Posteroanterior movements of the cervical spine

Neil Tuttle, BSc, GradDipAdvManipTher, MPhil

School of Physiotherapy and Exercise Science, Faculty of Health, Griffith University

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Abstract

Posteroanterior (PA) movements are commonly used to assess and treat musculoskeletal neck pain but little is known about their relationship to symptoms or treatment effectiveness.

The general purpose of this research program was to determine relationships between the manual therapy techniques known as PA movements of the cervical spine and symptoms in patients with neck pain. The specific aims of the studies were to:

- Establish a reliable immediate indicator of symptoms in patients with non-acute neck pain that is a good predictor of longer-term change in symptoms.
- Develop and establish the repeatability of a methodology for measuring PA movements of the cervical spine.
- Determine how changes in PA movements are related to:
  - local tenderness as an indicator of potential symptoms in an asymptomatic population and
  - change in symptoms in a population with non-acute neck pain.

In the first two studies change in impairments predicted change in the same impairment both between treatment sessions and by the end of treatment. Change in impairments did not however predict changes in other impairments or activity limitations. Of the impairments considered, change in active range of motion (AROM) was found to be the best predictor of longer-term change in symptoms.

In the third study, the repeatability of a custom made Posteroanterior Movement Assessment Device (PMAD) was assessed using coefficients of multiple determination (CMDs) and adjusted CMDs for inter-rater intra-day (Inter-rater), intra-rater inter-day (Inter-day) and intra-rater intra-day (Intra-rater) repeated measurements. The PMAD was found to produce repeatable measurements of PA movements of the cervical spine and maximum repeatability was achieved if the same operator reassessed the patient on the same day.

In the fourth study PA movements were measured on each side of the cervical spines of ten asymptomatic subjects. Locations with a difference in tenderness to pressure between sides were used for analysis. The tender side demonstrated greater variation of both displacement and stiffness. The tender sides demonstrated greater within-
subject stiffness for all force levels above 12 N. All individual stiffness-force curves of the tender sides were significantly different from the control side. Expected differences in single measures of either displacement or stiffness were not detected. The results suggest that the pattern of stiffness is a more effective method of characterising PA mobility than single measures used in previous studies.

In the fifth study one symptomatic and one asymptomatic location were selected in 20 patients with neck pain of more than two weeks duration. PA stiffness at each location and AROM were measured before and after each of four manual therapy interventions consisting of posteroanterior movements to each location, a general treatment and a control intervention. Following treatment to the symptomatic location, PA stiffness at forces above 8 N demonstrated significant correlations with total AROM. Following manual therapy, increased AROM is related to decreased posteroanterior stiffness in patients with neck pain, but only for the treated location and only when that location had been identified previously as symptomatic.

Overall findings

The results of the studies indicated that change in active range of movement is a good predictor of longer-term change in symptoms. The PMAD provides a repeatable method for measuring PA movements of the cervical spine. Stiffness of PA movements is related to local tenderness in an asymptomatic population. In a symptomatic population, stiffness of PA movements is related to immediate changes in AROM. Immediate changes in AROM are related to between session and end of treatment changes in AROM. Differences in PA stiffness can therefore be considered to be related to symptoms as indicated by local tenderness and changes in PA stiffness can be considered to be related to end of treatment outcomes.
This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Signed __________________________ Date____________________________

Neil Tuttle
Publications and presentations

The experimental chapters contained in this thesis have been either published or submitted for publication and are listed below:

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7
The following conference presentations arose from the studies contained within this thesis:


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### Abbreviated terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AROM</td>
<td>Active range of motion</td>
</tr>
<tr>
<td>CMC</td>
<td>Coefficient of multiple correlation</td>
</tr>
<tr>
<td>CMD</td>
<td>Coefficient of multiple determination</td>
</tr>
<tr>
<td>D30</td>
<td>Displacement of PA movement up to a force or 30 N</td>
</tr>
<tr>
<td>FD</td>
<td>Force displacement as in FD curve</td>
</tr>
<tr>
<td>ICC</td>
<td>Intraclass correlation coefficient</td>
</tr>
<tr>
<td>K</td>
<td>Stiffness coefficient or the slope of a FD curve</td>
</tr>
<tr>
<td>LED</td>
<td>Light emitting diode</td>
</tr>
<tr>
<td>NDI</td>
<td>Neck Disability Index</td>
</tr>
<tr>
<td>PA</td>
<td>Posteroanterior as in PA movement</td>
</tr>
<tr>
<td>PMAD</td>
<td>Posteroanterior Movement Assessment Device</td>
</tr>
<tr>
<td>PSFS</td>
<td>Patient Specific Functional Scale</td>
</tr>
<tr>
<td>SAS</td>
<td>Spinal Assessment Simulator</td>
</tr>
<tr>
<td>SCB</td>
<td>Simultaneous confidence band</td>
</tr>
<tr>
<td>SF</td>
<td>Stiffness Force as in SF curve</td>
</tr>
<tr>
<td>SPAM</td>
<td>Spinal Posteroanterior Mobilisation Apparatus</td>
</tr>
<tr>
<td>SPB</td>
<td>Simultaneous prediction band</td>
</tr>
<tr>
<td>SPS</td>
<td>Spinal Physiotherapy Simulator</td>
</tr>
<tr>
<td>TROM</td>
<td>Total range of motion</td>
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Prologue

Polayi coined the term ‘tacit knowledge’ and described it as the stock of professional knowledge that experts possess, that is not processed in a focused cognitive manner but rather lies at a not quite conscious level where the knowledge is accessible through acting, judging or performing….It is a type of knowledge that is acquired through experience. Polayi called this tacit knowledge because experts were able to act on it but could not always verbalize exactly what they were doing or why. He expressed this concisely in the words ‘we know more than we can tell’ (Fleming & Mattingly, 2000).

When describing the topic of this thesis to friends and colleagues some have been perplexed enough to ask how I, who am so interested in the interactive nature of the therapeutic process, could undertake such a seemingly reductionist project. The contradiction is perhaps not as great as it might initially appear so with the reader’s indulgence, I will take the liberty of briefly telling a story to put the thesis in context.

The story starts in 1975 when, as a recently graduated, but somewhat disillusioned physical therapist I was riding a bicycle somewhere between San Francisco and the Mexican border. Unbeknownst to me and half a continent away, my future ex-housemate Ted Stone blithely signed my name accepting a position to study in Australia. For the following year, Geoff Maitland lent me his tools while I started to learn the craft of manual therapy. In the many years since I have become convinced of the value of being intellectually, emotionally and physically responsive to those who come to me for assistance with their musculoskeletal problems.

When physical manual therapy interventions are performed in a way that I am referring to as responsive, the therapist ceases to impose a technique or intervention on the patient. Rather there is a moment-to-moment interaction where both the therapist and patient continually respond to each other. There is an implicit assumption in this ‘conversation’ that the therapist feels and responds to meaningful information. The questions that prompted me to undertake this thesis are not just about the specific
technique of PA movements. Rather the questions are intended to be a first step towards understanding if there is a basis for the two-way physical conversations that manual therapists think we have with our patients or do we simply indulge in complex responses to random physical noise. Do we indeed know more than we can tell?

Reference
Acknowledgements

Nearly thirty years after the story began; I received invaluable advice from Professor Joy Higgs during a brief drive through the canyons of Surfer’s Paradise. It was a conversation from which fragments resurface at irregular intervals, but two points alluding to an economic model were: 1) It is your PhD, so the research question either needs to already be your own or one you are happy to purchase and 2) You ‘employ’ your supervisors on a long contract so hire them carefully. Thank you, Joy. The questions were (almost) all mine.

As for my supervisors, Liisa Laakso and Rod Barrett, you have both been invaluable and impeccable. Thanks Liisa for the structure from the whiteboard and timeline to the final product; for the regular meetings, warmth and encouragement; and for keeping your cards close to your chest while letting me run, but reigning me in just before I was too far astray. Rod, thank you for being a bridge between the scientific and the clinical; for struggling and forcing me to struggle with devils disguised as details; and for always giving the impression of being pleased to get another stack of papers on a Friday afternoon. Now that our ‘contract’ is finished, you both deserve a bonus as well as long-service leave.

I would like to thank: the School of Physiotherapy and Exercise and in particular the head of school, Lewis Adams for his ongoing support; Steve Obst and Lee Barber for assistance with data collection; Judy Waters for assistance with editing and formatting of the final document; and to Andrew Petersen – so long and thanks for all the coffee.

I can’t express sufficient thanks to my family Sue and Nathan. In particular thank you Sue, I don’t know how you have put up with me when my social interactions and contributions to our home and practice have often over the last few years rivaled those of a garden gnome.