Is manual therapy targeted at specific spinal segments possible or necessary for treatment?

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Abstract

Segmental specificity of treatment has been recommended for optimising outcomes in manual therapy. This review wanted to examine some necessary related concepts:

1) Is a posterior-anterior mobilisation specific to a motion segment?
2) Is a specific mobilisation better than a standardised mobilisation?
3) Is there evidence to support the reliability of determining specific problems?
4) Is there evidence to support the validity of determining specific problems?

Relevant studies were located by search of Medline and search of references from located studies. Over thirty studies were reviewed that addressed these different issues. A posterior-anterior mobilisation does not only affect the segmental level to which it is applied, but the local spine as a whole. There is no evidence to suggest that specific manual therapy techniques are superior to non-specific or standardised ones. It is unlikely that specific impairments, such as the comparable level, fixations or stiffness, can be reliably detected between therapists. The evidence regarding the link between such specific impairments and back pain is contradictory. Overall, the evidence suggests that manual therapy aimed at specific segments is neither possible nor necessary to optimise outcomes.

Introduction

Treatment specificity has been advocated by manual therapists. This means that forces provided by manual therapy techniques should be applied at specific spinal levels and in specific directions to be of optimal effectiveness. For instance, *'significant comparable signs will be evident on palpation at the appropriate intervertebral level'* (Maitland 1986, page 73). *'Manual diagnosis can consistently and accurately determine the offending level in cases of spinal pain' in the cervical spine* (Jull et al 1988). *'A patient's physiological movements may appear normal, yet the palpation tests for intervertebral movement will reveal joint signs'* (Maitland et al 2005, page 150). However, the belief that manual therapy treatment should be directed at specific segmental levels, although it appears to be logical, has not been explicitly proven. The specificity of manual therapy techniques has been advocated, but is it necessary?

If this assumption is true, then certain criteria should pertain. If specificity of manual therapy was important then it should be attainable and techniques should be shown to be able to target specific motion segments. Furthermore, it should be demonstrated that such specifically selected manual therapy procedures are more effective than standardised or randomly selected ones. A further underlying assumption is that treatment is aimed at specific impairments, which are diagnosed by the physical examination. For instance, that a hypomobile spinal segment, which is determined by palpation examination, requires mobilisation to improve the patient's condition. This assumption requires reliable and valid methods to make the diagnosis.

The aims of this review were to explore these issues by exploring the following questions:

1. Is the effect of specific techniques actually specific? As posterior-anterior (PA) or extension mobilisations have been most commonly studied; this question will be addressed by understanding what PA mobilisations achieve physiologically.
2. If clinicians can choose specific manual therapy techniques, are these more effective than standardised or randomly chosen techniques?
3. Can specific impairments be diagnosed reliably?
4. Is there a validated correlation between specific impairments and spinal pain?

Methods

To find material for this review, Medline was searched up to June 2008 with the following terms combined with Boolean operators: manual therapy, mobilisation/ mobilization, manipulation, spine, effect, palpation, reliability, validity. As the results of this search were not very effective, as it missed papers that were already in the author's library, particular emphasis was placed on hand searches. These included reference lists of all retained articles, and hand searching of relevant appropriate journals: *Manual Therapy, Journal of Manipulative and Physiological Therapeutics, Journal of Manual and Manipulative Therapy, Clinical Biomechanics, Physiotherapy, Physical Therapy, and Australian Journal of Physiotherapy* for the last two years. As the nature of study design varied considerably, a formal evaluation of study quality was not attempted.

Results

The effect of extension or posterior-anterior (PA) mobilisations

Snodgrass et al (2006) conducted a systematic review into what forces were applied during a PA spinal mobilisation. They retrieved 20 papers investigating the quantitative measurement of applied force during a PA mobilisation, with most focusing on the lumbar spine. Techniques, measurement and reporting procedures were performed using a range of methodologies. When defined by magnitude, frequency, amplitude and displacement, PA mobilisations were found to be extremely variable among clinicians applying the same technique. For instance, when applying grade I mobilisations to the lumbar spine, average peak force varied from 10 to 50 Newtons; grade II from 15 to 120 Newtons; grade III from 120 to 225 Newtons; grade IV

from 90 to 240 Newtons. Although there is a general pattern of increasing force with higher grades, there is considerable overlap between grades and marked variation between practitioners applying the same grade. It is reasonable to conclude that grades of mobilisation applied by different therapists are not consistent.

A number of studies have evaluated the effects of PA mobilisations in terms of motion achieved at the lumbar and cervical spines **(Table 1)**. These consistently show that the effect is not localised to the single segment where the force is applied, but affects the whole spine. In general, forces applied at lower lumbar segments produce extension of the whole lumbar spine; whereas forces applied at upper lumbar segments produce flexion at the lower segments. Clearly, it cannot be stated that the effect of a PA mobilisation is localised to the vertebral motion to which it is applied. However, in contrast to these findings, two studies actually found that there was no or minimal translation or intervertebral motion in response to PA mobilisations to the cervical spine in controls and in subjects with neck pain (McGregor et al 2001, 2005). PA mobilisations were simply shown to cause soft tissue compression.

Another way researchers have looked at this issue is by analysing the source of cavitation sounds compared to the segmental level supposedly being manipulated (Beffa and Matthews 2004, Ross et al 2004). No meaningful relationship was found between the segment being manipulated and the source of cavitation sound. So, the sound of the manipulation 'pop' is neither related to therapeutic effectiveness (Flynn et al 2003, 2006) nor to the segment being manipulated (Beffa and Matthews 2004, Ross et al 2004).

Does specificity improve outcomes?

The next question is whether specific techniques chosen by therapists are more effective than standardised techniques over which the therapist has no choice? Two randomised controlled trials (Chiradejnant et al 2003, Haas et al 2003), and a meta-analysis (Kent et al 2005) have examined the effect of clinician choice in manual therapy treatment; the trials were not included in the meta-analysis.

Chiradejnant et al (2003) conducted a randomised controlled trial in which 140 patients with non-specific low back pain were randomly allocated to receive either the therapist-chosen mobilisation technique or a randomly assigned mobilisation technique. Mobilisation techniques in both groups were applied at the segmental level and at the grade nominated by the examining therapist; only the technique was selected by the therapist or randomly applied. Follow-up measures were taken immediately after the interventions. Both interventions had an immediate effect in relieving back pain, but the choice of mobilisation had no effect on any of the outcomes investigated. Mobilisations applied to the lower lumbar spine had a greater effect than those applied to the upper lumbar spine, but the specific technique used seemed unimportant (Chiradejnant et al 2003).

Haas et al (2003) randomly assigned a group of patients with neck pain to either a segmentally targeted manipulation chosen by the examining clinician according to endplay restriction or to a randomly chosen manipulation. There were significant improvements in both groups short-term, but no significant differences between groups.

Kent et al (2005) included manual therapy interventions selected at the discretion of the treating clinician compared to no, sham or other interventions in ten trials. When trials using manual therapy were compared to no or sham intervention there was a significant difference in effect size for short-term activity limitation in favour of the no/sham intervention. There were no significant differences in any other short or long-term outcomes. When chosen manual therapy techniques were compared to other interventions there were significant differences in short-term pain and activity limitations in favour of the other interventions, but no significant differences long-term. The authors were cautious about making emphatic conclusions due to the limited available data. However, they were clear that the present data does not support the premise that therapist-selected manual therapy techniques have a greater therapeutic effect than no, sham or other treatments. All of the pooled estimates of effect size favoured the groups where clinicians did not have choice over their manual therapy technique.

The evidence from these three papers makes for sobering reading for believers in specificity of manual therapy in non-selected non-specific low back pain or neck pain patients. In essence, the data suggests that not only do specific techniques appear to confer no additional benefits to randomly chosen ones (Chiradejnant et al 2003, Has et al 2003), but also that treatment effect size appears to be greater in no/sham or other treatment compared to selected manual therapy procedures (Kent et al 2005). It should be noted, as well, that in the recent development of clinical prediction rules for identifying successful responders to manipulation (Flynn et al 2002, Childs et al 2004), the technique used was a standardised, routine manipulation purportedly aimed at the sacro-iliac joint and not related to examination findings, but still successful.

Reliability of palpation findings

Although there are a few studies that suggest that palpation can be reliable, for instance in detection of congenital fusion in the cervical spine (Humphreys et al 2004), the overwhelming weight of evidence points in the opposite direction. A number of recent systematic reviews have examined the reliability and validity of spinal examination procedures (Hestboek and Leboeuf-

Yde 2000, van der Wurff et al 2000a, 2000b, Seffinger et al 2004, van Trijffel et al 2005, Hollerwoger 2006, May et al 2006, Stochkendahl et al 2006). A consistent finding has been the poor reliability of palpation based assessment, compared to the moderate reliability of some examination procedures based on symptom response **(Table 2)**. From the available evidence, there is little doubt that decisions based upon palpation findings are of dubious consistency and, therefore, do not make a reliable basis upon which to base management decisions. Two reviews (May et al 2006, Stochkendahl et al 2006) produced levels of evidence based on the quality of the literature, with the following conclusions. There was conflicting evidence for identifying spinal level, muscle spasm and instability; and moderate evidence of low reliability of passive accessory and passive physiological movements, the comparable level, and 'fixations' (May et al 2006). There was strong evidence for unacceptable reliability for motion palpation (mean kappa 0.17) and soft-tissue changes (mean kappa 0.03); and conflicting evidence for static palpation and global assessment (Stochkendahl et al 2006). Consistently, pain responses have shown stronger reliability than findings made by palpation **(Table 2)**.

Validity of palpation findings

We might also ask if PA mobilisations are valid at detecting movement impairments or diagnostic classifications. Manual PA tests were unable to detect the most and least mobile segments as identified by the 'gold standard' of MRI investigation (Landel et al 2008). Previously, it was suggested that an experienced manual therapist could accurately identify symptomatic vertebral segments with neck pain, with 100% sensitivity and 100% specificity (Jull et al 1988). However, a replication study using contemporary criteria demonstrated poor specificity (47%), but reasonable sensitivity (89%) in identifying cervical zygapophyseal joint pain (King et al 2007). In general then, it must be concluded that palpation is neither reliable nor valid at identifying pathology.

Is there a correlation between specific impairments and spinal pain?

Regarding the relationship between impairments and back pain, a number of studies have considered this with a variety of methodologies **(Table 3)**. Generally, findings have been contradictory. Some studies have identified an association between hypermobility (Kulig et al 2007, Abbott et al 2006) or hypomobility (Lundberg and Gerdle 2000, McGregor et al 2002, Abbott and Mercer 2003, Abbott et al 2005, 2006) and back pain. However, the findings have not been consistently found and other studies have found no association between hypermobility (Lundberg and Gerdle 2000, Beneck et al 2005, Abbott et al 2006) or hypomobility (Beneck et al 2005, Kulig et al 2007, Owens et al 2007) and back pain or the most painful segment.

Discussion

In response to the questions posed above, the following answers arise from the material reviewed in this article. A PA mobilisation does not only affect the segmental level at which it is applied, but the local spine as a whole. However, there is also some evidence that they have no effect on inter-segmental motion at all, they simply cause soft tissue compression. Specific manual therapy techniques are not superior to non-specific or standardised ones. It is unlikely that specific impairments, such as the comparable level, fixations or amount of accessory movement, can be reliably detected between therapists. Nor does it appear that palpation findings offer valid methods of identifying impairment or pathology. The evidence regarding the link between such specific impairments and back pain is contradictory.

Only the evidence regarding the link between specific impairments and back pain was contradictory and might alter in light of new evidence, especially as the technology in this area is changing and developing. In the past, however, the cut-off points for diagnosis of hypomobility and hypermobility have been largely arbitrary, and it is clear that there is wide variability and a wide range of translation in asymptomatic individuals. Earlier studies reported a high prevalence of instability in 23-69% of chronic LBP subjects from flexion-extension radiographs (Abbott et al 2006). But these prevalence rates were deemed to be suspect as arbitrary definitions of 'abnormal' would have lead to high rates of false-positives (Abbott et al 2006). Abbott et al (2006) used a statistically defensible method, but their method only allowed for statistical not clinical identification. They reported hypomobility rates of 18-35% and hypermobility/instability rates of 5-32% depending on the method used and direction of abnormality (rotation or translation).

The overall contradictory findings suggest there may well be an association between these impairments and LBP, but this does not mean there is a causal link, nor that treatment directed at these impairments will lead to improved levels of pain and function. To prove a causal link, a prospective cohort study is necessary and such a study was not located. As it is it cannot be known if hypomobility and hypermobility cause back pain, are consequences of it, or are incidental findings rather than 'impairments', within the range of normal and nothing to with spinal pain. Studies that have sought to address the link between such impairments and treatment have produced contradictory findings. Fritz et al (2005) categorised patients as having either hypomobility (71%) or hypermobility (11.5%) and then randomised them to either spinal manipulation or stabilisation exercises. Patients with hypomobility who received manipulation and those with hypermobility who received stabilisation exercises showed greater improvements than those treated with the other

intervention, which logically would be expected if these impairments were relevant to symptoms. Failure rates in patients with hypomobility were 26% in those receiving manipulation and 74% in those receiving stabilisation exercises. Failure rates in patients with hypermobility were 83% in those receiving manipulation and 22% in those receiving stabilisation exercises. So, this study would suggest a link between these impairments and the type of treatment; however a similar study failed to demonstrate such a link. Ferreira et al (2008) also assessed spinal stiffness before and after randomisation and treatment by manipulation, stabilisation exercises or a general exercise programme. All groups showed a significant decrease in stiffness following treatment, but the decrease was not dependent on the treatment. There was a significant relationship (P=0.02) between changes in stiffness and pain and function, but the correlation was weak (r=0.18 and -0.28 respectively). So, this study does not support a link between impairment and specific treatment – if there was such a link it might be expected that manipulation would produce the most significant decreases in stiffness.

The nature of this review has meant that it has included a large variety of different study methodologies, and as mentioned in the introduction, the initial search was of limited value in selecting appropriate evidence. Most papers were found from reference lists of the included papers that were already in the author's library. It is difficult to know if other relevant evidence has been missed; however as most of the conclusions were generally consistent from a number of sources, any fundamental change in the study conclusions would be unlikely in the face of new material. But the difficulty of knowing if this review has been truly comprehensive is a significant weakness. Likewise, the review included multiple study designs, but has not been able to review study quality nor to determine the optimal study methods for addressing these questions.

Conclusions

From the evidence reviewed here, and taking into account the fact that some evidence is contradictory or that some additional evidence may not have been located, some conclusions can be drawn. Mobilisation forces are not consistently applied by different therapists. Although there is increasing force with increasing grades there is considerable overlap between the different grades. The effect of a PA mobilisation is not limited to the segment to which it is applied, but affects the whole local spine. Some evidence suggests that PA mobilisation only produces soft tissue compression and does not affect spinal motion at all. Regarding specific manual therapy techniques, these appear to confer no additional benefit to randomly chosen ones, but also the treatment effect size appears to be less in selected manual therapy procedures compared to no, sham or other treatments. Studies are consistent in demonstrating the poor reliability of findings based on palpation, so if these are being used to make management decisions it is clear that these are based on inconsistent decisions made by therapists. There is contradictory evidence about the validity of manual therapy examination to determine impairment or pathology. There is contradictory evidence relating impairments and back pain, and contradictory evidence relating specific impairments to specific treatment interventions.

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Table 1. Effects of extension or posterior-anterior (PA) mobilizations

Ref	Methods	Subjects	Findings	Conclusions
Lee and Evans 1994	Review of work using a biomechanical model - lumbar	Model	Maximal extension force at segment where force was applied, but affects all segments; posterior shear above and anterior shear below	Amount of local movement very small, highly improbable can be felt; whereas bending of the whole spine is much greater
Lee and Evans 1997	X-ray using loading frame to apply static force at L4	12 healthy volunteers	Lumbar segments extended, L5 -S1 flexed; L1/2 to L3/4 translated posteriorly, L5-S1 anteriorly	Limited mobility, unlikely that movement can be assessed with reliability
Caling and Lee 2001	Assessment of lumbar stiffness using a simulator	24 healthy volunteers	Stiffness varied with angle of force when applied at L3, but not at L5	Not clear if clinicians could detect changes in stiffness of 5-10%
McGregor et al 2001	PA within MRI to cervical spine	5 healthy volunteers	No significant intersegmental motion or translation with grade I or IV, but significant soft tissue compression	PA to cervical spine have no effect on intervertebral motion
Powers et al 2003	Manual application of lumbar PA within MRI	11 healthy volunteers	Force applied at L3/4 to L5-S1 caused extension at adjacent 2 segments. Force at L1/2 and L2/3 caused flexion at lower segments	PA caused extension locally, but affect on lordosis depended on where force was applied
Kulig et al 2004	Manual application of lumbar PA within MRI	20 healthy volunteers	Force applied at L3/4 to L5-S1 caused extension at adjacent 2 segments. Force at L1/2 and L2/3 caused flexion at lower segments	PA at single segment caused motion of all segments; direction depended on where force was applied
Lee et al 2005	Manual application of PA within MRI machine at C5	19 healthy volunteers	Produced extension of upper motion segments and flexion at C7-T1, middle segments were inconsistent	PA at single segment caused motion of all segments and overall increase in lordosis
McGregor et al 2005	PA within MRI to cervical spine	5 subjects with NP	No significant intersegmental motion or translation with grade I or IV, but significant soft tissue compression	PA to cervical spine have no effect on intervertebral motion
Landel et al 2008	Is lumbar PA exam reliable between raters and valid compared to MRI?	29 subjects with LBP	Overall reliability kappa 0.71; poor for most mobile segment (kappa 0.29); Validity was poor for least and most mobile segments (kappa 0.04 and 0.00)	PA could not detect least and most mobile segments compared to 'gold standard' of MRI

Table 2. Conclusions about palpation findings from systematic reviews

Reference	Review topic	N	Conclusions regarding palpation
Hestboek & Leboeuf-Yde 2000	Chiropractic tests for lumbar and pelvis to determine need for manipulation – reliability and validity	30	Only tests for palpation for pain had acceptable results. Motion palpation for lumbar spine showed poor reliability, but might be valid. Motion palpation of pelvis seemed to be slightly reliable, but was not valid. Presence of a manipulative lesion remains hypothetical
Van der Wurff et al 2000a	Tests for sacroiliac joint - reliability	11	Mobility tests showed consistently poor reliability; whereas pain provocation tests reliability was contradictory with good reliability in some studies
Van der Wurff et al 2000b	Tests for sacroiliac joint - validity	11	No evidence to support the validity of mobility or pain provocation tests in identifying SIJ dysfunction
Seffinger et al 2004	Spinal palpation for back and neck pain - reliability	49	12 highest quality studies found pain provocation, motion and landmark tests to have acceptable reliability (kappa > 0.40). The majority of palpatory diagnostic tests demonstrated low reliability. Pain provocation tests are most reliable
Van Trijffel et al 2005	Passive assessment of intervertebral motion in cervical and lumbar - reliability	19	Overall reliability for both areas of spine was poor to fair; range poor to substantial. Assessment of motion at C1/2 and C2/3 consistently fair reliability
Hollerwoger 2006	Manual cervical spine examination – reliability and validity	15	Detection of segmental cervical 'dysfunction' on manual assessment alone is questionable
May et al 2006	Physical exam procedures lumbar spine - reliability	48	Conflicting evidence for identifying spinal level, muscle spasm and instability. Moderate evidence of low reliability of passive accessory and passive physiological movements, the comparable level, and 'fixations'.
Stochkendahl et al 2006	Manual exam of spine - reliability	48	Strong evidence for reliability of osseous pain (mean kappa 0.53) and soft tissue pain (mean kappa 0.42). Strong evidence for unacceptable reliability for motion palpation (mean kappa 0.17) and soft-tissue changes (mean kappa 0.03). Conflicting evidence for static palpation and global assessment