Cervical Spine Manipulation: Risk Versus Benefit

Josh Cleland, PT, PhD
Franklin Pierce University
Concord, NH
FEAR

• DO NO HARM
• Stories of Sudden Death/Paresis
• The “unknown” of Manipulation/Mobilization
• Litigation

NECK911.COM

The Problem:
There are over 20 different kinds of stroke pathology that can happen as a result of neck manipulation.

Our Mission:
Neck911 is a volunteer group of individuals who provide consultations on complications due to neck manipulation. Although most cases are due to chiropractic manipulation, Neck911 is equally concerned about cases that arise from physical therapists or medical doctors.

Would you know if you had a stroke due to a chiropractic highest neck manipulation?

Click here to watch the Primeone video
Click here to watch video "Is a headache worth dying for?"

Send this site to a friend...

What Chiropractors are saying... Database of victims... Case Studies

England, United States, Canada, Italy

Please email: Stroke@neck911.com

Vertebral artery dissection causing stroke

0.97 per 100,000

The rate for occurrence of all strokes

269 per 100,000

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

Phys Ther. 2010;90(9)
Patients with Neck Pain Referred to Physical Therapy

Manipulation Group
- +CPR
- -CPR

Exercise Group
- +CPR
- -CPR

Follow-up at 1 week, 4 weeks, and 6 Months
Change in Neck Disability Index

- Significant Group*Time interaction (p=0.01)
Thoracic Spine Thrust Manipulation Versus Cervical Spine Thrust Manipulation in Patients With Acute Neck Pain: A Randomized Clinical Trial

Emilio J. Puente-dura, Merrill R. Landers, Joshua A. Cleland, Paul Mintken, Peter Huijbrgts, Cesar Fernandez-de-las-Peñas
24 patients with neck pain

R

T-Spine Thrust

C-Spine Thrust
Patients screened for eligibility (n = 96)

Randomized (n = 24)

Not eligible (n = 72):
- Did not meet CPR (n = 56)
- Whiplash (n = 8)
- Red flags (n = 5)
- Prior surgery (n = 2)
- Cervical stenosis (n = 1)

Thoracic spine TJM (n = 10)

1-wk follow-up (n = 10)

4-wk follow-up (n = 10)

6-mo follow-up (n = 10)

Cervical spine TJM (n = 14)

1-wk follow-up (n = 10)

4-wk follow-up (n = 10)

6-mo follow-up (n = 10)

Did not want to continue, “felt 100%” (n = 4)

FIGURE 5. Flow diagram of patient recruitment and retention. Abbreviations: CPR, clinical prediction rule; TJM, thrust joint manipulation.
FIGURE 6. Mean Neck Disability Index (NDI) score, with 95% CI for the intention-to-treat analysis over the course of the trial for the cervical and thoracic manipulation groups.
FIGURE 7. Mean numeric pain rating scale (NPRS) score, with 95% CI for the intention-to-treat analysis over the course of the trial for the cervical and thoracic manipulation groups.
FIGURE 8. Mean Fear-Avoidance Beliefs Questionnaire physical activity subscale (FABQ-PA) score with 95% CI for the per-protocol analysis over the course of the trial for the cervical and thoracic manipulation groups.

Research Report:
Thoracic Spine Thrust Manipulation Versus Cervical Spine Thrust Manipulation in Patients With Acute Neck Pain: A Randomized Clinical Trial
Is Cervical Manipulation Safe?
Safety of cervical spine manipulation: are adverse events preventable and are manipulations being performed appropriately? A review of 134 case reports

Authors: Emilio J Puentedura¹; Jessica March¹; Joe Anders¹; Amber Perez¹; Merrill R Landers¹; Harvey W Wallmann²; Joshua A Cleland²

Source: Journal of Manual & Manipulative Therapy

Publisher: Maney Publishing

Abstract:

Background: Cervical spine manipulation (CSM) is a commonly utilized intervention, but its use remains controversial. Purpose: To retrospectively analyze all available documented case reports in the literature describing patients who had experienced severe adverse events (AEs) after receiving CSM to determine if the CSM was used appropriately, and if these types of AEs could have been prevented using sound clinical reasoning on the part of the clinician. Data sources: PubMed and the Cumulative Index to Nursing and Allied Health were systematically searched for case reports between 1950 and 2010 of AEs following CSM. Study selection: Case reports were included if they were peer-reviewed; published between 1950 and 2010; case reports or case series; and had CSM as an intervention. Articles were excluded if the AE occurred without CSM (e.g. spontaneous); they were systematic or literature reviews. Data extracted from each case report included: gender, age; who performed the CSM and why; presence of contraindications; the number of manipulation interventions performed; initial symptoms experienced after the CSM; and type of resultant AE. Data synthesis: Based on the information gathered, CSMs were categorized as appropriate or inappropriate, and AEs were categorized as preventable, unpreventable, or unknown. Chi-square analysis with an alpha level of 0.05 was used to analyze differences between appropriate and inappropriate CSMs.
134 case reports (reported in 93 articles) Included in qualitative analysis

**CSM appropriate or inappropriate?**

*Appropriate* if CSM used for an indicated condition such as neck pain, neck stiffness, headache, or cervical radiculopathy

*Inappropriate* if CSM performed for reasons not indicative to cervical disorders, such as low back pain, or ‘maintenance therapy’

**Event preventable or unpreventable?**

*Preventable* when contraindications or red flags should have otherwise stopped care provider from using CSM

*Unpreventable* when patient appeared to be clear of any contraindications or red flags to CSM in either current and/or past history

*Unknown* category created when article did not provide enough information to allow it to be categorized as either preventable or unpreventable
Practitioners performing CSM in cases of adverse events

- Chiropractor: 70
- Osteopath: 8
- Non-clinician: 7
- Physical Therapist: 3
- Naturopath: 1
- Unknown: 11
### Distribution of cases categorized by appropriateness and preventability

<table>
<thead>
<tr>
<th></th>
<th>Appropriate</th>
<th>Inappropriate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventable</td>
<td>48</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>Appropriate</td>
<td>80.0%</td>
<td>20.0%</td>
<td>44.8%</td>
</tr>
<tr>
<td>Unpreventable</td>
<td>13</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>92.9%</td>
<td>7.2%</td>
<td>10.4%</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>47</td>
<td>13</td>
<td>60</td>
</tr>
<tr>
<td>78.3%</td>
<td>21.7%</td>
<td>44.8%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>26</td>
<td>134</td>
</tr>
<tr>
<td>80.6%</td>
<td>19.4%</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>
Deaths after CSM

• 7 cases (4 male/ 3 female)
• Ages between 25 and 51
• Practitioners involved
  – chiropractor (5)
  – naturopath (1)
  – unknown (1)
• 4 deaths determined to be preventable, 1 was unpreventable and 2 unknown
Risk versus Benefit
Types & Frequencies of Reactions Following Spinal Manipulation

U.S. Mortality Data for Seven Selected Disorders in 1997

- Leukemia: 20,197 deaths
- AIDS: 16,685 deaths
- Multiple myeloma: 16,500 deaths
- Asthma: 10,503 deaths
- Cervical cancer: 5338 deaths
- Hodgkin’s disease: 4441 deaths
- NSAID toxicity: 1437 deaths

The chart shows the number of deaths for each disorder.
## Comparative Analysis

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Reported Risk</th>
<th>Est # / 10,000</th>
<th>Potential Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical spine manipulation</td>
<td>6 / 10,000,000</td>
<td>0.006</td>
<td>Death</td>
</tr>
<tr>
<td>Exercise</td>
<td>1 / 1,500,000</td>
<td>0.007</td>
<td>Sudden Death</td>
</tr>
<tr>
<td>NSAIDS</td>
<td>1 - 3 / 100</td>
<td>100 – 300</td>
<td>GI bleed</td>
</tr>
<tr>
<td>ESI (w/ fluoroscopy)</td>
<td>8 – 11 / 100</td>
<td>800 - 1100</td>
<td>Intravascular Injection</td>
</tr>
<tr>
<td>Cervical Spine Surgery</td>
<td>15.6 / 1000</td>
<td>156</td>
<td>Varied</td>
</tr>
<tr>
<td>Lumbar Disc Surgery</td>
<td>1.6 – 17 / 10,000</td>
<td>1.6 – 17</td>
<td>Vascular perforations</td>
</tr>
<tr>
<td>Lumbar Disc Surgery</td>
<td>3.8 / 10,000</td>
<td>3.8</td>
<td>Visceral injuries</td>
</tr>
<tr>
<td>Lumbar Fusion</td>
<td>17 / 100</td>
<td>1700</td>
<td>Varied</td>
</tr>
<tr>
<td>Discectomy, laminectomy, +/- fusion</td>
<td>0.2-0.3 / 100</td>
<td>20 – 30</td>
<td>Death</td>
</tr>
</tbody>
</table>
Manipulation Risk in Perspective

- Cervical manip & serious event: 1/50,000 to 1/5 million
- Lumbar manip & cauda equina: 1/100 million
- Dying in a MVA: 1/6,000
- Dying from fall down stairs: 1/200,000
- Killed by falling object: 1/400,000
- Being struck by lightning: 1/700,000
- Drown in bathtub: 1/800,000
- Hit by a car crossing the street: 15/1 million
- Shot by a sniper in DC: 7/1 million
- Dying from a bee sting: 1/5.9 million
- Victim of shark attack in US: 1/10 million
- Winning the state lottery: 1/14 million
Vertebrobasilar Insufficiency

- Cervical Arterial Dysfunction: Knowledge and Reasoning for Manual Physical Therapists
  - Dissection (tear) of the Vertebral or ICA
    - Initial symptoms - usually present only with posterior cervical and occipital pain
    - Progressive symptoms of VBI
      - Dysphagia, Dysarthria, Dizziness, Drop Attacks, Diplopia (5 D’s)
      - Facial numbness, Hoarseness, Horner Syndrome Signs (1)

Kerry et al 2009
Pain Distribution

Kerry et al JOSPT, 2009
What is a *reasoned* estimate of risk from chiropractic manipulation and stroke?

1.3 per 100,000

1 per 9,122  
(Michaeli ’93)  

1 per 200,000  
(Haynes, ’94)
● There is an association between vertebrobasilar artery stroke and **chiropractic visits** in those under 45 years of age.

● There is also an association between vertebrobasilar artery stroke and use of **primary care physician visits** in all age groups.
The increased risks of vertebrobasilar artery stroke associated with chiropractic and physician visits is likely explained by patients with vertebrobasilar dissection-related neck pain and headache consulting both chiropractors and primary care physicians before their VBA stroke.
Contraindications to Thrust Manipulation

International Framework for Examination of the Cervical Region for potential of Cervical Arterial Dysfunction prior to Orthopaedic Manual Therapy Intervention

Authors: Rushton A, Rivett D, Carlesso L, Flynn T, Hing W, Kerry R.
Clinical Decision Making

Data obtained from patient history

Interpretation of data from patient history using evidence informed knowledge, and cognitive and metacognitive processes. Interpretation includes analysis of patient’s preferences.

Planning the physical examination
- Possible cervical vasculogenic contribution?
- Any gaps in data from patient history?
- Quality of data obtained?
- Any precautions or contraindications?
- Which physical tests to use?
- Priority for physical testing?
Evaluation

- Assessment of presence of Cervical Artery Dysfunction - Posterior and Anterior Circulation
- Red Flags
  - 5 D’s And 3 N’s
    - Dizziness  Ataxia  Nausea
    - Drop attacks  Numbness
    - Diplopia  Nystagmus
    - Dysarthria
    - Dysphagia

Kerry et al, UK Cervical Artery Assessment Framework, 2005
Functional Positional Screening

- Sensitivity (SnNout)
  - Negative tests rules out
- Specificity (SpPin)
  - Positive test rules in

- Likelihood ratios
  - Positive or negative
  - Shifts in probability for ruling in or out a disorder

TABLE 2

<table>
<thead>
<tr>
<th>Author</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>LR+</th>
<th>LR−</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cote et al 1996</td>
<td>0.00</td>
<td>0.86</td>
<td>0.00</td>
<td>1.16</td>
</tr>
<tr>
<td>Rivett et al 2000</td>
<td>0.10</td>
<td>0.39</td>
<td>0.16</td>
<td>2.30</td>
</tr>
<tr>
<td>Kerry et al 2003</td>
<td>0.31</td>
<td>0.48</td>
<td>0.59</td>
<td>1.44</td>
</tr>
<tr>
<td>Kerry 2006</td>
<td>0.10</td>
<td>0.44</td>
<td>0.16</td>
<td>2.30</td>
</tr>
</tbody>
</table>

*LR*+ is the likelihood ratio for a positive test. LR− is the likelihood ratio for a negative test. The further away from 1 (on a scale of 0.001 to 1000) the LR is (LR+, above 1; LR−, below 1), the better the test at ruling the condition in or out. Above 10 would be considered a good LR+, and below 0.01 would be considered a good LR−. All readings from the studies in the table would indicate poor and inconsistent findings for the diagnostic utility of the VBI test.

Kerry et al JOSPT, 2009
Canadian Cervical Spine Rule

- Traumatic
  - Motor Vehicle Accident
  - Fall
  - Collision

Steil, et al. New Eng J Medicine, 2003
Upper Cervical Ligamentous Instability
If suspected, initial imaging = flex/ext radiographs

Sharp Purser Test

(Always perform first if upper cervical instability is suspected!)

- Sensitivity: 0.69
- Specificity: 0.96
- +LR Ratio: 17.3
- -LR ratio: 0.32


The palm of one hand is placed on the patient’s forehead while the spinous process of the axis is held by a pinch grip. The patient is then asked to flex the head and neck. Through palmar pressure on the forehead, the occiput and atlas are translated posteriorly. Mintken et al *JOSPT* 2008;38(8):465-475.
Alar Ligament Test

Spinous process of the axis is stabilized while the head and the atlas are sidebent or rotated to assess for excessive movement. Mintken et al *JOSPT* 2008;38(8):465-475.
Transverse Ligament Test

- Provocative test
  - Only performed when Sharp purser test is negative!
- Provides anterior shear of C1 on C2 assessing transverse ligament stability.
- No Supportive Research except case report by Mintken et al (JOSPT 2008)

PT supports the occiput while the two index fingers are placed in the space between the occiput and the C2 spinous process. The head and C1 are then moved anteriorly as a unit on the cervical spine.
Upper Motor Neuron Screen

- Testing for Clonus
- Hoffman's Reflex
- Romberg Test
- Babinski Sign
Cranial Nerve Screen

- Olfactory Nerve
- Trigeminal Nerve
- Glossopharyngeal Nerve
- Oculomotor Nerve
- Facial Nerve
- Accessory Nerve
- Trochlear Nerve
- Vestibulocochlear Nerve
- Hypoglossal Nerve
What to do in times of uncertainty?

• Refer if uncertain
  – Discussion of findings with primary care or referring provider
• Document!
• Use a premanipulative hold for at least 10 seconds when using any manual therapy technique
Pre-manipulative Hold
International Framework for Examination of the Cervical Region for potential of Cervical Arterial Dysfunction prior to Orthopaedic Manual Therapy Intervention

Authors: Rushton A, Rivett D, Carlesso L, Flynn T, Hing W, Kerry R.
## Risk Benefit Ratio

<table>
<thead>
<tr>
<th>Risk</th>
<th>Benefit</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>High number/severe nature of risk factors</td>
<td>Low predicted benefit of manual therapy</td>
<td>Avoid treatment</td>
</tr>
<tr>
<td>Moderate number/moderate nature of risk factors</td>
<td>Moderate predicted benefit of manual therapy</td>
<td>Avoid or delay treatment / monitor and reassess</td>
</tr>
<tr>
<td>Low number/low nature of risk factors</td>
<td>Low / moderate / high predicted benefit of manual therapy</td>
<td>Treat with care / continual monitoring for change/new symptoms</td>
</tr>
</tbody>
</table>
A final note: Continuous Monitoring

• During the history
• During the physical exam
• During the intervention
• Prior to and after each phase of care
Should we manipulate the cervical spine?

• Who should we manip?
Development of a Clinical Prediction Rule to Identify Patients With Neck Pain Likely to Benefit From Thrust Joint Manipulation to the Cervical Spine

JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 42 | NUMBER 7 | JULY 2012 | 577

Rose Excellence in Research Award

The Best Research Article of 2012 in Orthopaedic Physical Therapy
Patients with neck pain

Subjective

Objective

Wait 48 hours

GROC

+5 or better?

YES or NO
Examination Items Predicting SUCCESS

• **HISTORY**
  1. Duration of symptoms 38 days or less
  2. Positive expectation that manipulation will help

• **PHYSICAL EXAM**
  3. Difference in cervical rotation ROM to either side at least 10 degrees
  4. Pain with spring (PA) testing middle cervical spine
Pre-Test Probability of SUCCESS = 39%

3 of 4 factors (+)

Post-Test Probability of SUCCESS = 90%

(+) LR = 13.5
Neck Disability Index (NDI)

- 29/82 (35%) patients were positive on the CPR

Baseline: CPR - 15.7, CPR + 14.5
Final: CPR - 9.5, CPR + 5.9
Pain (NPRS)

Baseline: CPR - 3.8, CPR + 4.7
Final: CPR - 2.5, CPR + 1.2
Developing a CPR

**Step 1 Derivation**
Id. Factors with predictive value

**Step 2 Validation**
Evidence of reproducible accuracy

- **Narrow validation** vs. **Broad validation**
  - Narrow validation: Apply to pop. & similar setting as step 1
  - Broad validation: Multiple settings with varying prevalence.

**Step 3: Impact analysis**
Evidence the rule changes behaviors & improves pt outcomes &/or reduces costs.

McGinn, *JAMA*, 2000
Maybe we need a CPR to identify those at risk?

It will never happen!
Questions?