

Manual Therapy

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1. Introduction

Manual therapy (MT) is a very common practice among primates and its range of uses and the variety of techniques is probably infinite. It has been professionalised for the treatment of a variety of conditions for at least two millennia, with texts appearing in China and in the fourth century BC in Greece by Hippocrates, whose applications of it were mainly musculoskeletal [1-3].

Manual therapy (MT) is considered to be a method of intervening therapeutically involving the application of movement to the body. This commonly takes the form of movement that is applied to the recipient rather than movement generated by the recipient and thus is termed passive movement [4] [5]. However, forms of guided active movement and isometric muscle contractions [6-8] are also considered to fall under the umbrella term of manual therapy. Practitioners undertaking MT will use clinical reasoning to determine the parameters, location and objectives of applied movement [9] and will typically label the type of MT used, based on the tissue perceived as being targeted. For example, there are numerous texts describing joint mobilisations, (Maitland, 1986, Vicenzino, Paungmali, 2007), muscle techniques, [8] and nerve techniques [10]. Of course, the application of contact to the body with the intention of guiding or evoking motion will influence skin, fascia, neural, vascular, lymphatic, myogenic and arthrogenic tissue and thus such labels are a little artificial.

This chapter will review the modern use of manual therapy for low back pain under the headings of: History and background, Scope and types, Evidence and guideline recommendations, Mechanisms of action and Clinical indications and contraindications.

2. History and background

There is historical evidence that manual therapy was used for back pain by the Greeks [1] and that the techniques were passed to the Romans. After the fall of Rome, knowledge of its use in Western Europe was preserved through the writings of Avicenna of Baghdad and mainly fell to bonesetters. Probably encouraged by the expansion of industry and agriculture in North America, it was professionalised in the mid-19th century under the name of osteopathy and in the late 19th century as chiropractic. By the 1920s, physiotherapists too began to take an interest - firstly in the form of massage and, in New Zealand and Australia, as mobilisation and manipulation. As the 20th century progressed, it was also adopted by a variety of medical groups in Europe who sometimes combined it with pharmaceutical treatments.

The initial theoretical constructs around manual therapies for the treatment of back pain were set down by leading figures in the professions from their experience, rather than from experimental evidence. As a consequence, the practice was for many years considered to be unscientific, and therefore undesirable, and its practitioners stigmatised. This absence of pathophysiological evidence was partially due to the complex multifactorial aetiologies and mechanisms in back pain and partially to their relative inaccessibility to *in vivo* biological measurement. It is a limitation that persists to the present day, but usually attracts greater understanding from conventional medical practitioners than before.

With increasing health care regulation towards the end of the 20th century, levels of education and accountability of the non-medical groups rose and their isolation abated. Although independent

practice remains the norm and original individual underpinning theories continue to some extent, the practice of manual therapy is now largely guided by our contemporary biopsychosocial model of health and is generally regarded as making a valuable contribution to the care of the large proportion of the population with low back pain [11].

3. Scope and types of manual therapy

Although some back pain can be attributed to identifiable lesions, most cannot be given a definitive diagnosis because the pathophysiological mechanisms have not been sufficiently described [12]. Manual therapy is mainly used for non-specific back pain, largely because this makes up approximately 85% of back cases and is characterised by the absence of serious pathology, whereas there is a need for greater selectivity when applying forces where there is nerve root involvement and there are contraindications presented by disease infiltrations. Manual therapists therefore necessarily have a role in the diagnostic triage of these conditions.

The list of MT procedures is endless and eclectic and cannot be accurately delineated. However, for purposes of identifying a coherent and reasonably well accepted categorisation for use in a major UK clinical trial, Harvey et al [13] achieved a consensus between representatives of the osteopathic, physiotherapy and chiropractic professional organisations in formulating broad major categories. These were presented under the headings of: soft tissue techniques, articulatory techniques or ‘mobilisations’ and thrust techniques, or ‘manipulations’ (Box 1.)

Box 1. Main types of manual therapy procedures used for low back pain (Harvey et al, 2003)

Soft tissue techniques:

cross-fibre stretch, longitudinal stretch, direct pressure, deep friction; neural mobilization.

Articulatory techniques (mobilizations):

Low through to high-amplitude passive movements of lumbar spine and sacroiliac joints; flexion, extension, rotation, side-bending, manual traction; oscillation, accessory glides.

Thrust techniques (‘manipulations’):

High or low velocity; low amplitude; direct or leverage; directed at central lumbar, zygapophysial or sacroiliac joints; unilateral or bilateral; at one or more locations.

MT can also be sub-categorised based on the parameters of the movement produced. Non-localised, light pressure, large amplitude, stroking movement could be considered to characterise “soft-tissue massage” [14] whilst, small amplitude, high velocity movement would be considered to be typical of “manipulative thrust” techniques [15 16]. Whilst there are differences in the methods, one might use to introduce movement to the lumbar spine, there appear to be some common responses to applied touch and movement that can offer therapeutic benefits to those experiencing pain in this region. Consideration of MT (as a component of a multimodal package of care) is recommended in the UK’s most recent national guideline on the management of low back pain and sciatica and its use is considered to be cost effective [17].

4. Evidence and guideline recommendations

Manual therapy involves a number of interacting elements and multiple outcome targets as part of treatment as well as tailoring of the intervention towards the individual. This fits with the definition of a complex intervention [18]. As such, the pragmatic randomised controlled trial (RCT) is the dominant research design that has been utilised to evaluate the outcomes of manual therapy. Whilst this approach is more suitable than explanatory designs typically used in pharmacological RCTs, it has meant that the majority of the evidence relating to manual therapy and low back pain relates to evidence of effectiveness (effectiveness of treatment approach) rather than efficacy (efficacy of individual specific procedures / techniques).

Pragmatic trials respond to questions about whether or not treatment approaches work when in the context of normal practice. The manual therapy approach is usually compared with another available treatment rather than a sham or a placebo. In a pragmatically designed trial, the aim is not to reduce or strongly control all the variables associated with the intervention, whereas explanatory trials are highly controlled and attempt to carefully constrain the treatment to a single reproducible intervention. The explanatory approach may have higher internal validity, but has less applicability in the real world for treatment approaches like manual therapy [19]. The quality of trials of spinal manipulative therapy for low back pain has improved over time. However there remains scope for further improvement [20], including more clearly describing the manual therapy interventions [21 22] and enhancing the description of the characteristics of those included and excluded from recruitment into trials [23].

Existing trials assessing manual therapy treatment for low back pain tend to show small to moderate benefits at best when manual therapy is compared to other conservative interventions or sham treatments. Not all trial evidence is consistent in demonstrating benefits from manual therapy [24]. This is reflected in clinical guidelines that mostly recommend considering manual therapy as an option for people with nonspecific low back pain. In an overview of guidelines for the management of non-specific back pain in primary care, twelve out of fifteen guidelines reviewed included manipulation as a recommendation. However the authors noted the variability of the timing of application and variations in the target groups [25]. Recent clinical guidelines in the UK and USA have included the consideration of manual therapy treatment as a recommendation [26 27]. In the UK NICE clinical guideline, manual therapy is not recommended as a standalone treatment, but to be delivered as part of a treatment package including exercise [26]. This reflects the recognition that manual therapy should not be delivered or construed of as a passive monotherapy, but should be delivered in the context of a biopsychosocial package of care.

The modest evidence of benefit is at odds with manual therapist's experience of delivering care to people with back pain where they see individuals making large improvements and reporting high levels of satisfaction [28]. There are several explanations for this including the lack of strength of the intervention, various forms of bias most notably confirmation bias [29] and the heterogeneity of nonspecific back pain leading to trial interventions not being targeted at the "right types" of back pain. Attempts to target treatment are being developed. However the current predominance of pragmatic trials evidence does not lend itself well to the development of targeted interventions. Targeted, or stratified care falls into three categories based broadly on epidemiological risk, on proposed underlying mechanisms such as pain or pathoanatomical cause and based on treatment responsiveness such as clinical prediction rules [30]. The epidemiological risk approach to stratifying care is promising [31 32] and consideration of risk stratification has been recommended in recent guidance [26]. It is likely that future research investigating the effectiveness of manual therapy will

draw on additional methods of stratification to better target manual therapy approaches to selected patient groups.

5. Mechanisms of action

Consideration of the mechanism of action of manual therapies for low back pain is inseparable from that of their effects on both pain generation and the possibility of a hypoalgesic effect [33]. The simple act of applying touch to the skin can have beneficial effects on the perception of pain [34]. Brief applications of light touch, small amplitude, low-pressure motion can evoke sufficient afferent stimulation to reduce dorsal horn sensitisation and amplification resulting in a reduction in temporal summation phenomena, an observable index of dorsal horn “wind-up” [34]. Similar CNS inhibitory mediation is also observed after high-velocity, small amplitude, stimulation (spinal manipulation) [35]. In addition, large amplitude, light pressure “stroking” touch of the skin, stimulating C-tactile skin receptors, has been shown to reduce pain. This is linked with responses in the orbitofrontal cortex, associated with pleasure, suggesting an inhibition of pain at a supra-spinal level being produced in the context of a pleasant touch sensation [36] [37]. High velocity thrust techniques, on the other hand, aim to produce an audible ‘pop’ or cavitation of synovial fluid and the conditions necessary for doing so have received considerable attention. However, there is evidence that this is not necessary to achieve the desired therapeutic effects [38 39].

Biomechanical effects

At present, the action of joint manipulation and mobilisation is expected to be on the stiffness of the spinal motion segments. Fritz et al [40] found short-term improvement in disability after spinal manipulative therapy to be mediated by improvements in lumbar multifidus recruitment and a decrease in global stiffness. Subsequent animal experiments using simulated manipulations found an immediate decrease in global stiffness and confirmed that segmental stiffness was indeed reduced [41]. However, despite higher peak loads being imposed with spinal manipulations than mobilisations, there was no difference in the reduction in stiffness [42] between these two techniques. In a systematic review of in vivo mobilisation, three out of four studies reported reduction in spinal stiffness [43].

Experimentally induced low back pain (with hypertonic saline injections) leading to increased spinal stiffness and trunk muscle co-contraction has been shown to be reduced with posterior-to-anterior mobilisation techniques, suggesting that greater intersegmental mobility had been achieved [44 45]. However, so far, there is little evidence that spinal manipulation or mobilisation has an effect on regional lumbar range of motion [46].

In order to be able to investigate the mechanisms of action of articular manual therapies on nociceptive pain, and to make better sense of their biomechanical effects, we will need to be able to distinguish between the restraint of the passive structures and that of the muscles, as there is evidence from animal experiments that high velocity manipulation inhibits muscle spindle activity in fixed joints, even when applied two levels away [47]. There is also debate regarding the mediation of motor activity following spinal manipulation, with evidence to support both short-term facilitation and attenuation of spinal reflex loops and paraspinal muscle activity [48 49]. It will therefore be necessary to move beyond considerations of stiffness and regional range of motion assessment and into the evaluation of dynamic segmental control parameters, if we are to better understand the effects of MT on lumbar biomechanics [50].

Patients with excessive segmental laxity have been found to constitute a subgroup more likely to benefit from a lumbar stabilization exercise program [51]), while uneven sharing of motion between lumbar segments during bending has been found to be more prevalent in patients with chronic, non-specific back pain [52]. These effects may be mediated by disc degeneration, whose role in nonspecific back pain is still unclear, but is known to affect intervertebral motion [53 54]. Recent studies have also found uneven motion sharing and disc degeneration to be much more strongly related in patients with nonspecific back pain than in people without pain [55]. However, it is not known whether MT or exercises influence these dynamic control parameters, and if they do, whether they mediate treatment effects.

Neurophysiological effects

There is a considerable body of evidence describing the influence of afferent stimulation, from various types of MT, on the mediation of central nervous system (CNS) orchestrated inhibitory pain mechanisms [56-63]. The precise type of afferent stimulation does not seem to be critical, with similar responses being reported with mobilisation techniques (slow, non-localised, large amplitude, low-pressure movements) and manipulative thrust techniques (localised, fast, high-pressure, small amplitude movements) [35 64]. A fast acting, short-term sympatho-excitatory response to MT has been well documented [59 60 65], with this “fight or flight” mechanism providing reductions in perception of nociceptive afferent information, local to the region of application, and to a lesser extent systemically [66 67].

Neuropathic pain in chronic states can additionally be due to peripheral or central sensitisation, making clinical assessment challenging, especially in the absence of objective tests. The nature of neuroplasticity in chronic pain has also seen a surge of research interest which may shed light on the effects of many interventions on central sensitisation pain. However there is already some evidence to suggest that the application of deep-pressure touch and movement, sufficient to stimulate high-threshold mechano-receptors and local nociceptors can evoke diffuse noxious inhibitory control (DNIC) cortical shifts [68-72]. The diversion of cortical attention from pathologic pain to a non-threatening, “less-significant” nociceptive stimulus (similar to that observed with the insertion of acupuncture needles) can reduce painful states [72]. In addition, functional MRI imaging evidence has shown that the perception of non-threatening, discomfort can be interpreted in the pain neuromatrix [73] as pleasure, resulting in a systemic hypoalgesia [36].

The relief of pain, following the application of MT can be interpreted by the brain as a reward, particularly if it is unexpected or greater than expected [74-79]. Unexpected reward sensations result in phasic release of the neurotransmitter dopamine which, in addition to contributing to systemic hypoalgesia, will facilitate motivation to seek that reward sensation again [78]. Thus, motivation to repeat movement can be facilitated and a process of graded exposure to movement undertaken [80]. A gradual upgrading of movement will lead to neurophysiological adaptations facilitating habituation to the nociceptive stimulus, resulting in a gradual reduction in pain [65]).

Circulating inflammatory markers have also been found in patients with nonspecific back pain and have been attributed to osteoarthritic changes [81-83], with one study finding a time-dependent attenuation of cytokines following a single manipulation [84]. In a narrative review, Zhang et al [85] reported an increase in tumour necrosis factor 2 hours after SMT and a decrease after 24 hours. These phenomena are difficult to separate from evidence that suggests that spinal mobilisations cause neurophysiological effects resulting in hypoalgesia as well [43]. Gay et al recognised this as changes in functional connectivity in the brain using MRI [86] resulting in modulation of the pain

experience. However, it has been hypothesised that this involves not only pain modulation, but, through the hypothalamic–pituitary–adrenal axis, actual physiological change [87].

6. Clinical indications and contraindications

Today's manual therapists are taught to tailor their treatment to the individual needs of their patients and to recognise that not all patients with back pain need manual therapy. Therefore, a clear distinction is needed between manual therapy treatment and treatment by a manual therapist. Seen in this light and coupled with the fact that manual therapists also use exercises, cognitive interventions and lifestyle adjustments, the range of management approaches is not as confined as might be imagined. When a manual therapist decides to use one of the procedures listed above, it is seldom used in isolation and its intensity and application can also vary widely. It is also conventionally combined with exercise and lifestyle adjustments [88].

Clinical indications are therefore sometimes more a matter for informed common sense and the recognition of key clinical clues and circumstances. For example, a common indication that manual therapy should be considered would be for subacute or recurrent non-radicular back pain with movement impairment and no red flags [11]. It has also been suggested that manual therapy can be preventive in cases of recurrent back pain and there is some evidence for this [89].

Palpation is a key diagnostic skill that is inextricably linked to that of MT, and although description of its use is beyond the scope of this chapter, it is not difficult to imagine how the patient's response to it, the tone of the soft tissues and the resistance to movement by osseous elements felt through the skin, could inform the choice and application of a manual technique in an individual. However, apart from local tenderness, palpation of lumbar joint function has been shown to be imprecise [90]. Likewise, the targeting of a high velocity manipulative force to a specific joint has also been shown to be inexact [91]. Nevertheless, questions regarding the ability, and need, for MT to be targeted to specific regions (levels) of the lumbar spine, deemed significant by clinicians, remain [56]. This is pertinent, particularly when one considers that the validity of the identification of clinically significant regions (targets for treatment) is poor [92] and that pain relief following MT has been shown to be equivocal when applied to random versus clinician selected levels [93-95].

7. Conclusion

Whilst there is confidence that MT is a useful modality in the relief of lumbar pain and reduction in disability, its specific biomedical, psychological and social influences and interactions have yet to be fully understood. Manual therapy is a complex intervention and it will require further mixed methods research to fully understand its role within the biopsychosocial management of back pain.

3458 words

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