Palpatory Assessment & Mobilization of the Cervical Spine: Advancing from Conceptual Models to Clinical Practice

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 Passive Intervertebral Motion Palpation

- Historically taught by convention w/ no means of objective assessment
- Imitation of instructor & only subjective feedback
  - Little or no knowledge of results
  - Naïve student w/ feedback to naïve student

Purpose

- Consider the use of PIVM in examination & classroom/lab instruction
- Evaluate PIVM classroom/lab instruction
- Present teaching strategies for enhanced PIVM learning experiences

Cervical PIVM Validity: Pain Origin


- 16 subjects w/ neck pain examined by primary investigator
- Identified hypomobile segments for comparison vs diagnostic injection
- 100% sensitivity & 100% specificity
King et al., *Spine J*, 2007

- 173 pts w/ neck pain
- Examined w/ same P→A procedure as Jull et al.
- Comparison w/ diagnostic blocks protocol

King et al., *Spine J*, 2007

- PIVM assessment & diagnostic block agreement approximately equal to chance
- + LR = 1.4 – 1.8 across all levels
- “...manual examination of the cervical spine to lack validity ...”

King et al. & Jull et al. studies rely on a single examiner for comparison vs diagnostic injection standard to z-joints

Neither study accounts for pain from segment not of z-joint origin

24 pts w/ nonspecific neck pain in each experimental & control groups

- Mobs to most sx level vs random level
- Central, unilateral, transverse oscillations
- No differences in pain levels between groups
- Limitation: Low levels of starting pain (<3)

Aquino et al, 2009
**Cervical PIVM Validity: Motion**

- Compared A-P radiographs in lateral flexion to lateral glide PIVM in 25 subjects
- Distance between TPs in lateral flexion on rads compared to manual palpation results
- “...as good as a radiological assessment for the diagnosis of intervertebral dysfunctions.”
  
  de las Pena et al, 2005

- Compared P-As w/ flexion-extension radiography
- 50 consecutive pts w/ mechanical neck pain
- P-As “as good as dynamic radiographic assessment for the diagnosis of intervertebral hypomobility”

  Rey-Eiriz et al, 2010

**Cervical PIVM Validity: Motion**

- 20 symptomatic & 10 asymptomatic participants
- Random assignment
- Blinded PIVM examiner
- Rx group: Manipulation
- Control: Detuned US
- Perceived motion restriction found before treatment improves after SMT

  Lakhani et al., 2009

**Cervical PIVM: Reliability**

- 17 studies
- Kappa & Weighted-Kappa values: -0.07 to 0.84
- Study descriptions & reports highly variable
- Scores across & within studies highly variable
**Cervical PIVM: Reliability Systematic Reviews**

Seffinger et al, 2004 - Systematic Review:
“The majority of spinal palpatory diagnostic procedures are unreliable.”

Van Trijffel et al, 2005 - Systematic Review:
“.interexaminer reliability of passive assessment of segmental intervertebral motion in the cervical spine ranged from poor to substantial.”

- Poor design cited in both, esp. study protocol

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**PIVM Inter-Rater Reliability: New Data**

- PIVM at C2-3
- Study population w/ cervicogenic headache
- 120 patients
- Protocol: International Academy of Manual Musculoskeletal Medicine
- $K = 0.72 – 0.77$

Bakhtadze et al, 2011

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**Cervical PIVM: Reliability**

**Research Problem Areas**
- Studies typically use 2-3 examiners only
- Repeated examination potentially changes patient being examined
- Artificial forced choice of categories
- PIVM methodology variable

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**PIVM Inter-Rater Reliability: New Data**

- 60 subjects w/ CHA + 20 asymptomatic subjects
- 2 examiners
- Unilateral prone P-As C1-4
- Identify headache causative segment(s)
- Bias adjusted Kappas: 0.64 – 0.76

Hall et al, 2010
To Palpate or Not Palpate PIVM?

- Current evidence is conflicting as to value of PIVM in decision making in manual therapy
- Value of PIVM among clinicians highly variable

Therapist Perception of PIVM Value

- Survey of NZMPA & AAOMPT w/ 466 responses
- 66-76% completing survey expressed confidence in accuracy of PIVMs
- 5% skeptical of procedures
- 98% include PIVM results as criteria for Rx decision making
  
  Abbott et al, 2009

Therapist Perception of PIVM Value

- Survey among Dutch physios (367 / 56%)
- End-feel > pain provocation for diagnosis
- PIVMs viewed as important & confident in conclusions from testing
  - 77% somewhat to very confident in dx conclusions
  - 85% viewed as somewhat to very important for Rx
- Perceived importance & confidence in results associated w/ routine work in pts w/ spine care
  
  Van Trijffel et al, 2009

Use of PIVMs: Evidence

Use as Criteria for Classification or Treatment

“Restricted cervical segmental mobility.”
  
  Childs et al., *JOSPT*, 2008
  Clinical Practice Guideline

“...passive accessory motion testing to assess cervical spine segmental mobility...”
  
  Walker et al., *Spine*, 2008
  Randomized Clinical Trial
**Force of PIVM Studies**

- Multiple studies on mechanical models & human subjects
- Huge variances in force application w/ PIVM
- Commonly far exceeding measured force-displacement curve in cervical spine of human subjects

**Table w/ load cells**

- Patients & PTs
- Practicing clinicians w/ avg >10 yrs experience

<table>
<thead>
<tr>
<th>Grade</th>
<th>Force Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>21.8 N (4.9 lbs)</td>
</tr>
<tr>
<td>II</td>
<td>35.3 N (7.94 lbs)</td>
</tr>
<tr>
<td>III</td>
<td>58.2 N (13.08 lbs)</td>
</tr>
<tr>
<td>IV</td>
<td>61.0 N (13.71 lbs)</td>
</tr>
</tbody>
</table>

**Mechanical device offering resistance**

- 10 PTs w/ avg apx 13 years experience

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Simmonds et al, 1995

Snodgrass et al, 2007

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**Force-Displacement Curve in Human Cervical Spine**

*Tuttle et al., 2008*
Force & Accuracy of PIVM on Mechanical Model

- 66 subjects applying simulated PIVMs
- Mechanical model w/ force-displacement curves approximating that of Tuttle et al.
- Viscoelastic resistance
- 4 cohorts of students & clinicians

Hazle & Nitz, in review

Force Plate Data

<table>
<thead>
<tr>
<th>Group</th>
<th>Subject Mean Ranges in Groups</th>
<th>Group Mean (N)</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st-Year Students</td>
<td>5.71 – 48.86 N (1.28 – 10.98 lbs)</td>
<td>20.38</td>
<td>13.66</td>
</tr>
<tr>
<td>3rd-Year Students</td>
<td>4.61 – 63.82 N (1.04 – 14.35 lbs)</td>
<td>21.20</td>
<td>14.86</td>
</tr>
<tr>
<td>Novice Clinicians</td>
<td>3.71 – 38.99 N (0.83 – 8.77 lbs)</td>
<td>17.54</td>
<td>11.20</td>
</tr>
<tr>
<td>Experienced Clinicians</td>
<td>4.98 – 124.52 N (1.12 – 27.99 lbs)</td>
<td>29.46</td>
<td>30.22</td>
</tr>
</tbody>
</table>

Accuracy & Mean Peak Force

- Lighter force application associated w/ greater accuracy
  - Pr > Chi Square 0.0401

Hazle & Nitz, in review
**Forces Applied Pre & Post Feedback**

- 27 t-DPT students
- Participating in 2-day c-spine clinical course
- Force measured w/ subject standing on force plate while completing P-As on live model

Tuttle & Hazle, 2010; unpublished data

**Clinical & Teaching Application**

- Inexpensive force sensor application
- Feedback through computer’s soundcard
- Visual display

Tuttle & Jacuinde, 2011

**Feedback in Teaching Lab Setting**

**Questions/Concepts to Consider**

Hypothetical R1 & R2?

- No toe
- Resistance begins with initiation of mvmt
- R points unlikely to exist
Is the absence of objective assessment & real-time feedback a major contributor to PIVM low reliability?

Does increased early range resistance more accurately indicate segmental motion loss than the hypothetical R2?
Questions/Concepts to Consider

Will PIVM training to encourage force application at lower levels allow greater identification of segmental motion loss?

Questions/Concepts to Consider

Will real-time feedback to encourage force application within the identified force-displacement curve of the cervical spine enhance the PIVM learning experience?

Lab Session

Options for real time feedback mechanisms for classroom/instruction laboratory use

*Handout will be supplemented at time of lab session*
References


