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CERVICAL SPINE
CASE 1
MECHANICAL DYSFUNCTION

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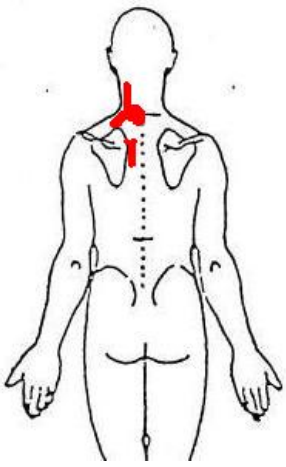
Orthopaedic Manual Physical Therapy Series
Charlottesville 2017-2018

Body Chart

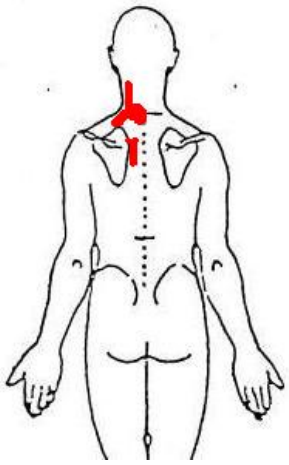


Body Chart – Initial Hypothesis:

_____
_____
_____
_____

Subjective History

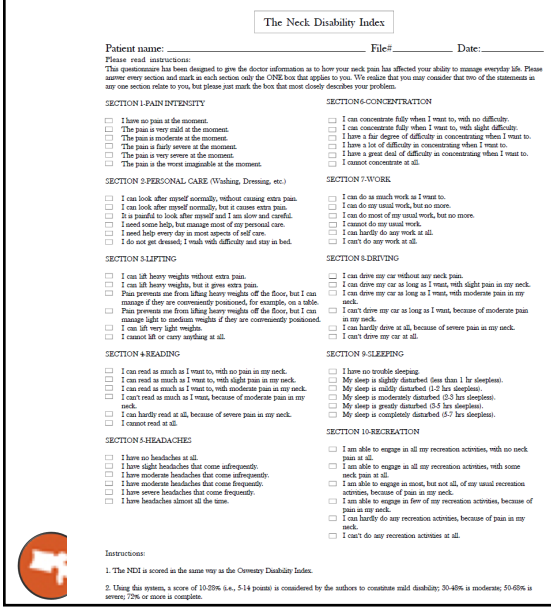
- 38 y/o female with chronic episodic neck pain on/off for 10 years
- Recent episode after sleeping awkwardly on couch
- Previous episodes (3-4x per yr), typically last 1-2 days. Current episode 2 weeks no improvement
- Slightly more intense than previous episodes. Episodes appear to be lasting longer and occurring more frequently
- Was a collegiate gymnast, previously involved in 2 low-speed MVAs as teenager
- Neck Disability Index = 32% perceived disability



Screening and Outcome Measures

- Medical History Form
- Pain Diagram
- Neck Disability Index (NDI)
- Patient Specific Functional Scale (PSFS)
- Numeric Pain Rating
- Fear-Avoidance Belief Questionnaire (FABQ)
- Global Rating of Change (GROC)
- Impact of Event Scale

Neck Disability Index (NDI)



The Neck Disability Index

Patient name: _____ File#_____ Date:_____

Please read instructions:

This questionnaire has been designed to give the doctor information as to how your neck pain has affected your ability to manage everyday life. Please answer every section and mark in each section only the ONE box that applies to you. We realize that you may consider that two of the statements in any one section relate to you, but please just mark the box that most closely describes your problem.

SECTION 1-PAIN INTENSITY

- I have no pain at the moment.
- The pain is very mild at the moment.
- The pain is moderate at the moment.
- The pain is fairly severe at the moment.
- The pain is very severe at the moment.
- The pain is the worst imaginable at the moment.

SECTION 2-PERSONAL CARE (Washing, Dressing, etc.)

- I can look after myself normally, without causing extra pain.
- I can look after myself normally, but it causes extra pain.
- It is painful to look after myself and I am slow and careful.
- I need some help, but manage most of my personal care.
- I need help every day in most aspects of self care.
- I do not get dressed; I wash with difficulty and stay in bed.

SECTION 3-LIFTING

- I can lift heavy weights without extra pain.
- I can lift heavy weights, but it gives extra pain.
- Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, for example, on a table.
- Pain prevents me from lifting heavy weights off the floor, but I can manage light to medium weights if they are conveniently positioned.
- I can lift very light weights.
- I cannot lift or carry anything at all.

SECTION 4-READING

- I can read as much as I want to, with no pain in my neck.
- I can read as much as I want to, with slight pain in my neck.
- I can read as much as I want to, with moderate pain in my neck.
- I can't read as much as I want, because of moderate pain in my neck.
- I can hardly read at all, because of severe pain in my neck.
- I cannot read at all.

SECTION 5-HEADACHES

- I have no headaches at all.
- I have slight headaches that come infrequently.
- I have moderate headaches that come infrequently.
- I have moderate headaches that come frequently.
- I have severe headaches that come frequently.
- I have headaches almost all the time.

SECTION 6-CONCENTRATION

- I can concentrate fully when I want to, with no difficulty.
- I can concentrate fully when I want to, with slight difficulty.
- I have a fair degree of difficulty in concentrating when I want to.
- I have a lot of difficulty in concentrating when I want to.
- I have a great deal of difficulty in concentrating when I want to.
- I cannot concentrate at all.

SECTION 7-WORK

- I can do as much work as I want to.
- I can do my usual work, but no more.
- I can do most of my usual work, but no more.
- I cannot do my usual work.
- I can hardly do any work at all.
- I can't do any work at all.

SECTION 8-DRIVING

- I can drive my car without any neck pain.
- I can drive my car as long as I want, with slight pain in my neck.
- I can drive my car as long as I want, with moderate pain in my neck.
- I can't drive my car as long as I want, because of moderate pain in my neck.
- I can hardly drive at all, because of severe pain in my neck.
- I can't drive my car at all.

SECTION 9-SLEEPING

- I have no trouble sleeping.
- My sleep is slightly disturbed (less than 1 hr sleepless).
- My sleep is mildly disturbed (1-2 hrs sleepless).
- My sleep is moderately disturbed (2-3 hrs sleepless).
- My sleep is greatly disturbed (3-5 hrs sleepless).
- My sleep is completely disturbed (5-7 hrs sleepless).

SECTION 10-RECREATION

- I am able to engage in all my recreation activities, with no neck pain at all.
- I am able to engage in all my recreation activities, with some neck pain at all.
- I am able to engage in most, but not all, of my usual recreation activities, because of pain in my neck.
- I am able to engage in few of my recreation activities, because of pain in my neck.
- I can hardly do any recreation activities, because of pain in my neck.
- I can't do any recreation activities at all.

Instructions:

1. The NDI is scored in the same way as the Oswestry Disability Index.

2. Using this system, a score of 10-28% (i.e., 5-14 points) is considered by the authors to constitute mild disability; 30-48% is moderate; 50-68% is severe; 72% or more is complete.

Reliability = .89
MCID = 5-7 Points

Numeric Pain Rating Scale

Please rate your current level of pain on the following scale:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5 6 7 8 9 10

(no pain) (worst imaginable pain)

Please rate your worst level of pain in the last 24 hours on the following scale:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5 6 7 8 9 10

(no pain) (worst imaginable pain)

Please rate your best level of pain in the last 24 hours on the following scale:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

0 1 2 3 4 5 6 7 8 9 10

(no pain) (worst imaginable pain)

ICC = .61
MCID = 2 Points

Name:_____ Date:____/____/____
mm dd yy

Here are some of the things other patients have told us about their pain. For each statement please circle the number from 0 to 6 to indicate how much physical activities such as bending, lifting, walking or driving affect or would affect your back pain.

	Completely Disagree			Unsure			Completely Agree
1. My pain was caused by physical activity.	0	1	2	3	4	5	6
2. Physical activity makes my pain worse.	0	1	2	3	4	5	6
3. Physical activity might harm my back.	0	1	2	3	4	5	6
4. I should not do physical activities which (might) make my pain worse.	0	1	2	3	4	5	6
5. I cannot do physical activities which (might) make my pain worse.	0	1	2	3	4	5	6

The following statements are about how your normal work affects or would affect your back pain.

	Completely Disagree			Unsure			Completely Agree
6. My pain was caused by my work or by an accident at work.	0	1	2	3	4	5	6
7. My work aggravated my pain.	0	1	2	3	4	5	6
8. I have a claim for compensation for my pain.	0	1	2	3	4	5	6
9. My work is too heavy for me.	0	1	2	3	4	5	6
10. My work makes or would make my pain worse.	0	1	2	3	4	5	6
11. My work might harm by back.	0	1	2	3	4	5	6
12. I should not do my regular work with my present pain.	0	1	2	3	4	5	6
13. I cannot do my normal work with my present pain.	0	1	2	3	4	5	6
14. I cannot do my normal work until my pain is treated.	0	1	2	3	4	5	6
15. I do not think that I will be back to my normal work within 3 months.	0	1	2	3	4	5	6
16. I do not think that I will ever be able to go back to that work.	0	1	2	3	4	5	6

FABQ

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IMPACT OF EVENT SCALE – REVISED

INSTRUCTIONS: Below is a list of difficulties people sometimes have after stressful life events. Please read each item, and then indicate how distressing each difficulty has been for you **DURING THE PAST SEVEN DAYS** with respect to _____, which occurred on _____. How much were you distressed or bothered by these difficulties?

Item Response Anchors are 0 = Not at all; 1 = A little bit; 2 = Moderately; 3 = Quite a bit; 4 = Extremely.

The Intrusion subscale is the **MEAN** item response of items 1, 2, 3, 6, 9, 14, 16, 20. Thus, scores can range from 0 through 4.

The Avoidance subscale is the **MEAN** item response of items 5, 7, 8, 11, 12, 13, 17, 22. Thus, scores can range from 0 through 4.

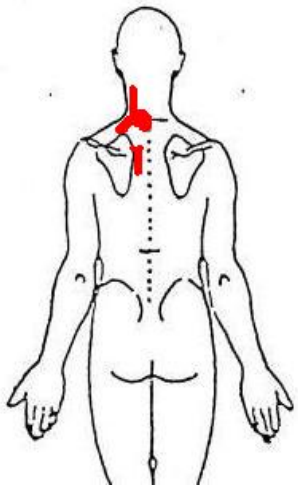
The Hyperarousal subscale is the **MEAN** item response of items 4, 10, 15, 18, 19, 21. Thus, scores can range from 0 through 4.

1. Any reminder brought back feelings about it.
2. I had trouble staying asleep.
3. Other things kept making me think about it.
4. I felt irritable and angry.
5. I avoided letting myself get upset when I thought about it or was reminded of it.
6. I thought about it when I didn't mean to.
7. I felt as if it hadn't happened or wasn't real..
8. I stayed away from reminders of it.
9. Pictures about it popped into my mind.
10. I was jumpy and easily startled.
11. I tried not to think about it.
12. I was aware that I still had a lot of feelings about it, but I didn't deal with them.
13. My feelings about it were kind of numb.
14. I found myself acting or feeling like I was back at that time.
15. I had trouble falling asleep.
16. I had waves of strong feelings about it.
17. I tried to remove it from my memory.
18. I had trouble concentrating.
19. Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart.
20. I had dreams about it.
21. I felt watchful and on-guard.
22. I tried not to talk about it.

Total IES-R score:_____

Subjective *Asterisks* Signs/Symptoms: (Aggravating/Easing factors, Description/location of symptoms, Behavior, Mechanism of injury):

- Symptom Behavior:
  - Constant L sided mid and lower cervical spine low grade dull ache with occasional sharp/stabbing/catching with movement
  - Intermittent L scapular deep ache
- Symptoms related
- Works full time as administrative assistant, still working
- Aggs: prolonged sitting (45-60 mins), driving, computer work, turning head to back up car, describes end range movements
- Eases: frequent changes of position, previously self manipulation would help, but not this episode



➢ **Rate your assessment of Severity & Irritability**
Justify your assessment with examples from the Subjective Exam &/or Objective Exam

- Severity: Non | Min → Mod | Max

Constant low grade ache, not interfering with work function, full ADLs

- Irritability: Non | Min | Mod | Max

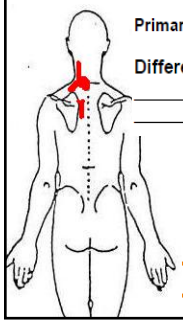
Requires prolonged/sustained positioning to provoke, eases with position changes, intermittent referral

➢ Stage & Stability?

- Acute | Subacute | Chronic | Acute on chronic
- Stable | Improving | Worsening | Fluctuating | Red Flags

STRUCTURE at Fault:

Joints in/refer to the painful region	Myofascial tissue in/refer to the painful region	Non Contractile tissue in/refer to the painful region	Neural tissue in/refer to the painful region	Other structures that must be examined – non MSK



Primary HYPOTHESIS after Subjective Examination: _____

Differential List (Rank/List in order to rule out):

_____

_____

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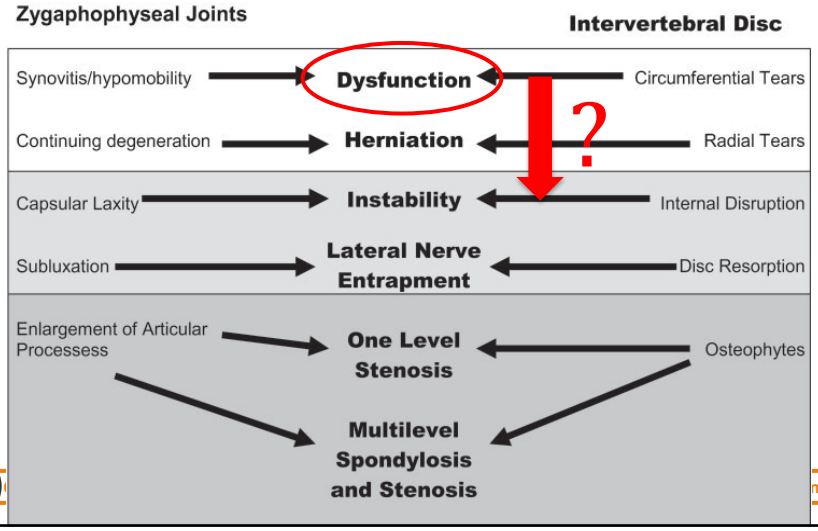
What drives a mechanical dysfunction?

- Hypomobility
- Hypermobility/Stability
- Degenerative Cascade



Referral Patterns (1959!)

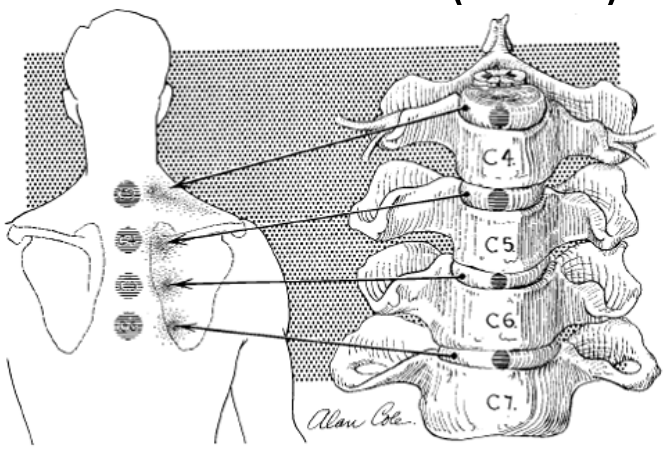


Fig. 2. Diskogenic pain: Referred from anterior surface of lower cervical disks.

Cervical Discography:

Clinical Implications From 12 Years of Experience

Spine • Volume 25 • Number 11 • 2000

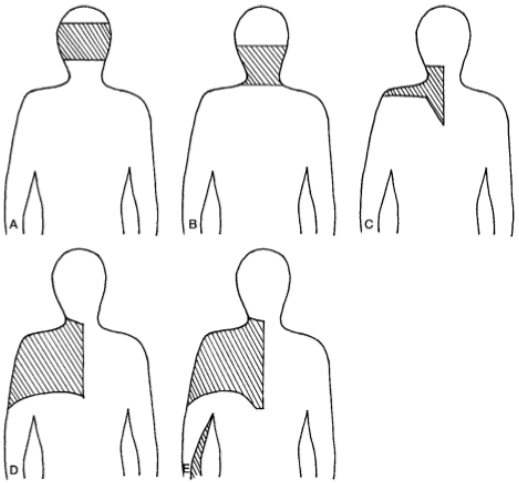


Figure 2. Pattern of pain provoked by discography at each cervical level: C2–C3 (**A**), C3–C4 (**B**), C4–C5 (**C**), C5–C6 (**D**), and C6–C7 (**E**). For purposes of illustration only, pain is depicted as unilateral to the left at C4–C5 through C6–C7.

Cervical Intervertebral Disc (IVD)

- Fibrocartilagenous joint between adjacent cervical vertebral bodies
- Shares passive control of movement with U-Jt and Z-Jt
- Nucleus Pulposus
  - Buffer to axial compression in distribution of compressive forces
- Annulus Pulposus
  - Acts to withstand tension within the disc
- Research indicates some innervation to periphery of the annulus
  - Sinuvertebral Nerve and branch from symptathetic chain

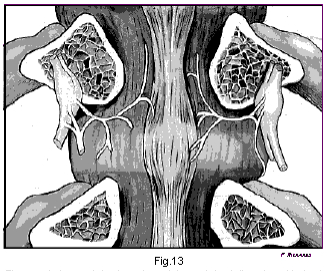


Fig.13
The nervi sinu vertebrales of one intervertebral disc, from Herbert Luschka. The vessels and some other details contained in the original drawing have been omitted for clarity.

Facet Referral Pattern: Dwyer, et al.

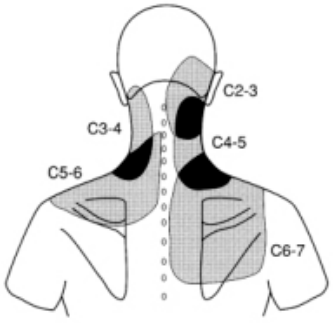


FIGURE 2
Pain Referral Patterns from Cervical C2-3 through C6-7 Facet Joint Injections. Shaded areas indicate areas of pain experienced by asymptomatic volunteers after injection of facet joints C2-3 through C6-7. (From Dwyer AB, Aprill C, Bogduk N. Cervical zygapophyseal joint pain patterns. I: A study in normal volunteers. Spine 1990; 15:453–457.)

Facet Diagnostic Block - Symptomatics

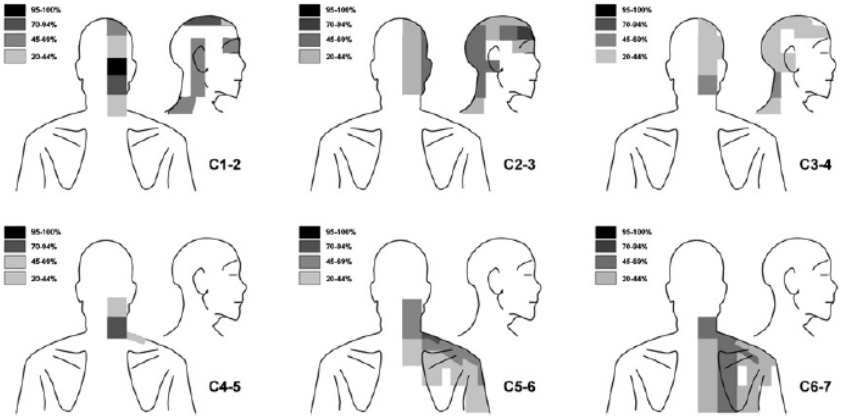
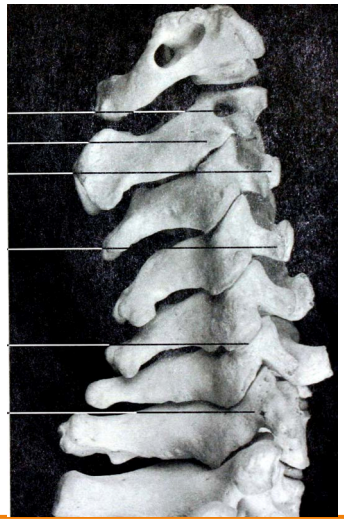


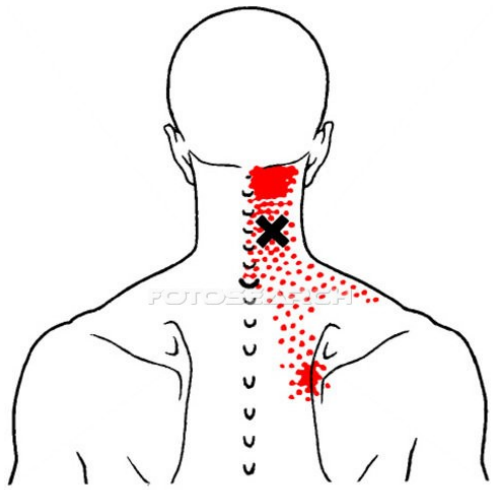
Fig. 2. The distribution of pain relieved in patients with neck pain, after anesthetization of the synovial joints indicated, using controlled diagnostic blocks. The density of shading is proportional to the number of patients whose pain extended into the area indicated. (*From* Cooper G, Bailey B, Bogduk N. Cervical zygapophysial joint pain maps. Pain Med 2007;8:344–53; with permission.)

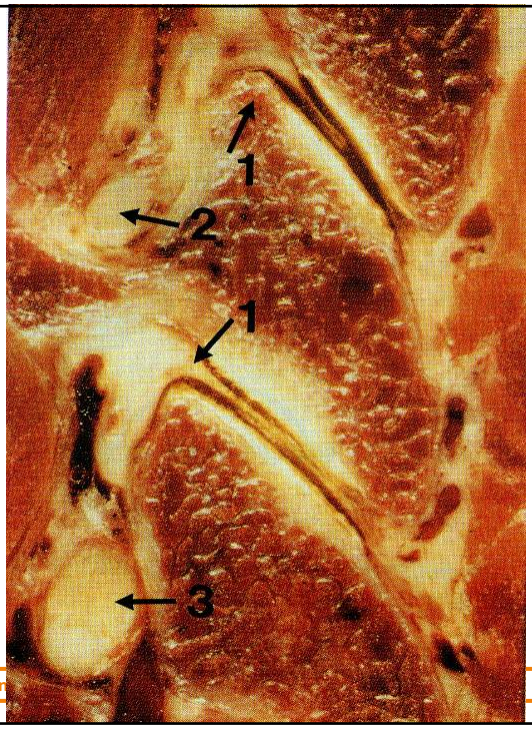
Cervical Zygapophyseal (Facet) Joints

- Synovial joints covered with hyaline cartilage
- Superior Facets
- Inferior Facets
- Orientation
  - Upper closer to 35 deg and Lower closer to 65 deg
- Plane facilitates Flexion/Extension
- Prevents rotation or SB without both occurring to some degree together
- Highly innervated by Medial Branch of Posterior Primary Rami and Recurrent Meningeal/Sinuvertebral Nerve



What Muscular Referral Is This?





Cervical Objective Examination

- Observation/Postural Assessment/Functional Testing
- Shoulder and Thoracic Clearing
- Cervical AROM/PROM/Resisted Testing
- Compression/Distraction
- Neurological Testing
  - Segmental
  - Central
- PA Provocation Testing
- Biomechanical Examination
  - Cervical PPIVMs
  - Cervical PAIVMs
  - Thoracic Screening

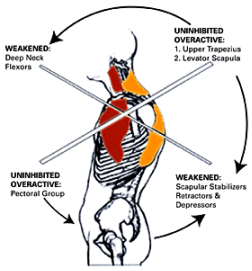
Common Postural Presentation

- What do you see?
  - Head Posture?
  - Cervical Lordosis?
  - Upper Cervical Spine?
  - Cervicothoracic Junction?
  - Shoulder rotation?
  - Ribcage positioning?
- What muscles become shortened and hypertonic?
- What muscles become lengthened and hypotonic?

Upper Quarter Crossed Syndrome

Vladimir Janda, MD, DsC

- Tight/Overactive
  - Levator Scapulae
  - Upper Trapezius
  - SCM
  - Pectoralis Major/Minor
  - Anterior/Middle Scalene
  - Latissimus Dorsi
  - Subscapularis
- Weak/Underactive
  - Middle/Lower Trapezius
  - Serratus Anterior
  - Rhomboids
  - Supraspinatus, Teres Minor
  - Posterior Deltoid
  - UE Extensors
  - **Deep Cervical Flexors**



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Shoulder Clearing

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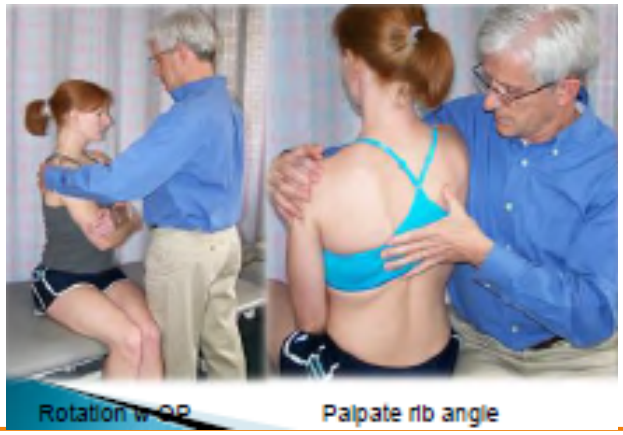
JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 44 | NUMBER 6 | JUNE 2014

The Relevance of Scapular Dysfunction in Neck Pain: A Brief Commentary

(-)

Thoracic Spine Clearing

- Deep Breath In/Out



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Cervical Scan
Selective Tissue Testing

- Active ROM: assesses the patient's ability to move and their perception of acuity
- Passive ROM and over-pressure: at the end of each active motion to assess end feel
  - Pain experienced prior to, at or after resistance helps determine acuity
- Resisted isometrics: tested in their lengthened position (if no pain with over-pressure) otherwise tested in neutral
  - Graded as
    - Painless
    - Painful
    - Strong
    - Weak

Cervical ROM Assessment

- Active ROM:
  - Rotation
  - Flexion
    - Cervicothoracic Flexion
    - Mid-Cervical Flexion
  - Extension
  - Side bending
- Combined Motions
  - SB with flexion or extension

Cervical ROM Assessment

- Allow patient to move in natural posture (no cueing)
- Observe quality and quantity
- Look for compensation strategies
  - Flexion: CV region in extension, jaw opening
  - SB: rotation, shoulder shrug
  - Rotation: SB, thoracic rotation, flexion of mid cervical
  - Extension: CV extension and CTJ flexion
- OVERPRESSURE when appropriate
  - Quantity, Quality, End Feel, Symptom Provocation
- Change posture and re-assess movement
  - Does motion change in quality or quantity?
  - Is there a decrease in pain? (pt buy in)

Manual Therapy xxx (2012) 1–7

Contents lists available at SciVerse ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Original article

Effects of thoracic kyphosis and forward head posture on cervical range of motion in older adults

June Quek [a,*], Yong-Hao Pua [a], Ross A. Clark [b], Adam L. Bryant [b]

- Increased thoracic kyphosis related to increased FHP
- Increased FHP significantly associated with decreased cervical ROM
  - Cervical flexion
  - Mid cervical rotation
  - Not upper cervical rotation (CFRT)

Cervical ROM Assessment

- Does ROM quantity change in non weight bearing?
  - Potential stability/motor control problem
- Does ROM increase when you unweight the shoulder girdle?
  - Potential muscle restriction
- Rotation and SB limited to the same side
  - Potential Mid cervical restriction
- Rotation and SB limited opposite sides
  - Potential Upper cervical restriction

Cervical ROM Assessment

- Rotation
  - Most provocative movement
    - Most likely to reproduce VBI s/s
  - Assessing quantity and quality
    - Noting deviations and compensation esp with SB
  - Splinting with hx of trauma may indicate fracture of the dens esp hyperextension injury
    - Require medical referral immediately

Cervical ROM Assessment

- Flexion
  - CT flexion: CV flexion then bring chin to the chest
    - Nuchal ligament tightens and limits motion through rest of mid cervical spine
  - Mid cervical flexion: FHP with CV extension which slackens nuchal ligament allowing flexion from C2/3-C6-7
    - Typically not limited, but often pain provoking

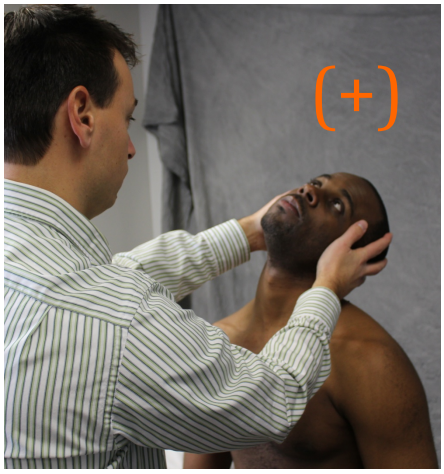
Cervical ROM Assessment

- Extension
  - Mid cervical: CV extension, bring back of head towards the spine
    - Chronic FHP may see flexion at the CT junction

Cervical ROM Assessment

- Side bending
  - Assess quantity and quality
  - Axis of rotation should be through the mouth for mid cervical
  - Most useful for mid cervical pathology
    - Loss of motion usually indicates a need for a biomechanical exam

Combined Motions



Cervical ROM Assessment

- Active ROM:
  - Rotation
  - Flexion
    - Cervicothoracic Flexion
    - Mid-Cervical Flexion
  - Extension
  - Side bending
- Combined Motions
  - SB with flexion or extension

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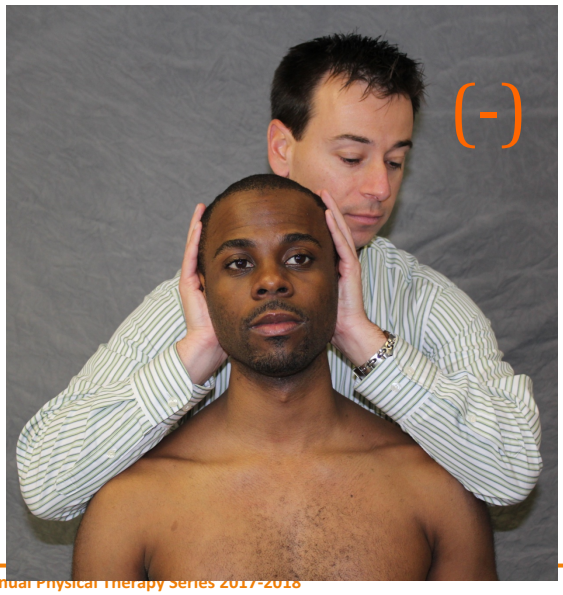
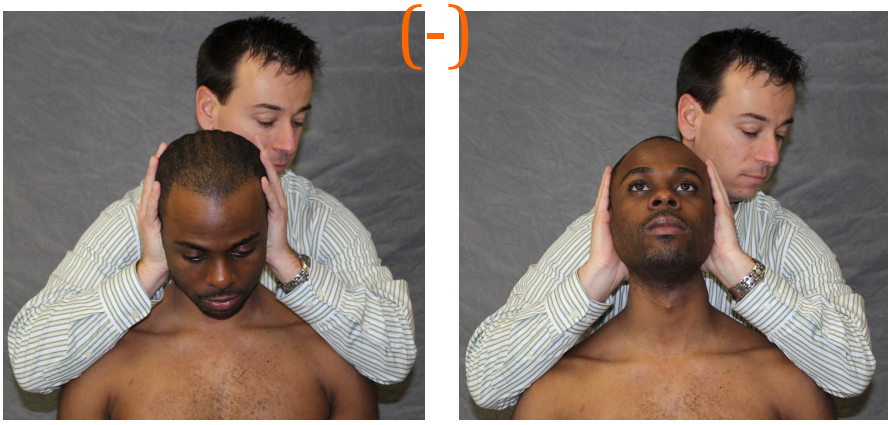
Compression

Distraction



Distraction in Flexion vs. Extension

(-)



Cervical Compression/Distraction

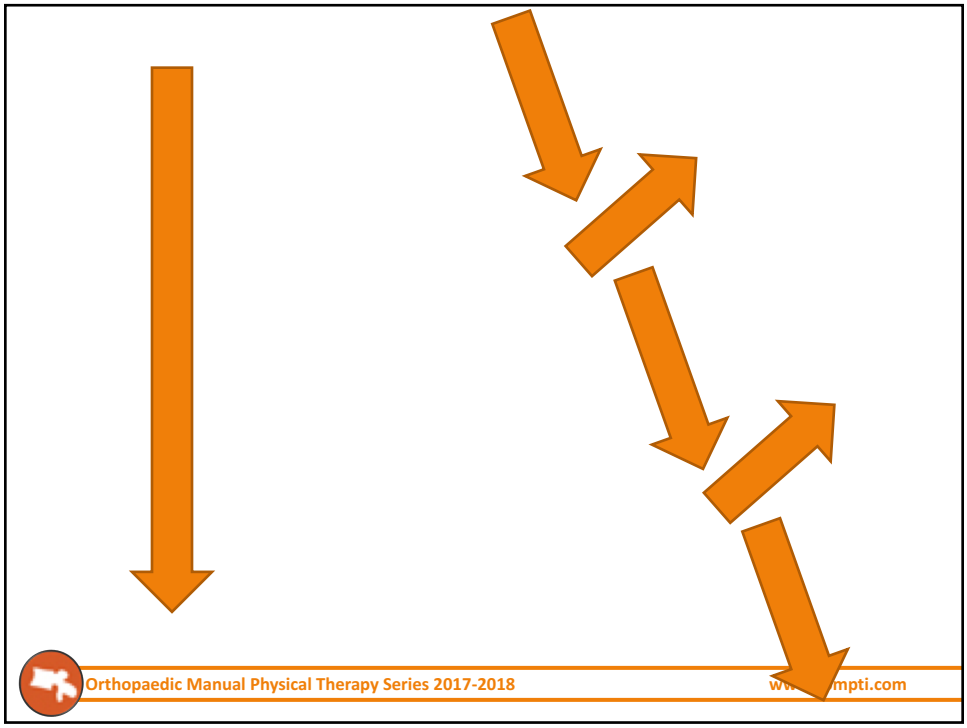
- Compression
  - Neutral
  - Flexion
  - Extension
- Distraction
  - Neutral
  - Flexion
  - Extension

Cervical Objective Examination

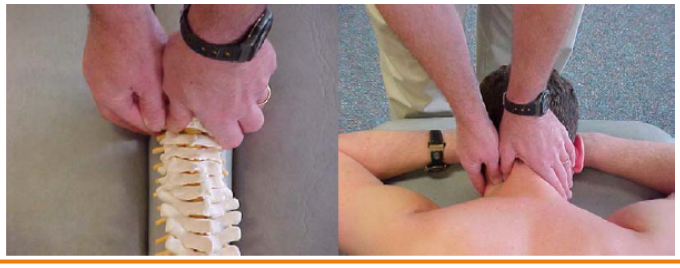
- Observation/Postural Assessment/Functional Testing
- Shoulder and Thoracic Clearing
- Cervical AROM/PROM/Resisted Testing
- Compression/Distraction
- Neurological Testing
  - Segmental
  - Central
- PA Provocation Testing
- Biomechanical Examination
  - Cervical PPIVMs
  - Cervical PAIVMs
  - Thoracic Screening

Cervical Provocation Test

- Central PA shear testing
- Unilateral PA shear testing
  - Helps to localize segmental dysfunction
  - Pain provoking
  - Can get a sense of segmental mobility
- Can be treatment pending severity/irritability
- Assessment of Neutral Zone



PA Testing – Mobility and Provocation



Diagnostic Utility: PA Glide Testing

- Pain during segmental testing was associated with reports of neck pain
  - Sensitivity = .82 - LR = .23
  - Specificity = .79 + LR = 3.9
- Reliability:
  - Kappa = .14 - .37 (pain)
  - ICC = .42 - .79 (pain)

Grade	Description	Treatment
0	Ankylosis detecta...	Need...ograph to confirm if ar...esent. If not it is ...l
1	Consto... in Movem...	...g
2	Slight limitat... Movement	...g, thrust
3	Normal-f... individ...	...t
4	Sligh... motion	
5	Considera... ...ease in motion	Stabi... exercises. Treat neighbo...g stiffness
6	Unstable	Support, Fusion

Basic Research Calculation

	Diagnosis (+)	Diagnosis (-)
Test (+)	A (true positive)	B (false positive)
Test (-)	C (false negative)	D (true negative)

Specificity (SpPIN) = D/(B+D)
- The ability to rule in a diagnosis with a positive test

Sensitivity (SnNout) = A/(A+C)
- The ability to rule out a diagnosis with a negative test

Likelihood Ratios: "The best statistics for summarizing the usefulness of a diagnostic test"

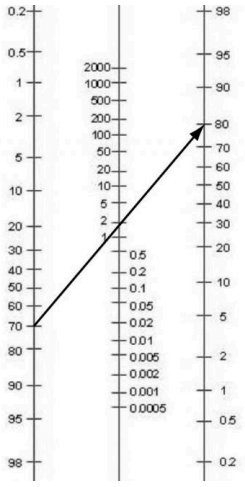
Positive LR = Sensitivity/(1 - specificity)
- Given a positive test result, the increase in odds favoring the condition

Negative LR = (1 – sensitivity)/specificity
- Given a negative test result, the decrease in odds favoring the condition

Likelihood Ratios

Positive LR	Negative LR	Interpretation
>10	<0.1	Generate large and often conclusive shifts in probability
5–10	0.1–0.2	Generate moderate shifts in probability
2–5	0.2–0.5	Generate small, but sometimes important, shifts in probability
1–2	0.5–1	Alter probability to a small, and rarely important, degree

[a] Adapted from Jaeschke et al.[83]

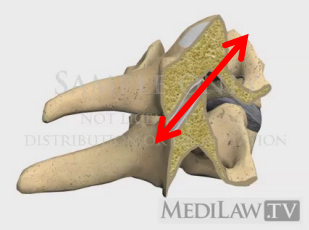


Cervical Objective Examination

- Observation/Postural Assessment/Functional Testing
- Shoulder and Thoracic Clearing
- Cervical AROM/PROM/Resisted Testing
- Compression/Distraction
- Neurological Testing
  - Segmental
  - Central
- PA Provocation Testing
- Biomechanical Examination
  - Cervical PPIVMs
  - Cervical PAIVMs
  - Thoracic Screening

Mid Cervical Biomechanics

- Zygapophyseal Joint
  - 45 deg from horizontal plane
  - Flexion and Extension
- Flexion
  - IAP on SAP: Superior and Lateral Glide
- Extension
  - IAP on SAP: Inferior and Medial Glide



- Side Bending
  - Extension of Ipsilateral Joint and Flexion of Contralateral Joint
- Rotation
  - Coupled with Side Bending
  - Extension of Ipsilateral Joint and Flexion of Contralateral Joint

Cervical Spine Segmental Mobility

Table 4.3 Mean and standard deviation in degrees for segmental motion during cervical flexion and extension

Study	Mean values and (SD) of flexion and extension motion				
	C2–3	C3–4	C4–5	C5–6	C6–7
Aho et al 1955	12 (5)	15 (7)	22 (4)	28 (4)	15 (4)
Bhalla & Simmons 1969	9 (1)	15 (2)	23 (1)	19 (1)	18 (3)
Lind et al 1981	10 (4)	14 (6)	16 (6)	15 (8)	11 (7)
Dvorak et al 1988	10 (3)	15 (3)	19 (4)	20 (4)	19 (4)

Table 4.4 Mean and range of axial rotation of cervical motion segments (based on Penning & Wilmink 1987)

Level	Range of motion (degrees)	
	Mean	Range
Occ–C1	1.0	−2–5
C1–2	40.5	29–46
C2–3	3.0	0–10
C3–4	6.5	3–10
C4–5	6.8	1–12
C5–6	6.9	2–12
C6–7	2.1	2–10
C7–T1	2.1	−2–7

Cervical Spine Segmental Mobility

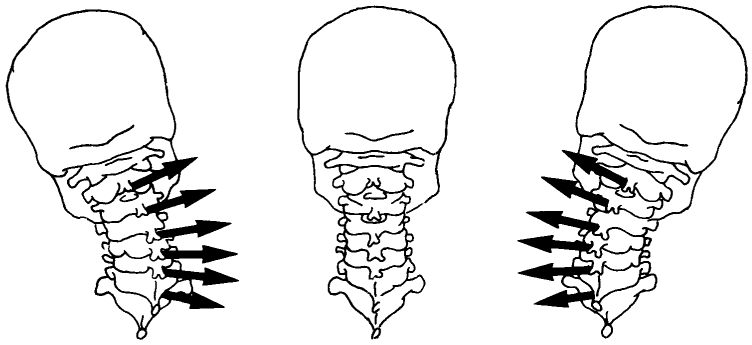
In vivo three-dimensional kinematics of the cervical spine during maximal axial rotation

W. Salem et al. / Manual Therapy 18 (2013) 339–344

Table 4
Comparison of the mean range of intervertebral axial rotation (°) on one side.

Authors	Year	Methods	C0–C1	C1–C2	C2–C3	C3–C4	C4–C5	C5–C6	C6–C7
Lysel	1969	vitro	–	–	3.0	4.9	5.2	4.0	2.9
Penning and Wilminck	1987	vivo	1.0	40.5	3.0	6.5	6.8	6.9	5.4
Dvorak	1988	vivo	2.8	41.5	–	–	–	–	–
Mimura	1989	vivo	–	–	3.7	2.9	2.1	2.7	3.2
Iai	1993	vivo	−4.0	38	4.0	3.5	3.5	3.0	3.0
Wen	1993	vitro	–	36.6	5.6	6.1	7.8	5.5	4.9
Dumas	1993	vivo	1.4	37	0.6	4.9	5.2	5.1	3.4
Panjabi	2001	vitro	4.9	28.4	1.7	2.6	3.4	2.5	1.5
Ishii	2004	vivo	1.7	36.3	2.2	4.5	4.6	4.0	1.6
Present study		vivo	2.5	36.7	1.2	5.0	5.5	5	3.9

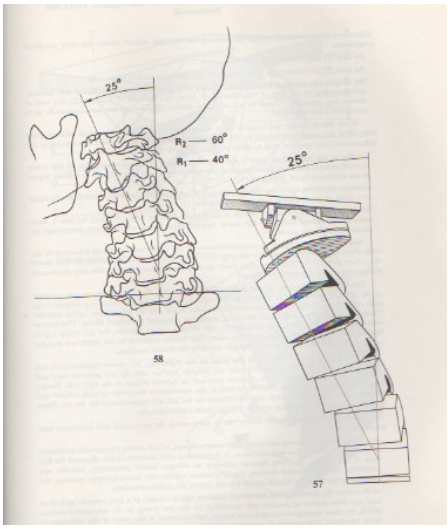
Mid Cervical Spine Coupling Biomechanics



Lateral Flexion and Rotation occur in the SAME direction

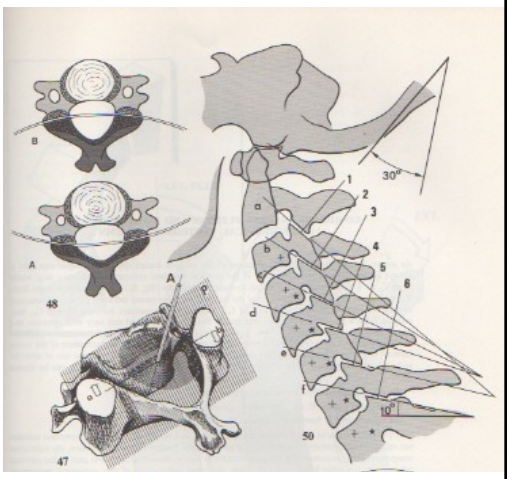
Mid Cervical Side Bending

- Ipsilateral osteokinematic rock with a superior-anterior glide of the contralateral superior facet and an inferior-posterior glide of the ipsilateral facet
- Contralateral translation of the vertebra on the disc
- Inferior-medial glide of the ipsilateral U-Jt and superior-lateral glide of contralateral U-Jt
- Composite curved translation results due to glide/translation of Z-Jt, U-Jt, and IVD
- Osteokinematics limited by contralateral scalenes and intertransverse ligaments
- Arthrokinematics limited by capsule
- Translation limited by IVD



Coupled Lateral Flexion and Rotation

- In oblique view, note direction of plane of the anterior facet
- Obliquity increases inferior to superior
  - C7/T1 = 10 degrees
    - More pure rotation and less coupled lateral flexion
  - C2/3 = 40-45 degrees
    - Nearly equal rotation and lateral flexion



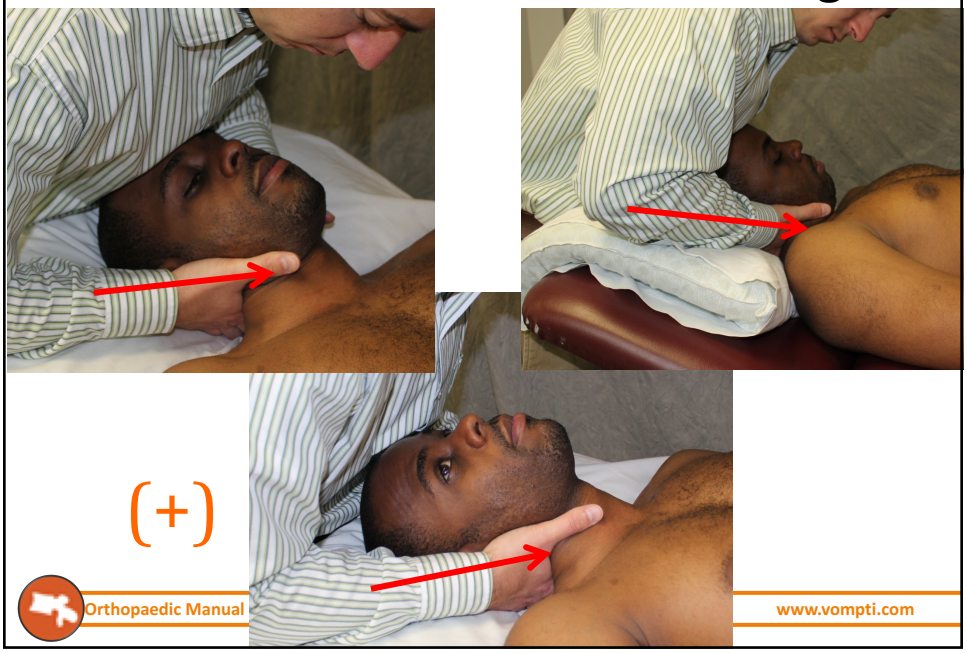
Joint Assessment

- Neutral Zone (amount of movement before resistance)
- Amount of Movement
- End Feel
- Response of contractile tissue around the area

Cervical Biomechanical Exam

- Passive Physiological Intervertebral Mobility (PPIVM)
  - Assessing physiological motion at every segment
  - Utilize sidebending or rotation to assess segmental motion
    - Assessed in neutral if planar motions were limited and or painful
    - Assessed in flexion or extension depending on quadrant results
  - What are we looking for?
    - End Feel – Stiff or Not Stiff?
    - Quantity of motion – compared to opp side and adjacent levels
    - Symptom provocation

Cervical PPIVMs - Sidebending

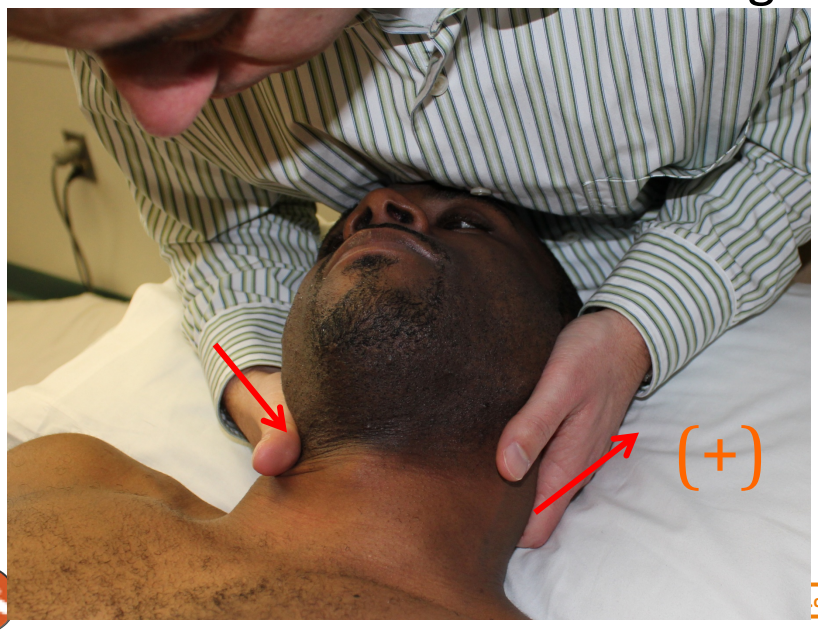


Cervical PPIVMs - Rotation

Cervical Biomechanical Exam

- Passive Arthrokinematic Intervertebral Mobility (PAIVM)
  - Assessing accessory motion at the facet joints
  - Identify end feel
  - Tested in position of PPIVM and in plane of facet
    - Inferior/medial
  - Planar position
    - Both sides tested
  - Combined motion
    - Assessment biased to one facet

Cervical PAIVMs - Sidebending



Derivation of a Clinical Decision Guide in the Diagnosis of Cervical Facet Joint Pain

Archives of Physical Medicine and Rehabilitation 2014;

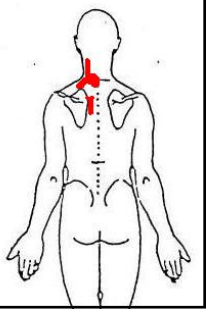
Geoff M. Schneider, PT, PhD,[a] Gwendolen Jull, PT, PhD,[b] Kenneth Thomas, MD, MHSc,[c] Ashley Smith, PT,[b] Carolyn Emery, PT, PhD,[d] Peter Faris, PhD,[e] Chad Cook, PT, MBA, PhD,[f] Bevan Frizzell, MD,[g] Paul Salo, MD[c]

- Clinical Decision Guide (CDG) for identification of symptoms from Facet Joint
  - PA Testing
  - Segmental palpation
  - Extension + Rotation AROM

  - SP = 0.84
  - (+) LR = 4.94

Physical Exam *Asterisks* Signs/Symptoms (Special tests, Movement/Joint Dysfunction, Posture, Palpation, etc)

- Observation – mild FHP, long/slender neck, no acute distress
- Increased tonicity noted to SCM, scalenes, upper traps and erector
- ROM: Full planar motions
  - (+) Extension + L SB Quadrant with pain
- Aberrant movements noted with extension and rotation
- Difficulty staying in plane with Side-Bending
- Neuro/Neurodynamic Testing (-)
- PPIVMs/PAIVMs
  - Hypermobility noted L C5/6 with pain
  - Hypomobility noted L C2/3, C7/T1
  - Hypomobility with pain T4/5
- Neck Disability Index = 32% perceived disability

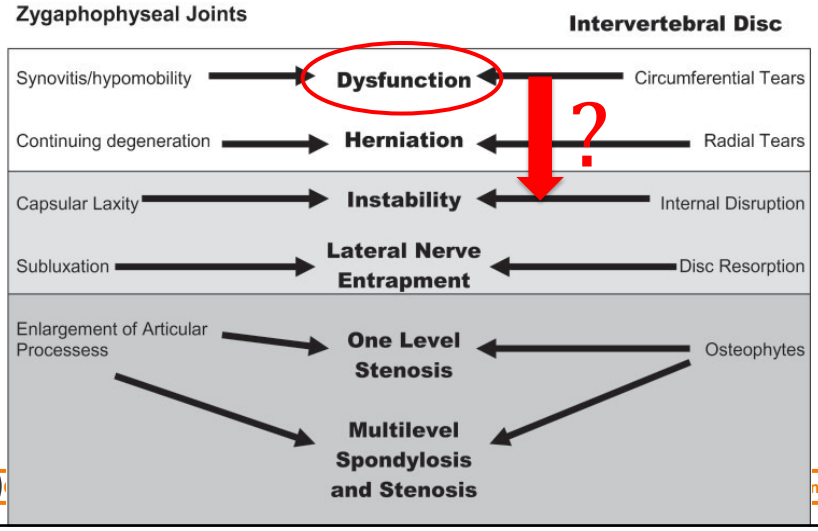


Orthopaedic Manual Physical Therapy Series 2017-2018

➢ Are the relationships between the areas on the body chart, the interview, and physical exam consistent? "Do the features fit" a recognizable clinical pattern? **Yes** **No**

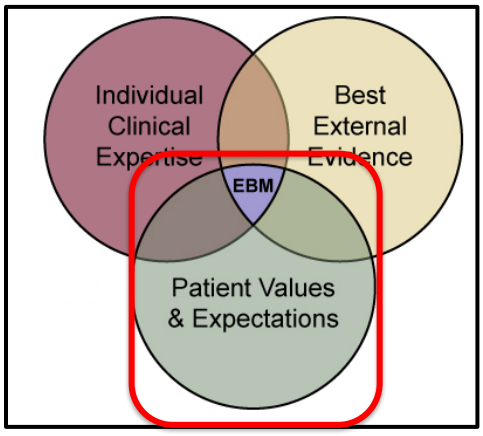
Please explain areas that may need clarificati

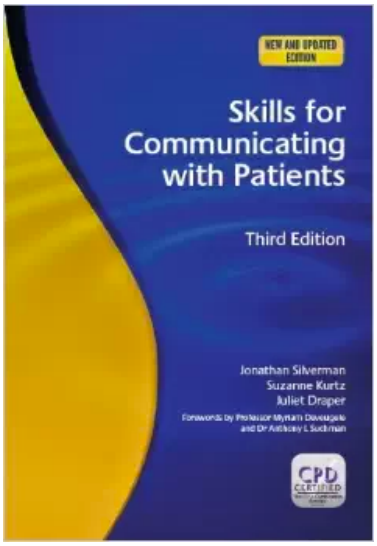
Mechanical Neck Pain with Somatic Referred Pain (facet) C5/6



- What is your primary treatment Objective after initial evaluation?
  - Education: EXPECTATIONS! Postural control/correction, work station ergonomics, sleep positioning, avoidance of self manipulation, Imaging Results?!?
  - Manual Therapy: (Specific Technique)
    Adjacent Hypomobilities – C2/3 PPIVM and mob, Mid T/S Mobilization/Manipulation
  - Exercise Prescription: (Specific)
    Deep Cervical Flexors, Mid/Lower Traps, Serratus Anterior, Cervical Proprioception

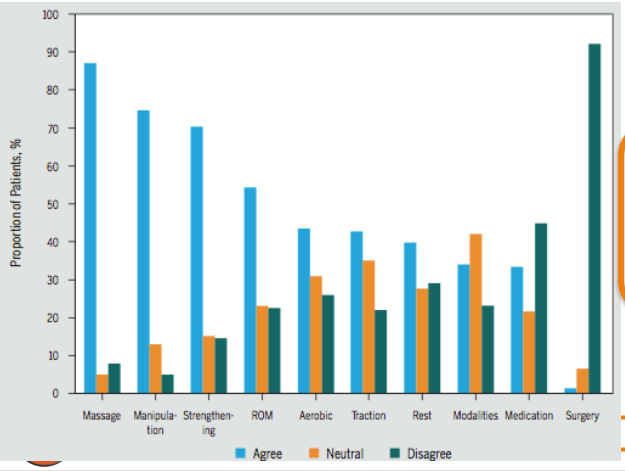
What are you going to re assess at subsequent visit?_ Quality of movement, CCFT, Cervical Flexor Endurance Testing, Upper C/S and T/S mobility testing





MARK D. BISHOP, PT, PhD[1] • PAUL MINTKEN, PT, DPT[2] • JOEL E. BIALOSKY, PT, PhD[1] • JOSHUA A. CLELAND, PT, PhD[3]

Patient Expectations of Benefit From Interventions for Neck Pain and Resulting Influence on Outcomes



CONCLUSION

IN SUMMARY, PATIENTS WITH NECK PAIN had high general expectations for physical therapy. Most patients specifically expected manual therapy and exercise to be beneficial treatments for neck pain. Patients with low general expectations for pain relief had worse outcomes at 6 months than patients who expected complete pain relief. Expectations for manipulation as a specific intervention provided during treatment increased short-term odds of success and long-term changes in disability in this study. ◉

KEY POINTS

FINDINGS: High general expectation of benefit from treatment was related to better short-term outcomes. Low general expectation was related to worse long-term outcomes. These findings were independent of the interventions provided.

IMPLICATIONS: Patient expectations prior to starting treatment for neck pain are important to assess when planning interventions for neck pain.

CAUTION: These data were collected from patients willing to participate in a randomized trial of interventions.

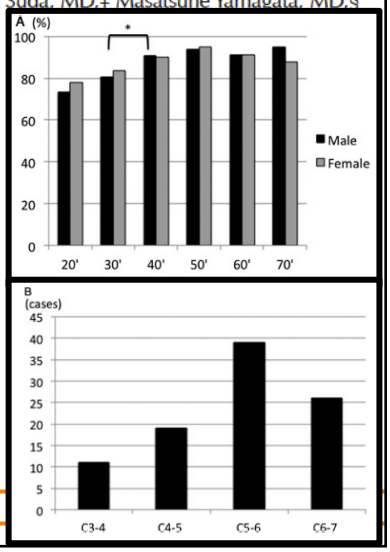
JOSPT Perspectives for Patients

Abnormal Findings on Magnetic Resonance Images of the Cervical Spines in 1211 Asymptomatic Subjects

SPINE Volume 40, Number 6, pp 392-398

Hiroaki Nakashima, MD,* Yasutsugu Yukawa, MD,† Kota Suda, MD,‡ Masatsune Yamagata, MD,§ Takayoshi Ueta, MD,¶ and Fumihiko Kato, MD†

Conclusion. Disc bulging was frequently observed in asymptomatic subjects, even including those in their 20s. The number of patients with minor disc bulging increased from age 20 to 50 years. In contrast, the frequency of SCC and increased signal intensity increased after age 50 years, and this was accompanied by increased severity of disc bulging.



- What is your primary treatment Objective after initial evaluation?
  - **Education:** Postural control/correction, work station ergonomics, sleep positioning, avoidance of self manipulation
  - **Manual Therapy:** (Specific Technique)
    Adjacent Hypomobilities – C2/3 PPIVM and mob, Mid T/S Mobilization/Manipulation
  - **Exercise Prescription:** (Specific)
    Deep Cervical Flexors, Mid/Lower Traps, Serratus Anterior, Cervical Proprioception

What are you going to re assess at subsequent visit?_ Quality of movement, CCFT, Cervical Flexor Endurance Testing, Upper C/S and T/S mobility testing

What About Classification?

Journal of Orthopaedic & Sports Physical Therapy
Official Publication of the Orthopaedic and Sports Physical Therapy Sections of the American Physical Therapy Association

Proposal of a Classification System for Patients With Neck Pain

Maj John D. Childs, PT, PhD, MBA, OCS, FAAOMPT[1]
Julie M. Fritz, PT, PhD, ATC[2]
Sara R. Piva, PT, MS, OCS, FAAOMPT[3]
Julie M. Whitman, PT, DSc, OCS, FAAOMPT[4]

Proposed Classification Categories

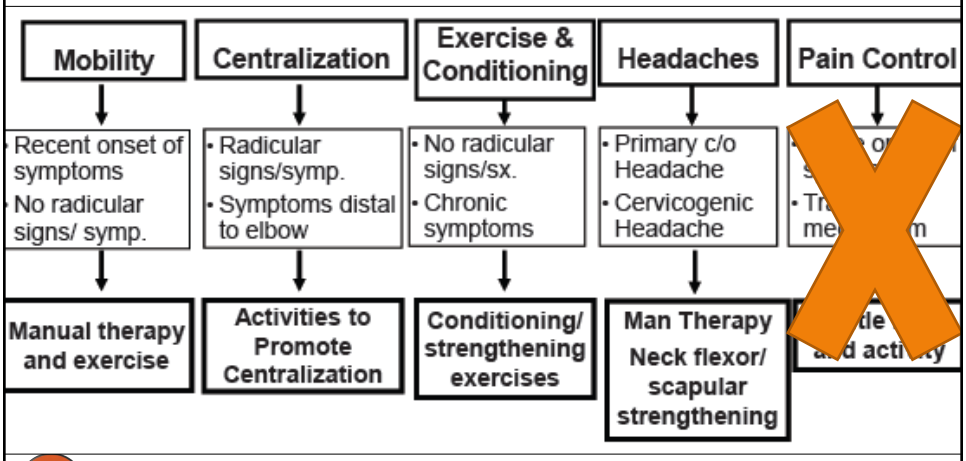


TABLE 3. Overview of classification categories with key examination findings and proposed matched interventions.

Classification	Examination Findings	Proposed Matched Interventions
Mobility	• Recent onset of symptoms • No radicular/referred symptoms in the upper quarter • Restricted range of motion with side-to-side rotation and/or discrepancy in lateral flexion range of motion • No signs of nerve root compression or peripheralization of symptoms in the upper quarter with cervical range of motion	• Cervical and thoracic spine mobilization/manipulation • Active range of motion exercises
Centralization	• Radicular/referred symptoms in the upper quarter • Peripheralization and/or centralization of symptoms with range of motion • Signs of nerve root compression present • May have pathoanatomic diagnosis of cervical radiculopathy	• Mechanical/manual cervical traction • Repeated movements to centralize symptoms
Conditioning and increase exercise tolerance	• Lower pain and disability scores • Longer duration of symptoms • No signs of nerve root compression • No peripheralization/centralization during range of motion	• Strengthening and endurance exercises for the muscles of the neck and upper quarter • Aerobic conditioning exercises
Pain control	• High pain and disability scores • Very recent onset of symptoms • Symptoms precipitated by trauma • Referred or radiating symptoms extending into the upper quarter • Poor tolerance for examination or most interventions	• Gentle active range of motion within pain tolerance • Range of motion exercises for adjacent regions • Physical modalities as needed • Activity modification to control pain
Reduce headache	• Unilateral headache with onset preceded by neck pain • Headache pain triggered by neck movement or positions • Headache pain elicited by pressure on posterior neck	• Cervical spine manipulation/mobilization • Strengthening of neck and upper quarter muscles • Postural education

Preliminary Examination of a Proposed Treatment-Based Classification System for Patients Receiving Physical Therapy Interventions for Neck Pain

Julie M Fritz, Gerard P Brennan

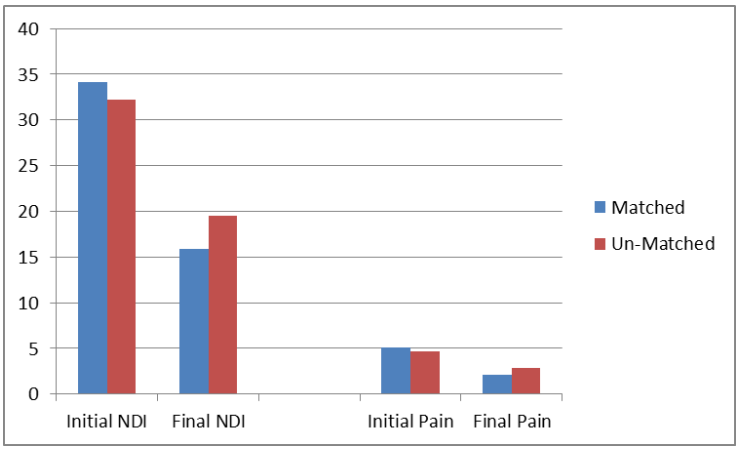
Background and Purpose

Neck pain frequently is managed by physical therapists. The development of classification methods for matching interventions to subgroups of patients may improve clinical outcomes. The purpose of this study was to describe a proposed classification system for patients with neck pain by examining data for consecutive patients receiving physical therapy interventions.

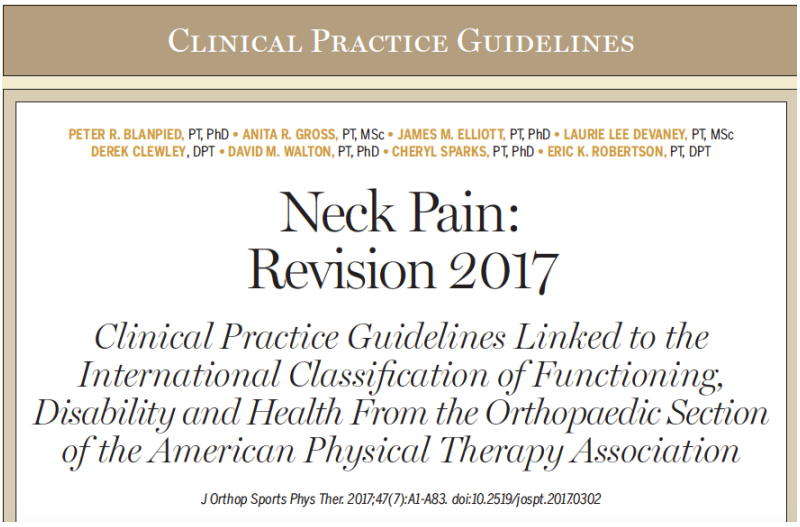
Discussion and Conclusion

The development of classification methods for patients with neck pain may improve the outcomes of physical therapy intervention. This study was done to examine a previously proposed classification system for patients receiving physical therapy interventions for neck pain. Receiving interventions matched to the classification system was associated with better outcomes than receiving nonmatched interventions. Although the design of this study prohibited drawing conclusions about the effectiveness of the system, the results suggest that further research on the system may be warranted.

Mobility Results



How Does This Relate to Treatment?



CLINICAL PRACTICE GUIDELINES

PETER R. BLANPIED, PT, PhD • ANITA R. GROSS, PT, MSc • JAMES M. ELLIOTT, PT, PhD • LAURIE LEE DEVANEY, PT, MSc
DEREK CLEWLEY, DPT • DAVID M. WALTON, PT, PhD • CHERYL SPARKS, PT, PhD • ERIC K. ROBERTSON, PT, DPT

Neck Pain:
Revision 2017

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association

J Orthop Sports Phys Ther. 2017;47(7):A1-A83. doi:10.2519/jospt.2017.0302

Interventions: Neck pain with Mobility Deficits

Acute

For patients with **acute** neck pain with mobility deficits:

B Clinicians should provide thoracic manipulation, a program of neck ROM exercises, and scapulothoracic and upper extremity strengthening to enhance program adherence.

C Clinicians may provide cervical manipulation and/or mobilization.

Subacute

For patients with **subacute** neck pain with mobility deficits:

B Clinicians should provide neck and shoulder girdle endurance exercises.

C Clinicians may provide thoracic manipulation and cervical manipulation and/or mobilization.

Chronic

For patients with **chronic** neck pain with mobility deficits:

B Clinicians should provide a multimodal approach of the following:

- Thoracic manipulation and cervical manipulation or mobilization
- Mixed exercise for cervical/scapulothoracic regions: neuromuscular exercise (eg, coordination, proprioception, and postural training), stretching, strengthening, endurance training, aerobic conditioning, and cognitive affective elements
- Dry needling, laser, or intermittent mechanical/manual traction

C Clinicians may provide neck, shoulder girdle, and trunk endurance exercise approaches and patient education and counseling strategies that promote an active lifestyle and address cognitive and affective factors.

Recommendations From 2008 CPG

- Interventions
  - **<u>Cervical mobilization/manipulation = A</u>**
  - Coordination, strengthening, endurance = A
  - **<u>Thoracic mobilization/manipulation = C</u>**
  - Stretching exercises = C
  - Centralization procedures and exercises = C

- A = Strong Evidence – Preponderance of Level I and/or Level II studies support the recommendation. Must include at least one Level I study
- C = Weak Evidence – A single Level II study or preponderance of Level III and IV studies including statements of consensus by context experts support the recommendation

Cost effectiveness of physiotherapy, manual therapy, and general practitioner care for neck pain: economic evaluation alongside a randomised controlled trial

Ingeborg B C Korthals-de Bos, Jan L Hoving, Maurits W van Tulder, Maureen P M H Rutten-van Mölken, Herman J Adèr, Henrica C W de Vet, Bart W Koes, Hindrik Vondeling, Lex M Bouter

BMJ VOLUME 326 26 APRIL 2003

- Results:
  - Manual Therapy: $402
  - Standard PT: $1167
  - General Practitioner: $1241

- Conclusion:
  - Manual physical therapy was more effective (26 wks) and less costly than standard physical therapy or general practitioner care

Evidence Supporting Manual Therapy for Treatment of Neck Pain

- Hoving et al. Annals Internal Medicine 2002 RCT MT vs PT vs GP: MT sig improved pain and perceived success compared to other treatment. PT also sig better than GP for outcome measures.
- Hoving et al Clin J Pain 2006 RCT MT vs PT vs GP: sig improvements for MT group in short term, no sig difference in long term
- Walker et al Spine 2008 RCT Significant short term and long term improvements in pain relief, and function with MT and exercise group as compare to control (postural advice and ROM exercises)

Evidence Supporting Treating the Thoracic Spine for Neck Pain

- Short term improvements in pain and disability with thoracic thrust vs non-thrust mobilization/manipulation (Cleland, et al., 2007)
- Immediate changes in neck pain and AROM following T/S manipulation (Fernandez De-Las-Penas, 2007)
- RCT, Immediate effects of thoracic manipulation - increased cervical rotation and decreased pain at end range rotation (vs. control group of rest)(Krauss, et al., 2008)
- T/S manipulation demonstrated superior benefits (versus TENs/Heat) for acute neck pain at 2 weeks and 4 week follow-up (Gonzalez-Igelsias, et al., 2009)
- Short-term improvement in lower trapezius strength following T/S manipulation (Cleland, et al., 2002)

Regional interdependence and manual therapy directed at the thoracic spine

Journal of Manual and Manipulative Therapy 2015 VOL. 23 NO. 3

Amy McDevitt[1], Jodi Young[2], Paul Mintken[1], Josh Cleland[2]

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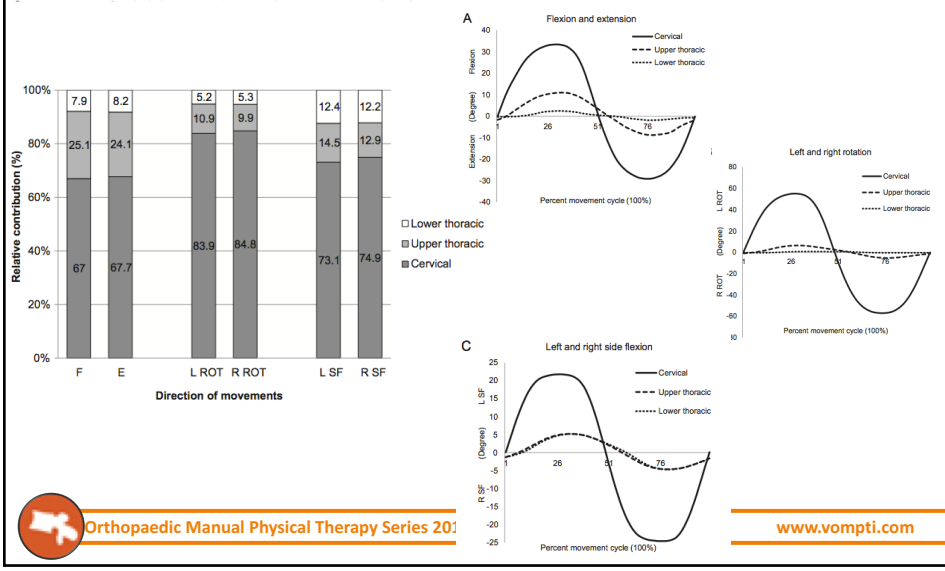
- "emerging evidence supporting neurophysiologic effect"
- "non-specific technique acting on pain modulating system, even though the exact mechanisms remain elusive"

making. Rather than using manual therapy to treat a localized biomechanical impairment, today's clinician, armed with current best evidence, may decide to treat a patient with shoulder pain using thoracic manipulation based on a well-documented neurophysiological effect, as opposed to a local biomechanical effect. This decision would be weighed more heavily towards current best evidence over examination findings from clinical tests and measures that are limited by questionable reliability and validity.[82,83] In addition, non-specific

Normal kinematics of the neck: The interplay between the cervical and thoracic spines

Manual Therapy 18 (2013) 431–437

Sharon M.H. Tsang [a,b,*], Grace P.Y. Szeto [a], Raymond Y.W. Lee [b]



Research Report

Development of a Clinical Prediction Rule for Guiding Treatment of a Subgroup of Patients With Neck Pain: Use of Thoracic Spine Manipulation, Exercise, and Patient Education

Joshua A Cleland, John D Childs, Julie M Fritz, Julie M Whitman, Sarah L Eberhart

January 2007
Volume 87 Number 1 Physical Therapy

- Predictors
  - Symptoms <30 days
  - No symptoms distal to the shoulder
  - Looking up does not irritate symptoms
  - FABQPA <12
  - Diminished upper t-spine kyphosis
  - Cervical extension <30°
- Prediction of success
  - 3 out of the 6 predictors = 86% (+LR 5.49)
  - 4 out of the 6 predictors = 93% (+LR 12)
- Not validated upon attempt

Examination of a Clinical Prediction Rule to Identify Patients With Neck Pain Likely to Benefit From Thoracic Spine Thrust Manipulation and a General Cervical Range of Motion Exercise: Multi-Center Randomized Clinical Trial

Joshua A. Cleland, Paul E. Mintken, Kristin Carpenter, Julie M. Fritz, Paul Glynn, Julie Whitman, John D. Childs

The Bottom Line

What do we already know about this topic?

Thoracic spine manipulation appears to be beneficial in the short term for reducing pain and improving function in patients with mechanical neck pain. The authors have attempted to identify a subgroup of patients with neck pain most likely to benefit from thoracic spine manipulation.

What new information does this study offer?

The results suggest that, regardless of the patient's clinical presentation, those who received thoracic spine manipulation in addition to exercise had superior outcomes to those who received exercise only. This suggests that patients with mechanical neck pain and no contraindications to manual therapy may benefit from thoracic spine manipulation.

[LITERATURE REVIEW]

KEVIN M. CROSS, PT, PhD, ATC[1] • CHRIS KUENZE, MA, ATC[2] • TERRY GRINDSTAFF, PT, PhD[3] • JAY HERTEL, PhD, ATC[4]

Thoracic Spine Thrust Manipulation Improves Pain, Range of Motion, and Self-Reported Function in Patients With Mechanical Neck Pain: A Systematic Review

- Consistently reduced pain, improves ROM among patients with acute or sub-acute neck pain
- Treatment parameters not clear
- Immediate and Short-Term, Long-Term unclear
- Limited RCTs and limited generalizability

Thoracic vs. Cervical Spine Treatment

- Cleland et al. (2005, 2007) – Immediate and short term reduction in neck pain and disability from thoracic manipulation
- However, many practitioners still manipulate upper cervical spine, in addition, for chronic mechanical neck pain (Jull, 94, 97; Licht, 2000; Clements, 2001; Hartman, 2001; Hall/Robinson, 2004, 07; Gibbons/Tehan, 2005)
- Literature supports need to manipulate as close to the specific vertebral level that is neuroanatomically connected and segmentally associated with dysfunctional muscle group
- No evidence to support notion that thoracic spine manipulation can have any mechanical or neurophysiological effect on the cervical spine

RESEARCH REPORT

MICHAEL MASARACCHIO, PT, PhD[1] • JOSHUA CLELAND, PT, PhD[2] • MADELEINE HELLMAN, PT, EdD[3] • MARSHALL HAGINS, PT, PhD[1]

MARCH 2013 | VOLUME 43 | NUMBER 3 | JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY

Short-Term Combined Effects of Thoracic Spine Thrust Manipulation and Cervical Spine Nonthrust Manipulation in Individuals With Mechanical Neck Pain: A Randomized Clinical Trial

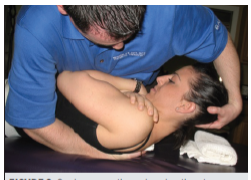


FIGURE 3. Supine upper thoracic spine thrust manipulation used in this study. The therapist applied

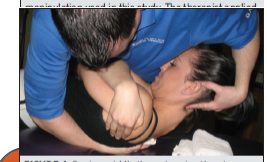


FIGURE 4. Supine middle thoracic spine thrust manipulation used in this study. The therapist applied a high-velocity, low-amplitude thrust through the patient's arms.

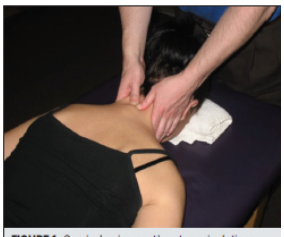


FIGURE 1. Cervical spine nonthrust manipulations used in this study. The therapist used his thumbs to perform a posterior-to-anterior grade 3 oscillatory nonthrust manipulation on the spinous processes of C2-C7.

KEY POINTS

FINDINGS: Participants who were treated with a combination of cervical spine nonthrust manipulation and thoracic spine thrust manipulation and exercise demonstrated greater within-group improvements in pain and disability when compared to participants treated with cervical spine nonthrust manipulation and exercise.

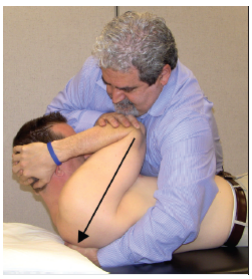
IMPLICATIONS: Based on the added clinical benefit, clinicians should consider implementing thoracic spine thrust manipulation in the plan of care for individuals with mechanical neck pain.

CAUTION: Several factors limit the generalizability of this study, including a short-term follow-up, possible gender bias, possible attention bias, and a single physical therapist having provided most (97%) of the interventions.

Thoracic Spine Thrust Manipulation Versus Cervical Spine Thrust Manipulation in Patients With Acute Neck Pain: A Randomized Clinical Trial

| APRIL 2011 | VOLUME 41 | NUMBER 4 | JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY

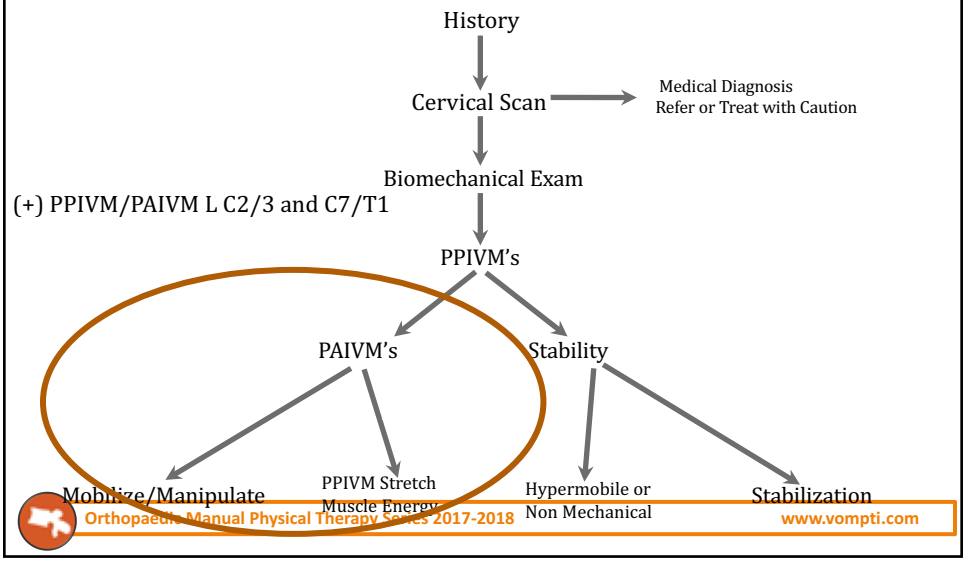
EMILIO J. PUENTEDURA, PT, DPT[1] • MERRILL R. LANDERS, PT, DPT[2] • JOSHUA A. CLELAND, PT, PhD[3]
PAUL MINTKEN, PT, DPT[4] • PETER HUIJBREGTS, PT, DPT[5] • CESAR FERNANDEZ-DE-LAS-PEÑAS, PT, DO, PhD[6]



Thoracic Spine Thrust Manipulation Versus Cervical Spine Thrust Manipulation in Patients With Acute Neck Pain: A Randomized Clinical Trial

- 24 consecutive patients with neck pain who met CPR for thoracic spine manipulation (4/6)
- Two groups: Thoracic TJM/Exercise and Cervical TJM/Exercise
- Outcomes: 1 wk, 4 wks, 6 months
  - NDI, NPRS, FABQ
- Cervical Group greater improvements in all measures at all follow-up times
- Cervical Group also with fewer transient side-effects

CERVICAL EXAM BIOMECHANICAL ALGORITHM



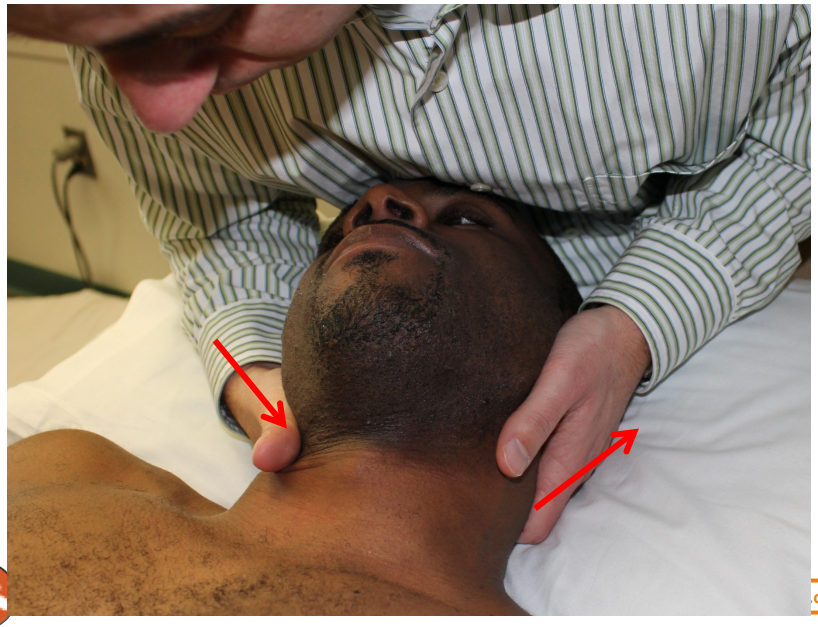
Treatment: PAIVM vs. PPIVM

- Passive mobility and accessory glide limited = PAIVM treatment (either supine or prone PA)
- Passive mobility limited but accessory glide is normal = PPIVM treatment
  - Direct or Indirect based on severity/irritability
  - PPIVM Rotation away (flexion) – Indirect
  - PPIVM SB towards (extension) – Direct
  - Soft tissue mobility?

Cervical Treatment – SB PPIVM/PAIVM

(+) Gr IV L C2/3 in Extension

Cervical Treatment – SB PAIVM



PPIVM vs. PAIVM

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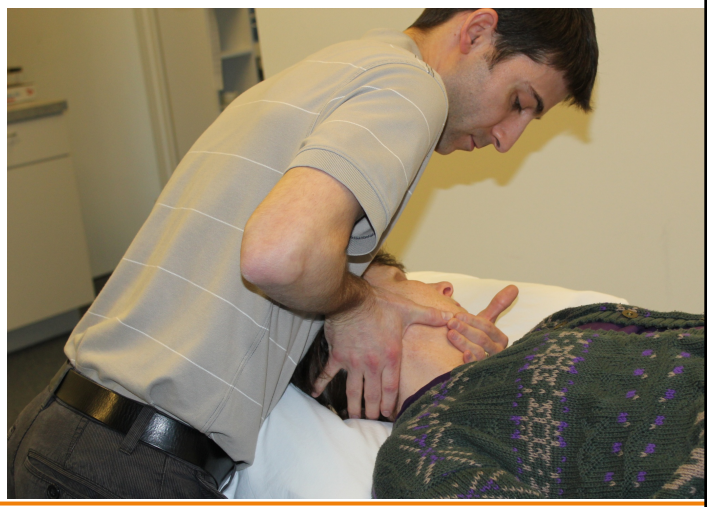
  - Direct or Indirect based on severity/irritability
  - PPIVM Rotation away (flexion) – Indirect
  - PPIVM SB towards (extension) – Direct
  - Soft tissue mobility?

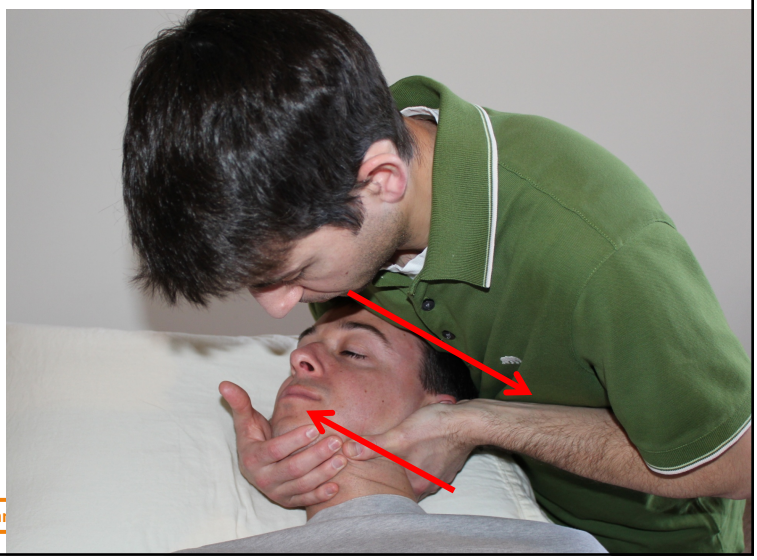
Cervical Treatment – PPIVM Rotation Away

Gr IV R rotation C5/6



Cervical Treatment – PPIVM SB Towards

Gr IV L C2/3 SB PPIVM



Cervical Treatment
PA Mobilization

- Central PA mobilization
  - Mobilizing through the SP
- Unilateral PA mobilization
  - Mobilizing through the articular pillar
- Positioning?
- Vigor??

Gr IV L unilat PA C7/T1

SUZANNE J. SNODGRASS, PhD[1] • DARREN A. RIVETT, PhD[2] • MICHELE STERLING, PhD[3,4] • BILL VICENZINO, PhD[4]

JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 44 | NUMBER 3 | MARCH 2014 |

Dose Optimization for Spinal Treatment Effectiveness: A Randomized Controlled Trial Investigating the Effects of High and Low Mobilization Forces in Patients With Neck Pain

KEY POINTS

FINDINGS: A high mobilization force (90-N mean peak force) significantly decreases spinal stiffness at a short-term follow-up of approximately 4 days after treatment, though stiffness was not reduced immediately after treatment. Also at this follow-up, pain was significantly less following a high-force (90 N) compared with a low-force (30 N) mobilization, but was not significantly different from that of a placebo treatment.

IMPLICATION: A particular threshold of force appears necessary for more effective mobilization treatment, suggesting that specific doses of mobilization should be further investigated.

CAUTION: These results are limited to patients with chronic, nonspecific neck pain and relatively low disability.

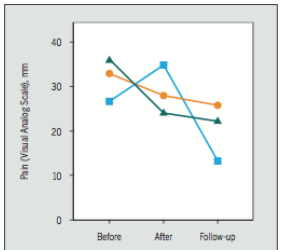


FIGURE 2. Pain measured on a 100-mm visual analog scale before and immediately after treatment (low-force [30 N] or high-force [90 N] mobilization or placebo) and at short-term follow-up.

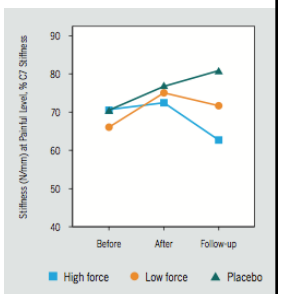


FIGURE 3. Spinal stiffness (N/mm) at the painful spinal level, normalized as a percentage of a participant's C7 spinal stiffness, measured before and immediately after treatment (low-force [30 N] or high-force [90 N] mobilization or placebo) and at short-term follow-up. Percentages less than 100% indicate that the painful spinal levels were less stiff than C7.

Manipulation as a Treatment?

J. TIMOTHY NOTEBOOM, PT, PhD[1] • CHRISTIAN LITTLE, PT, DPT, OCS, FAAOMPT[1]
WILLIAM BOISSONNAULT, PT, DHSc[2]

Thrust Joint Manipulation Curricula in First-Professional Physical Therapy Education: 2012 Update

- 72% programs responded
- **99%** programs teaching TJM
- 97% of faculty believing TJM to be an entry-level skill
- Cervical spine TJM is still being taught at a lower rate than techniques for other body regions
- Faculty deemed 91% of students at entry level and 77% above entry level competency
- Avg teaching time spent = 10.5 hrs (lecture) and 21.1 hrs (lab)

TABLE 3 PERCENTAGE OF THRUST JOINT MANIPULATION CURRICULAR HOURS FOR EACH BODY REGION

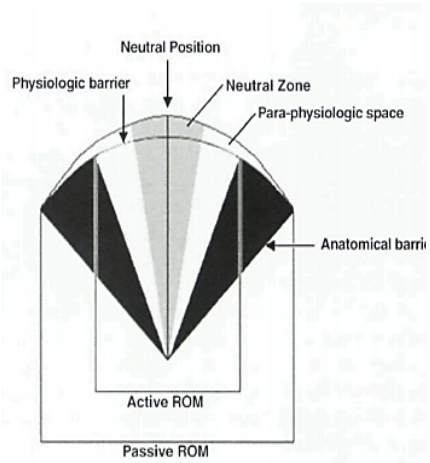
Body Region	Percentage of Curriculum*	Programs Not Teaching TJM, %†
Cervical spine	9.9 ± 9.8	35
Thoracic spine	25.5 ± 10.7	3
Lumbar spine	28.1 ± 12.6	1
Pelvis/sacrum	15.6 ± 8.1	7
Upper extremity	8.7 ± 8.3	23
Lower extremity	12.2 ± 9.5	13

Barriers to TJM Curricular Implementation

Several barriers to implementing TJM into curricula were reported in 2004,[5] with the belief that TJM was not an entry-level skill and lack of time, qualified faculty, and evidence being the most frequently cited. In the current survey, respondents noted very few barriers to implementation. The one area of consistency between the 2 surveys was potential time constraints. Although 57% of our respondents stated that they had sufficient time to teach TJM, 97% of respondents stated that they would like more time to teach the content area.

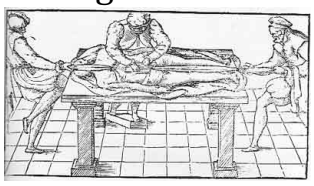
What Is Manipulation?

- APTA: HVLA movement **<u>within</u>** or at end range of motion
  - Historically, the aim of HVLA is to achieve joint cavitation
  - HVLA = Manipulation = Thrust Joint Manipulation (TJM)
    - TJM predominant term in PT literature



Who Owns Manipulation?

- No Ownership – Dates to Hippocrates, 460-355 B.C. who wrote 'On Setting Joints by Leverage'



- P.T. Practice – 1920's
- The Guide to Physical Therapist Practice outlines practice standards for physical therapists
  - Regarding manual therapy, this includes the entire continuum of mobilization/manipulation interventions including thrust techniques

What is the "Crack"?

- Results from phenomenon known as "joint cavitation"
  - Formation of vapor and gas bubbles within fluid
  - Local reduction in pressure
    - Some argue the "crack" may result from collapse of bubble
- Should not be an absolute requirement for achievement of mechanical effects but it may be necessary to achieve neurophysiological effects
  - Does not correlate with therapeutic effect
- After cavitation
  - Increase in size of joint space and gas may be found within space
    - "gas" has been described as 80% CO^2, or having density of nitrogen
  - Refractory period – gas bubble remains in space 15-30 mins

MRI of MCP Cavitation (Kawchuk, 2015)

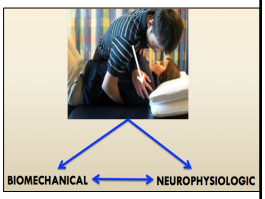
Mechanisms of Manipulation?

What do we tell patients?

How Spinal Manipulative Therapy Works: Why Ask Why? JOSPT 2008

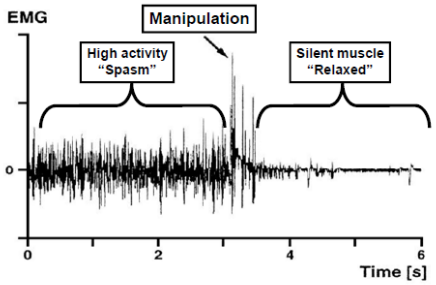
JOEL E. BIALOSKY, PT, MS, OCS, FAAOMPT[1]
STEVEN Z. GEORGE, PT, PhD[2]
MARK D. BISHOP, PT, PhD, CSCS[3]

"When the scientific literature is considered, attributing successful spinal manipulative therapy outcomes solely to the identification and correction of biomechanical faults makes as much sense as crediting a beard for winning a hockey playoff series."



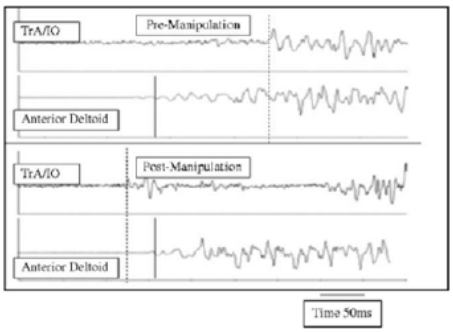
Neurophysiological Effects – Inhibitory vs. Excitatory

Inhibitory



Electrical signal changes in a muscle spasm after manipulation
From: Herzog: Spine, Volume 24(2).January 15, 1999.146-152

Excitatory



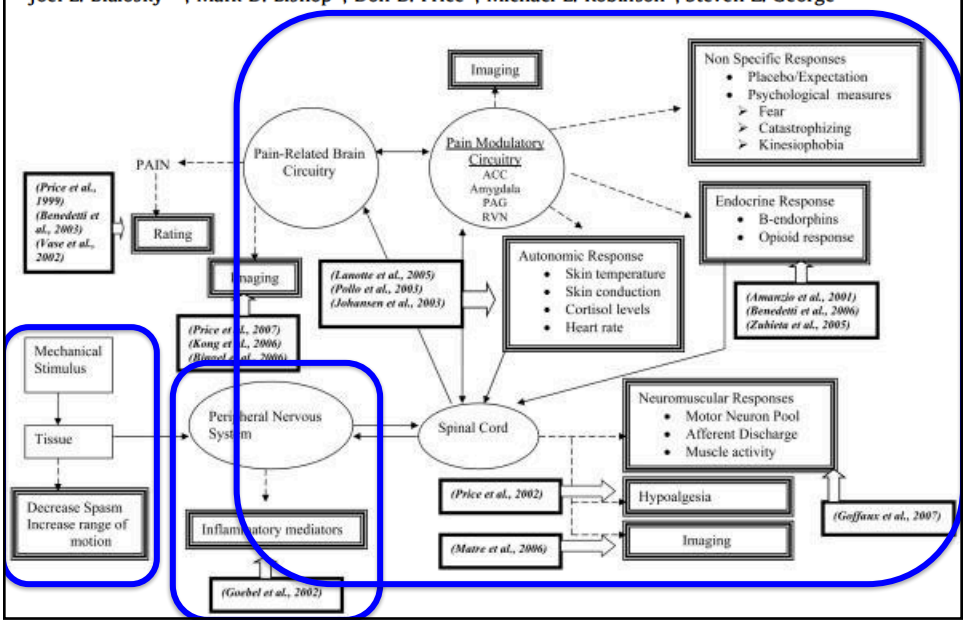
(J Manipulative Physiol Ther 2006;29:196-202)

Neurophysiologic Effects of Manipulation

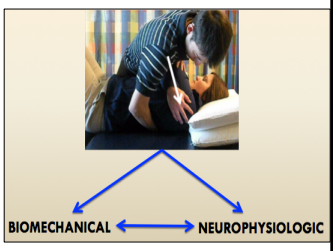
- Decrease in motor neuron activity following HVLA to C/S and L/S (H Reflex) (Dishman, 2003)
- Increased transversus abdominus activity immediately following lumbar spine HVLA (Raney, 2007)
- Increased motor evoked potentials from paraspinals after L/S HVLA. Sham manipulation did not exhibit change (Dishamn, 2008)
- HVLA to lumbar spine significantly reduced EMG activity of tonic paraspinals in patients with chronic LBP (Bicalho, 2010)
- Attenuation of production of inflammatory markers after thoracic HVLA in asymptomatic subjects. SMT may down regulate inflammatory type responses (Teodorczyk-Injeyan, 2006)

The mechanisms of manual therapy in the treatment of musculoskeletal pain: A comprehensive model

Joel E. Bialosky [a,*], Mark D. Bishop [a], Don D. Price [b], Michael E. Robinson [c], Steven Z. George [a]



Indications to Manipulate



- To facilitate Biomechanical effects
  - Increase movement
    - Mechanically locked/blocked spinal joint
    - Stiffness > pain
    - Oscillations may be too painful or plateaued
  - Release an entrapment (meniscoids/capsules)
- To facilitate Neurophysiological effects
  - To relieve pain
    - MIA – Manipulation Induced Analgesia
    - Non-opiod mechanism
    - Changes in pain pressure threshold
  - To increase circulation (sympathetic and parasympathetic effects)
  - To increase strength
    - Lower Trap
    - Abdominals
    - Deep Cervical Flexors
- To facilitate Psychological/Non-specific effect
- To differentially diagnose?
  - Stiff and painless C4/5 with adhesive capsulitis

Precautions for Manipulation

- **<u>Neuromuscular</u>**
  - Spinal Anomalies: scoliosis, spondylolisthesis, spina bifida, Arnold Chiari malformation, Scheuermann's disease, Klippel-Fiel, transitional or hemi-vertebrae
  - Stable fracture, hypermobility, instability, spasm end feel with palpation, stable neuro deficits, osteopenia (degree dependent)
  - Connective tissue disorders: Crohn's disease, inflammatory arthrites (RA)
- **<u>Vascular</u>**
  - Anatomical abnormalities of Vertebral Artery
  - Past history of DVT
  - Past history of Anti-Coagulant use
- **<u>General Health</u>**
  - Advanced or brittle Diabetes
  - Radiculopathy or Neurogenic pain

Absolute Contraindications to Manipulation

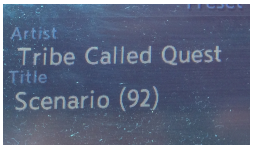
- **Neuromuscular**
  - Hx of Cancer (due to common Metastatic areas)
  - Bone diseases – osteoporosis, Paget's Disease, TB, Osteomyelitis
  - S/S of spinal cord involvement
  - S/S of Cauda Equina Syndrome
  - Neural S/S of > 1 adjacent cervical or 2 adjacent lumbar nerve roots (Neoplasm)
  - Others: severe pain, high irritability, acute radicular pain, unstable radicular pain, unstable compression fracture, increase in distal most symptoms early in range

Absolute Contraindications to Manipulation

- **Vascular**
  - S/S of VBI (for cervical techniques)
  - Blood clotting disorders (hemophilia, Von Willebrands, Factor V Leiden)
  - Current use of Anti-Coagulants
  - Hx of multiple DVTs of spontaneous nature
- **General Health**
  - Pregnancy after 3rd - 4th month and 6-12 weeks following delivery
  - Hx of oral corticosteroid use, 5mg or more for more than 3-6 months within the last 12 months
    - Risk of fracture increased rapidly after starting (3-6 months) but decreases after 1 year of stopping
  - Psychological pain or suspect non-musculoskeletal pain
  - Patient request not to be manipulated
  - Prolonged immobilization – leads to Ca+ loss
  - Bones exposed to high does of Radiation
  - Lack of clinical diagnosis or **patient consent**

Interpersonal Indications: Who to Manipulate??

- How do we determine who to manipulate?
- How do we "sell" this type of treatment to our patients?
  - What/How do we tell them?
- How do we fit this into management?
  - Minimize the **"event"**
- What does the ideal patient "look" like?
  - Subjectively
  - Objectively
  - Personality Traits?
  - EXPECTATIONS??

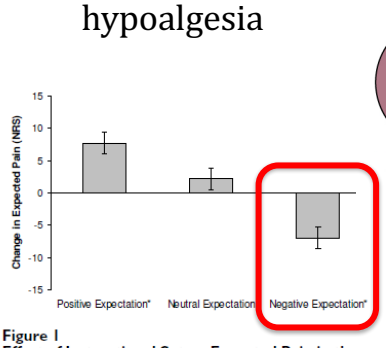


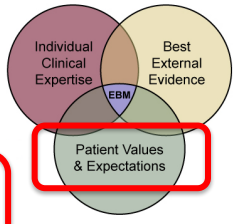
Research article **Open Access**

The influence of expectation on spinal manipulation induced hypoalgesia: An experimental study in normal subjects

Joel E Bialosky*[1], Mark D Bishop[1], Michael E Robinson[2], Josh A Barabas[1] and Steven Z George*[1] *BMC Musculoskeletal Disorders* 2008, **9**:19

- Significant increase in pain perception occurred in those who had negative expectation
- Potential influence of expectation on SMT induced hypoalgesia





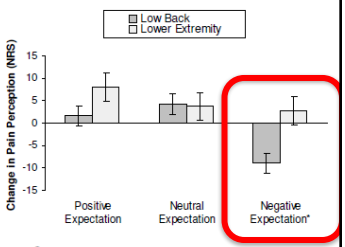


Figure 1
Effect of Instructional Set on Expected Pain in the Low Back. Change in expected pain in the low back follow-

Figure 2
Change in Pain Perception in the Low Back and Lower Extremity by Expectation Instructional Set.

What are the Risks?
Can We Minimize Them?

Danish Institute for Health Technology Assessment; Denmark, 2000

- Risk Evaluation
  - Manual treatment is generally a very safe treatment when relevant contraindications are addressed
  - Approx. 25% of patients experienced short-lived tenderness in the treated area. Serious complications (Cauda Equina Syndrome) are rare

Risk with Thoracic Manipulation

- Fracture secondary to osteoporosis or another metabolic disorder leading to bone density loss
- Paraplegia secondary to a space occupying lesion (disc protrusion, tumor)

Risk with Thoracic Spine Manipulation

- Lopez-Gonzalez et al (Eur Spine Jou 2011)
  - Case study where pt was paralyzed after t-spine manipulation
    - Pt had undiagnosed calcified herniated disc at T8-9
- Oppenheim et al (Spine Journal 2005)
  - Review of case studies resulting on nonvascular complications due to spinal manipulation
    - Both thoracic spine cases led to vertebral fractures and temporary paralysis requiring decompression
- Masneri et al (JAOA 2007)
  - Pneuomothorax after "bear-hug back crack" home remedy by a layperson
    - 20 y/o female, required chest tube, thoracostomy and hospitalization

Safety of thrust joint manipulation in the thoracic spine: a systematic review

Journal of Manual and Manipulative Therapy 2015 VOL. 23 NO. 3

Emilio J. Puentedura, William H. O'Grady

Table 3 The 10 cases of serious adverse events (AEs) reported in seven published articles

No.	Authors and year	Age (years), sex	Interval to symptom onset	Practitioner	Thoracic level manipulated	AE
1	Ruelle *et al.* (1999)[35]	64, F	2 hours	Chiropractor	Lumbar and thoracic spine	Acute epidural haematoma T9–11
2	Oppenheim *et al.* (2005)[39]	60, F	Not known	Chiropractor	Upper thoracic spine	T4–5 collapse; cord compression
3		56, F	Not known	Chiropractor	Upper thoracic spine	T4 pathology; epidural tumour
4		71, F	Not known	Chiropractor	Upper thoracic spine	T4 fracture; lung CA
5		32, M	Not known	Chiropractor	Middle thoracic spine	Thoracic syrinx, swollen cord
6	Lopez-Gonzalez and Peris-Celda (2011)[33]	45, F	2 hours	Chiropractor	Middle thoracic spine	Traumatic T8–T9 disc herniation; complete T6 level paraplegia secondary to spinal cord ischaemia
7	Lee *et al.* (2011)[34]	38, F	4 hours	Chiropractor	Cervical and upper thoracic spine	Acute epidural haematoma T1–7
8	Struewer *et al.* (2013)[38]	17, M	2 days	Osteopath	Middle thoracic spine	Large left hematothorax
9	Masneri *et al.* (2007)[37]	20, F	24 hours	Lay person	Middle thorax	Right pneumothorax
10	Donovan *et al.* (2007)[36]	32, F	2 weeks	Physical Therapist	Cervical and upper thoracic spine	CSF leak and spontaneous intracranial hypotension from dural sleeve tear C8–T

Conclusion

This review showed that serious AEs do occur in the thoracic spine. The most commonly reported AE involved trauma to the spinal cord, followed by pneumothorax. This suggests that excessive peak forces may have been applied to thoracic spine, and it should serve as a cautionary note for clinicians to work on their TJM skills to decrease these peak forces. Finally, we recommend the performance of a thorough examination and the use of sound clinical reasoning as a means whereby the likelihood of AE's may be mitigated. Clinicians should always endeavour to reduce risks associated with TJM and improve patient safety.

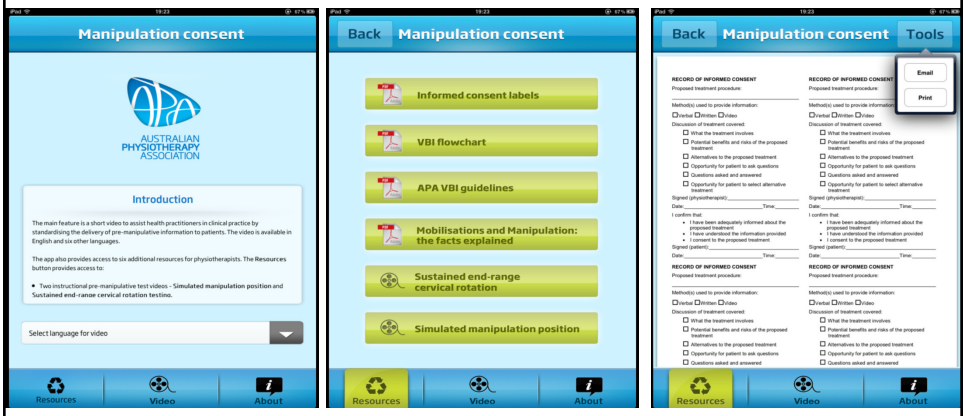
Orthopaedic Manual Physical Therapy Series 2017-2018

Adverse Events – Manual Therapists Suffer Too!!!

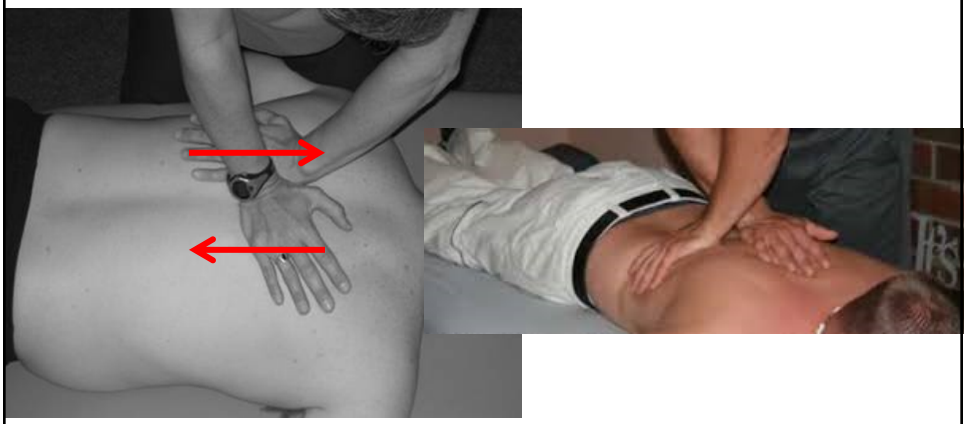
TABLE 3: Type and number of Manual Medicine related injuries experienced by physicians.

Grades of Manual Medicine related injuries	Classification of Manual Medicine related injuries	Affected part of the body	Number
Major	None		
Moderate	Fracture	Of a carpal bone	(n = 1)
		Of a rib	(n = 2)
Mild	Joint dysfunction syndrome (physiological barrier limiting range of movement)	Spine, not specified	(n = 8)
		Sciatic pain	(n = 8)
		Thoracic spine	(n = 7)
		Lumbar spine	(n = 6)
		Cervical spine	(n = 1)
	Distortion	Finger, not specified	(n = 3)
		Thumb	(n = 3)
	Pain	Digitus index	(n = 1)
		Shoulder	(n = 3)
	Slap in the face		(n = 1)
Others		Inguinal hernia	(n = 1)
		Cervical spine degeneration	(n = 1)
		Carpal tunnel syndrome	(n = 1)

Manipulation Informed Consent App



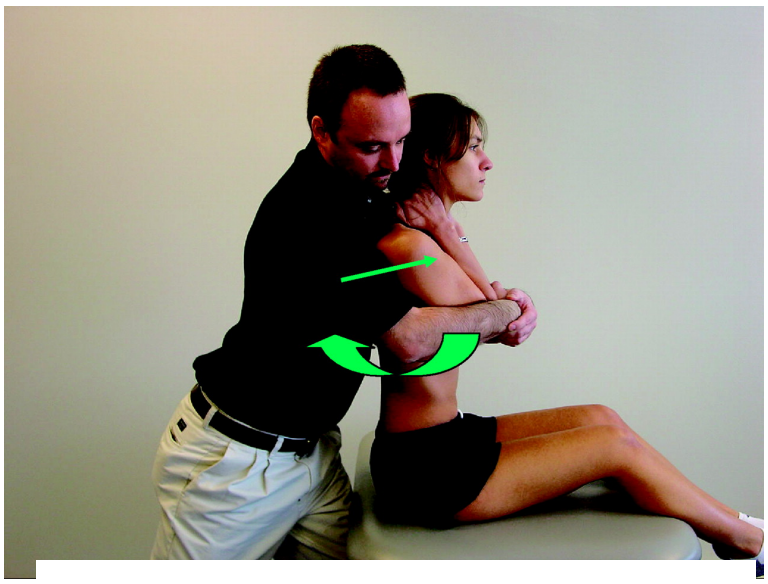
Prone Rotary Thoracic PA Manipulation – Facet (Extension)



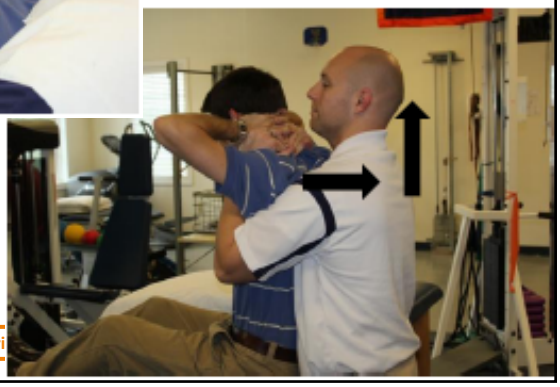
Supine Upper and Mid-Thoracic AP HVLAT

Upper and Mid Thoracic AP Variations

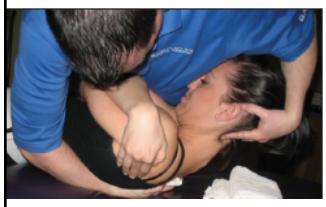
- T3/4 and Above – "Loose Fist"
- Mid Thoracic – Flat Hand/"Dog" or Pistol
  - Pistol De-Rotation



Seated CT Junction Distraction Manipulation



Prone CT Junction (C7-T3) Lateral Flexion HVLAT



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Manual Therapy 15 (2010) 334–354

Contents lists available at ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Systematic review

Manual therapy and exercise for neck pain: A systematic review

Jordan Miller [a], Anita Gross [a,b,*], Jonathan D'Sylva [a], Stephen J. Burnie [c], Charles H. Goldsmith [b], Nadine Graham [a], Ted Haines [b], Gert Brønfort [d], Jan L. Hoving [e]

- Manual therapy alone provides good short term pain relief compared to exercise alone
- Manual therapy combined with exercise provides better long term pain relief and improved function than MT alone

Effect of Therapeutic Exercise on Pain and Disability in the Management of Chronic Nonspecific Neck Pain: Systematic Review and Meta-Analysis of Randomized Trials

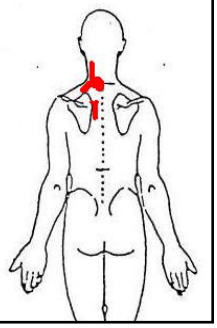
Physical Therapy Volume 93 Number 8 August 2013

Lucia Bertozzi, Ivan Gardenghi, Francesca Turoni, Jorge Hugo Villafañe, Francesco Capra, Andrew A. Guccione, Paolo Pillastrini

- 7 studies met criteria
- **Significant** short-term and immediate-term effects on **pain**
- Not significant short-term and immediate-term effects on disability
- Only 1 study investigated effects of TE on pain/disability > 6 months after intervention
- Results support use of TE in management of CNSNP

Physical Exam *Asterisks* Signs/Symptoms (Special tests, Movement/Joint Dysfunction, Posture, Palpation, etc)

- Observation – mild FHP, long/slender neck, no acute distress
- Increased tonicity noted to SCM, scalenes, upper traps and erector
- ROM: Full planar motions
  - (+) Extension + L SB Quadrant with pain
- Aberrant movements noted with extension and rotation
- Difficulty staying in plane with Side-Bending
- Neuro/Neurodynamic Testing (-)
- PPIVMs/PAIVMs
  - Hypermobility noted L C5/6 with pain
  - Hypomobility noted L C2/3, C7/T1
  - Hypomobility with pain T4/5
- Neck Disability Index = 32% perceived disability
- WHAT ELSE DO WE NEED TO TEST? WHAT ABOUT MUSCLES?
- HOW CAN WE TEST CERVICAL FLEXORS/STABILIZERS?
- ANY OTHER TESTS OF SYSTEMIC HYPERMOBILITY?
  - Craniocervical Flexion Test
  - Neck Flexor Endurance Test
  - Beighton Scale



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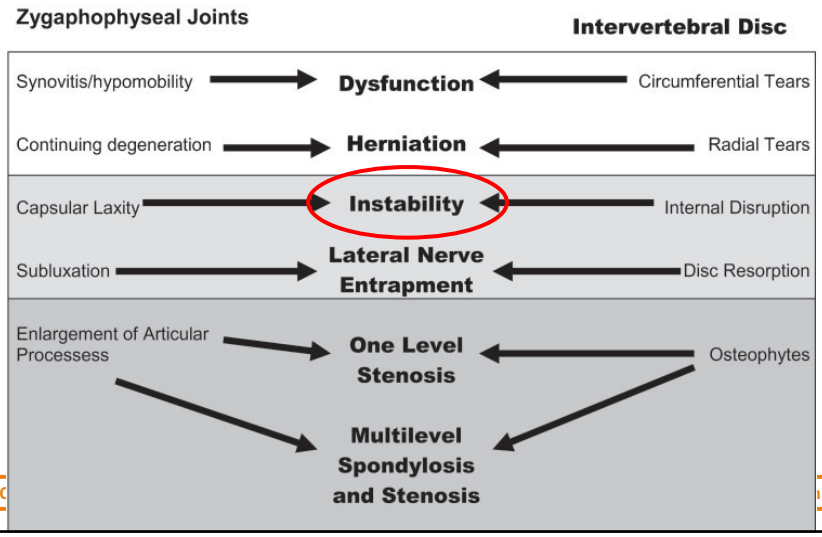
- Are the relationships between the areas on the body chart, the interview, and physical exam consistent? "Do the features fit" a recognizable clinical pattern? **Yes** **No**

Please explain areas that may need clarificati

Mechanical Neck Pain with Somatic Referred Pain (facet) C5/6 Secondary to segmental instability



Cervical Hypermobility/Instability

- 2 Categories of Spinal Instability
  - **Radiologic appreciable instability**
    - Disruption of passive osseoligamentous anatomical constraints
    - Diagnosed by flex/ext film measurements
  - **Clinical Instability**
    - More challenging to diagnose
    - May have discrepancies in radiographic findings
    - Commonly demonstrates subtle quantifiable clinical features with inconsistent findings during traditional radiographic analysis

Cervical Hypermobility/Instability

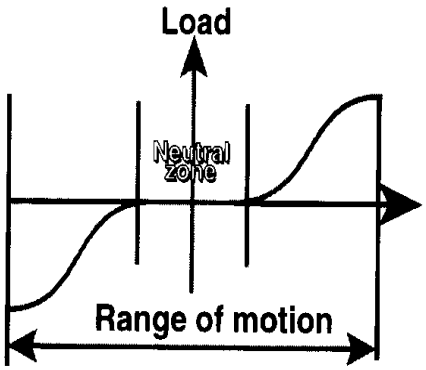
- Beighton Scale
- 1-3 = Low
- 4-6 = Moderate
- 7-9 = High

(+)

Figure 1. Beighton's modification of the Carter and Wilkinson scoring system. Give yourself 1 point for each of the manoeuvres you can do, up to a maximum of 9 points.

Neutral Zone - Panjabi

Small range of displacement near neutral joint position - minimal osteoligamentous resistance




Manohar M. Panjabi, PhD

Panjabi's Components of Stability

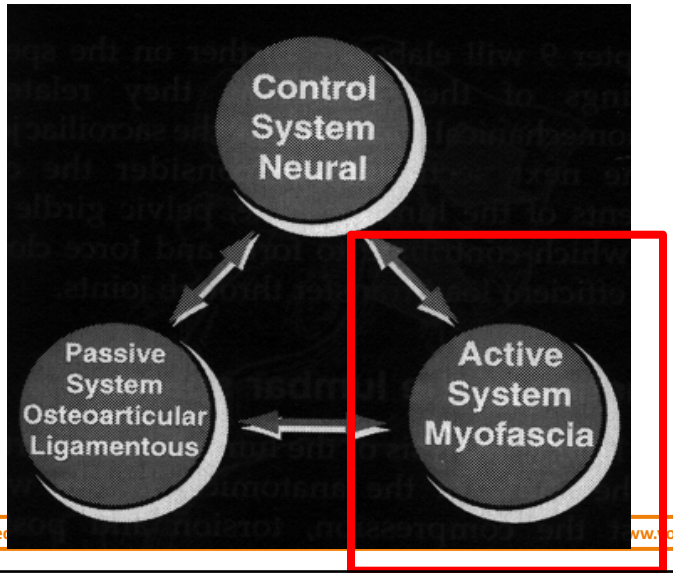
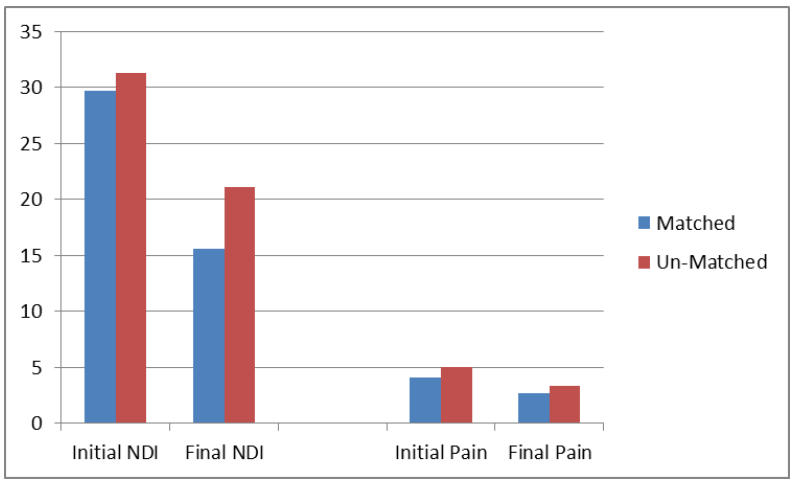


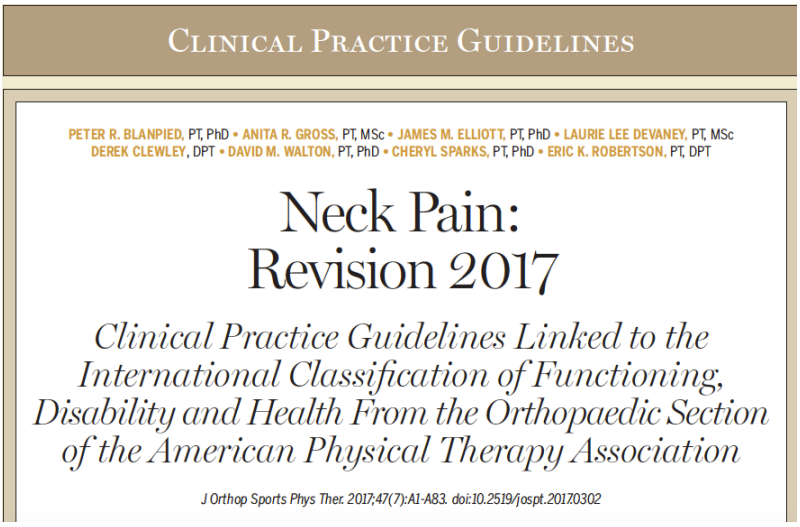
TABLE 3. Overview of classification categories with key examination findings and proposed matched interventions.

Classification	Examination Findings	Proposed Matched Interventions
Mobility	• Recent onset of symptoms • No radicular/referred symptoms in the upper quarter • Restricted range of motion with side-to-side rotation and/or discrepancy in lateral flexion range of motion • No signs of nerve root compression or peripheralization of symptoms in the upper quarter with cervical range of motion	• Cervical and thoracic spine mobilization/manipulation • Active range of motion exercises
Centralization	• Radicular/referred symptoms in the upper quarter • Peripheralization and/or centralization of symptoms with [illegible] range of motion • Signs of nerve root compression present • May have pathoanatomic diagnosis of cervical radiculopathy	• Mechanical/manual cervical traction • Repeated movements to centralize symptoms
Conditioning and increase exercise tolerance	• Lower pain and disability scores • Longer duration of symptoms • No signs of nerve root compression • No peripheralization/centralization during range of motion	• Strengthening and endurance exercises for the muscles of the neck and upper quarter • Aerobic conditioning exercises
Pain control	• High pain and disability scores • Very recent onset of symptoms • Symptoms precipitated by trauma • Referred or radiating symptoms extending into the upper quarter • Poor tolerance for examination or most interventions	• Gentle active range of motion within pain tolerance • Range of motion exercises for adjacent regions • Physical modalities as needed • Activity modification to control pain
Reduce headache	• Unilateral headache with onset preceded by neck pain • Headache pain triggered by neck movement or positions • Headache pain elicited by pressure on posterior neck	• Cervical spine manipulation/mobilization • Strengthening of neck and upper quarter muscles • Postural education

Conditioning and Increase Exercise Tolerance Results



How Does This Relate to Treatment?



CLINICAL PRACTICE GUIDELINES

PETER R. BLANPIED, PT, PhD • ANITA R. GROSS, PT, MSc • JAMES M. ELLIOTT, PT, PhD • LAURIE LEE DEVANEY, PT, MSc
DEREK CLEWLEY, DPT • DAVID M. WALTON, PT, PhD • CHERYL SPARKS, PT, PhD • ERIC K. ROBERTSON, PT, DPT

Neck Pain: Revision 2017

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Orthopaedic Section of the American Physical Therapy Association

J Orthop Sports Phys Ther. 2017;47(7):A1-A83. doi:10.2519/jospt.20170302

Interventions: Neck pain with Movement Coordination Deficits

Acute

For patients with **acute** neck pain with movement coordination impairments (including WAD):

B Clinicians should provide the following:

- Education of the patient to
  - Return to normal, nonprovocative preaccident activities as soon as possible
  - Minimize use of a cervical collar
  - Perform postural and mobility exercises to decrease pain and increase ROM
- Reassurance to the patient that recovery is expected to occur within the first 2 to 3 months.

Chronic

For patients with **chronic** neck pain with movement coordination impairments (including WAD):

C Clinicians may provide the following:

- Patient education and advice focusing on assurance, encouragement, prognosis, and pain management
- Mobilization combined with an individualized, progressive submaximal exercise program including cervicothoracic strengthening, endurance, flexibility, and coordination, using principles of cognitive behavioral therapy
- TENS

B Clinicians should provide a multimodal intervention approach including manual mobilization techniques plus exercise (eg, strengthening, endurance, flexibility, postural, coordination, aerobic, and functional exercises) for those patients expected to experience a moderate to slow recovery with persistent impairments.

C Clinicians may provide the following for patients whose condition is perceived to be at low risk of progressing toward chronicity:

- A single session consisting of early advice, exercise instruction, and education
- A comprehensive exercise program (including strength and/or endurance with/without coordination exercises)
- Transcutaneous electrical nerve stimulation (TENS)

F Clinicians should monitor recovery status in an attempt to identify those patients experiencing delayed recovery who may need more intensive rehabilitation and an early pain education program.

Recommendations

- Interventions
  - Cervical mobilization/manipulation = A
  - **Coordination, strengthening, endurance = A**
  - Thoracic mobilization/manipulation = C
  - Stretching exercises = C
  - Centralization procedures and exercises = C

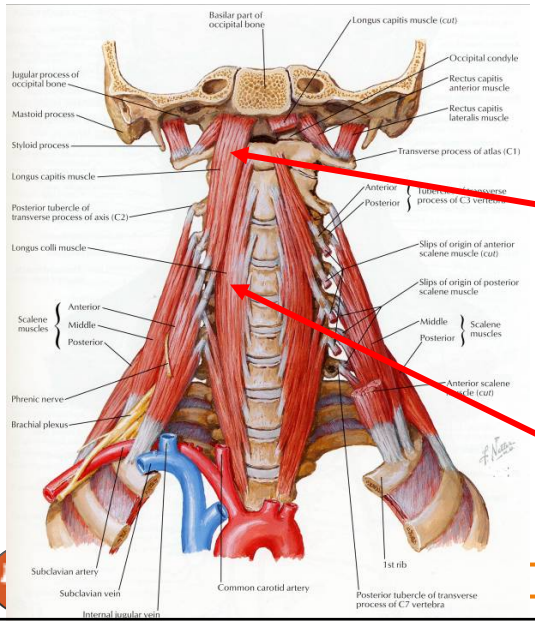
- A = Strong Evidence – Preponderance of Level I and/or Level II studies support the recommendation. Must include at least one Level I study
- C = Weak Evidence – A single Level II study or preponderance of Level III and IV studies including statements of consensus by context experts support the recommendation

A Recommendation: Clinicians should consider the use of coordination, strengthening, and endurance exercises to reduce neck pain and headache.

Objective Examination Modification

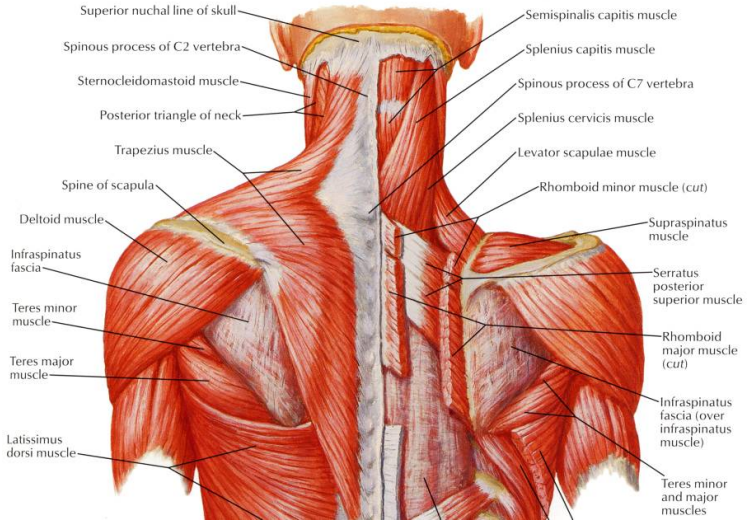
- **Typical Cervical Sequence**
  - Active/Passive/Resisted Testing
  - Provocation Testing
  - Neurological Testing
  - Neurodynamic Testing
  - Biomechanical Exam
- **Cervical Hypermobility or Instability**
  - Craniocervical Flexor Test (CCFT)
  - Neck Flexor Endurance Test
  - Posterior Neck Endurance Test
  - Scapular Endurance Test

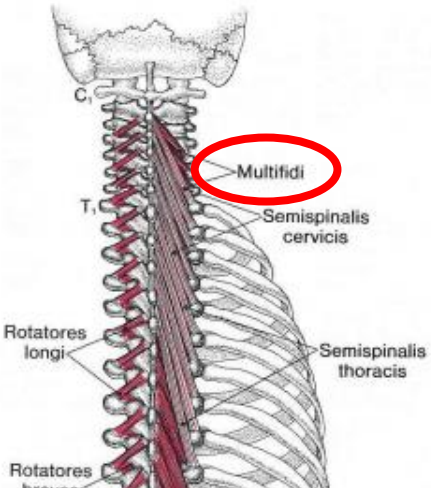
Deep Cervical Flexors

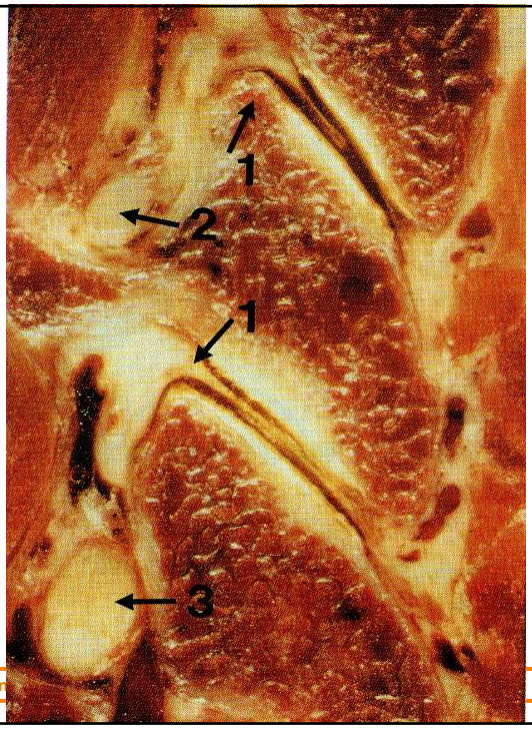


Anterior Longus Capitis

Anterior Longus Colli





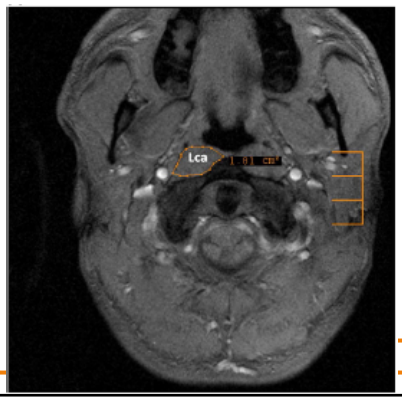


Functions of Deep Cervical Flexors

Cagnie, et al., 2010, JMPT

- Contraction (Lco and Lca) creates craniocervical flexion (CCF)
  - Greatest Cross Sectional Area increase:
    - Longus Capitis = C0/1
    - Longus Colli = C2/3

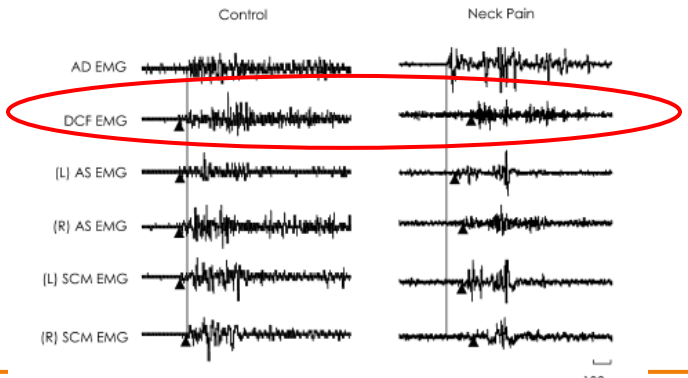
			Mean (±SD)	*P* value
Lca	C0-C1	Rest	1.35 (±0.34)	
		CCF	1.50 (±0.43)	<.001
	C2-C3	Rest	0.54 (±0.11)	
		CCF	0.59 (±0.13)	.043
Lco	C2-C3	Rest	0.69 (±0.17)	
		CCF	0.81 (±0.22)	.031
	C6-C7	Rest	1.11 (±0.20)	
		CCF	1.18 (±0.26)	.036



Function of Deep Cervical Flexors

Falla, Jull, Hodges (2004)

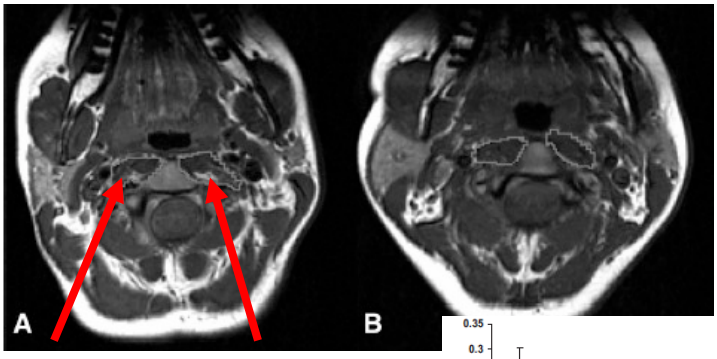
- Feedforward mechanism to stabilize cervical spine
  - 1st muscles to contract with active arm elevation
  - Delay associated with chronic neck pain

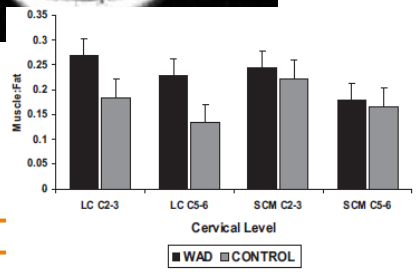


Magnetic Resonance Imaging Findings of Fatty Infiltrate in the Cervical Flexors in Chronic Whiplash

SPINE Volume 35, Number 9, pp 948–954

James M. Elliott, PT, PhD,*†‡ Shaun O'Leary, PT, PhD,* Michele Sterling, PT, PhD,*† Joan Hendrikz, BSc(Hons), PGDip,† Ashley Pedler, PT, PhD-c,*† and Gwen Jull, PT, PhD*





Consequences of Neck Pain

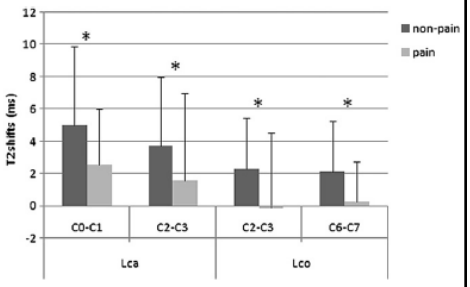
Falla, O'Leary, Farina, Jull (2011)

- Association between the intensity of neck pain and impairment in the onset and activation of the deep cervical flexors

Functional reorganization of cervical flexor activity because of induced muscle pain evaluated by muscle functional magnetic resonance imaging

Manual Therapy xxx (2011) 1–6 B. Cagnie [a,*], R. Dirks [a], M. Schouten [a], T. Parlevliet [b], D. Cambier [a], L. Danneels [a]

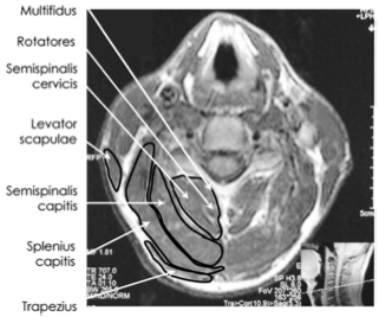
- Measurement of cervical **FLEXORS** with CCFT with and without induced pain
- Longus Colli and Capitis activity reduced B and at multiple levels when pain induced, while SCM activity increased
- Suggests local excitation of nocioceptive afferents causes immediate reorganization of cervical flexor activity



Review article

Function and structure of the deep cervical extensor muscles in patients with neck pain

J. Schomacher, D. Falla / Manual Therapy 18 (2013) 360–366



- 4 Layers
  - UT & levator
  - Splenius capitus
  - Semispinalis capitus
  - Semispinalis cervicus, multifidus and sub-occipitals
- Superficial 2 layers show increased activation with mechanical neck pain

Altered Joint Position Sense and Kinesthesia with Cervical Pain

- Retraining cervical joint position sense: the effect of two exercise regimes. Jull G, Falla D, Treleaven J, Hodges P, Vicenzino B. J Orthop Res. 2007 Mar;25(3):404-12
- The relationship of cervical joint position error to balance and eye movement disturbances in persistent whiplash. Treleaven J, Jull, G, LowChoy N. Man Ther. 2006 May;11(2):99-106.
- Feedforward activity of the cervical flexor muscles during voluntary arm movements is delayed in chronic neck pain. Falla D, Jull G, Hodges PW. Exp Brain Res. 2004 Jul;157(1):43-8. Epub 2004 Feb 5.
- Altered motor control patterns in whiplash and chronic neck pain. Woodhouse A, Vasselien O. BMC Musculoskelet Disord. 2008 Jun 20;9:90.

Deep Neck Flexor Assessment

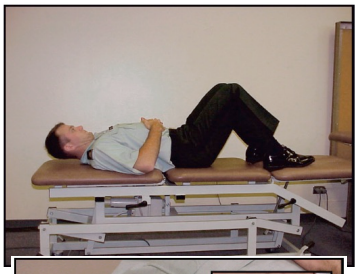
- Craniocervical Flexion Test (CCFT)
- Assessed and trained with Pressure Biofeedback Unit (PBU)
- Start at 20 mm Hg
- Increase increments of 2 mm Hg (20-30)
- Normative values in young asymptomatics = 24 mm Hg (3 reps of 10 seconds to advance)
  - Kelly, Cardin, et al (Manual Therapy, 2012)

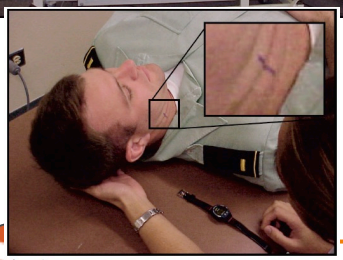
Figure 1. Training the cranio-cervical action with the use of feed-back from the pressure biofeedback unit.

Reliability of a Measurement of Neck Flexor Muscle Endurance

Kevin D Harris, Darren M Heer, Tanja C Roy, Diane M Santos, Julie M Whitman, Robert S Wainner

Physical Therapy . Volume 85 . Number 12 . December 2005





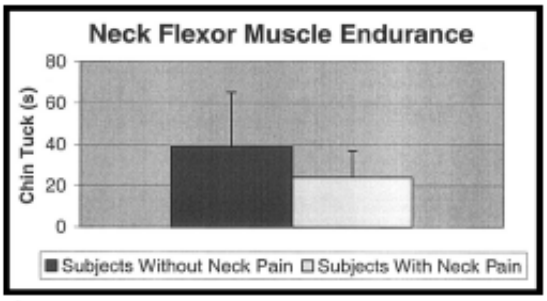


Figure 3.
Chin-tuck endurance times for subjects with and without neck pain (P=.013).

Figure 2.
The rater sits to the subject's right and visually estimates when the subject's head is approximately 2.5 cm (1 in) off the plinth. Inset shows line drawn across 2 approximated skin folds along the subject's neck.

Neck Flexor Endurance Test

(+)

- Edmondston, et al. (2008)
- Hold as long as you can while maintaining chin retraction
- Timed test
- Normal = 46 seconds
- Minimal Clinically Important Change = 17.8 seconds
- Prescriptive > Diagnostic
- Predicts future occurrence of cervical spine pain

SPINE Volume 29, Number 19, pp 2108–2114

Patients With Neck Pain Demonstrate Reduced Electromyographic Activity of the Deep Cervical Flexor Muscles During Performance of the Craniocervical Flexion Test

Deborah L. Falla,* Gwendolen A. Jull, and Paul W. Hodges

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.

Key words: electromyography, neck muscles, neck pain, clinical evaluation. **Spine 2004;29:2108–2114**

Journal of Orthopaedic & Sports Physical Therapy
Official Publication of the Orthopaedic and Sports Physical Therapy Sections of the American Physical Therapy Association

Performance of the Craniocervical Flexion Test in Subjects With and Without Chronic Neck Pain

Thomas Tai Wing Chiu, PhD[1]
Ellis Yuk Hung Law, MSc[2]
Tony Hiu Fai Chiu, MSc[2]

J Orthop Sports Phys Ther • Volume 35 • Number 9 • September 2005

Methods and Measures: Twenty asymptomatic subjects and 20 subjects with chronic neck pain (duration, >3 months) were recruited. The CCFT was performed with the subject supine and required performing a gentle head-nodding action of craniocervical flexion (indicating yes) for 5 incremental stages of increasing difficulty. Each stage was held for 10 seconds, as guided by the pressure biofeedback unit. The data used for analysis were the highest pressure level that each subject was able to hold for 10 seconds, up to a maximum of 30 mmHg.

Results: Reliability data obtained on 10 asymptomatic subjects indicated that the CCFT was reliable, with a kappa coefficient equal to 0.72. Subjects with chronic neck pain had significantly poorer (P<.001) performance on the CCFT (median pressure achieved, 24 mmHg) when compared with those in the asymptomatic group (median pressure achieved, 28 mmHg).

Conclusions: The results of this study demonstrated that patients with chronic neck pain had a poorer ability to perform the CCFT when compared with asymptomatic subjects. The study adds to the evidence that poor ability to perform the CCFT may be clinical evidence of an impairment that characterizes neck pain, regardless of origin. *J Orthop Sports Phys Ther 2005;35:567-571.*

Immediate effects of active cranio-cervical flexion exercise versus passive mobilisation of the upper cervical spine on pain and performance on the cranio-cervical flexion test

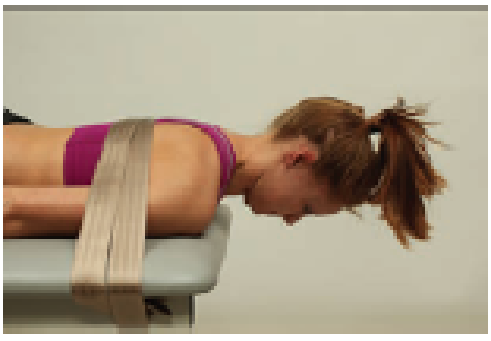
Manual Therapy 19 (2014) 25–31

Enrique Lluch [a], Jochen Schomacher [b], Leonardo Gizzi [c], Frank Petzke [c], Dagmar Seegar [c], Deborah Falla [c,d,*]

Vs.

- Immediate decrease in pain and PPT in both groups
  - Greater change in Exercise group
- No change in ROM
- Decreased SCM and Scalene EMG activity in Exercise group
- Only Exercise group improved on a task of motor function
  - Highlighting the importance of specific active treatment for improved motor control of cervical spine

Posterior Neck Endurance Test



[RESEARCH REPORT]

CÉSAR FERNÁNDEZ-DE-LAS-PEÑAS, PT, PhD[1,2] • JOAN C. ALBERT-SANCHÍS, PT, DO[2] • MIGUEL BUIL, MD, PhD[3]
JOSE C. BENITEZ, PT, DO[2] • FRANCISCO ALBURQUERQUE-SENDÍN, PT, DO[2,4]

Cross-sectional Area of Cervical Multifidus Muscle in Females With Chronic Bilateral Neck Pain Compared to Controls

JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 38 | NUMBER 4 | APRIL 2008

CONCLUSIONS: Females with bilateral chronic neck pain had generalized smaller CSA of the cervical multifidus muscles compared to healthy females.

KEY POINTS

FINDINGS: Females with bilateral chronic neck pain had smaller CSA of the cervical multifidus muscles compared to healthy females.

IMPLICATION: This finding suggests that exercises to restore multifidus muscle size should be considered as an intervention for these patients.

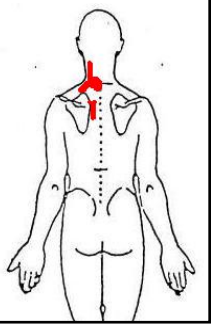
CAUTION: Only females with significant chronic mechanical neck pain were included in this study. Based on the case-control design of the study, it is unknown if smaller cervical multifidi actually play a role in the etiology or persistence of neck pain in this group.

Scapular Endurance Test

- Hold as long as you can
- ER while holding the ruler between the elbows
- Normal = 51 seconds
- Minimal Clinically Important Change = 30.1 seconds

Physical Exam *Asterisks* Signs/Symptoms (Special tests, Movement/Joint Dysfunction, Posture, Palpation, etc)

- Observation – mild FHP, long/slender neck, no acute distress
- Increased tonicity noted to SCM, scalenes, upper traps and erector
- ROM: Full planar motions
  - (+) Extension + L SB Quadrant with pain
- Aberrant movements noted with extension and rotation
- Difficulty staying in plane with Side-Bending
- Neuro/Neurodynamic Testing (-)
- PPIVMs/PAIVMs
  - Hypermobility noted L C5/6 with pain
  - Hypomobility noted L C2/3, C7/T1
  - Hypomobility with pain T4/5
- (+) Craniocervical Flexion Test
  - Unable to hold DNF contraction at 24 mm Hg
- (+) Neck Flexor Endurance Test = 30 seconds (normal = 46 sec)
- Beighton Scale = 8/9
- Neck Disability Index = 32% perceived disability



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- Are the relationships between the areas on the body chart, the interview, and physical exam consistent? "Do the features fit" a recognizable clinical pattern? **Yes** **No**

Please explain areas that may need clarification **Mechanical Neck Pain with Clinical Cervical Segmental Instability**

Identify any potential risk factors (Yellow, Red flags, non MSK involvement, biopsychosocial)

None

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Reflection To Help Improve Pattern Recognition

Identify the key subjective and physical features (i.e. **clinical pattern)** that would help you recognize this disorder in the future.

Subjective	Physical

Identifiers Suggestive of Clinical Cervical Spine Instability: A Delphi Study of Physical Therapists

Chad Cook, Jean-Michel Brismée, Robert Fleming, Phillip S Sizer Jr

Phys Ther. 2005;85:895–906.

Symptoms of Consensus and Rank Outcomes for Clinical Cervical Spine Instability (CCSI), Listed in Descending Rank

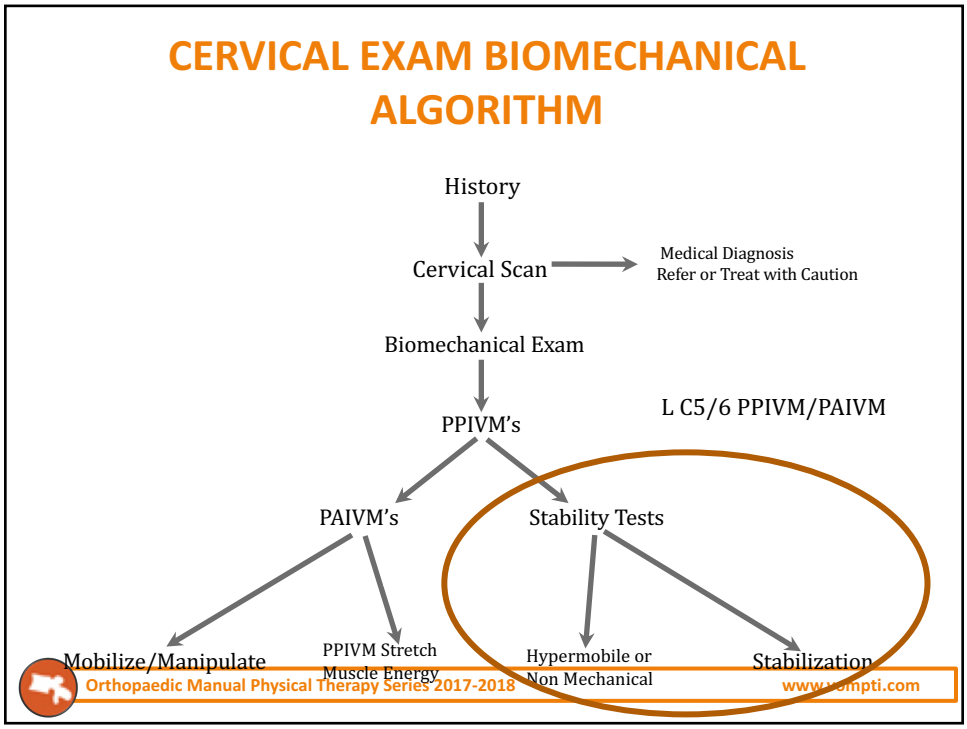
Identifier	Round 3 Consensus Status[a]	Round 2 Composite Score	Round 3 Composite Score
Intolerance to prolonged static postures	CR	481	502
Fatigue and inability to hold head up	CR	464	499
Better with external support, including hands or collar	CR	487	493
Frequent need for self-manipulation	CR	466	488
Feeling of instability, shaking, or lack of control	CR	464	485
Frequent episodes of acute attacks	CR	466	483
Sharp pain, possibly with sudden movements	CR	470	481
Head feels heavy	CR	473	480
Neck gets stuck, or locks, with movement	CR	462	479
Better in unloaded position such as lying down	CR	449	476
Catching, clicking, clunking, and popping sensation	CR	462	476
Past history of neck dysfunction or trauma	CR	480	476
Trivial movements provoke symptoms	CR	456	469
Muscles feel tight or stiff	CR	464	467
Unwillingness, apprehension, or fear of movement	CR	435	462
Temporary improvement with clinical manipulation	CR	442	464
Increased pain as day progresses	NCR	445	453
Complaints of dull ache	U	438	443
Reports of sleep disturbances	U	438	439
Inconsistency of symptoms, including pain that shifts from side to side	U	425	435
Feeling that head is disconnected from neck	U	416	433
Complaints of headache	U	436	430
History of disorder or syndrome, such as Ehlers-Danlos syndrome, Marfan syndrome, or Down syndrome	U	401	395
Pain with the initiation of motion	U	363	385
Pain through the range of motion	U	372	355
Vertebrobasilar insufficiency symptoms that include dizziness, diplopia, drop attacks, and nausea	U	371	352
Spinal cord symptoms with neck movement	U	361	325
Temporomandibular joint symptoms	U	343	323
Cervical instability does not exist	CNR	190	157

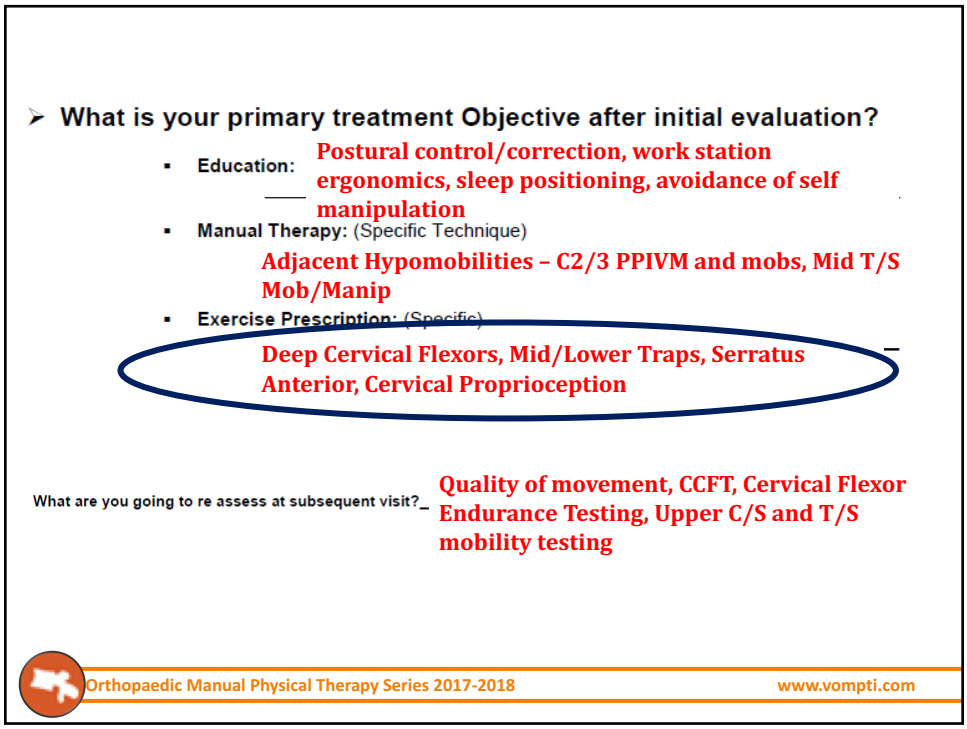
Physical Examination Findings of Consensus and Rank Outcomes for Clinical Cervical Spine Instability (CCSI), Listed in Descending Rank

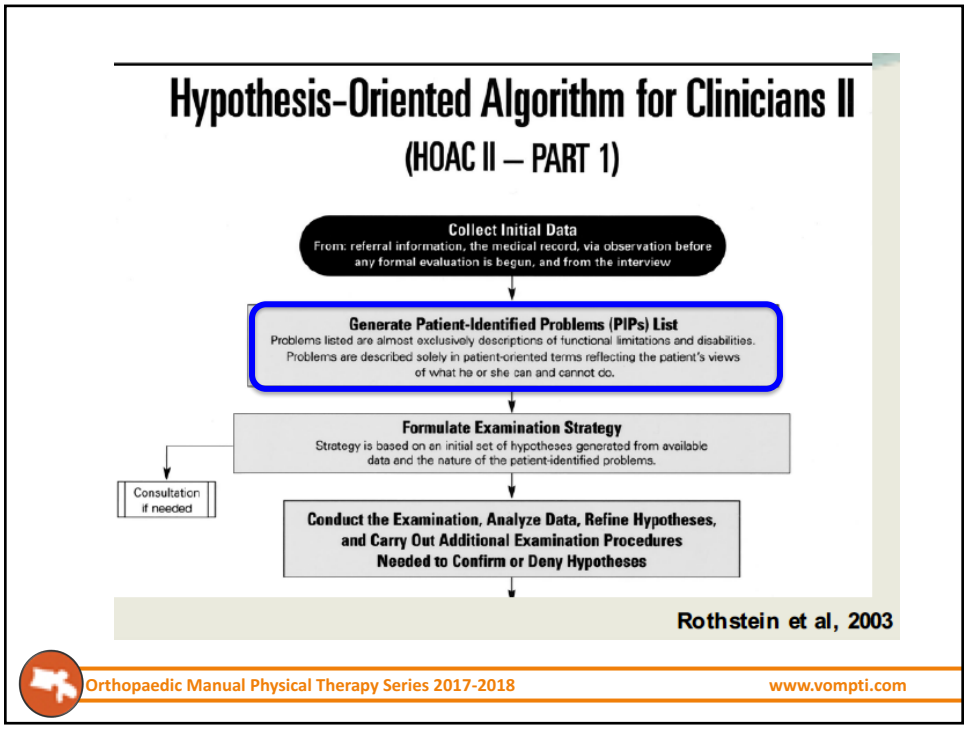
Identifier[a]	Round 3 Consensus Status[b]	Round 2 Composite Score	Round 3 Composite Score
Poor coordination/neuromuscular control, including poor recruitment and dissociation of cervical segments with movement	CR	481	508
Abnormal joint play	CR	492	508
Motion that is not smooth throughout range (of motion), including segmental hinging, pivoting, or fulcruming	CR	491	499
Aberrant movement	CR	459	486
Hypomobility of upper thoracic spine	CR	467	478
Increased muscle guarding, tone, or spasms with test movements	CR	474	477
Palpable instability during test movements	CR	469	475
Jerkiness or juddering of motion during cervical movement	CR	450	472
Decreased cervical muscle strength	CR	428	468
Catching, clicking, clunking, popping sensation heard during movement assessment	CR	454	467
Fear, apprehension, or decreased willingness to move during examination	CR	457	465
Pain provocation with joint-play testing	CR	451	456
Motion disparity between AROM and PROM	NCR	434	455
Poor posture; postural deviations	U	443	448
Decreased AROM in weight bearing	NCR	419	446
Need to support head during examination movements	U	425	441
Positive radiographic evidence	U	425	439
Palpable segmental changes, such as step-off at C5-C6	U	426	429
Positive ligament shear test	U	423	424
Painful arc, including through range of pain	U	423	422
Forward head posture	U	369	412
Positive test for transverse ligament of atlas	U	414	396
Hypomobility of upper cervical spine	U	387	391
Positive Alar Ligament Stress Test	U	406	389
Positive Sharp-Purser Test	U	412	352
Pain at end range of movement	U	395	374
Positive VBI tests	U	348	321
Segmental instability does not exist	CNR	249	152

Cervical Hypermobility/Instability Clinical Pearls

- Area: General ache, may have localized area of sharp/stabbing pain
- Subjective: min-mod severity and irritability
  - Weight bearing sensitivity, especially to prolonged positioning
- Postural component: upper cervical extension, mid cervical flexion, upper thoracic kyphosis
- History: Episodic hx of neck pain off and on, improving b/w episodes, often have historical increase in frequency and severity of episodes which occur with less aggravation and take longer to ease
- Objective: Increased quantity > quality of ROM in all planes, aberrant quality of movement and may hinge around a segment with flex/ext or rotation
  - Hypermobility noted with PPIVMs/PAIVMs at the level
  - Look for adjacent hypomobility
  - Spasm/guarding/splinted noted with testing
  - May see systemic hypermobility throughout other joints






Hypothesis-Oriented Algorithm for Clinicians II
(HOAC II – PART 1)
Collect Initial Data
From: referral information, the medical record, via observation before any formal evaluation is begun, and from the interview
Generate Patient-Identified Problems (PIPs) List
Problems listed are almost exclusively descriptions of functional limitations and disabilities. Problems are described solely in patient-oriented terms reflecting the patient's views of what he or she can and cannot do.
Formulate Examination Strategy
Strategy is based on an initial set of hypotheses generated from available data and the nature of the patient-identified problems.
Consultation if needed
Conduct the Examination, Analyze Data, Refine Hypotheses, and Carry Out Additional Examination Procedures Needed to Confirm or Deny Hypotheses
Rothstein et al, 2003
Orthopaedic Manual Physical Therapy Series 2017-2018
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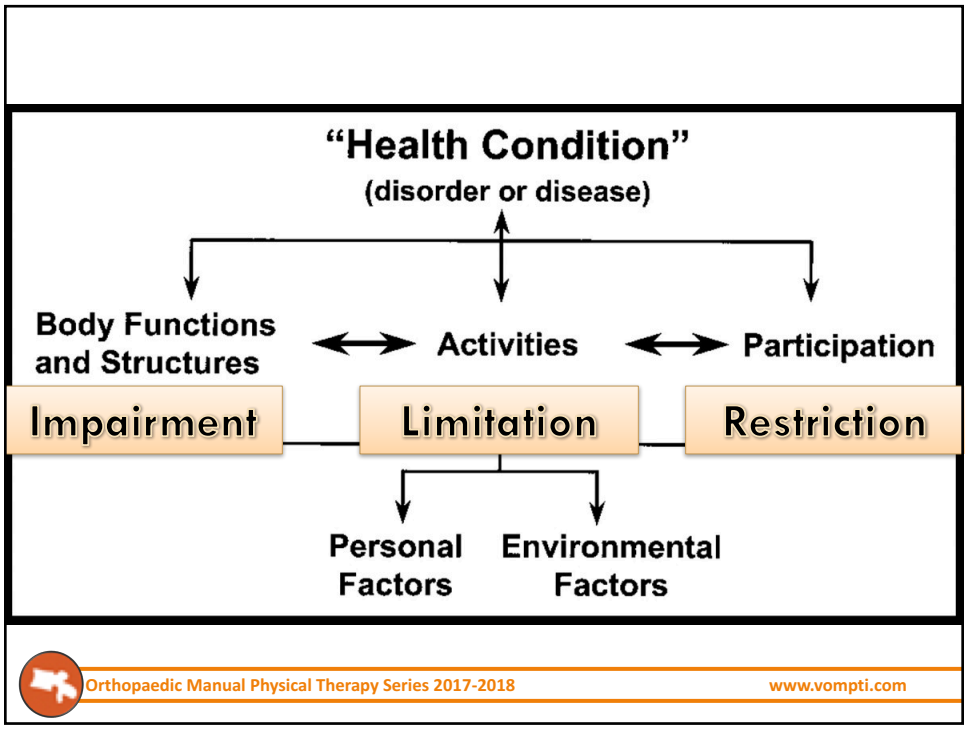
"Health Condition"
(disorder or disease)
Body Functions and Structures
Activities
Participation
Impairment
Limitation
Restriction
Personal Factors
Environmental Factors
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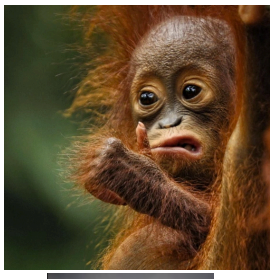
ICF Applied: HIAPEP

- "H"ealth Condition
- "I"mpairment
  - Body Function/Structures
- "A"ctivity
- "P"articipation
- "E"nvironmental Factors
- "P"ersonal Factors



Primary Impairment

- "That impairment MOST related to activity limitation"
- Direct focus of care
  - "The anchor"
- Guides consideration of other impairments
  - How does the impairment list impact:
    - Their LIFE, ACTIVITY, and PARTICIPATION?
    - **<u>This makes it BPS and Patient-Centered</u>**

Patient-Centered Intervention Guided by Function

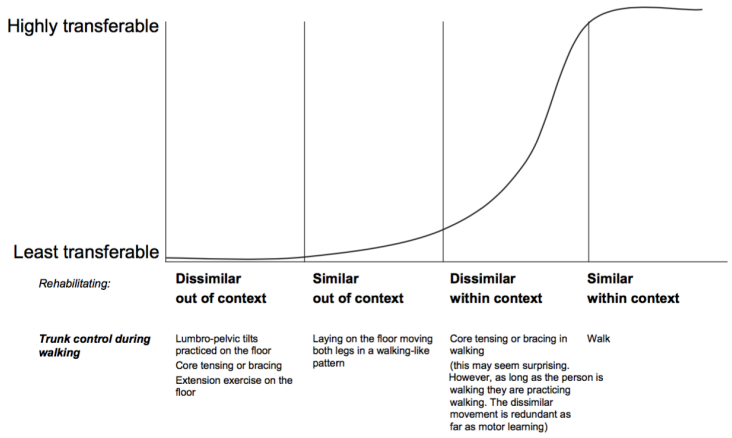


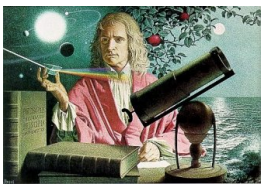
Figure 3 Similarity and context principle. Training and practice of movement can be dissimilar and out of context, similar but out of context, dissimilar within context or similar and within context. Ideal neuromuscular organisation to movement occurs when the movement is in similar patterns to the goal movement and practiced in context of the particular movement. Most CS training regimes contain movement patterns that are dissimilar and out of context to the trunk patterns used during normal activities. Adapted from Lederman E, Neuromuscular rehabilitation in manual and physical therapy, to be published 2010. London, Elsevier.

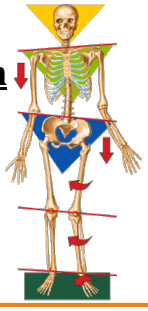
Patient-Centered Task Analysis

- HI**AP**EP
- Assess task performance
  - Symptom reproduction
    - "Show me"
  - Dosage considerations
    - Contraction type
  - Static, Transition, Dynamic
  - Environmental Considerations
  - Personal Factors

Exercise Considerations Applied

- Identify External Moment Arm
  - **Gravity**
- Relate **special tests** to function
- Identify **level of control**
  - Retrain, **Attain**, Maintain, Sustain (RAMS)
  - Static, Transition, Dynamic
- Emphasize muscle contraction **spectrum**
  - Concentric (force production)
  - Eccentric (force reduction)
  - Isometric (dynamic stabilization)
- Correlate **HIAPEP**



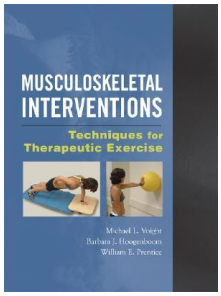


Exercise Considerations Level of Control

- "RAMS"
- **R**: Retrain
  - Control of muscle
- **A**: Attain
  - Available range for task
- **M**: Maintain
  - Maintain/control position against gravity
- **S**: Sustain
  - Sustain control during activity

Exercise Considerations Level of Control

- Preparation Phase
- Phase I: **Static** Stabilization
- Phase II: **Transitional** Stabilization
- Phase III: **Dynamic** Stabilization
- Function



Training Mode–Dependent Changes in Motor Performance in Neck Pain

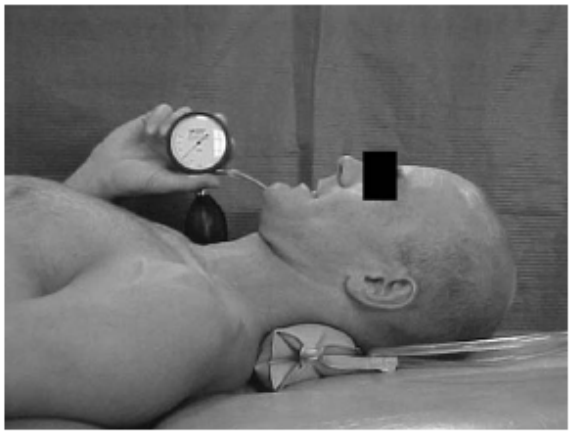
Shaun O'Leary, PhD, PT, Gwendolen Jull, PhD, PT, Mehwa Kim, MPhty, PT, Sureeporn Uthaikhup, PhD, PT, Bill Vicenzino, PhD, PT

Arch Phys Med Rehabil Vol 93, July 2012

CONCLUSIONS

For clinicians prescribing exercises for patients with mechanical neck disorders, the results of this study have shown that changes in motor function appear to be specific to the mode of training. Clinicians need to be aware that improvements in domains of motor performance other than those aligned with the primary behavioral demand of an exercise protocol may not be adequately acquired. Different patients may require different exercise protocols depending on their presenting motor impairments. To ensure optimal exercise prescription, clinicians should monitor the response of their patients to exercise in terms of changes in patients' motor abilities in addition to their reported levels of neck pain and disability.

Craniocervical Flexion Test (CCFT)



Craniocervical Flexion Test

- Face parallel to surface
- Tongue on roof of mouth
- Nod, activate deep neck flexors
- Avoid SCM, scalene activation
- Try 2 mm Hg increments 20-30 mm Hg

- According to Jull, adequate strength is 10 reps, 10 second holds increased 10 mm Hg

The effect of therapeutic exercise on activation of the deep cervical flexor muscles in people with chronic neck pain

Manual Therapy 14 (2009) 696–701

G.A. Jull [a,*], D. Falla [b], B. Vicenzino [a], P.W. Hodges [a]

- CCF training > Strength Training to improve CCFT and also decreased superficial neck flexor (SCM/Ant Scalene) activity after 6 week training period

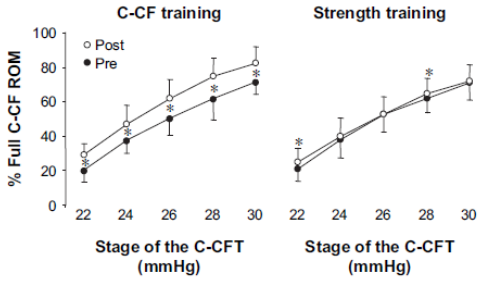
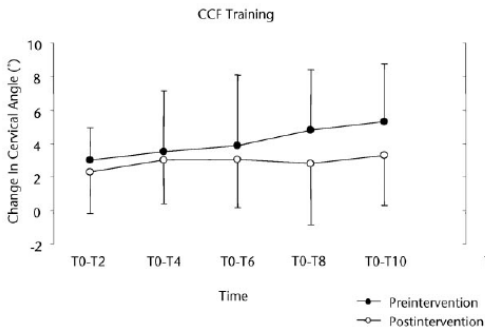


Fig. 4. Percentage of full C-CF ROM (mean and standard deviation) for each stage of the CCFT are presented for the C-CF training group and strength-training group both pre and post intervention. *indicates significant difference between pre and post intervention data ($P < 0.05$).

Other Therapeutic Exercise Evidence



Improves postural control of cervical and thoracic spines (Falla, Jull, et al. – 2007)

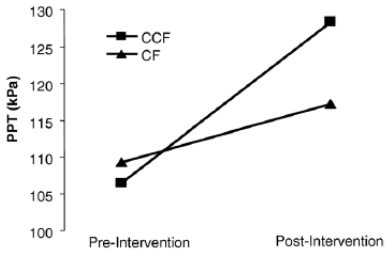


Figure 2. Change in pressure pain threshold. Interaction plot for pressure pain threshold recorded over the most symptomatic cervical motion segment ($P = .03$). CCF, Cranio-cervical flexion coordination exercise group; CF, cervical flexion endurance exercise group.

Induces local hypoalgesia (O'Leary, Falla – 2007)

SPINE Volume 27, Number 17, pp 1835–1843

A Randomized Controlled Trial of Exercise and Manipulative Therapy for Cervicogenic Headache

Gwendolen Jull, PT, PhD,* Patricia Trott, PT, MSc,† Helen Potter, PT, MSc,‡ Guy Zito, PT, Grad Dip Manip Ther,§ Ken Niere, PT, Mph,‖ Debra Shirley, PT, BSc,¶ Jonathan Emberson, MSc,# Ian Marschner, PhD,# and Carolyn Richardson, PT, PhD*

- Exercise – low load endurance training for cervico-scapular region
  - CCF in Supine
  - Serratus Ant and Lower Trap in Prone
  - Postural retraining
  - Isometric rotary exercises for flex/ext
- **MT + Exercise** = Significant decrease in HA freq/intensity/pain at 7 wks and 12 mo

Figure 1. Training the cranio-cervical action with the use of feedback from the pressure biofeedback unit.

Prone Axial Extension with and without Rotation

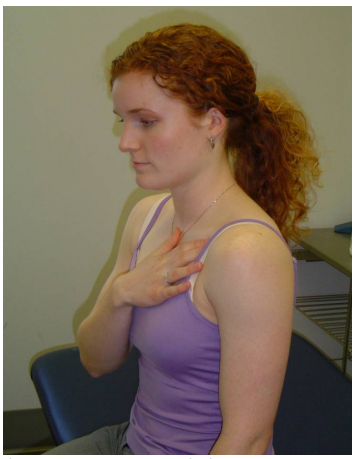
Prone on Elbows

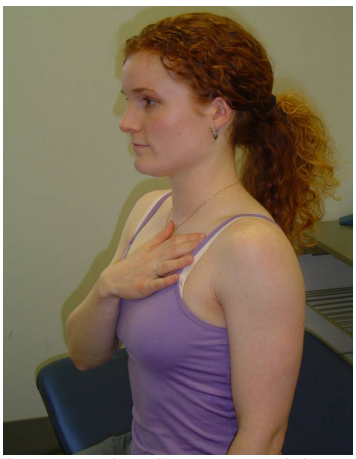
- DNF activation with "nod"
- Control rotation right and leftScapula neutral

Quadruped Progression

- DNF activation and upper cervical flexion/extension ROM with UE weight bearing for scapular positioning
- Progress with addition of UE movements for middle and lower trap
  - With or without resistance

Postural Re-education





Palpate coracoid process, pull scapula down and back

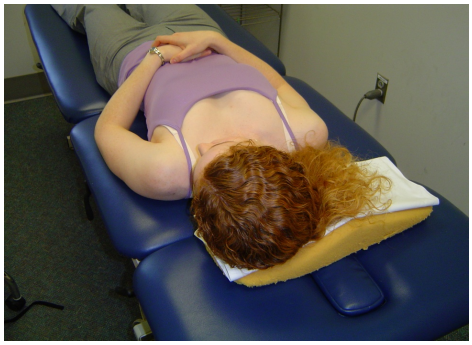
Postural Re-education

- Beer, et al. (2012)
- Functional postural exercise
- Performed for 2 weeks
- Improved CCFT and decreased SCM activity on EMG

Fig. 2. Functional posture exercise. The participant assumes an upright posture in a neutral lumbo-pelvic position and then gently lengthens the cervical spine by imagining they are lifting the base of their skull from the top of their neck.

Cervical Rotation – Multifidus

- Rotation on wedge
- Concentric/eccentric control
- Can varying eye focus

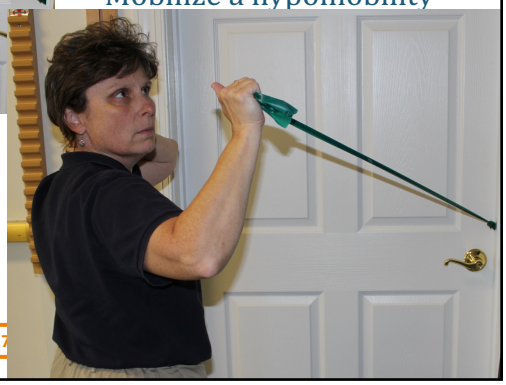


Cervical Proprioceptive Training

Stabilization vs. Mobilization Exercise

Stabilize an irritable hypermobility

Mobilize a hypomobility



Cervical Stabilization Motor Control

Advanced Functional Stabilization Exercise

Advanced Functional Stabilization Exercise