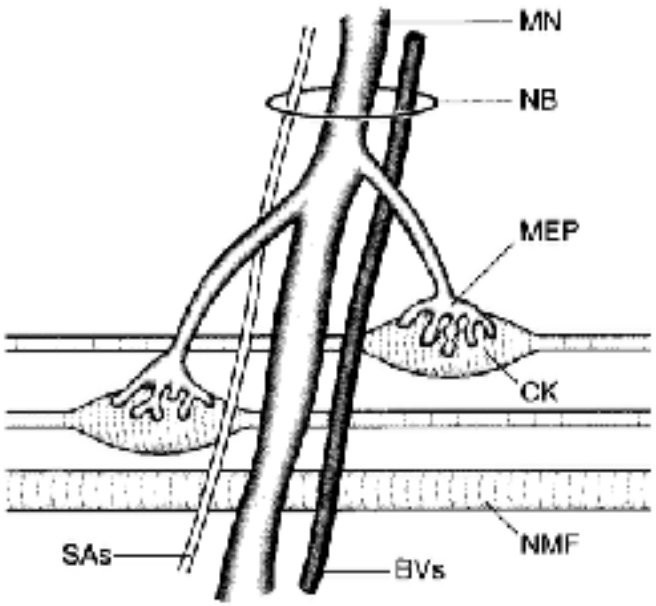
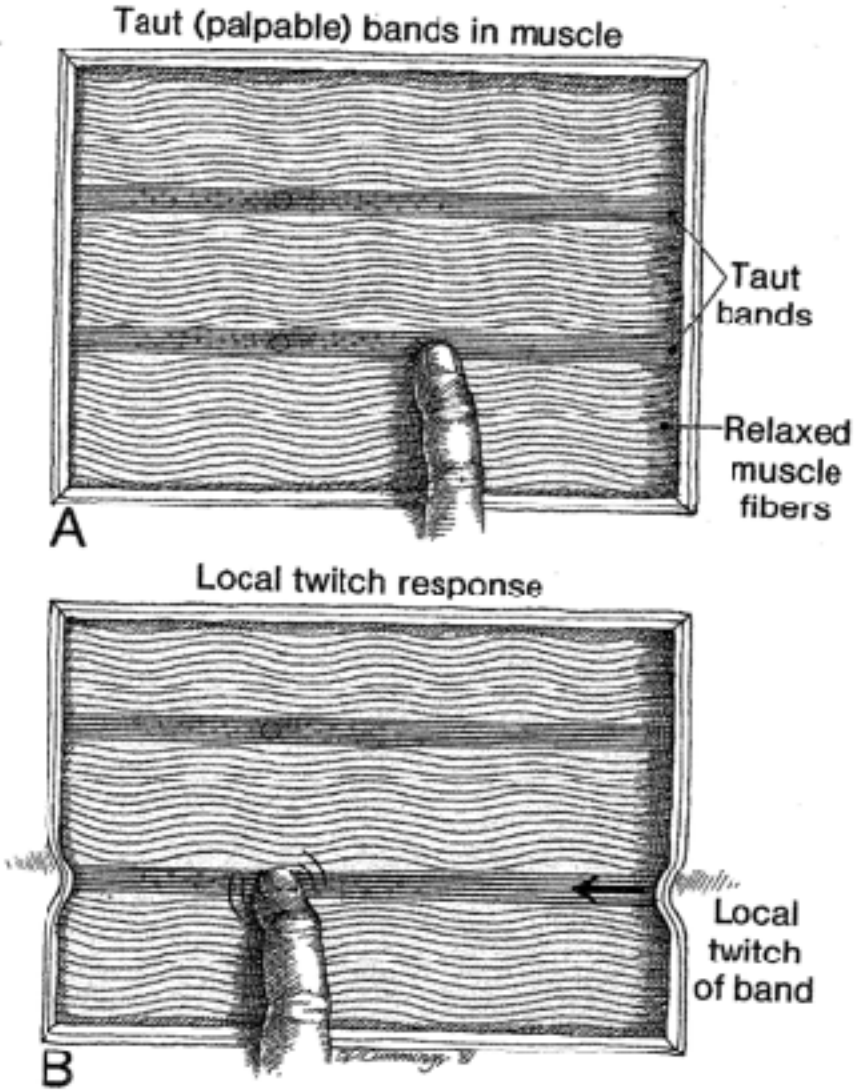
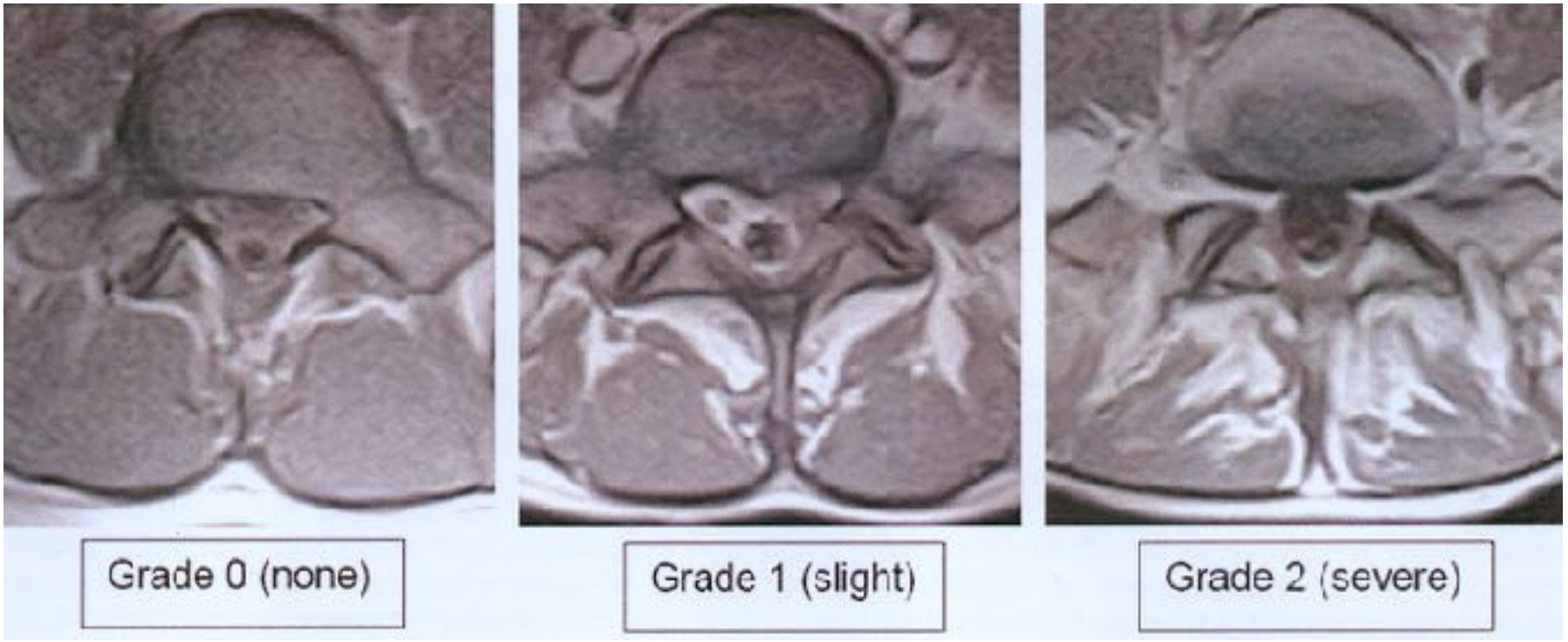


Figure 4.2 Diagrammatic representation of part of a myofascial trigger point showing two motor endplates (MEPs) and juxtapositional contraction knots (CKs); also a neurovascular bundle (NB) containing motor nerves (MNs), nociceptive and proprioceptive sensory afferents (SAs) and blood vessels (BVs) with closely associated sympathetic fibres. Note: in normal muscle fibre (NMF) the sarcomeres are of equal length. In a muscle fibre containing a contraction knot there is shortening of the sarcomeres at that site and compensatory lengthening of them on either side.



Baldry, PE. Myofascial Pain and Fibromyalgia – A Clinical Guide to Diagnosis and Management. Churchill Livingstone

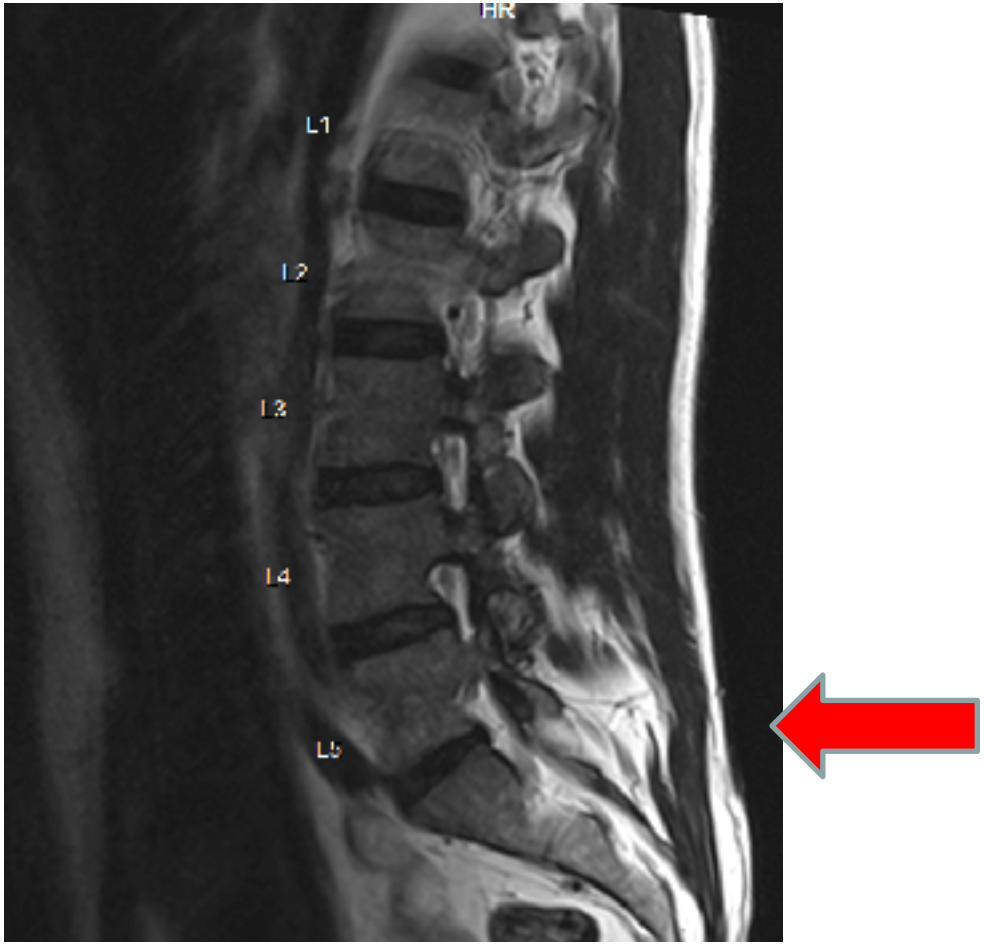
Are MRI-defined fat infiltrations in the multifidus muscles associated with low back pain? (YES)



BMC Med. 2007 Jan 25;5:2. Kjaer, P., et. Al.

The Back Research Center, Backcenter Funen, Part of Clinical Locomotion Science, University of Southern Denmark

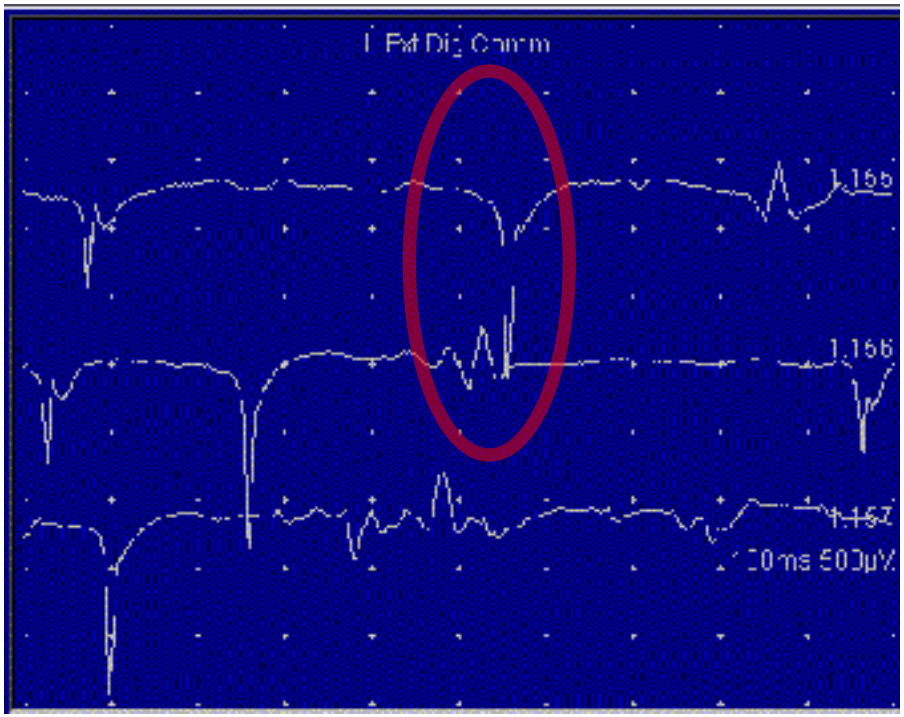
L5-S1 Degenerative Disc Narrowing Correlates w/ Level of Multifidi Dystrophy



EMG 'Positive Sharp Waves' or Fibrillations' = <u>ACUTE</u> RADICULOPATHY

Neuropathic Myofascial Pain: Chronic, so

'Nml EMG'



NMPS: Findings of Chronic Radiculopathy: Increased Insertional Activity, Polpyphasic MUAPS but difficult to quantitate
SFEMG not practiced in community

Myofascial Trigger Point Pain is Common Epidemiologically

- **Myofascial Pain in Childhood 85 cases/23 MFPS due to illness or injury Age 1-18, Majority < 10 years Rx w/ethyl chloride spray and stretch: COMPLETE RELIEF 69/85 (81%) + INCOMPLETE RELIEF 9/85 (92%) INDEFINITE/NO RELIEF 7/85 BATES and GRUNDWALDT 1958**

- **Asymptomatic 'Latent' Trigger Points – found in 54% females 45% males AGE 17-35 Median/Mean19/19.5 SOLA 1955**

Myofascial Trigger Point Pain is Common

- 55% of 164 patients referred to a dental clinic for chronic head and neck pain were found to have active myofascial trigger points as the cause of their pain

- Trigger points were the primary source of pain in 74% of 96 patients with musculoskeletal pain seen by a neurologist in a community pain medical center

Cummings, T. Needling Therapies in the Management of Myofascial Trigger Point Pain: A Systematic Review, Arch Phys Med Rehabil Vol 82, July 2001

Prevalence of Myofascial Pain in General Internal Medicine Practice.

Skootsky, S.A. West J Med. 1989 Aug;151(2):157-60

- 54/172 (>30%) Patients @ Primary Care: PAIN
- 16/54 (30%)=Clinical Criteria for MFPS
- @10% OF ALL PATIENTS HAVE MFPS!
- Intensity by VAS HIGH = or > ALL other PAIN

- Physicians RARELY Dx, Yet Rx Provides Substantial & Abrupt RELIEF

Myofascial Pain Common and Commonly Overlooked, Undertreated, Severe yet Rxable!!!

Myofascial Pain Findings Increase w/ Age

2006 JAGS 54:11–20
Chronic Low Back Pain in Older Adults:
Prevalence, Reliability, and Validity of Physical Examination Findings
Weiner, D. et. Al.

Incidence of Findings: Back Pain vs. No Back Pain

Scoliosis	77.5%	vs.	60%
Myofascial Pain Syn	**96%**	**vs.**	**10**
Sacroiliac	84%	vs.	5%
Fibromyalgia	19%	vs.	0%
Hip Pain	48%	vs.	0%

TABLE 7–1.

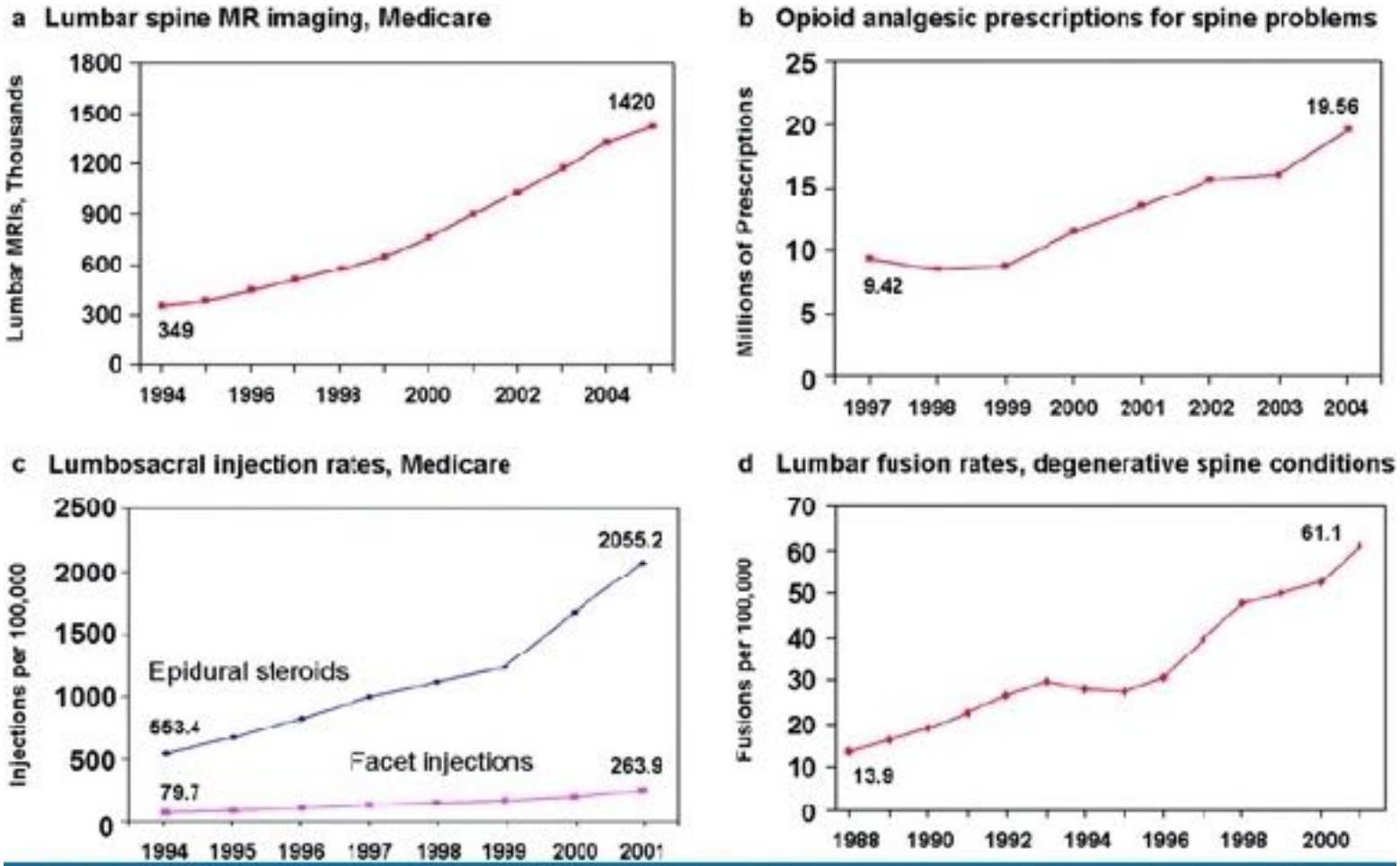
Epidemiology of Trigger Points

Higher in women than men
Most common in 30- to 50-year age range
Most commonly found in the following muscles: trapezius, levator scapulae, axial postural muscles
Chronic pain clinics study reported incidence of 85% of patients having myofascial pain syndrome
Asymptomatic shoulder girdle trigger points are found in 54% of females and 45% of males

Rachlin ES. Myofascial Pain and Fibromyalgia – Trigger Point Management. Mosby, 1994

Overtreating Chronic Back Pain: Time to Back Off?

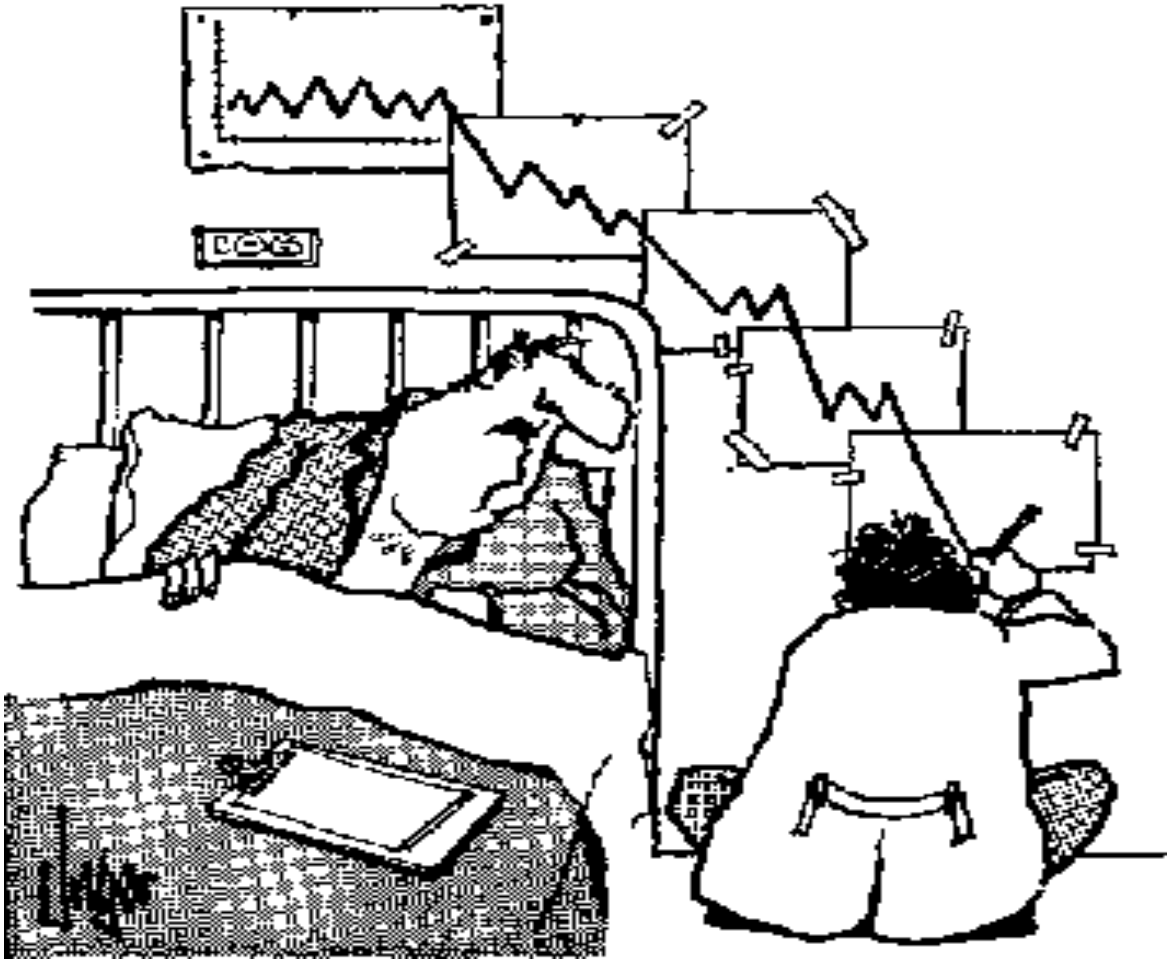
Deyo, R. J Am Board Fam Med. 2009 Jan-Feb;22(1):62-8.



Medscape

Source: J Am Board Fam Med © 2009 American Board of Family Medicine

“I really look forward to your cheery little visits.”



STIMULATION to Modulate & Normalize Neurophysiologic Function is Both Natural:

Ex: Reflexively Rubbing an Injured Area of Body

AND, Commonly Used in Medicine

‘Gate Theory’ Describes Role of Large Fiber Modulation of Small Fibre Generated Pain Melzack & Wall 1965

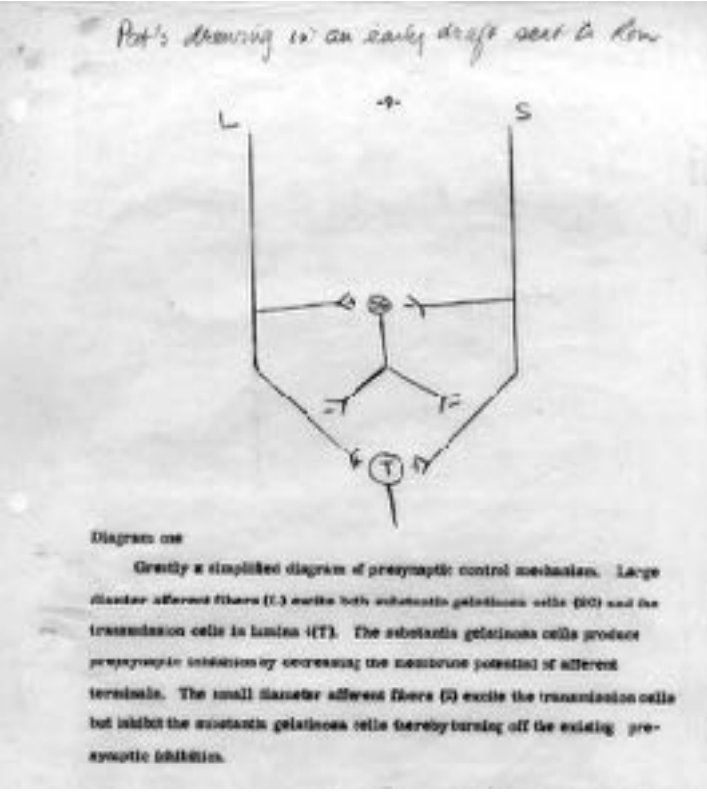


Diagram one

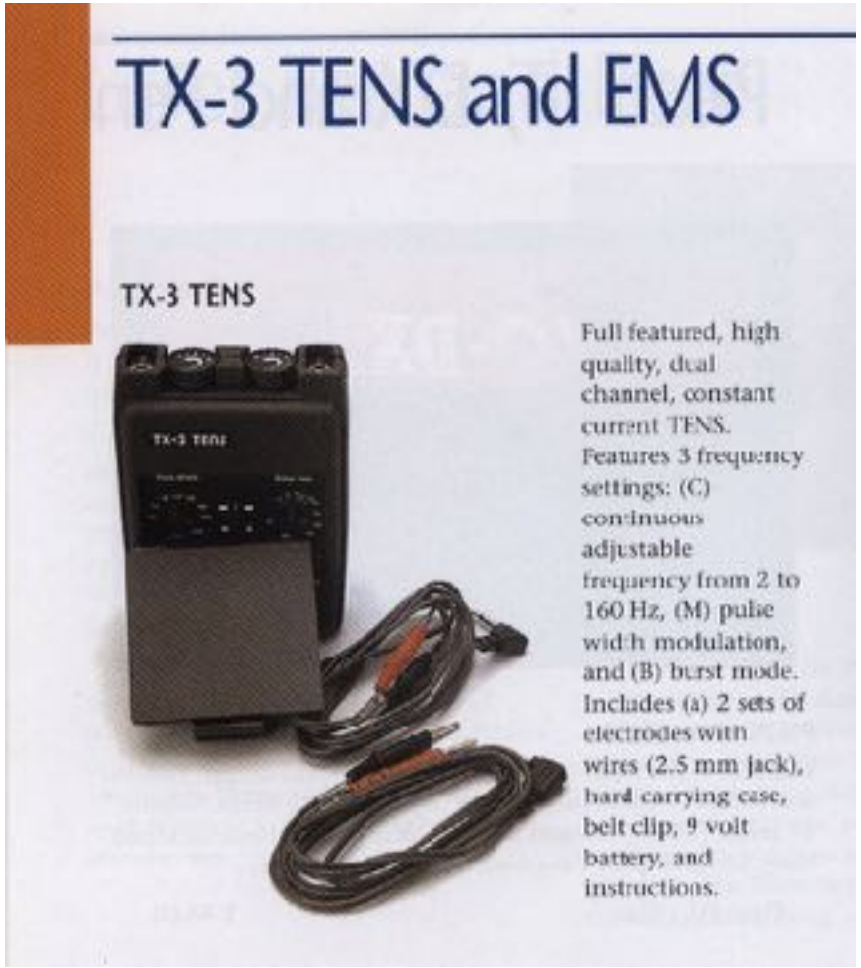
Greatly a simplified diagram of presynaptic control mechanism. Large diameter afferent fibers (L) excite both substantia gelatinosa cells (SG) and the transmission cells in lamina 4(T). The substantia gelatinosa cells produce presynaptic inhibition by decreasing the membrane potential of afferent terminals. The small diameter afferent fibers (S) excite the transmission cells but inhibit the substantia gelatinosa cells thereby turning off the existing pre-synaptic inhibition.

Prolonged Relief of Pain by Brief, Intense Transcutaneous Somatic Stimulation Melzack 1975

T.E.N.S.

ELECTRO-ANALGESIA

Battery Powered Electric Nerve Stimulator 2008



FREMS = Frequency Modulated TENS

2008 J Neurol. Mar 14
Deep brain stimulation for dystonia: outcome at long-term follow-up. Loher, TJ, et.al

CONCLUSION : DBS maintains marked long-term symptomatic and functional improvement in the majority of patients with dystonia

---

2011 J Neurosurg Dec;115(6):1248-55.
Vagus nerve stimulation for epilepsy: a meta-analysis of efficacy and predictors of response

VNS is an effective and relatively safe adjunctive therapy in patients with medically refractory epilepsy not amenable to resection.

2007 Adv Tech Stand Neurosurg. 32:63-89

Spinal cord stimulation for ischemic heart disease and peripheral vascular disease.

Ischemic disease (ID) is now an important indication for electrical neuromodulation (NM), particularly in chronic pain conditions. NM is defined as a therapeutic modality that aims to restore functions of the nervous system or modulate neural structures involved in the dysfunction of organ systems. One of the NM methods used is chronic electrical stimulation of the spinal cord (spinal cord stimulation: SCS). SCS in ID, as applied to ischemic heart disease (IHD) and peripheral vascular disease (PVD), started in Europe in the 1970s and 1980s, respectively.

2005 Adv Tech Stand Neurosurg. 30:177-224.

Sacral neuromodulation in lower urinary tract dysfunction

So-called idiopathic bladder overactivity still the major indication for this technique. Patients not likely to benefit from the procedure were those with complete or almost complete spinal lesions, but incomplete spinal lesions seemed to be a potential indication. This technique is now also indicated in the case of idiopathic chronic retention and chronic pelvic pain syndrome. When selection is performed, more than three-quarters of the patients showed a clinically significant response with 50% or more reduction in the frequency of incontinent episodes,

Percutaneous Tibial Nerve Stimulation: A Clinically and Cost Effective Addition to the Overactive Bladder Algorithm of Care

Curr Urol Rep (2012) 13:327–334

Percutaneous Tibial Nerve STIMULATION for the Long-Term Treatment of Overactive Bladder: 3 -Year Results of the STEP Study
Peters, KM. Jrnl of Urology, June 2013

CONCLUSION: Most STEP participants with an initial positive response to 12 weekly percutaneous tibial nerve stimulation treatments safely sustained over active bladder symptom improvement to three years with an average of one treatment per month

Scribonius Largus 45 A.D.
Headache Rx: Electric Eel

CXI.

¶ Capitis dolorē quemuis ueterem & intolerabilem protinus tollit, & imperpetuum remediat torpedo uiua nigra, imposita eo loco q̃ in dolore est, donec desinat dolor, & obstupescat ea pars: quod cum primū sensérit, remoueatur remedium, ne sensus auferatur eius partis. Plures aūt parādæ sunt eius generis torpedines: quia nōnunq̃ uix ad duas, trésue respondet curatio, id est, torpor, quod signū est remediationis.

Scribonius Largus Designatus
"Scripta mea Latina medicalia, codex instar"
editio prima, cap. XI. De compositione medicamentum liber.
Ed. J.M.Berthold, Argentor, 1786.

ALL forms of ‘Counter–Irritation Reflex Stimulation’ operate through afferent stimulation of specialized receptors

- **Massage, acupressure, MFR, *Kinesiotape***
  tactile & pressure receptors
- **Exercise, traction, manual Rx, Electrical-stimulation TENS**
  tactile, pressure, muscle spindles & Golgi tendon organs
- **Diathermy, cold, ultrasound, infrared, lasers**
  thermal receptors, photobiomodulation
- **Dry Needling, Intramuscular Stimulation**
  muscle spindle hyperstimulation, spinal reflexes, ‘current of injury’

Touch = Low Tech Afferent Stimulation

MANUAL SOFT TISSUE THERAPY: Trigger Point Massage, Pin & Stretch, Myofascial Release, Acupressure, Shiatsu
Strain-Counterstrain, Rolfing

Changes in Blood Flow and Cellular Metabolism at a Myofascial Trigger Point With Trigger Point Release (Ischemic Compression):

A Proof-of-Principle Pilot Study

Albert F. Moraska, et. al.

Archives of Physical Medicine and Rehabilitation 2013;94:196-200

Responsiveness of Myofascial Trigger Points to Single and Multiple Trigger Point Release Massages:

A Randomized, Placebo Controlled Trial.

Moraska AF[1], Schmiege SJ, Mann JD, Butryn N, Krutsch JP.
Am J Phys Med Rehabil. 2017 Sep;96(9):639-645.

Effect of ischemic compression for cervicogenic headache and elastic behavior of active trigger point in the sternocleidomastoid muscle using ultrasound imaging.

Jafari M[1], Bahrpeyma F[2], Togha M[3]. J Bodyw Mov Ther. 2017 Oct;21(4):933-939

Independent Therapeutic Aides

Clinical Research on Dry Needling for MFPS

LEWITT: ‘The Needle Effect (NE) in Relief of Myofascial ’ Pain

PAIN 1979 NE: Immediate (Hyperstimulation) Analgesia Without Hypasthesia

241 Pts./312 Painful Structures = 86.8% Immediate Analgesia

288/312 sites: 92 ‘Permanent’, 58 Several Mos
63 Weeks, 32 Days, 43 NO Relief

75/244 pts. most effective c/w manipulation, traction, exercise

Clinical Research on T.P.I. vs. DN

- **Prospective, randomiized, dbl-blind eval of t.p.i. therapy for LBP**

  Garvey TA: SPINE 1989

  Injectate NOT critical: dry needling = ly effective

- **Dbl-blind controlled study of different myofascial injection techniques**

  Jaeger B: PAIN 1987

  Reduction t.p. tenderness dependent only on needle

  Reduction in referred sxs greater with solution but indep. of kind

Gunn: 'Dry Needling of Muscle Motor Points for Chronic LBP: A Randomized Clinical Trial w/ Long Term F/U'

SPINE 1980

Runner Up Volvo Award

- **56 Men w/ C-LBP 12 – 28.6 wks. duration**
- **29 Study / 27 Ctrl Pts.**
- **IMS avg 7.9 Rx f/u: D/C, 12 wks., 27.3 wks.**
- **Ctrl. 4 RTW, 14 LD, 9 DISABLED**
- **18/29 RTW, 10 LD NO DISABLED**

Hong CZ: Lidocaine Injection vs. Dry Needling to Myofascial T.P. The Importance of Local Twitch Response

AMER JRNL of P M & R 1994

Vol. 73, No. 4, July/August 1994

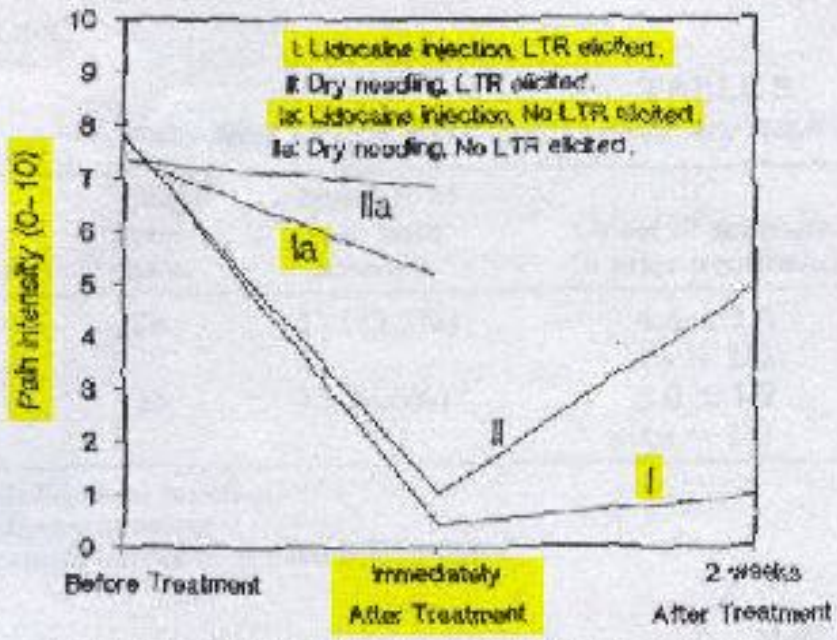


Figure 1. Effect of trigger point injection or dry needling on subjective pain intensity: 0, no pain; 10, most severe pain.

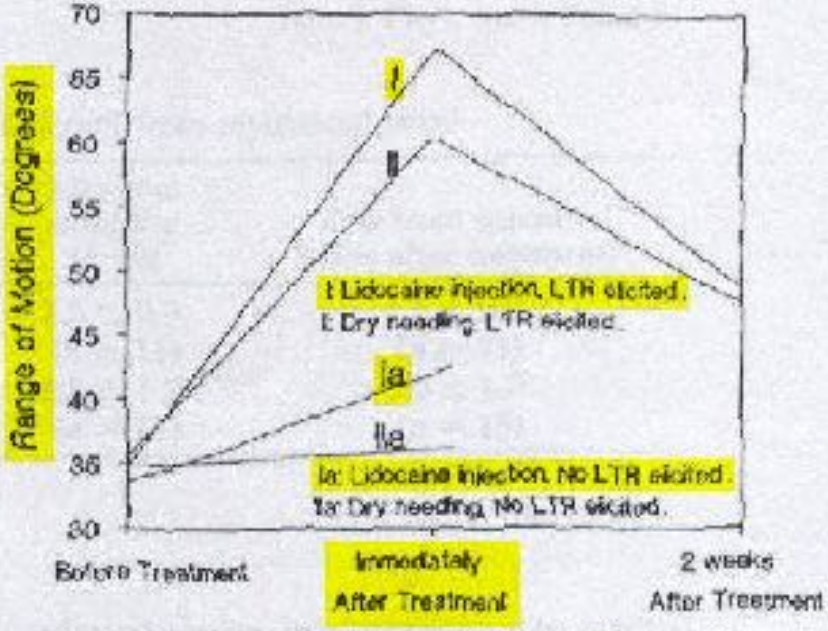


Figure 3. Effect of trigger point injection or dry needling on range of motion of cervical spine (lateral bending).

INTRAMUSCULAR STIMULATION DRY NEEDLING RESEARCH

- Kim HK, Kim SH, Kim MJ, Lim JA, Kang PS, Woo NS, Lee YC. Intramuscular stimulation in chronic pain patients. J Korean Pain Soc 2002 15:139-145 (In Korean with English introduction)

- Kim JK, Lim KJ, Kim C, Kim HS. Intramuscular stimulation therapy in failed back surgery syndrome patients. J Korean Pain Soc 2003 16:60-67 (In Korean with English introduction)

- Ga H, Koh HJ, Choi JH, Kim CH. Intramuscular and nerve root stimulation vs lidocaine injection of trigger points in myofascial pain syndrome. J Rehabil Med 2007 39: 374-378

- Ga H, Choi JH, Park CH, Yoon HJ. Dry needling of trigger points with and without paraspinal needling in myofascial pain syndromes in elderly patients. J Altern Complement Med 2007 13: 617-624

- Lim SM, Seo KH, Cho B, Ahn K, Park YH. A systematic review of the effectiveness and safety of intramuscular stimulation therapy. J Korean Med Assoc 2011 54(10): 1070-1080

Cochrane Reviews

Highly regarded, rigorous reviews of the available evidence of clinical treatments.

2005: "To assess the effects of dry needling for myofascial pain in the low back region"

Thirty-five RCTs covering 2861 patients were included in this systematic review.

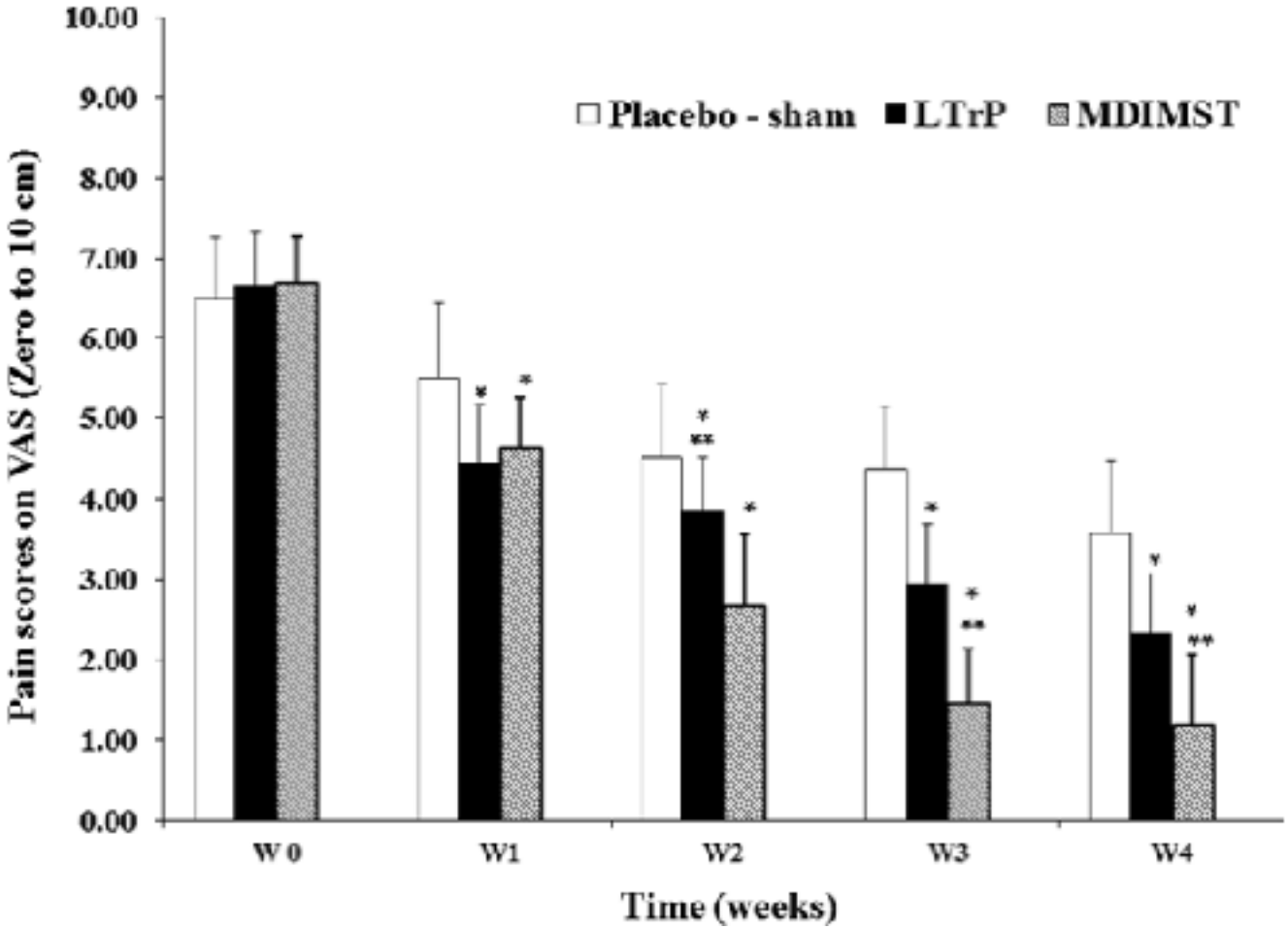
"Dry-needling appears to be a useful adjunct to other therapies for chronic low-back pain."

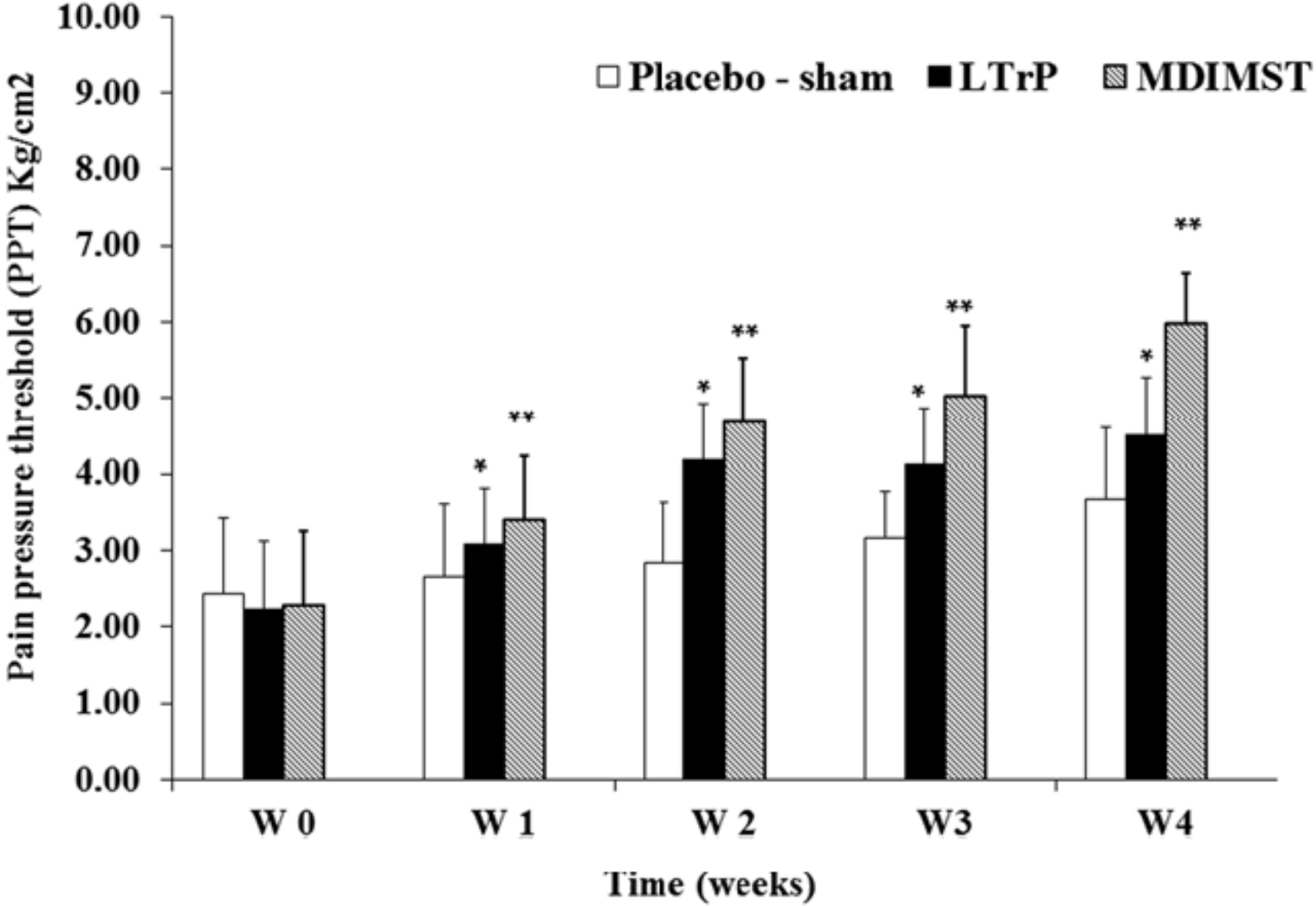
Furlan AD, et.al. Acupuncture and dry-needling for low back pain. Cochrane Database of Systematic Reviews 2005, Issue 1. Art. No.: CD001351

Emerging Concepts in the Treatment of Myofascial Pain: A Review of Medications, Modalities, and Needle-based Interventions:
"DN has moderate evidence that supports its use in MPS"
2011 Annaswamy PM&R
STUDY LIMITATION: PROPER PLACEBO CONTROL

Paraspinal Stimulation Combine with Trigger Point Needling & Needle Rotation for the Treatment of Myofascial Pain: A Randomized Sham-controlled Clinical Trial

Couto, C., et. al. Clinical Journal of Pain Vol 30(3) 2014




Placebo - sham
LTrP
MDIMST
Pain pressure threshold (PPT) Kg/cm2
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
W 0
W 1
W 2
W3
W4
Time (weeks)
*
**

PMR July 2015 Volume 7, Issue 7, 711–718

Original Research CME

Dry Needling Alters Trigger Points in the Upper Trapezius Muscle and Reduces Pain in Subjects With Chronic Myofascial Pain

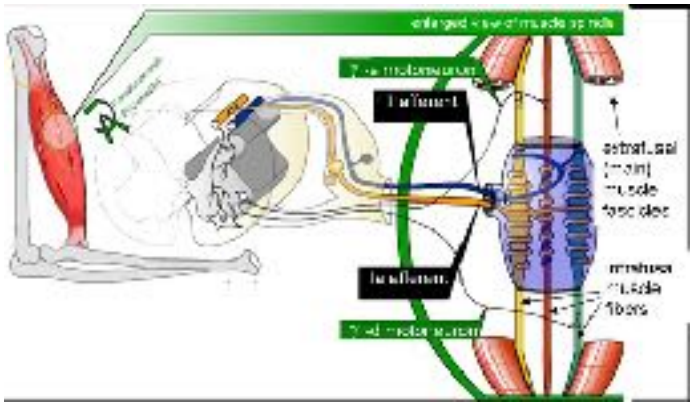
Lynn H. Gerber, MD, Jay Shah, MD, et. al.

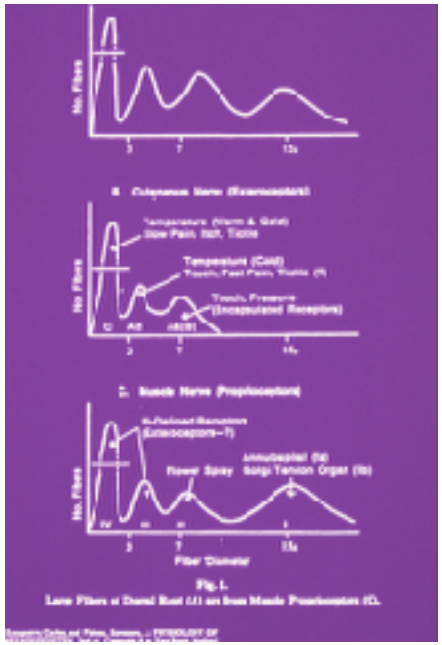
Participants: A total of 56 subjects with neck or shoulder girdle pain of more than 3 months duration and active MTrPs were recruited from a campus-wide volunteer sample. Of these, 52 completed the study (23 male and 33 female). Their mean age was 35.8 years.

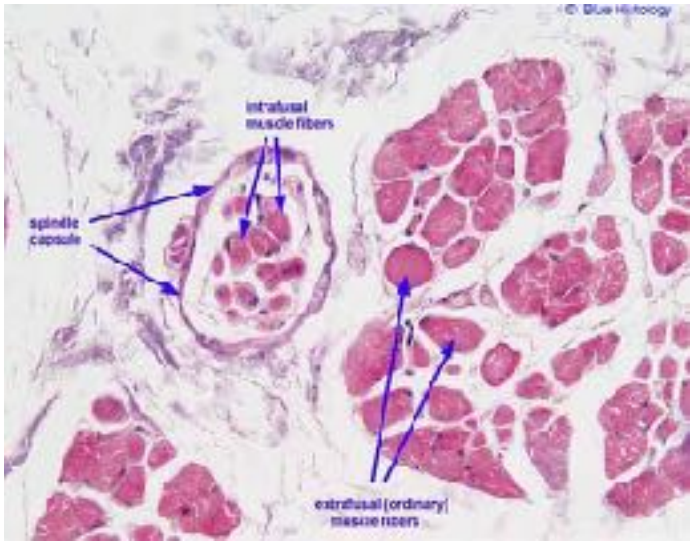
Conclusions: Dry needling reduces pain and changes MTrP status. Change in trigger point status is associated with a statistically and clinically significant reduction in pain. Reduction of pain is associated with improved mood, function, and level of disability.

Mechanisms of Needle Effect?

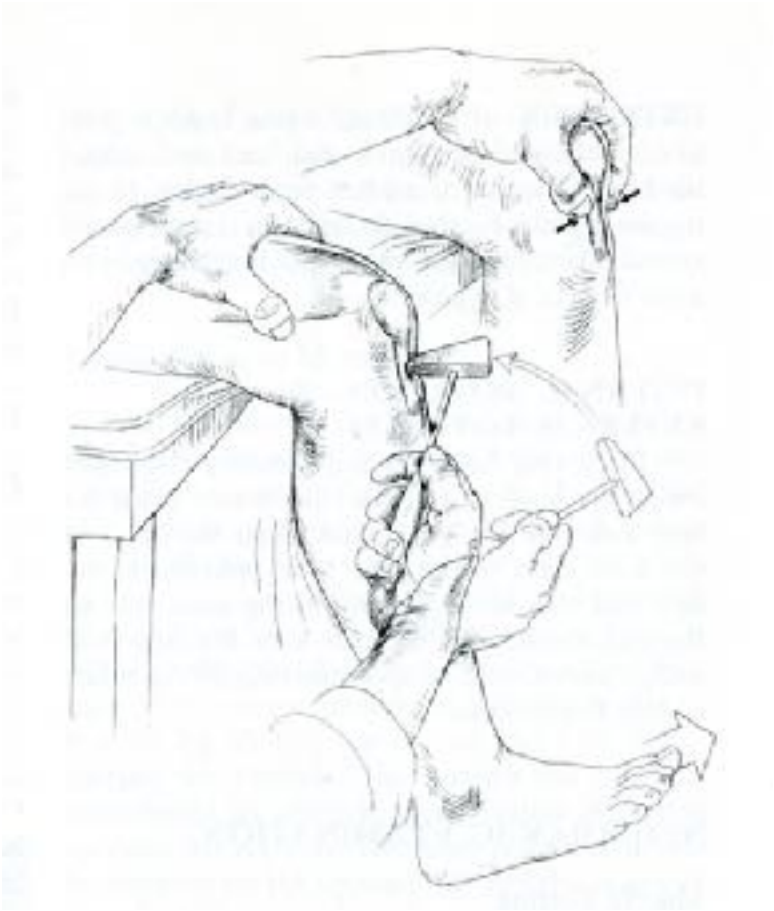
- **Local Twitch Response: Stimulation of Muscle Spindle & Spinal Reflex leading to**
- **Reversal of Muscle Contracture and Increased ROM**





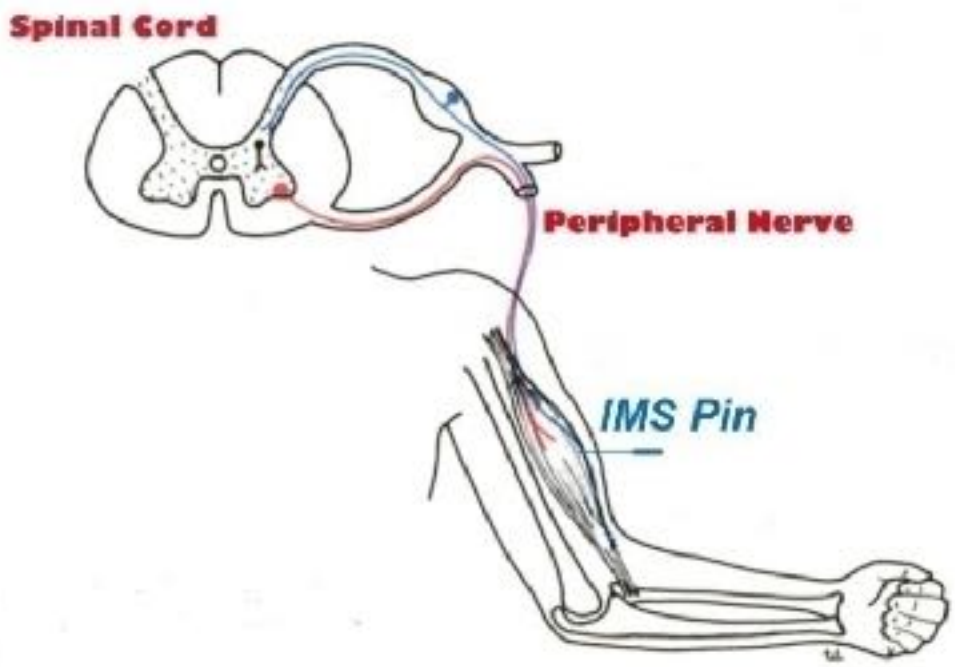


Myotatic Spinal Reflex



<u>The Reflex Hammer Stimulates Brief Muscle Contraction, Then Release</u>

Dry Needling Stimulates Local Twitch Response - LTR thru Spinal Reflexes



The Pin Causes Shortened Muscle Fibers To Contract Briefly, Then Relax

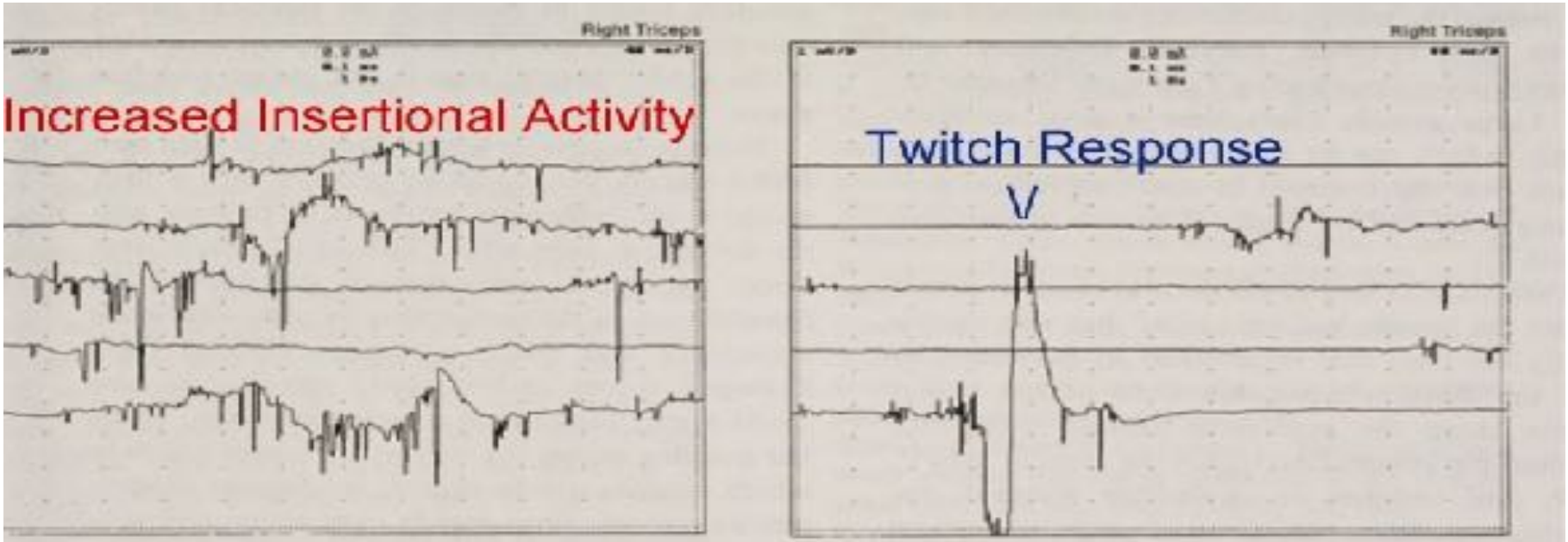
Chu: Does EMG (Dry Needling) Reduce Myofascial Pain Symptoms Due to Cervical Root Irritation?

Electromyogr. clin. Neurophysiol. 1997

One 'Treatment' Only

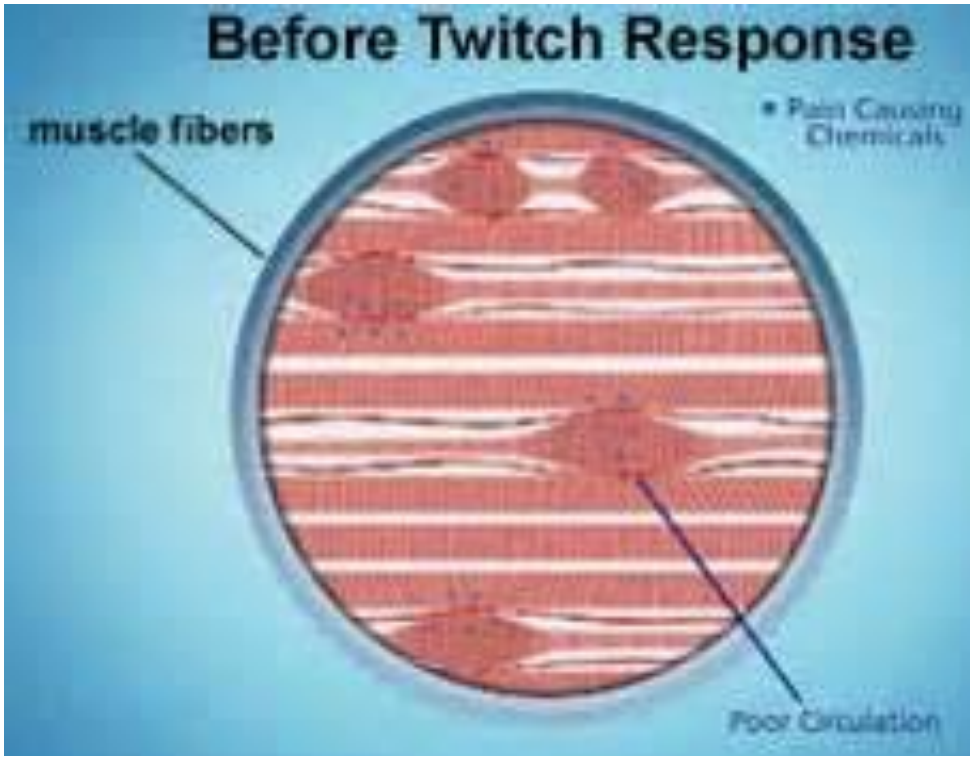
Grp 1 82/122: avg 52% decr Pain, 14% > 75%

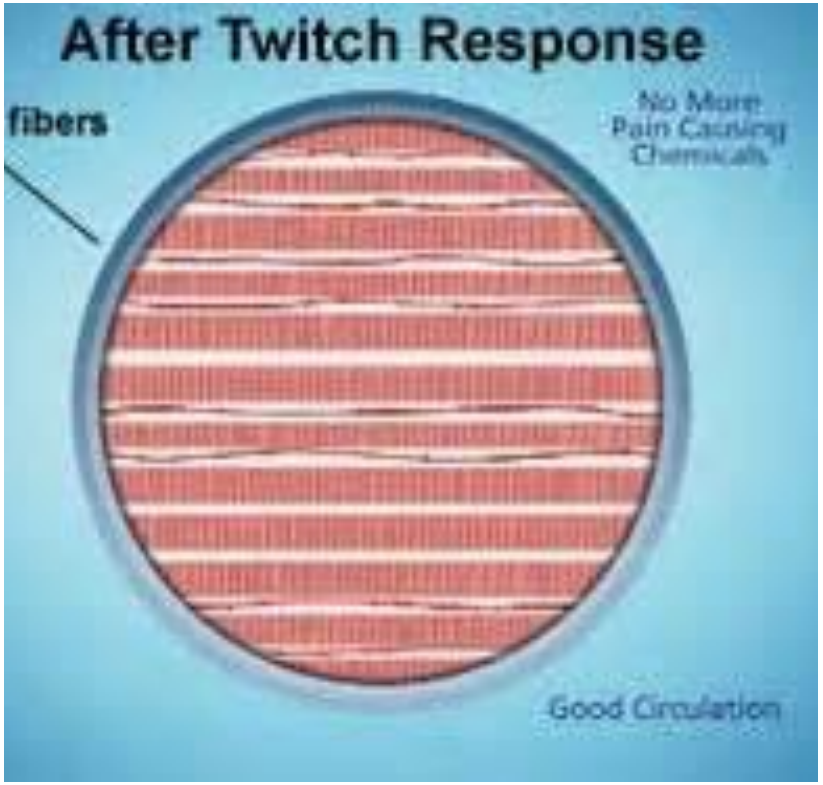
Grp 2 23/42: avg 39%, 0 > 75%



g. 4. – Insertional activity in a triceps muscle at a tender point within a myofascial band showing *(A)* increased insertional activity nsisting of grouped endplate spikes (negative or negative-positive form) and positive spikes, and Trace *(B)* showing a grouped sertional activity culminating into a large twitch response. Sensitivity in both traces was set at 1 mV/division Sweep speed was set at ms/division for Trace A and 80 ms/division for Trace B.

ote: Tracings recorded with Keypoint Electromyograph, DANTEC Corp., Allendale, NJ, USA.]

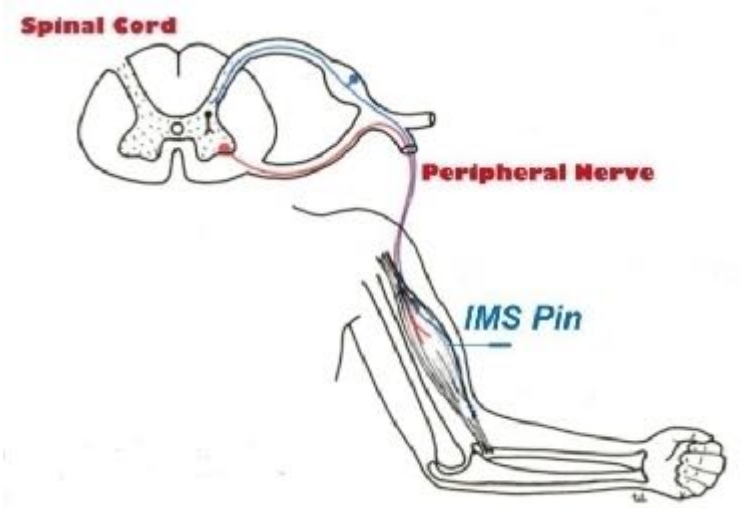

Before Twitch Response
muscle fibers
• Pain Causing Chemicals
Poor Circulation

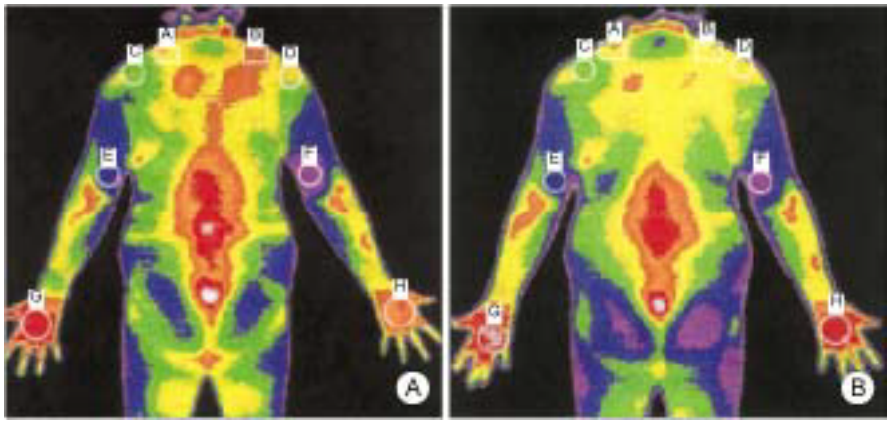

After Twitch Response
fibers
No More Pain Causing Chemicals
Good Circulation

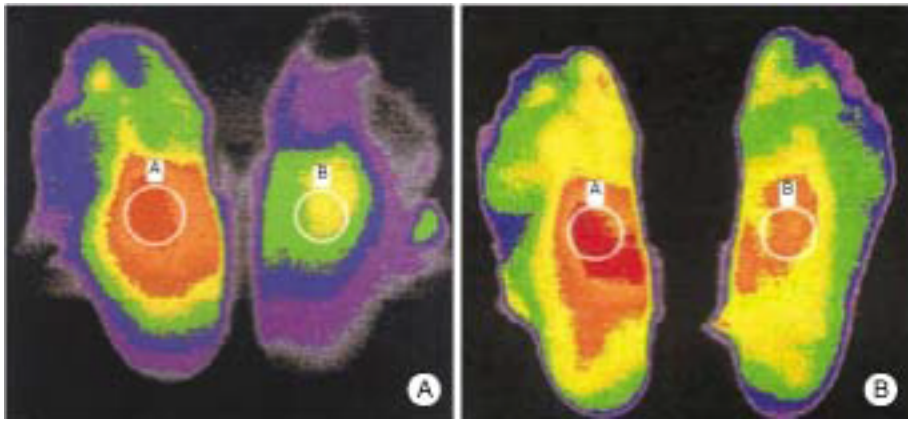
IMS is Like 'Catch-and-Release' Fly Fishing:

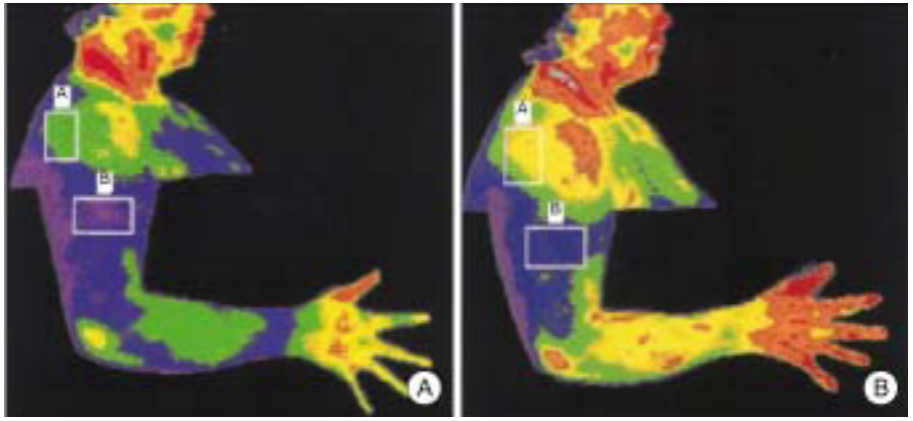
We are 'Casting' for the 'Bites' = Needle Grasp or

'Local Twitch Response'









Kim HK, Kim SH, Kim MJ, Lim JA, Kang PS, Woo NS, Lee YC.

Intramuscular stimulation in chronic pain patients.

J Korean Pain Soc 2002 15:139-145

An In Vivo Microanalytical Technique for Measuring the Local Biochemical Milieu of Human Skeletal Muscle

The Milieu Level of Analytes is different in those with/without pain, those with active vs. latent or no tps, and that changes can be tracked before, during and after a LTR

2005 Jrnl Appl Physiol 99: 1977-84. Shah, J.

Biochemicals Associated With Pain and Inflammation are Elevated in Sites Near to and Remote From Active Myofascial Trigger Points

2008 Arch PMR 89: 16-23; Shah, J., et.al.

Needle Effect	Clinical Response	Neurophysiological Basis
Local Twitch Response Stimulation of Spinal Reflexes	Increased ROM	Reversal of Muscle Contracture ? Normalization of Spindle Mechanism/Sensitivity
Hyperstimulation Analgesia	Decreased Pain	Melzack and Wall Gate Theory
Direct and Reflex Stimulation & Normalization of Therapeutic Target	Decreased Myalgic Hyperalgesia	Reversal of Neuropathic Supersensitivity - Cannon and Rosenblueth's Law of Denervation Supersensitivity
Direct and Reflex Stimulation & Normalization of Therapeutic Target	Decreased Spontaneous Endplate Activity	Reversal of Neuropathic Supersensitivity Cannon's Law
Direct & Reflex Stimulation	Vasodilation > Warming Normalization of Local Biochemical Milieu	?Spinal/Axon Reflexes
Minor Tissue Trauma - Bleeding	Inflammatory Response, release of PDGF & 'Current of Injury'	Reversal of Neuropathic Supersensitivity by electric stimulation - Lomo

Treatment Ladder of Neuropathic-Myofascial Pain

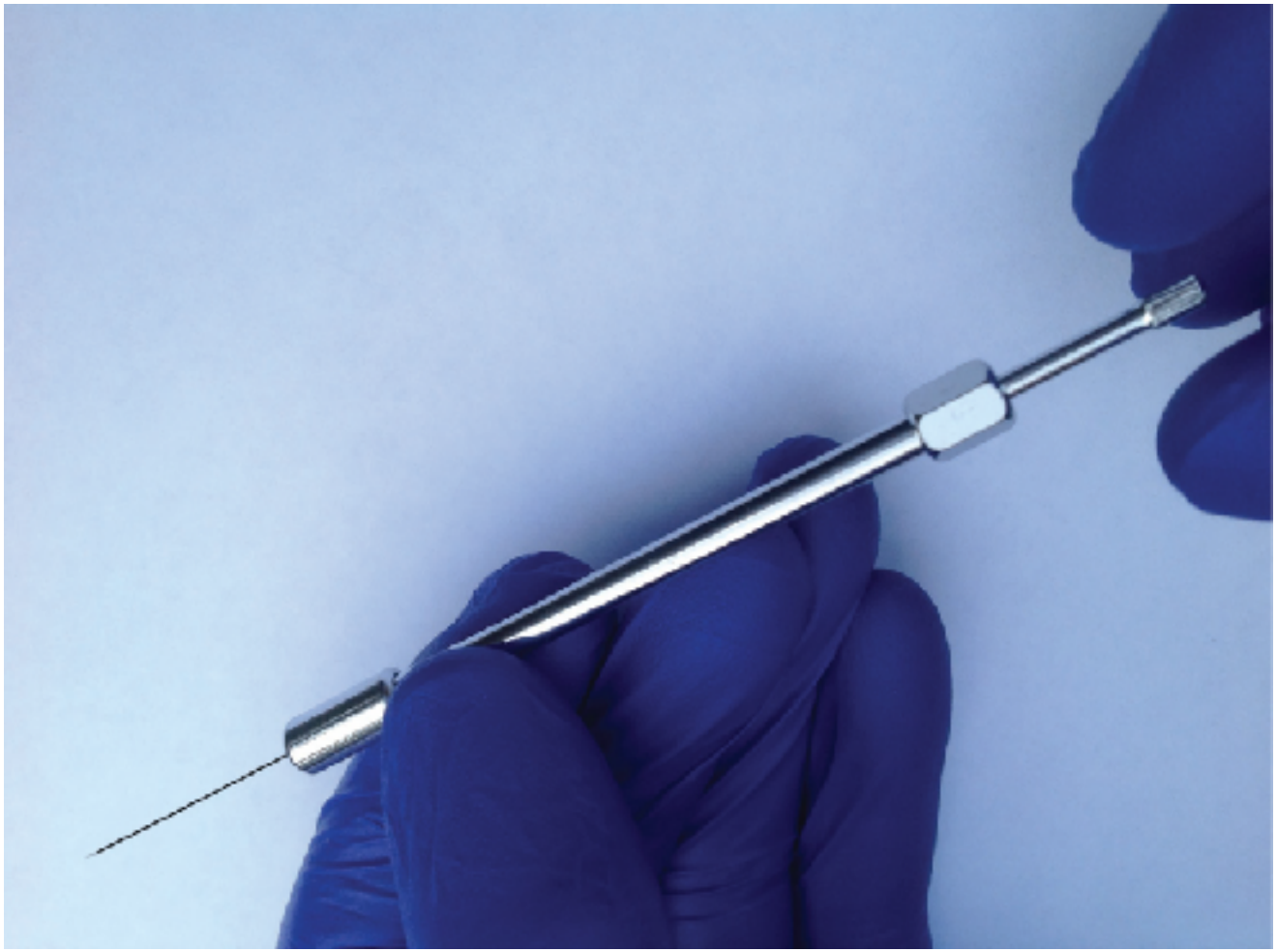
- **Manual soft tissue: 'ischemic compression':**
  trigger point massage, strain-counterstrain, Shiatsu, acupressure, pin & stretch, Astym
- **FREQUENT FREQUENT FREQUENT 2x/wk (7x/week)**
- **Independent Therapeutic Aids: tennis ball, Theracane, Accumassage**
- **S-T-R-E-T-C-H: NOT strengthen**
- **Vapocoolant (Fluoromethane) Spray & Stretch: children**
- **Heat: moist heating pad/hot bath/magnesium salts**
- **Electrical-stim, TENS, U/S, Low Level Laser, Kinesiotape:**
  TREAT DIRECTLY OVER TENDER MOTOR POINTS
- **Osteopathic, manual PT : GENTLE, CONTROLLED, Activator**
- **No Impact CV for LIMBERING/RELAXATION, not 'conditioning'**

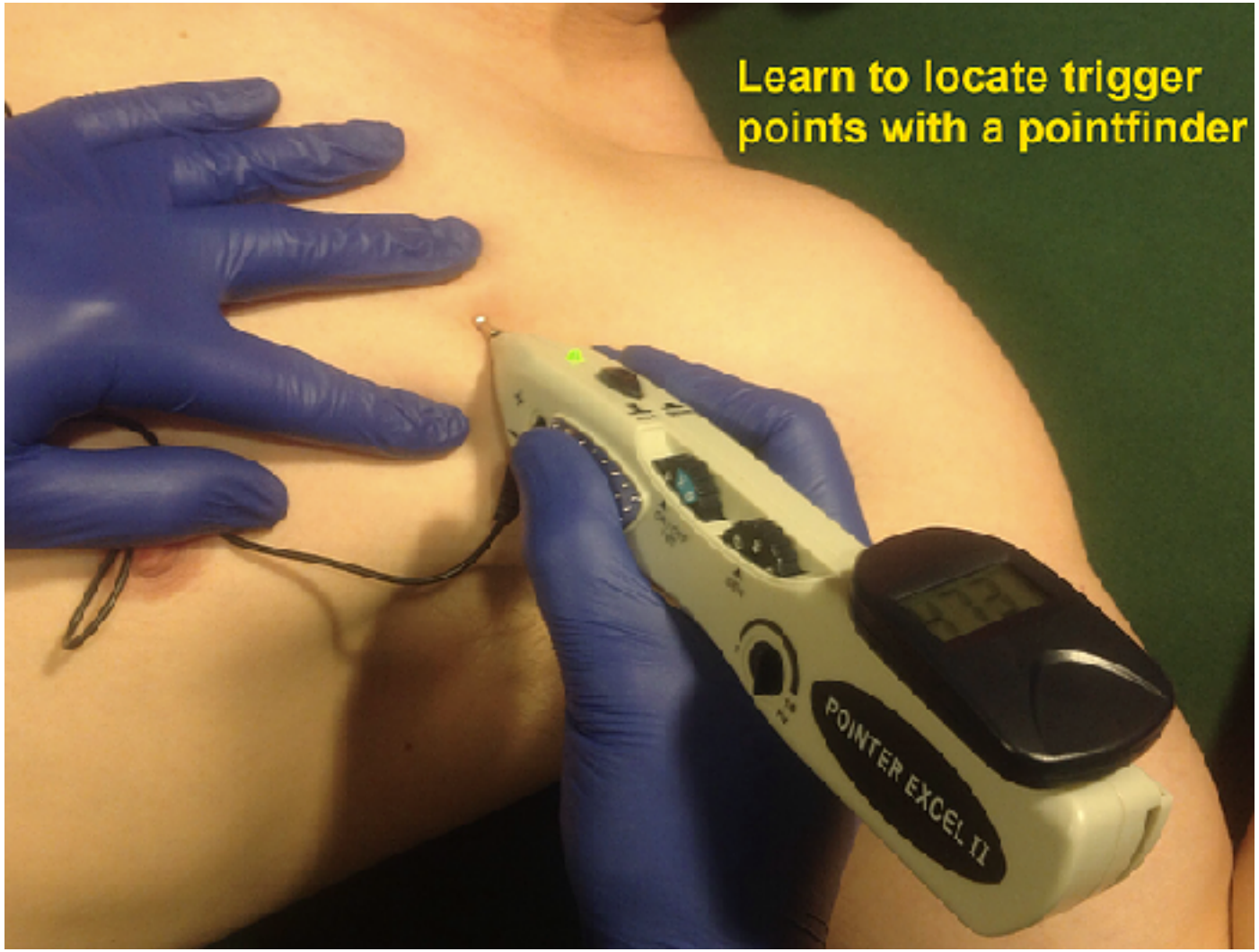
Treatment Ladder of Neuropathic-Myofascial Pain cont'd

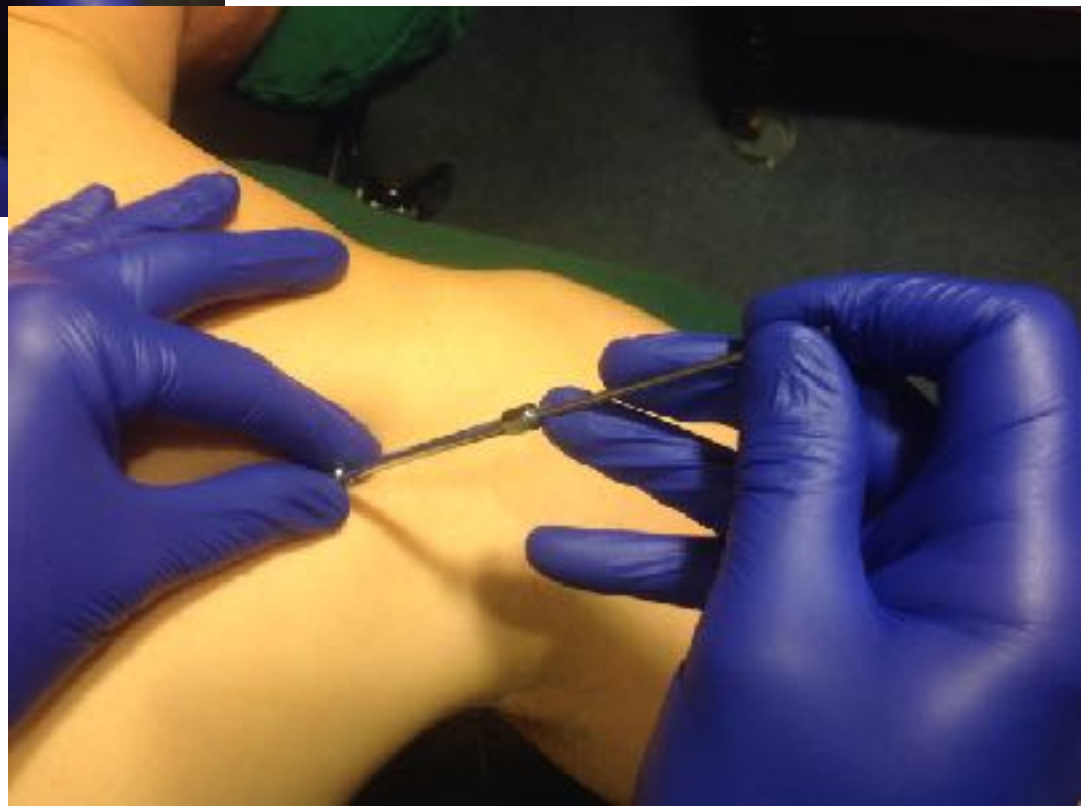
- Dry Needling/IMS: Best in Mild/Moderate NMPS:
- NOT a SALVAGE Treatment: PAINFUL!!!
- Ergonomic & other Postural Habits: supported forearms for keyboarders, avoid sitting with legs tucked under pelvis; heel inserts for pelvic obliquity
- Biofeedback for breathing & psychophysiological factors
- Rx: Muscle relaxants, Anti-cholinergic/TCAs
- Anti-neuropathics/gabapentin
- 'Pro-neuronal': Acetyl-L-carnitine1000mg 2-4x/day,
  R-lipoic acid 300 mg/day
- Topical Rx Anti-Cholinergic/Neuropathic/Inflammatory
  CREAMS: Local, Multiple Rx, $$$$$
- Treat ANXIETY, sleep disturbance, Depression
- Anti-Inflammation Diet: omega-3, Vit D, turmeric, cannbanoids/CBD

Intramuscular Stimulation

Dry Needling

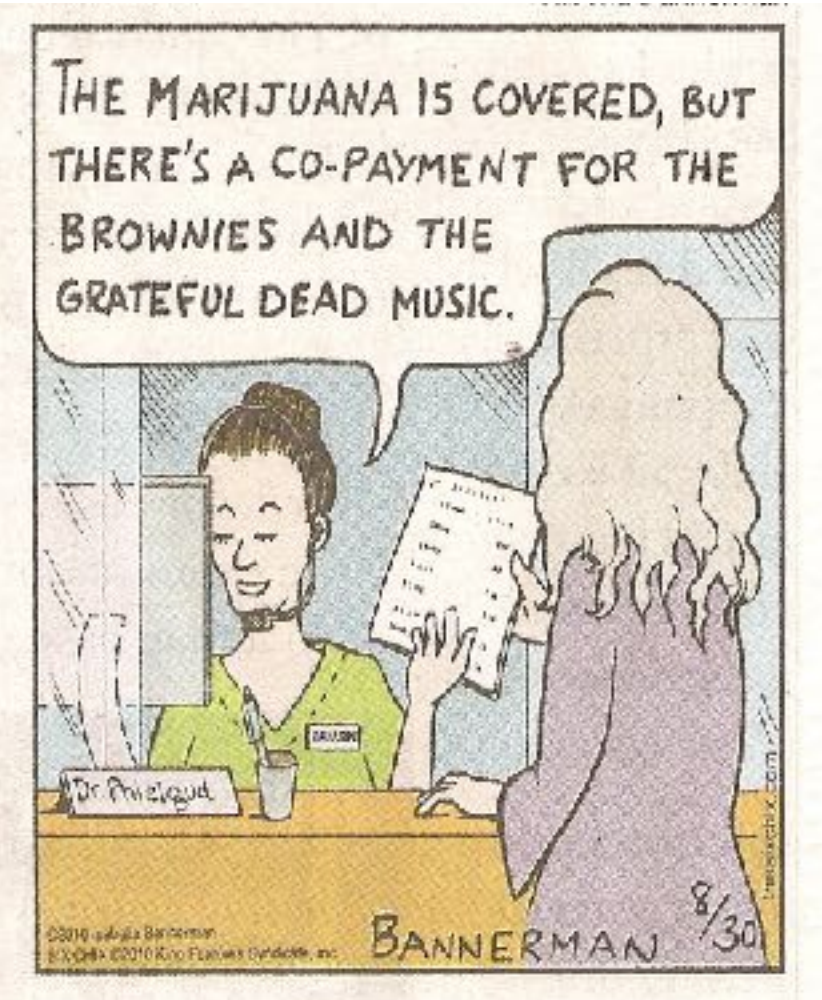



Learn to locate trigger points with a pointfinder
POINTER EXCEL II



VIDEO DEMO of Intramuscular Stimulation - IMS Dry Needling

Thank You!


THE MARIJUANA IS COVERED, BUT THERE'S A CO-PAYMENT FOR THE BROWNIES AND THE GRATEFUL DEAD MUSIC.
Dr. Priceless
BANNERMAN
8/30