EBP - Advanced Topics in Manual Therapy

Thrust Manipulation of the Cervical Spine: When, Who, Why, & How?

Eric Schneider, PT, MPT

Board-Certified Clinical Specialist in Orthopaedic Physical Therapy

Certified Manual Trigger Point Therapist

Assistant Professor

Department of Physical Therapy

Mount St Joseph University

MOUNT ST. JOSEPH
UNIVERSITY

Michael Obert, PT, MPT

Board-Certified Clinical Specialist in Orthopaedic Physical Therapy

Instructor

Department of Physical Therapy

Mount St Joseph University

MOUNT ST. JOSEPH
UNIVERSITY

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Conflict of Interest

No Conflict

- The views expressed in these slides and the today's discussion are mine
- My views may not be the same as the views of my company's clients or my colleagues
- Participants must use discretion when using the information contained in this presentation
- Information disseminated is a culmination of the best available evidence, years of clinical practice, and multiple biases on how to instruct and perform thrust manipulation of the cervical spine

Learning Objectives

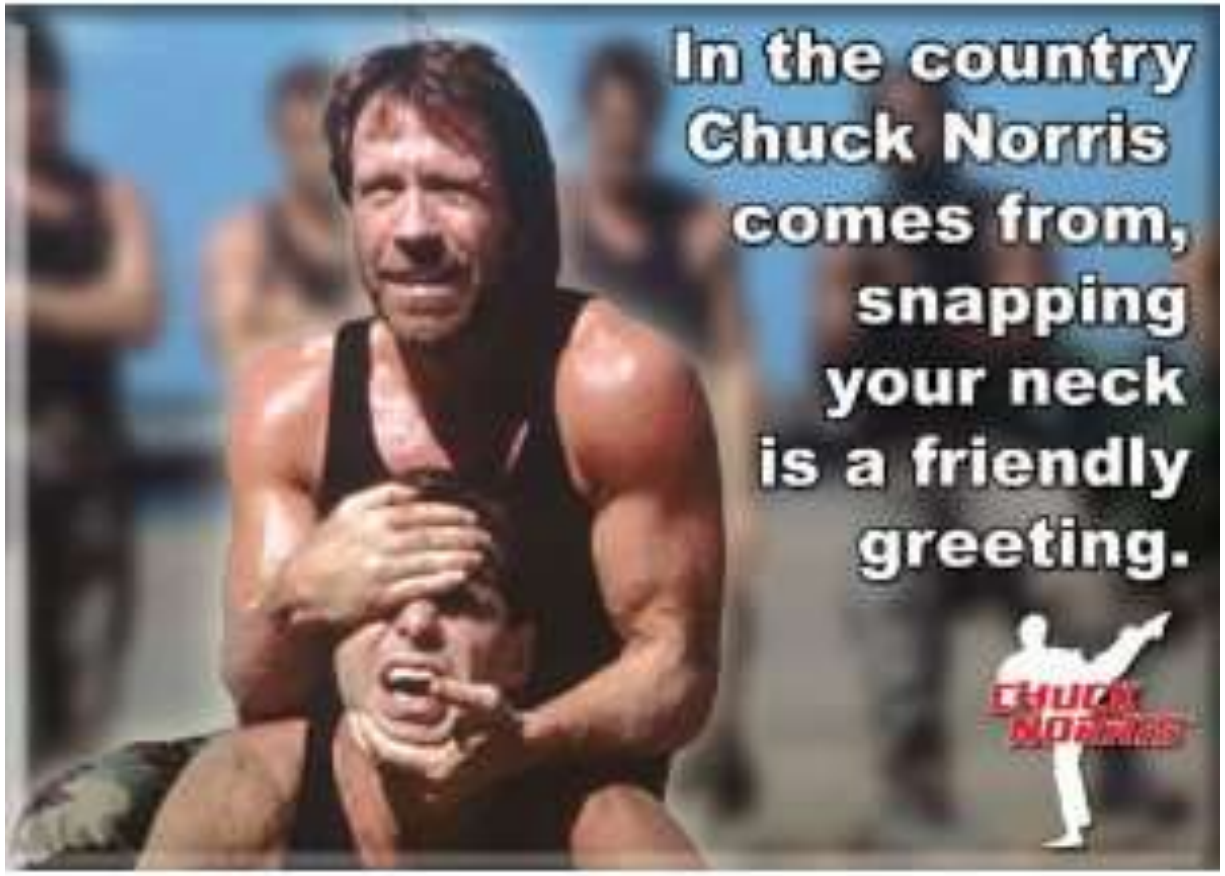
At the conclusion of this EBP session, the attendee will demonstrate the ability to:

- Explain the indications and contraindications of high velocity low amplitude thrust manipulations of the cervical spine.
- Determine if a high velocity low amplitude thrust manipulation of the cervical spine is appropriate based on the patient's presentation.
- Identify the most appropriate thrust manipulation technique for the cervical spine based on the patient's presentation.
- Safely apply a high velocity low amplitude thrust manipulation to the upper and lower cervical spine.
- Demonstrate the ability to finely engage movement barriers of the upper and lower cervical spine based on patient presentation and a kinesthetic awareness of joint motion.
- Integrate the use of high velocity low amplitude thrust manipulations of the cervical spine into a progressive treatment plan of care.

How we as clinicians view cervical manipulation…

See Tseng YL, Wang WT, Chen WY, et al. Predictors for the immediate responders to cervical manipulation in patients with neck pain. *Man Ther.* 2006;11:306-315.

How everyone else views cervical manipulation…



Contraindications for Cervical Manipulation[1,2]

- Bone weakening and destructive disorders
- Articular derangement
- Neurological disorders
- Circulatory and hematological disorders

*Fear of manipulation

Red Flags[2]

- Vertebrobasilar insufficiency (VBI)
- Facial parasthesias
- Visual disturbances
- Dizziness/vertigo
- Diplopia
- Drop attacks
- Dysarthria
- Dysphagia
- Nausea
- Tinnitus

*Symptoms that do not improve with repeated manipulation

More on this later…

Are thrust manipulations of the cervical spine safe?

- Yes, IF we screen prior to applying the manipulation
  - Must follow recognized contraindications and screen for red flags
    - Puentedura et al.[2]
      - 44.8% of adverse events following cervical thrust manipulations reviewed could have been avoided

- What should we be most concerned about?
  - Bone weakening and/or fracture PRIOR to manipulation
  - VBI PRIOR to manipulation

The Vertebral Artery and Manipulation

- Much of the literature on adverse events and cervical manipulation focus on a cerebral vascular accident as a result of VBI[3]
  - Incidence of a cerebral vascular accident and cervical manipulation is not agreed upon in the literature
    - 1 in 50,000[4]
    - 1.46 in 1 million[5]
    - 1 in 5.85 million[6]
  - There has been no strong evidence that establishes a causal relationship between cervical manipulation to a cerebral vascular accident[7-10] or any other major adverse event[8,10]

The Vertebral Artery and Manipulation

- The correlation between a cerebral vascular accident and cervical manipulation is not greater than the correlation between PCP visits and a cerebral vascular accident[9,10]
  - < 45 years of age = More likely to seek practitioner care[9]
  - > 45 years of age = More likely to seek care from PCP[9]

The Vertebral Artery and Manipulation

- Maiers et al.[11]
  - 192 symptomatic elderly adults were randomized into
    - HEP
    - Supervised Ther Ex and HEP
    - Manipulation and HEP
  - 10 Major adverse events reported
    - 2 related to the study
      - 1 death from aneurysm – Ther Ex group
      - 1 fall and fracture – Ther Ex group
    - 8 adverse events reported unrelated to study

The Vertebral Artery and Manipulation

% of Change in Vertebral Artery Length with Cervical Manipulation[12]

End-Range Cervical Rotation ROM		**Cervical Manipulation**	
UCS	12.2% change	UCS	3.9% change
MCS	4.9% change	MCS	% change
LCS	3.3% change	LCS	3.3% change

Mean failure occurred at a change in length of 58%

The Vertebral Artery and Manipulation

- Does cervical manipulation damage the vertebral artery?
  - No evidence of tissue damage markers were found immediately following or two hours following cervical manipulation[13]

- Does repeated cervical manipulation damage the vertebral artery?
  - No histological damage found in arteries that were strained 6% of resting length over 1000 times[14]
    - Damage was found in arteries that were strained 30% of resting length over 1000 times

The Vertebral Artery and Manipulation

- Does cervical manipulation affect the amount of blood flow to the brain?
  - No difference was found in flow rate of the vertebral and internal carotid arteries when C0-C7 were placed in
    - Neutral[15, 16]
    - 45 degrees of rotation[16]
    - End range rotation[15,16]
    - Distraction[15]
    - Distraction + rotation[15]
    - Position for cervical manipulation[16]

So why do we care?

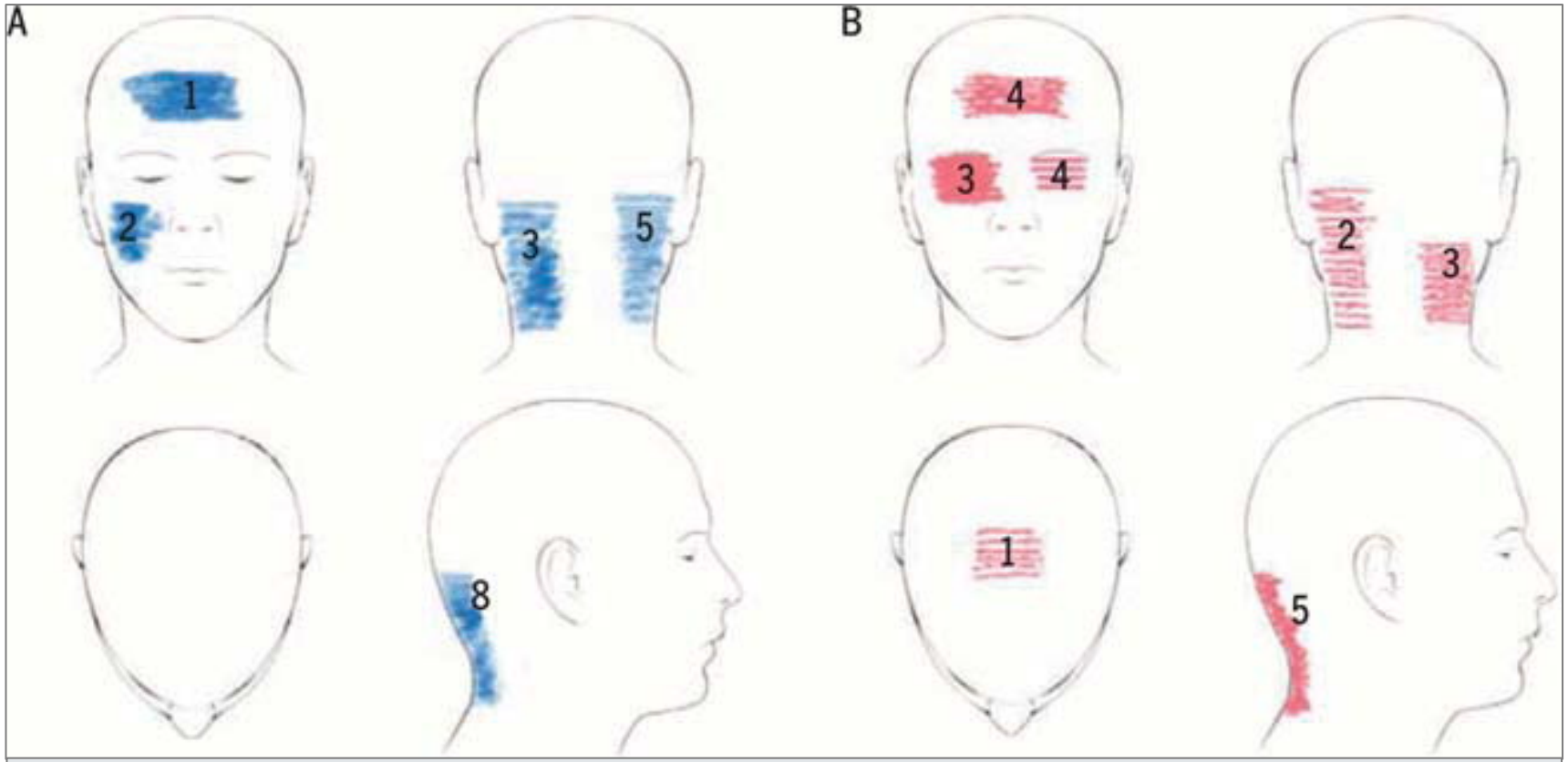
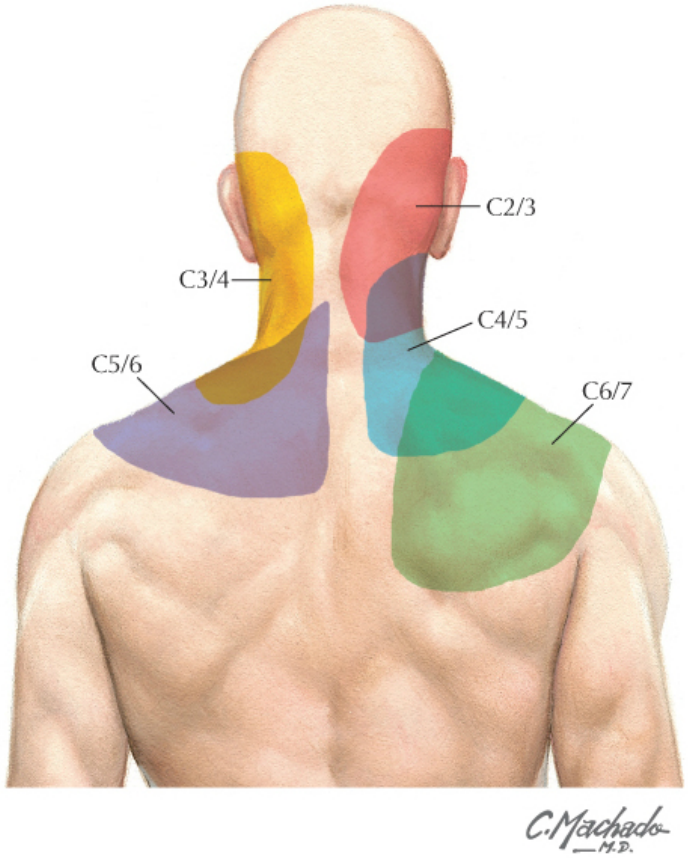


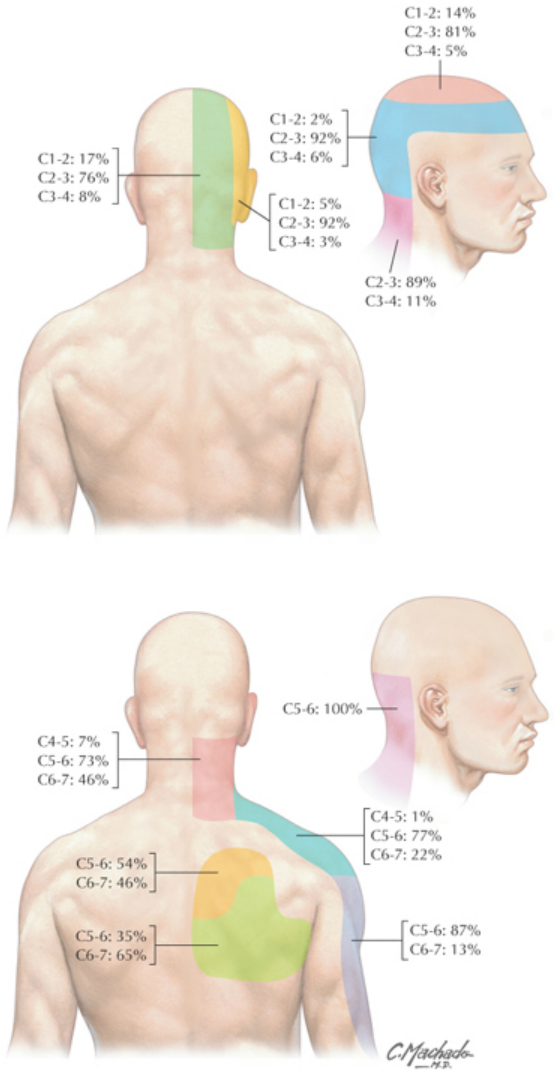
FIGURE. The frequency and distribution of headache and neck pain in participants with (A) vertebral artery dissection (n = 10) and (B) internal carotid artery dissection (n = 14). Two participants with internal carotid artery dissection had no pain, and some participants in both groups had more than 1 site of pain.

J Orthop Sports Phys Ther 2015;45(7):503-511. DOI: 10.2519/jospt.2015.5877

So why do we care?



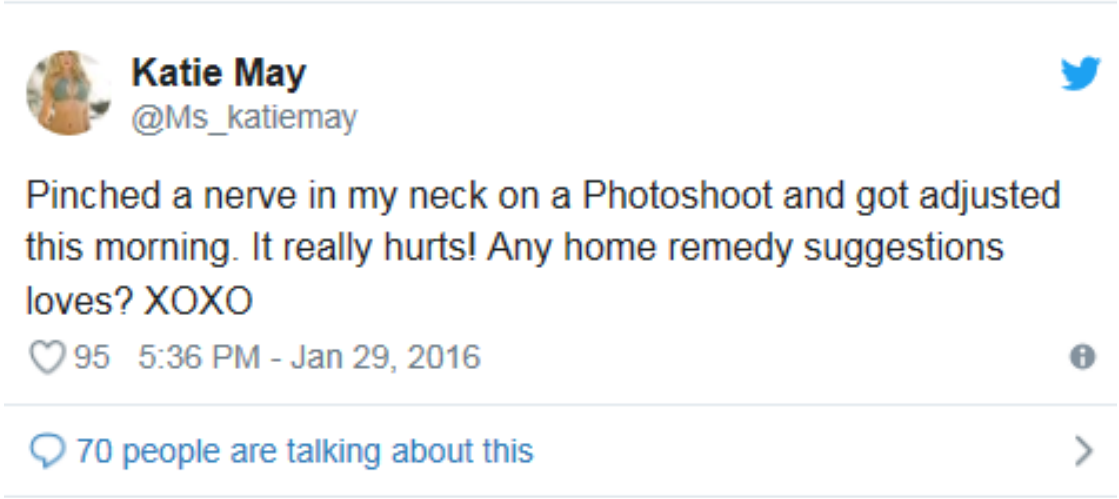
Dwyer A, Aprill C, Bogduk N. Cervical zygapophyseal joint pain patterns. I: A study in normal volunteers. *Spine*. 1990;15:453-457.

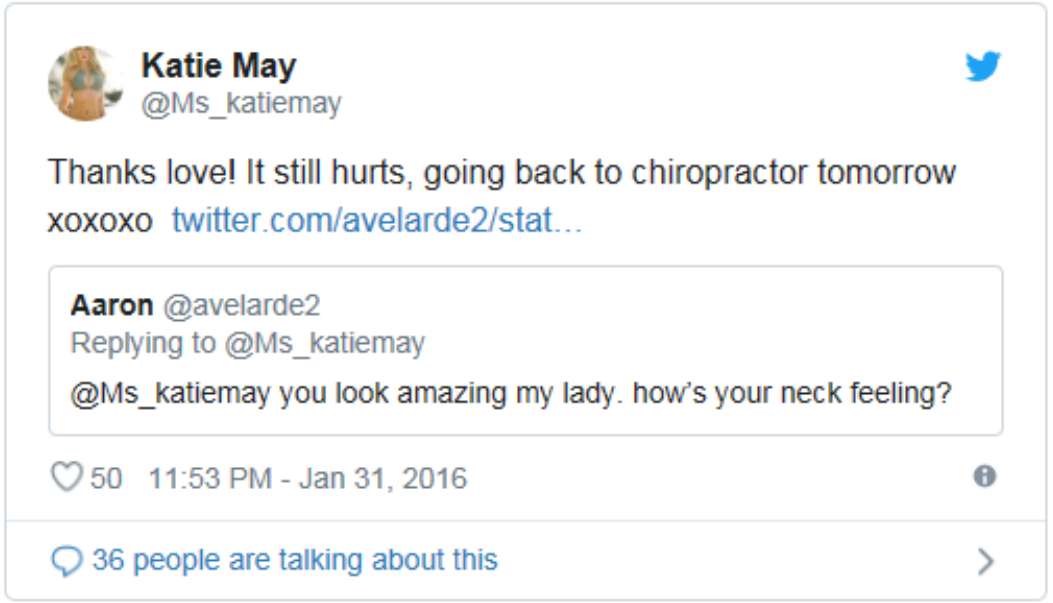


Cooper G, Bailey B, Bogduk N. Cervical zygapophysial joint pain maps. *Pain Med*. 2007;8:344-353.

The Curious Case of Katie May

"Model Katie May died after a visit to the chiropractor left her with a torn artery in her neck" - PEOPLE Magazine, October 19, 2016





https://people.com/bodies/playboy-model-katie-may-died-after-chiropractor-ruptured-an-artery-in-her-neck-coroner-says/

Take Home Message

- The state of the artery prior to manipulation is more important than the manipulation itself[7,15]
- Patients with undiagnosed vertebral artery dissection are seeking care for head and neck pain[7,9]
  - Sudden onset of pain?
  - Traumatic vs non-traumatic?
  - Quality of pain?

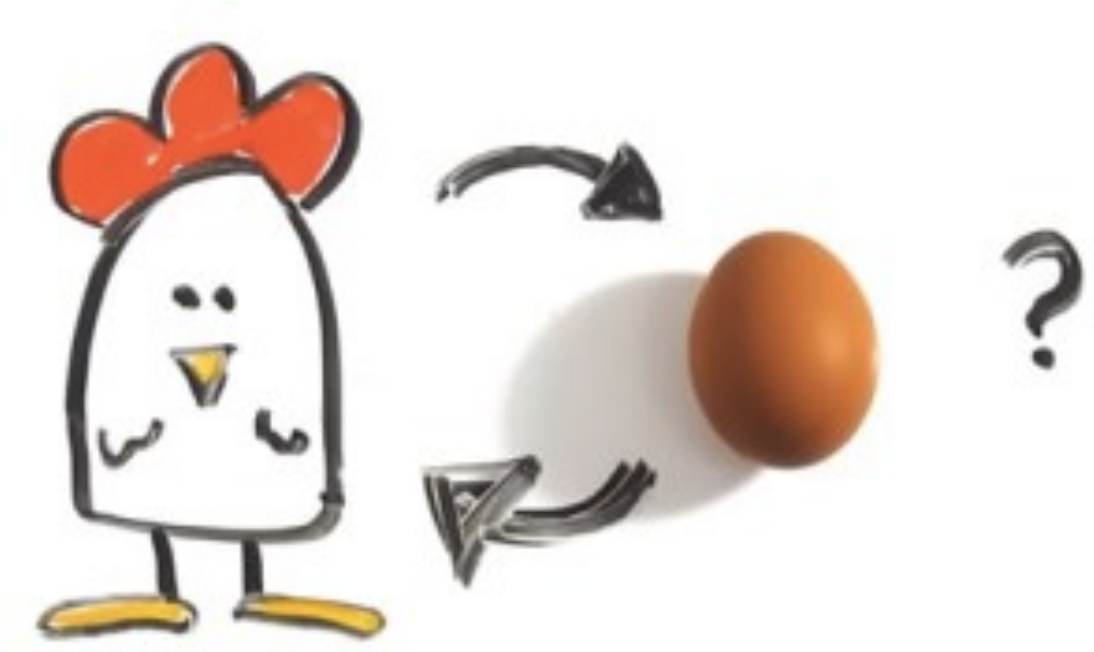
- Always screen for contraindication and/or red flags
- When in doubt, do not manipulate

Indications for Cervical Manipulation

- Non-Specific Neck Pain[17-21]
  - Acute vs Chronic
- Cervicogenic Headaches[18,19,21]
  - A result of stiff and painful upper cervical segments
  - Presentation of Symptoms
    - Unilateral headaches
    - Symptoms start in neck and run to fronto-occular area
- Neck Related Arm Pain[18]

Indications for Cervical Manipulation

- Motion Restriction[17,19,21]
  - Reliable and valid?
- Somatic Dysfunction[21-26]
- Trigger Points within Surrounding Soft Tissue[27,28]



https://www.brainpickings.org/2013/02/01/which-came-first-the-chicken-or-the-egg/

Things to Consider when Performing a Thrust Manipulation of the Cervical Spine

- Manufacturing a Movement Barrier
  - In order to reduce movement and thrust into extreme end ranges of cervical movement a movement barrier is manufactured by the clinician
    - Primary lever for manipulation is spinal motion (i.e. Rotation)
    - Secondary levers are introduced to manufacture the barrier prior to the primary lever of rotation being applied
  - Intervertebral joint motion is introduced in multiple planes to take up joint capsule extensibility
    - When motion is introduced in one plane, movement in all other planes is reduced
    - Make sure each movement barrier that is engaged is maintained as another motion is introduced

Things to Consider when Performing a Thrust Manipulation of the Cervical Spine

- Manufacturing a Movement Barrier
  - The goal is to take up extensibility of the joint capsule with the top of the head in line with the midline of the body
    - Head should still be positioned in the midline of the body
    - If you feel that the cervical spine is maximally rotated, DO NOT apply a thrust

GOOD
Thrust!!!

BAD
STOP!!!

BAD
STOP!!!

Things to Consider when Performing a Thrust Manipulation of the Cervical Spine

- Manufacturing a Movement Barrier
  - DO NOT lock out the joint
    - Skillfully feel for the end range of joint motion and back off slightly
      - Do not lose previously engaged movement barriers
    - We want to accelerate THROUGH the tissue resistance
      - The joint segment should be free to move through the tissue resistance
        - This cannot be achieved if the joint is maximally locked out
    - Smaller preload magnitude leads to greater muscle spindle discharge following manipulation[29]

Things to Consider when Performing a Thrust Manipulation of the Cervical Spine

- Force Delivery
  - Thrust Velocity
    - 20-30 mm/s has been shown increase muscle spindle discharge[30]
    - Ngan et al.[31]
      - Average peak thrust velocity = 127 deg/sec
      - Mean thrust velocity = 72 deg/sec
      - Mean peak acceleration = 2183 deg/sec^2
  - Thrust Duration
    - 75-150 ms has been shown to increase muscle spindle discharge[30]
    - Ngan et al.[31]
      - Mean thrust duration = 158 ms (117 ms – 250 ms)

Things to Consider when Performing a Thrust Manipulation of the Cervical Spine

- Force Delivery
  - Thrust Amplitude
    - Amplitude has not been shown to have an affect on muscle spindle discharge[30]
    - So how far should we thrust?
  - Thrust Force
    - If barriers are engaged correctly, there is not a substantial amount of force required to manipulate the cervical spine

*Speed is the most important factor

Things to Consider when Performing a Thrust Manipulation of the Cervical Spine

- Patient should be relaxed
  - If the patient is guarding
    - Maximal thrust velocity cannot be achieved
    - Greater risk for strain/injury
  - Take the patient through the motion and into the position of manipulation first
    - Ask if there is any pain
      - If there is, do not manipulate

Things to Consider when Performing a Thrust Manipulation of the Cervical Spine

Relaxed hands are fast hands

- Movement barriers are engaged by the clinician moving their body
  - If the clinician's hands are tense/supporting the weight of the head and neck, sufficient thrust velocity cannot be achieved

Relax your hands, Feel the barrier, Back off slightly, Thrust through the barrier

Quick start with an abrupt stop

Reasons for Failure[32]

- Loss of engaged movement barriers
- Velocity is too slow
- Improper thrust application
- Not enough or too much force
- Not enough or too much amplitude
- Clinician is not active with both the manipulation and guiding hands
- Patient is guarding
- Patient did not need the manipulation in the first place

Lab Session #1

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Patient Position:

- Supine with head resting on a pillow
- Make sure that the most cranial portion of the Pt's head is close to the top edge of the table

Clinician Position:

- At the "head" of the table
- Staggered stance with the leg on the side that is to be manipulated positioned behind the clinician
- ELBOWS ARE TUCKED IN TO THE CLINICIAN'S SIDE and flexed to approximately 50-90 degrees

Table Height:

- Whatever position allows the clinician's elbows to be flexed to approximately 50-90 degrees without "slumping" forward over the head of the patient

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Clinician's Hand Position:

Manipulation Hand

- The 2nd and 3rd fingers make contact with the laminar groove/articular pillar of the segment to be manipulated on the side that is to be manipulated
- Do not cross the spine, the clinician's fingers should not be touching the spinous process
- The palm of the clinician's hand should be resting on the mandible with the thumb angling down the jawline to the chin
- The higher the segment, the further up the mandible the palm should be
- The lower the segment, the lower down the mandible the palm should be

*DO NOT PLACE ANY PART OF YOUR HAND/THUMB ON THE PT'S THROAT

Guiding Hand

- Palm of the hand should be cradling the temporal portion of the head on the contralateral side of manipulation
- Fingers should be wrapped around supporting the Pt's occiput

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Technique: It is very important to engage the barriers one at a time. Remember, we are using Law III of spinal motion to achieve barrier development. We DO NOT take the patient through their end range of spinal motion

*It is important to note that the development of barriers is achieved by full body motion of the clinician, not hand motion. The clinician's hands should be free of tension, they should NOT be shaking. If they are, the clinician is doing too much with their hands.

We will use secondary levers to take up motion at the spinal segment and engage each barrier

- Side Bending
- Side Glide
- PA Shift

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Side Bending Barrier

- This is achieved by the clinician rotating their body away from the side to be manipulated
- If the clinician keeps their elbows adducted at their side, as they rotate contralaterally, the Pt's head will side bend towards the side to be manipulated
- Make sure to facilitate this with the guiding hand

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Side Glide Barrier

- The clinician should shift their weight forward and laterally on to their front foot
- The goal is to translate the segment to be manipulated laterally so that the head moves back towards the midline of the body
- Make sure to maintain the side bending barrier while side gliding the segment

PA Shift Barrier

- A slight PA moment is introduced at the segment by radially deviating BOTH of the clinician's wrists
- Care must be taken to not lose the side bending or side gliding barrier

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Rotational Barrier

*Rotation is the primary lever for the thrust manipulation. It is the last barrier that is to be engaged and how we manipulate the segment

- At this point, the Pt's head should be facing away from the manipulation hand and slightly cranially
  - Will cause the axis of rotation to now be angled in a multiplaner orientation
- Both the manipulation and guiding hands will facilitate contralateral rotation of the head and the segment to be manipulated around the angled rotational axis of the spine
- A FIRM and "CRISP" barrier to movement should be felt

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Rotational Barrier

- Make sure that the rotational force is introduced AROUND this new axis. If a rotational force is introduced in only the horizontal plane, the previous three barriers will be lost.
  - How do we know we have lost the barriers
    - The Pt's head is able to rotate all the way down to the table
    - A firm/crisp barrier is not felt

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Slight adjustments may need to be made via the secondary levers (i.e. Side bending, side glide, PA shift) along with the primary lever of rotation to find the final barrier to movement.

- Rotation is the most important component

A “crisp” end feel will be felt when the clinician has engaged the “final” barrier to movement. Rotate the segment on the appropriate angle into the “crisp” barrier and back off slightly. Repeat this 2-3 times.

- DO NOT BACK OFF TOO MUCH!!
- DO NOT LOSE THE PREVIOUS MOVEMENT BARRIERS!!

Lower Cervical Spine (C3-C7) Rotational HVLA Thrust – Cradle Hold

Thrust Technique:

- A high velocity, low amplitude rotational force WITH BOTH the manipulation and guiding hand is introduced through the movement barrier
  - ACCELERATE THROUGH THE BARRIER
- Both hands must be active with this technique
  - Manipulation hand = Pronation of the forearm
  - Guiding hand = Supination of the forearm
- The force should be directed on an angle cranially to the Pt's opposite eye
  - The higher the segment (i.e. C2), the more the force should be angled cranially
    - Underneath the patient's eye
  - The lower the segment (i.e. C7) the "flatter" the angle of applied force
    - More towards the mandible

REMEMBER to apply a quick yet firm thrusting/manipulation force

Quick start with an abrupt stop

What was that popping sound?

Cavitation – The Audible Pop

Do the “pops” matter?

- Cervical thrust manipulations
  - Magnitude of force and the rate of change of the force application is more important than an audible cavitation[38]
- Thoracic thrust manipulations
  - Little to no relationship between an audible cavitation and overall improvement in pain and disability levels as well as cervical ROM[39]

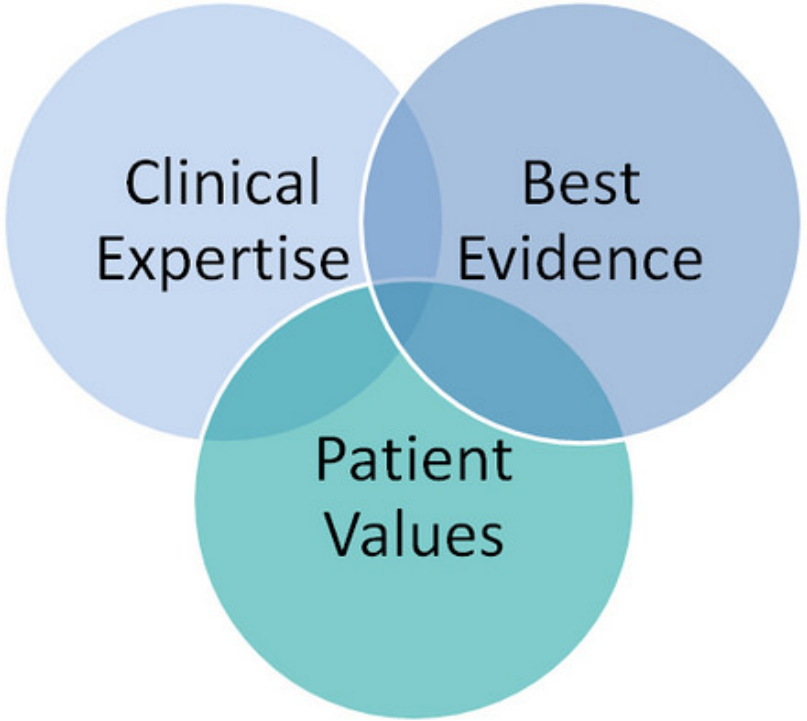
Cavitation – The Audible Pop

Do the “pops” matter?

- Hyopalgesia occurred with a lumbar thrust manipulation regardless of an audible cavitation[40]
  - Greater reduction in central sensitization if audible cavitation occurs[40]

Cavitation – The Audible Pop

Do the “pops” matter?



https://heartland.libguides.com/pta/ebp

Cavitation – The Audible Pop

How many pops will we hear?

- Reggars[33]
  - Average number of cavitations at C3/C4 was 2.5 per subject per thrust
    - High of 5 audible “pops”
    - Low of 1 audible “pop”

- Dunning et al.[34]
  - Average number of cavitations
    - 3.57 per side
    - 6.95 per subject

Cavitation – The Audible Pop

Can one vertebral segment be isolated?

- Literature does not support the claim that clinicians can isolate only the target segment[35-37]
  - Should we care?
  - What are the implications clinically?

Effects of Thrust Manipulation

- Neurophysiological effect > Biomechanical effect[25]
  - Increase in ROM following thrust manipulation due to a reduction in pain levels and resting tension of surrounding soft tissue[22,25]
  - No change in facet joint space following cervical manipulation[43]
- Analgesic effect
  - Decrease activity of central pain processing centers[25,37]
  - Reduction in dorsal horn activation rates leading to decreased pain and decreased resting tension in surrounding soft tissue[22-27,40,41]
  - Reduction in pain pressure thresholds locally and distally[42]

Effects of Thrust Manipulation

- Is thrust manipulation of the cervical spine an effective technique?
  - Gross et al.[20]
  - Clinical Practice Guidelines[18,44]

Lab #2

- Upper Cervical Spine (C1-C2) Rotational HVLA Thrust – Cradle Hold

Upper Cervical Spine (C1-C2) HVLA Thrust – Cradle Hold

Very similar technique to C2-C7 with a few exceptions

Manipulation Hand Position

- Rotate the head slightly to the contralateral side to expose the posterior and lateral aspect of the occiput on the side that is to be manipulated
- The lateral aspect (radial boarder) of the 2nd MCP should slide down the occiput in a caudal direction and come to rest on the posterior arch of the atlas
  - Just inferior to the occiput and medial to the mastoid process
- The elbow of the manipulation hand should be flexed to 90 degrees and the forearm should be in the same plane as the hand
  - The forearm and hand should be perpendicular to C1-C2
- The thumb of the manipulation hand will cross the ear and come to rest on zygomatic arch pointing to the eye

Upper Cervical Spine (C1-C2) HVLA Thrust – Cradle Hold

Technique

- Barrier development is similar using the secondary levers of:
  - Side bending
  - Side Glide
  - PA Shift

  *Make sure to use your body to introduce these levers as you did with the C2-C7 technique
- The final barrier is engaged by rotating the head and the spinal segment
  - Both hands have to be active; Rotate around the new axis of motion
  - Angle of rotation is up towards the area slightly superior to the contralateral eye
    - Angle is not as shallow as the technique learned for C2-C7

Upper Cervical Spine (C1-C2) HVLA Thrust – Cradle Hold

Thrust Technique:

- A high velocity, low amplitude rotational force WITH BOTH the manipulation and guiding hand is introduced through the movement barrier
  - ACCELERATE THROUGH THE BARRIER
- Both hands must be active with this technique
  - Manipulation hand = Pronation of the forearm
  - Guiding hand = Supination of the forearm
- The force should be directed on an angle cranially to area just superior to the contralateral eye

REMEMBER to apply a quick yet firm thrusting/manipulation force

Quick start with an abrupt stop

Review and Questions

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