Position of undergraduate students' thumbs during mobilisation is poor: an observational study

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Questions: What is a clinically-representative maximum force for central posteroanterior mobilisations performed using the thumbs on the lower cervical spine? Can students reach this force while maintaining the recommended thumb position of neutral to slight flexion at the interphalangeal and metacarpophalangeal joints? What happens at the interphalangeal and metacarpophalangeal thumb joints of students who are unable to maintain this position? ***Design:*** Observational study. ***Participants:*** Eleven physiotherapy educators (academic and clinical) and 25 physiotherapy students (4th year). ***Outcome measures:*** The clinically-representative maximum force was determined by physiotherapy educators performing posteroanterior mobilisations on a simulated neck for a hypothetical patient. The force used by the educators became the target force. Videos of physiotherapy students performing posteroanterior mobilisations to this force were analysed for (i) the ability to maintain the recommended thumb position while attempting to reach the force, and (ii) the ability to maintain the position during 30 oscillations around the force. ***Results:*** A mean maximum force of 122.86 N (SD 50.16) which equates to 12.52 kg was determined. Only 2 of the 25 students assessed could maintain the required position while applying approximately 12 kg through their thumbs. Of the remaining 23 (92%), 14 (56%) could reach the target force but could not concurrently stabilise their thumbs in the recommended position. The other nine (36%) could not reach the target force and also could not maintain their thumbs in the recommended position. ***Conclusion:*** This study has occupational health and safety implications for physiotherapy students. **[Buckingham G, Das R, Trott P (2007) Position of undergraduate students' thumbs during mobilisation is poor: an observational study. *Australian Journal of Physiotherapy* 53: 55–59]**

Key words: Thumb; Physical Therapy Modalities; Physical Therapy (specialty); Manipulation, Orthopaedic

Introduction

There is a high prevalence of work related musculoskeletal disorders in physiotherapy (Cromie et al 2000, Reglar and James 1999). The work can be repetitive and may use high loading of physiotherapists' joints. In physiotherapists the wrist and hand is rated the second highest anatomical area of injury after low back injuries (Bork et al 1996, Caragianis 2002, Cromie et al 2000, Holder et al 1999). Manual orthopaedic techniques, and in particular posteroanterior mobilisations have been identified as a causative factor in work related musculoskeletal disorders of the thumbs (Cromie et al 2000, Cromie et al 2001, Wajon and Ada 2003, Winzeler and Rosenstein 1996). Incorrect thumb position during these techniques, coupled with high compressive loads, could theoretically lead to pain, or even permanent and debilitating thumb injury.

Posteroanterior mobilisation as described by Maitland (2001) is taught in the undergraduate physiotherapy program at the University of South Australia. It is not known whether students who are taught this technique are able to maintain the recommended position of their thumbs while applying forces required in clinical practice. The high prevalence of work-related musculoskeletal disorders in young therapists (Cromie et al 2000) indicates that there is a requirement to understand why they are developing these problems, and whether they first occur in physiotherapy students. There is also a requirement to increase student and therapist knowledge about recommended workplace environment, posture during the application of manual techniques, and workload limits.

The recommended position of the thumbs for the application of a posteroanterior technique is with the thumbs in opposition and as close to back-to-back as possible, neutral to slight flexion of the metacarpophalangeal and interphalangeal joints and points of contact over the spinous process to be mobilised (Maitland 2001, Manheim 2000). It has been calculated that increased flexion or hyperextension (extension beyond zero degrees) at the metacarpophalangeal or interphalangeal joints can cause increased loading on the joints during weight bearing (Buckingham 2003, Wan 1986). The ability to maintain the recommended position of the thumb when performing posteroanterior mobilisation may depend on both dynamic and static stability of the thumb joints, as well as the magnitude of force that students are required to use in clinical practice. Currently the magnitude of these forces is not known. The research questions for this study were, therefore:

1. What is a clinically-representative maximum force for central posteroanterior mobilisations performed using the thumbs on the lower cervical spine?
2. Can students reach this force while maintaining the recommended thumb position of neutral to slight flexion at the interphalangeal and metacarpophalangeal joints?
3. What happens at the interphalangeal and

metacarpophalangeal thumb joints of students who are unable to maintain this position?

Method

Design: The observational study comprised two parts. In Part 1, physiotherapy educators were asked to perform posteroanterior mobilisations on a simulated neck for a hypothetical patient. The patient was described as a young male with a short stocky build and thickset neck who had a hypomobile C6 that was stiff, not painful or irritable, and had no contraindications to any treatment. The force used by the educators became the target force. In Part 2, physiotherapy students were asked to perform posteroanterior mobilisations to the target force on the simulated neck using the recommended thumb position of neutral to slight flexion at the interphalangeal and metacarpophalangeal joints (Figure 1). Ethical approval was granted by the Divisional Ethics Committee (Health Sciences) of the University of South Australia. Each participant gave informed consent.

Participants: Physiotherapy educators (academic and clinical) from the University of South Australia, who were involved in teaching posteroanterior mobilisations to undergraduate physiotherapy students, and had postgraduate Masters qualifications in manipulative physiotherapy were invited to participate in Part 1 of the study. Participants were excluded if they had: an upper limb injury within the last six weeks, a known generalised inflammatory or joint condition involving the upper limbs, or a known neurological condition affecting the upper limbs.

Fourth year physiotherapy students from the University of South Australia were invited to participate in Part 2 of the study. They were chosen because they had been exposed to Maitland techniques since the second year of the course. The exclusion criteria were the same as for Part 1.

Outcome measures: In Part 1, a clinically-representative maximum force for central posteroanterior mobilisations was measured using a simulated neck. It consisted of a metal bar with a strain gauge attached to one side, an amplification circuit, power supply, and a laptop computer strapped to an adjustable plinth. The metal bar represented a cervical vertebra with the inherent stiffness of the metal providing resistance. As the metal was bent by educators pressing on it with their thumbs, the change in resistance was calibrated to provide an output that represented the force applied. This output was viewed as a real time display on the laptop. Validity of the equipment was tested by applying loads of up to 20 kg to the metal bar. There was a high linear relationship between the output data and the applied loads ($r = 0.99$) and more than 99% of the variability in load could be predicted by variability in the output. The equipment was also tested for reliability by repeated application of specific loads. The output results were so similar that statistical variance between them could not be calculated with an intra-class correlation coefficient, which indicated near perfect reliability (Buckingham 2003). Having familiarised themselves with the equipment and adjusted the plinth height, educators were given three attempts to 'treat' the hypothetical patient using posteroanterior mobilisations by pushing down on the metal bar. Each attempt was recorded and a marker inserted into the data stream when participants indicated they had reached their preferred maximal treatment force. This force was held for approximately 5 seconds for ease of locating the data during processing. The three attempts were averaged to provide a treatment force for that participant. Results were averaged across participants to produce a clinically-representative maximum force for posteroanterior mobilisations to the lower cervical spine. This was designated the target force for use in Part 2.

Figure 1. Recommended thumb position.

In Part 2, students tried to maintain the recommended thumb position while applying the target force. Having familiarised themselves with the equipment and adjusted the plinth height, students were given three attempts to reach the target force using posteroanterior mobilisations by pushing down on the metal bar. They were asked to view the laptop screen to watch the output in real time. There was an indicator on the screen that changed from 'Press Harder' to 'Target Reached' when sufficient force had been applied. If they were successful in any of the three attempts then they were asked to oscillate around the target force for 30 repetitions to the beat of a metronome at a rate of approximately 2 beats a second, to simulate a treatment. Participants were videotaped to determine thumb position and deviation from the recommended position. The camera was positioned at the head of the table to achieve a lateral view of thumb position and was focused on the thumbs to reduce the likelihood of participants being recognised by the examiners. The video was analysed for (i) the ability to maintain the recommended thumb position while attempting to reach the target force, and (ii) the ability to maintain the position during 30 oscillations around the target force.

Data analysis: Analysis of thumb position was descriptive. All three researchers analysed the video footage together to assess the participant's thumb position during the application of force. They determined whether the thumb position was acceptable and, if not, described the pattern of deviation. If necessary, footage was viewed repeatedly until agreement between researchers was reached. In the majority of cases, deviation of thumbs from the desired position was obvious to all three examiners on the first viewing.