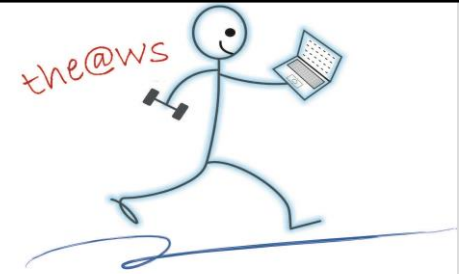




Erasmus+



«Therapeutic Exercise in the workplace - THEWS»

# Concepts of exercise therapy for neck pain

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# Neck pain

Country	1 year incidence	Reference
UK	30%	Palmer et al. 2001, Scand J Work Environ Health 27 (1): 49-56 Webb et al. 2003 Spine 28 (11): 1195-202
Netherlands	31.4%	Picavet and Schouten 2003, Pain 102 (1-2): 167-78
Sweden	26%	Brattberg et al. 1989, Pain 37 (2): 215-22
Norway	34.4%	Bovim et al. 1994, Spine 19 (12): 1307-9
Canada	22.2 -39.6%	Côté et al. 2000, Spine 25 (9): 1109-17 Côté et al. 1998, Spine 23 (15): 1689-98 McMillan et al. 2015 J Agromedicine 20 (3): 292-301



# Neck pain prevalence

- ❖ Prevalence increases with age up to 60 years (Badley and Tennant 1992, Cote et al. 1998 & 2000, Cassou et al. 2002, Cote et al. 2003, Bot et al. 2005, Cagnie et al. 2007)
- ❖ Then drops slightly (Makela et al. 1991) and remains steady thereafter (Badley and Tennant 1992)
- ❖ Life time prevalence is reported as 70% (Makela et al. 1991)



# Neck pain epidemiology

- ❖ Prevalence of neck pain is higher in females than in males (Badley and Tennant 1992, Cote et al. 1998, Cassou et al. 2002, Bot et al. 2005, Cagnie et al. 2007)
- ❖ Neck pain is related to occupational factors such as
  - ❑ heavy lifting (Cagnie et al. 2007),
  - ❑ static or repetitive work loading (Makela et al. 1991),
  - ❑ awkward postures (Ariens et al. 2001),
  - ❑ sitting more than 90% of working time and generally physically demanding tasks (Cassou et al. 2002)



# Associated pain

- ❖ Pain in the cervical spine is closely associated with pain in surrounding areas such as:
  - ❑ head (Cote et al. 2000, Sjaastad et al. 2006),
  - ❑ shoulders (Luime et al. 2005, Nyman et al. 2007)
  - ❑ upper extremity (Bot et al. 2005)
- ❖ Is reported to have a high incidence of sick absence and high concurrence with low back pain (Cote et al. 2000, Nyman et al. 2007)



# Chronic pain

A small percent of chronic back and neck patients (5-10%) accounts for more than 50% percentage of the total cost

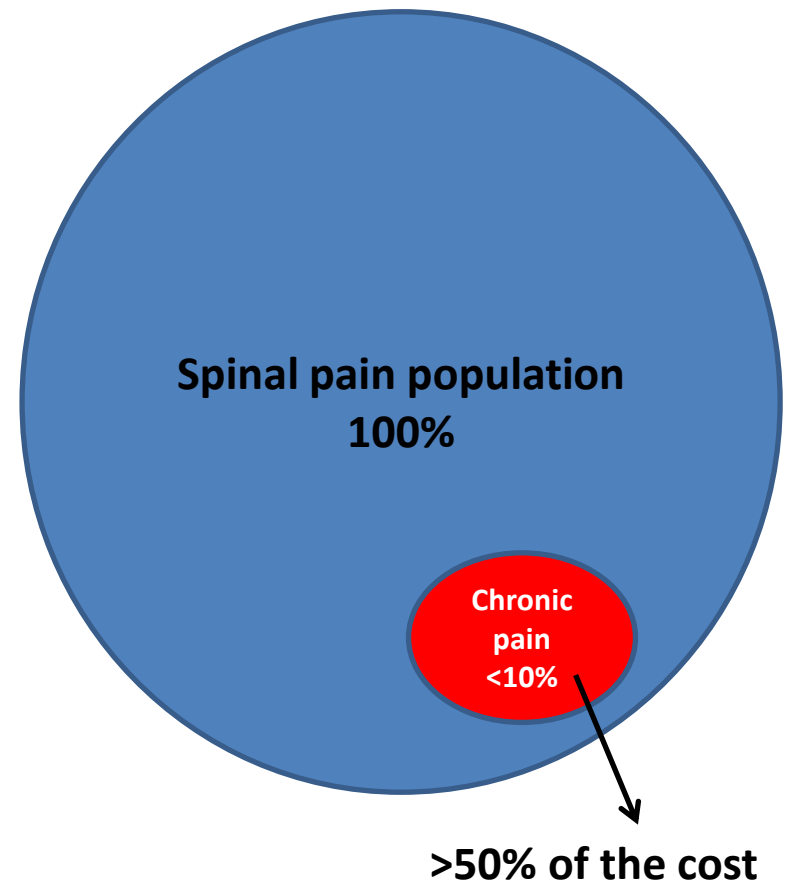
Linton and Ryberg 2000 Eur J Pain 4:347-354

Linton et al. 1998 Spine 23: 1457-1463

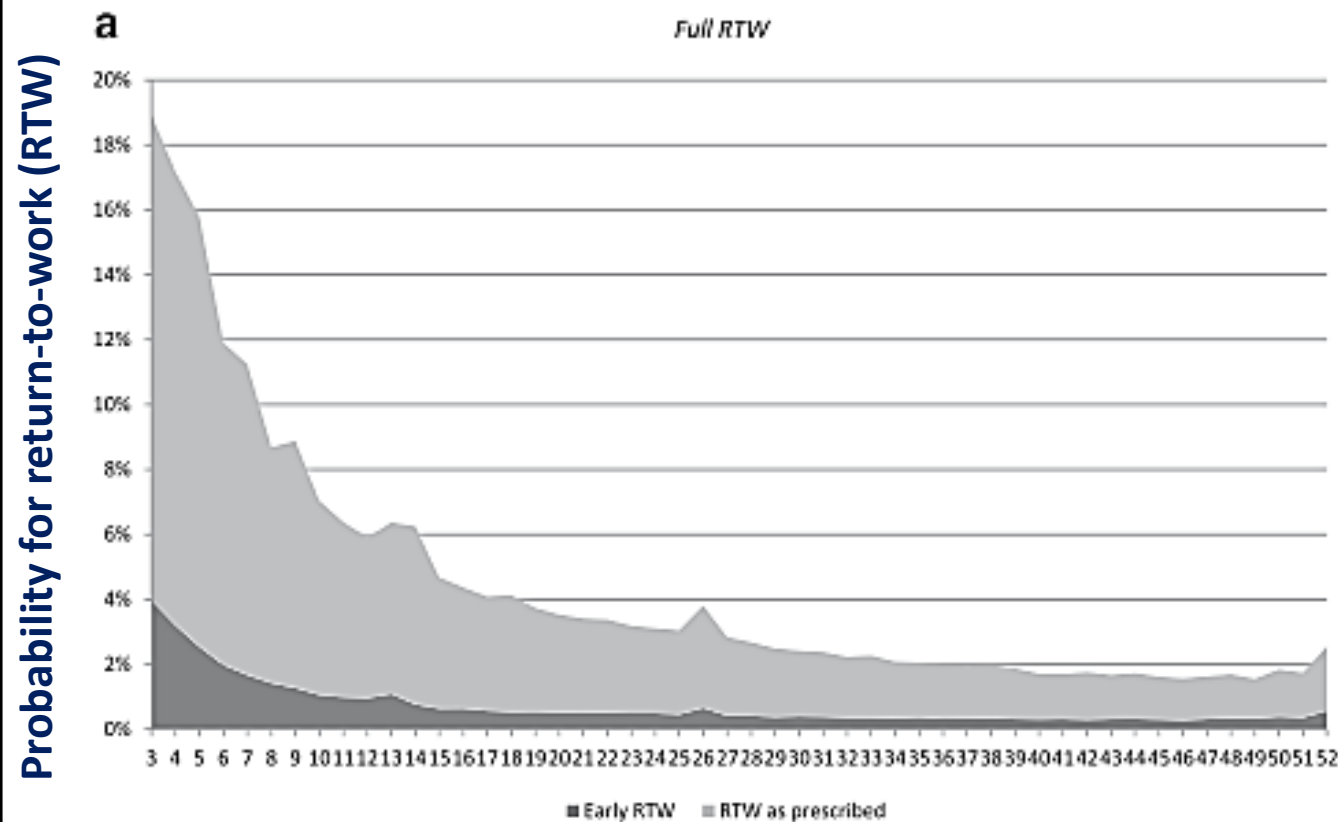
Borghouts et al. 1999 Pain 80: 629-636

Bovim et al. 1994 Spine 19 (12): 1307-9

Jacobsson et al. 1989 Scand J Rheumatol 18 (6): 353-60



# Sick leave and return to work



As weeks of sick leave increases the probability to return to work decreases

This emphasizes the need for early at work management

Sick leave duration (weeks)

Graph from: Leijon et al.  
BMC Public Health (2015)  
15: 380



# Neck pain diagnosis

Remember: «First do not harm.....!» Hippocrates 5<sup>th</sup> Century BCE





# Risk factors for serious pathology

- ❖ Trauma especially car accident
- ❖ Disturbances in walking pattern
- ❖ Acute headache in middle age that persists for days
- ❖ Problems with eating, swallowing, double or blurred vision, nausea and drop attacks
- ❖ Severe numbness and muscle weakness in the arms or legs
- ❖ Changes in tendon reflexes and abnormal reflexes (Babinski sign)



# X-Ray after trauma

## Low risk

- ❖ Able to sit in the emergency department
- ❖ Simple rear-end motor vehicle collision
- ❖ Ambulatory at any time
- ❖ Delayed onset of neck pain
- ❖ No midline cervical tenderness
- ❖ Cervical rotation  $>45^{\circ}$
- ❖ These patients do not require imaging

## High risk

- ❖ Age  $>65$
- ❖ Dangerous mechanism of injury
- ❖ Paraesthesia in the extremities
- ❖ These patients need imaging



# Neck pain diagnosis

- ❖ A lot of patients don't have any specific diagnosis
- ❖ Even with findings in diagnostic imaging it is difficult to find the structure that causes pain
- ❖ No clear distinction between ageing and degeneration
- ❖ After excluding serious medical condition most patients are classified as «mechanical pain patients»



# Diagnostic labels

## ICD categories

- ❖ Cervicalgia
- ❖ Pain in thoracic spine
- ❖ Headaches
- ❖ Cervicocranial syndrome
- ❖ Sprain and strain of cervical spine
- ❖ Spondylosis with radiculopathy
- ❖ Cervical disc disorder with radiculopathy

## ICF impairments

- ❖ Neck pain with mobility deficits
- ❖ Neck pain with headaches
- ❖ Neck pain with movement coordination disorders
- ❖ Neck pain with radiating pain



# Clinical presentation I

- ❖ Neck pain with mobility deficits
  - ☐ Age (<50)
  - ☐ Recent onset (<10 weeks)
  - ☐ Local neck pain without radiation
  - ☐ Reduced range of movement (ROM)



# Clinical presentation II

- ❖ Neck pain with movement coordination disorders
  - ❑ Prolonged duration (>12 weeks)
  - ❑ Inhibition of certain muscles presenting as reduced strength, coordination or endurance
  - ❑ Shortening of other muscles (scalenes, sternocleidomastoid, levator scapula, pectoralis minor)
  - ❑ Positive specific tests



# Exercise programs

## ICF impairments

- ❖ Neck pain with mobility deficits
- ❖ Neck pain with headaches
- ❖ Neck pain with movement coordination disorders
- ❖ Neck pain with radiating pain

## Intervention

- ❖ Exercises to improve range of movement (e.g stretches)
- ❖ Exercises to improve coordination (e.g proprioceptive exs, motor control exs)
- ❖ Exercises to reduce pain (e.g McKenzie exs, other specific exs)



# Classification based treatment

- ❖ 274 patients (74% female, age =  $44.4 \pm 16.0$  years)
- ❖ 41.2% received interventions matched to their classification
- ❖ Receiving matched interventions was associated with greater improvements in the Neck Disability Index (NDI) and in pain ratings

Fritz and Brennan 2007 Phys Ther 87 (5): 513-24





# Risk factors for chronicity

- ❖ Previous history of neck pain
- ❖ Age >40
- ❖ Concomitant back pain or headaches
- ❖ Previous trauma (e.g whiplash injury)
- ❖ Psychological factors
- ❖ Sick leave and prolonged duration of symptom

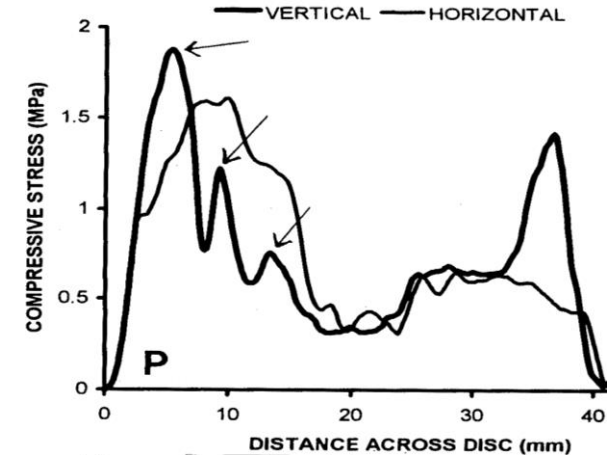
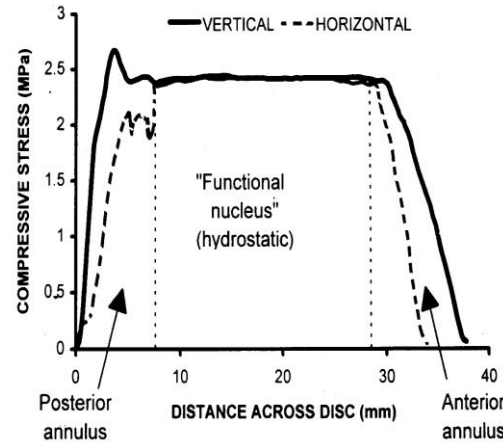
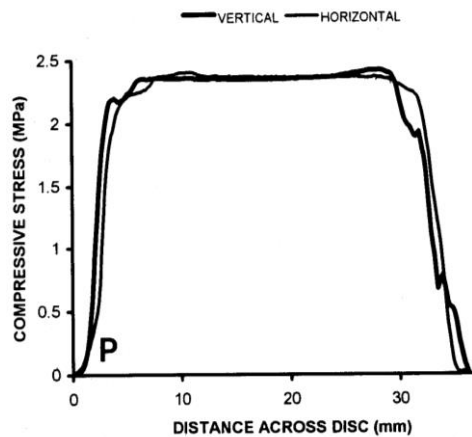
Bot et al. 2005 Ann Rheum Dis 64 (1): 118-23

Hill et al. 2004 Spine 29 (15): 1648-54

Hoving et al. 2004 Pain 110 (3): 639-45



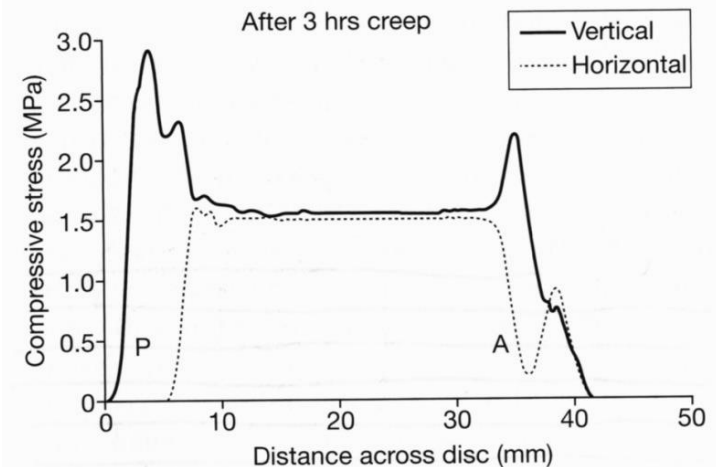
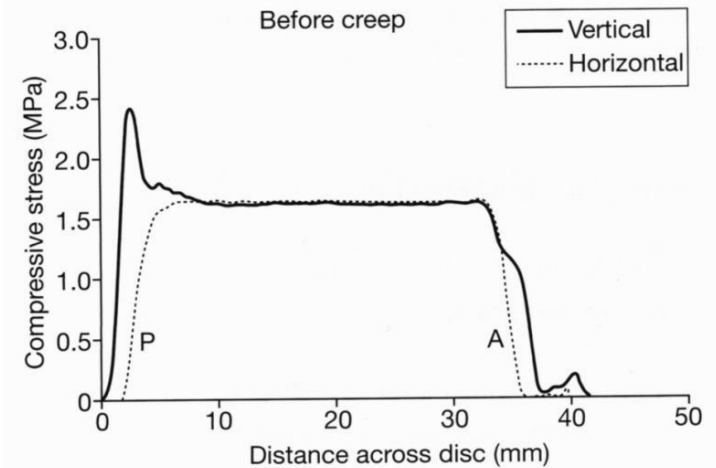
# Load distribution inside the disc



- ❖ Progressive dehydration of nucleus changes the distribution of load within the disc
- ❖ Pressure is distributed in smaller area and stress concentrations start to appear
- ❖ In severe degeneration there are areas with very little or no stress and areas with large stress. This changes cellular metabolism and initiates the biochemical destruction of the disc

# IVD Creep

- ❖ Sustained loading increases intradiscal pressure
- ❖ Fluids are forced out of the disc which becomes dehydrated
- ❖ Even distribution of load inside the disc is disturbed
- ❖ Stress concentrations appear
- ❖ Stress concentrations = ↑ probability of pain



# “Functional Pathology”

- ❖ Extension posture causes stress concentration in the posterior annulus
- ❖ Stress concentration in the posterior annulus also increases with sustained loading (creep)
- ❖ Posterior annulus contains nociceptive nerve endings
- ❖ This mechanism causes pain similar to a stone in your shoe



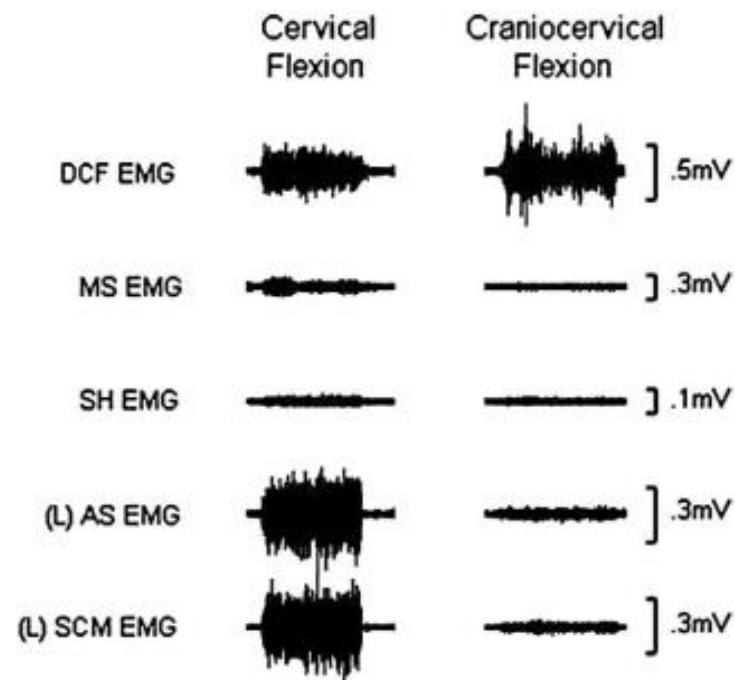
# Muscle groups

- ❖ Local stabilisers: control segmental movement (between two subsequent vertebrae)
- ❖ Global stabilisers: multi-segmental (regional) control during movement
- ❖ Global mobilisers: produce large torques and therefore movement



# Local vs global muscle

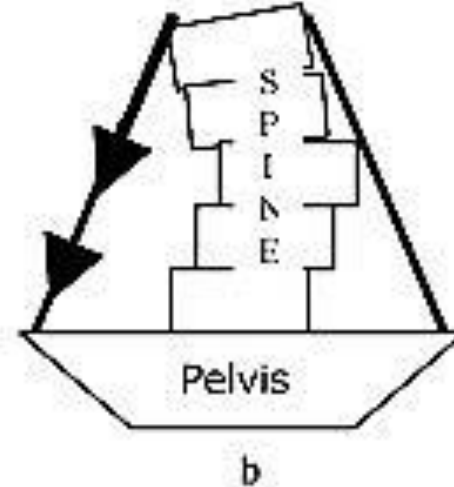
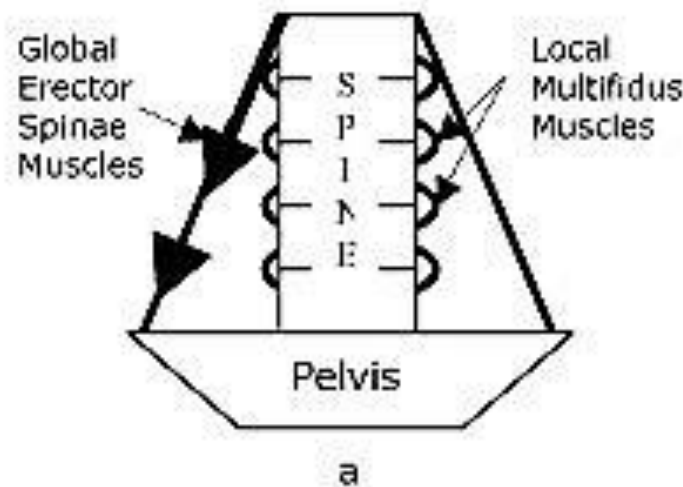
- ❖ Deep neck flexors demonstrate constant activation during flexion irrespective of the movement pattern
- ❖ Superficial muscle (scalene, SCM) show EMG silence during craniocervical flexion (head on neck flexion)



Jull et al. 2008 J Manipulative  
Physiol Ther 31: 525-533



# Coordinated stability



- ❖ Coordinated action of local and global stabilisers is needed
- ❖ If local stabilisers don't initiate contraction the spine will be de-stabilised by global stabilisers and mobilisers

# Φαύλος κύκλος

- ❖ Οι τοπικοί σταθεροποιοί όπως οι εν τω βάθην καμπήρες τείνουν να αναχαιτίζονται
- ❖ Η δράση των δυνατών γενικών σταθεροποιών και κινητήριων μυών αποσταθεροποιεί την σπονδυλική στήλη και δημιουργεί παραμόρφωση των ιστών
- ❖ Έτσι εμφανίζεται πόνος και αυτό μειώνει περεταίρω την παραγωγή δύναμης (φαύλος κύκλος)

Pressure Level (mmHg)	Number of Subjects Able to Achieve Target Pressure (%)	
	Group With Neck Pain*	Asymptomatic Group*
22	5 (25%)	1 (5%)
24	11 (55%)	2 (10%)
26	3 (15%)	6 (30%)
28	1 (5%)	5 (25%)
30	0	6 (30%)

\* Median, 24 mmHg.  
\* Median, 28 mmHg. The Mann-Whitney test indicated a significant difference in the performance of the craniocervical flexion test between groups ( $P<.001$ ).

Chiu et al. 2005 J Orthop Sports Phys Ther 35: 567-571





# Εν τω βάθει καμπήρες

*Spine (Phila Pa 1976)*. 2004 Oct 1;29(19):2108-14.

**Patients with neck pain demonstrate reduced electromyographic activity of the deep cervical flexor muscles during performance of the craniocervical flexion test.**

Falla DL<sup>1</sup>, Jull GA, Hodges PW.

## ➕ Author information

### Abstract

**STUDY DESIGN:** Cross-sectional study.

**OBJECTIVE:** The present study compared activity of deep and superficial cervical flexor muscles and craniocervical flexion range of motion during a test of craniocervical flexion between 10 patients with chronic neck pain and 10 controls.

**SUMMARY OF BACKGROUND DATA:** Individuals with chronic neck pain exhibit reduced performance on a test of craniocervical flexion, and training of this maneuver is effective in management of neck complaints. Although this test is hypothesized to reflect dysfunction of the deep cervical flexor muscles, this has not been tested.

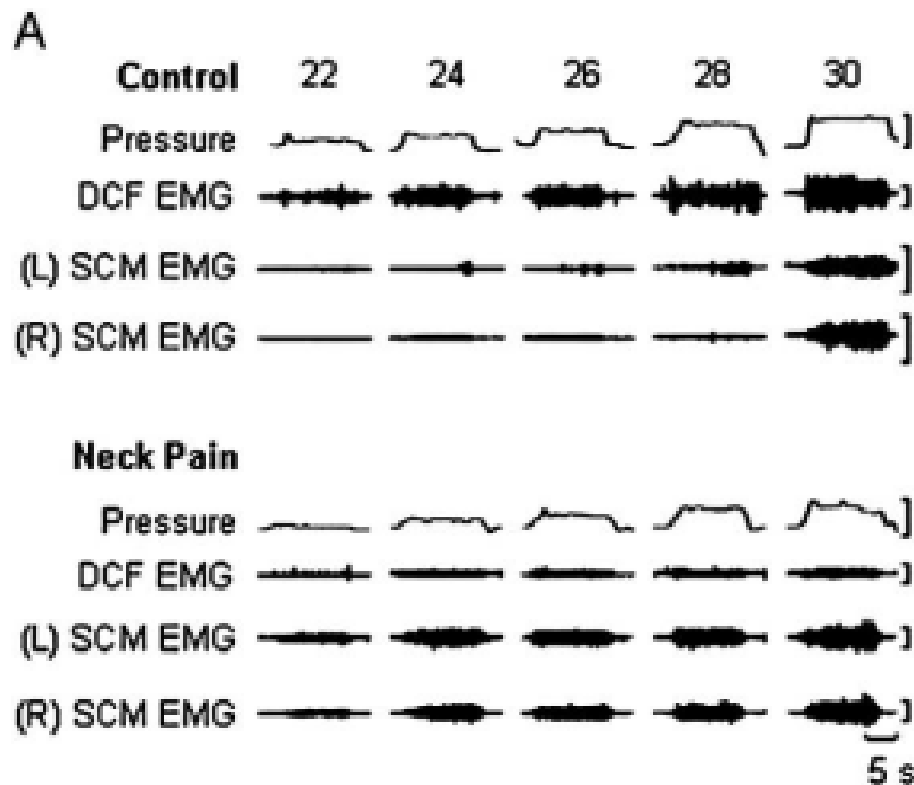
**METHODS:** Deep cervical flexor electromyographic activity was recorded with custom electrodes inserted via the nose and fixed by suction to the posterior mucosa of the oropharynx. Surface electrodes were placed over the superficial neck muscles (sternocleidomastoid and anterior scalene). Root mean square electromyographic amplitude and craniocervical flexion range of motion was measured during five incremental levels of craniocervical flexion in supine.

**RESULTS:** There was a strong linear relation between the electromyographic amplitude of the deep cervical flexor muscles and the incremental stages of the craniocervical flexion test for control and individuals with neck pain ( $P = 0.002$ ). However, the amplitude of deep cervical flexor electromyographic activity was less for the group with neck pain than controls, and this difference was significant for the higher increments of the task ( $P < 0.05$ ). Although not significant, there was a strong trend for greater sternocleidomastoid and anterior scalene electromyographic activity for the group with neck pain.

**CONCLUSIONS:** These data confirm that reduced performance of the craniocervical flexion test is associated with dysfunction of the deep cervical flexor muscles and support the validity of this test for patients with neck pain.



# Αναχαίτιση των ΕΒΚ



Μειωμένη ΗΜΓ δραστηριότητα των εν τω βάθι καμπτήρων και αυξημένη ΗΜΓ δραστηριότητα του ΣΚΜ μν σε ασθενείς με αυχενικό πόνο σε σχέση με υγιείς

Αυτό είναι μια αλλαγή του κινητικού ελέγχου κατά τη διάρκεια της κρανιοαυχενικής κάμψης σε ασθενείς με αυχενικό πόνο.

Falla et al. 2004 Spine 29: 2108-2114



# Αναχαίτιση μυών λόγω πόνου

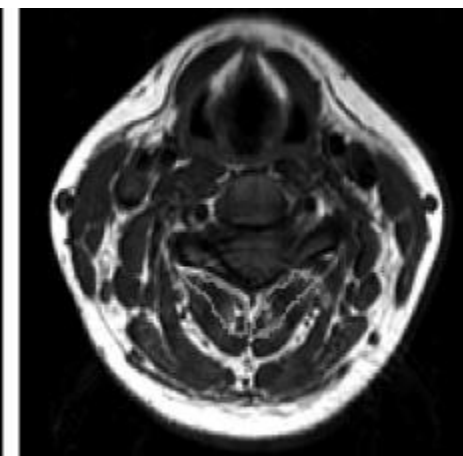
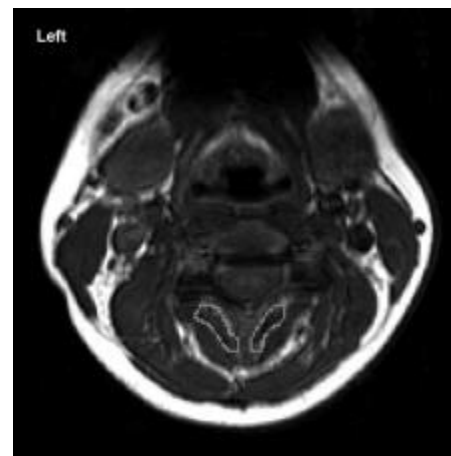
- ❖ Ο πόνος στη διάρκεια ενός τεστ δύναμης είχε αρνητική συσχέτιση με τα αποτελέσματα του τεστ
- ❖ Αυτό σημαίνει ότι ο πόνος μείωσε την παραγωγή μυϊκής δύναμης
- ❖ Η άσκηση θα πρέπει να στην αύξηση της αντοχής σε μεγαλύτερη παραμόρφωση

Ylinen et al. 2004 Eur J Pain 8 (5): 473-8



# Λιπώδης διήθηση των μυών

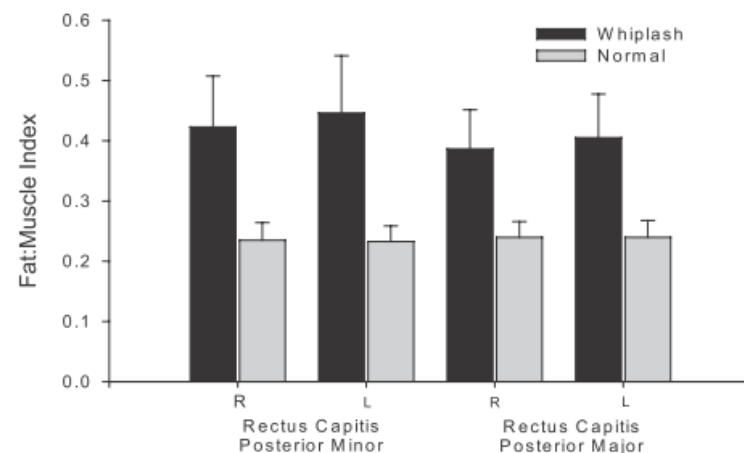
- ❖ Ο τραυματισμός και η αχρησία του μυ οδηγούν σε αντικατάσταση του μυϊκού ιστού από λίπος
- ❖ Ο πολυσχιδής και άλλοι εν τω βάθει μύες επηρεάζονται συχνά



a) C3

Healthy control

WAD



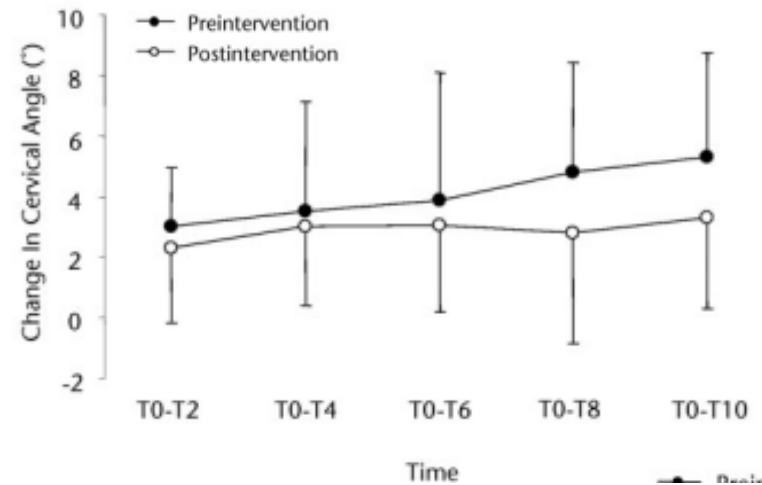
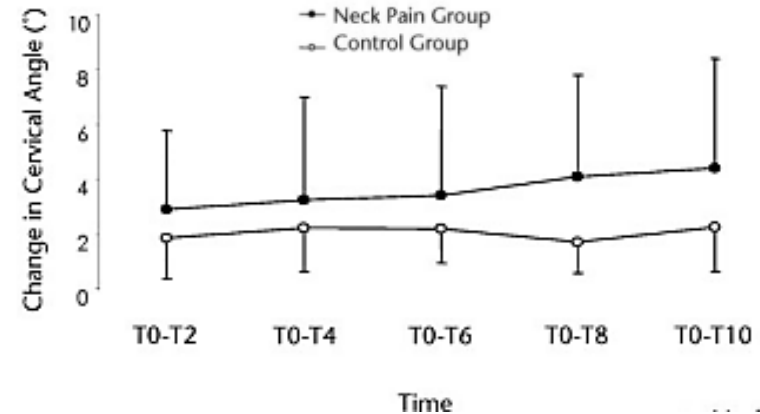
Elliot et al. 2006 Spine 31 (22): E847



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# Δυσλειτουργία στάσης

- ❖ Οι ασθενείς με αυχενικό πόνο εμφανίζουν δυσκολία να διατηρήσουν την όρθια θέση όταν η προσοχή τους αποσπάται από την εργασία σε υπολογιστή
- ❖ Οι ασθενείς με αυχενικό πόνο τοποθετούν το κεφάλι του σε θέση πρόσθιας προβολής
- ❖ Ασκήσεις για τους ΕΒΚ για 6 εβδομάδες αναστέλλει αυτό το πρότυπο

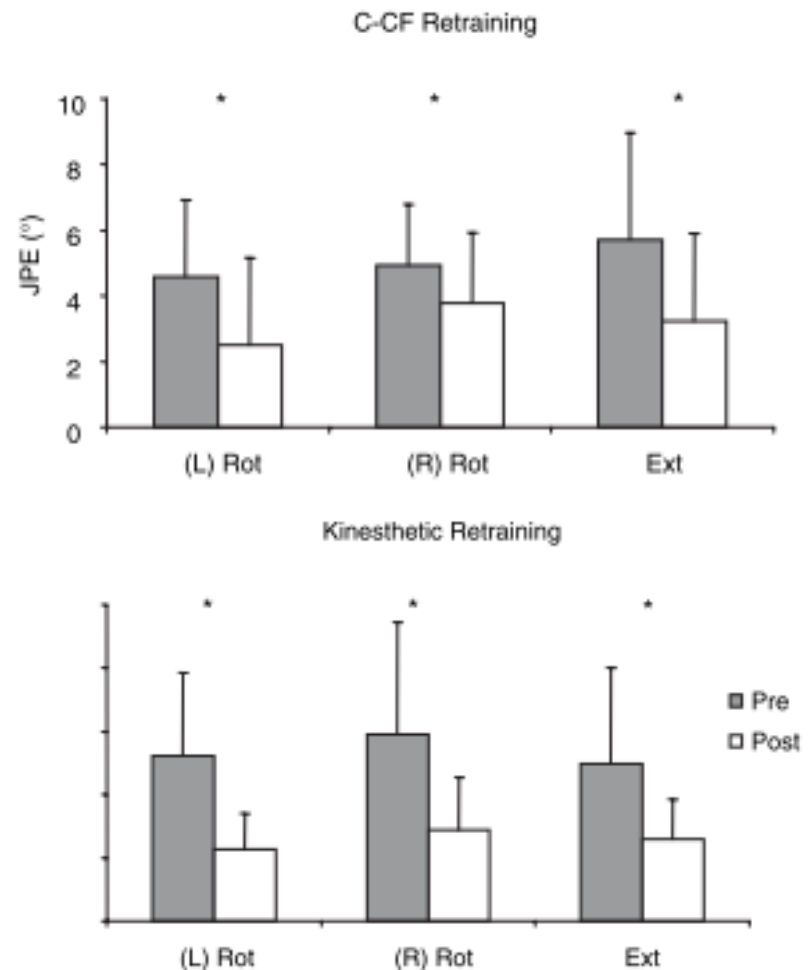


Falla et al. 2007 Phys Ther 87: 408–417



# Proprioception

- ❖ Cervical joint position sense is decreased in people with persistent neck pain
- ❖ Proprioceptive exs or deep neck flexors exercises for 6 week are able to reverse this deficit



Jull et al 2007 J Orthop Res 25:404–412

Joint position errors pre and post intervention



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# Stretching exercises for neck pain

- ❖ RCT of 125 women with non-specific neck pain
- ❖ No significant difference in pain between a group of patients receiving manual therapy 2/week and a group doing stretches 5 times/week
- ❖ Neck and shoulder pain, disability index and neck stiffness decreased significantly more in manual therapy
- ❖ Low-cost stretching exercises can be recommended as an appropriate therapy intervention to relieve pain, at least in the short-term

Ylinen et al. 2007 J Rehabil Med 39: 126–132



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# Strengthening exercises

## ❖ Strengthening exs improved the effect of manual therapy

Spine (Phila Pa 1976). 2001 Apr 1;26(7):788-97; discussion 798-9.

**A randomized clinical trial of exercise and spinal manipulation for patients with chronic neck pain.**

Bronfort G<sup>1</sup>, Evans R, Nelson B, Aker PD, Goldsmith CH, Vernon H.

**CONCLUSIONS:** For chronic neck pain, the use of strengthening exercise, whether in combination with spinal manipulation or in the form of a high-technology MedX program, appears to be more beneficial to patients with chronic neck pain than the use of spinal manipulation alone. The effect of low-technology exercise or spinal manipulative therapy alone, as compared with no treatment or placebo, and the optimal dose and relative cost effectiveness of these therapies, need to be evaluated in future studies.

## ❖ Results were maintained in the 2 years follow up

Spine (Phila Pa 1976). 2002 Nov 1;27(21):2383-9.

**Two-year follow-up of a randomized clinical trial of spinal manipulation and two types of exercise for patients with chronic neck pain.**

Evans R<sup>1</sup>, Bronfort G, Nelson B, Goldsmith CH.

**CONCLUSION:** The results of this study demonstrate an advantage of spinal manipulation combined with low-tech rehabilitative exercise and MedX rehabilitative exercise versus spinal manipulation alone over two years and are similar in magnitude to those observed after one-year follow-up. These results suggest that treatments including supervised rehabilitative exercise should be considered for chronic neck pain sufferers. Further studies are needed to examine the cost effectiveness of these therapies and how spinal manipulation compares to no treatment or minimal intervention.





# Motor control exercises

- ❖ Multicentre RCT (n=200 cervicogenic headache patients)
- ❖ Groups:
  - ❑ Mobilization/manipulation group
  - ❑ Exercise therapy group
  - ❑ Combined mobilization/manipulation and exercise group
  - ❑ Control group
- ❖ Groups 1-3 had significantly reduced headache frequency and intensity
- ❖ 10% more patients experienced a complete reduction in headache frequency when treated with mobilization/manipulation and exercise than those treated with the other approaches

Jull et al. 2002 Spine 27 (17): 1835-43



# Motor control exercises

- ❖ RCT (n=145)
- ❖ Groups:
  - exercise (n=67)
  - Control (n=78)
- ❖ Exercises for deep neck flexors and dynamic strengthening for 6 weeks
- ❖ 6 weeks: exercise group was significantly better in disability, subjective report of pain, and isometric neck muscle strength
- ❖ 6 months: subjective report of pain and patient satisfaction were still better in the ex group

Chiu et al 2004 Spine 30 (1): E1-7



# Motor control vs strengthening

- ❖ RCT: 180 female office workers (age= 25-53 years)
- ❖ Groups:
  - ❑ Endurance exs (lifting the head)
  - ❑ Strengthening exs (high-intensity isometrics with elastic band)
  - ❑ Control group
- ❖ At 12 months both training groups were significantly better than control in pain, disability and muscle strength

Ylinen et al. 2003 JAMA 289: 2509-2516



# Long term outcomes

- ❖ The results of the previous study were maintained at 3 years follow up
- ❖ Adherence to exs was not always maintained
- ❖ Authors suggest that long term strengthening results in improvements that are maintained long after the end of exercise program
- ❖ In a follow up study control group was offered strengthening exs and showed significant improvements in 2 years follow up

1. Ylinen et al. 2007 *Eura Medicophys* 43:161-169
2. Ylinen et al. 2006 *J Strength Cond Res* 20 (2): 304-8



# End

