

Research-informed Muscle Energy Concepts and Practice

BY GARY FRYER



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Evidence-Informed Practice

Like many techniques in manual medicine, muscle energy technique (MET) was developed through clinical observation, experimentation, and creative innovation, and based on a rationale that was consistent with knowledge at the time. Rarely has scientific discovery been the primary instigator for a new manual approach. The role of research typically follows creative innovation in order to explain the physiological mechanisms, verify the effectiveness, and test the relative superiority of variations or of different approaches. The developers of MET, such as Fred Mitchell Sr. and Jr. deserve gratitude from those that have benefited from this novel approach, but this should not prevent a critical appraisal or a revision of concepts and practices in response to evolving scientific research in the field.

In recent times, medical and allied health practitioners have been encouraged to use evidence-based medicine (EBM) [1]. However, some fear EBM may be applied to disease management for economic reasons rather than treatment [2, 3]. Others have argued that EBM does not account for other kinds of medical knowledge [4] and that

EBM studies, primarily randomly controlled trials (RCTs), address average results from large groups which fail to inform about individual patients [5]. The rigid adoption of the ‘best quality’ evidence (such as RCTs) may limit practice options in an unintended way. In osteopathic practice, a strict adherence to EBM is not possible due to a lack of high-quality evidence on which to base decisions: a better terminology for the profession would be ‘evidence-informed practice’ [6] or ‘evidence-informed osteopathy’ [7, 8]. Because EBM is meant to *integrate* individual clinical expertise with the best available clinical evidence [9], the guiding principle behind evidence-informed practice should be the use of research evidence when available, followed by personal recommendations based on clinical experience, while retaining a transparency about the process used to reach clinical decisions [6].

Current evidence offers some support for the efficacy of MET, but it may also make us reconsider our understanding of diagnostic techniques and the physiological mechanisms causing therapeutic effect. Overall, there is a lack of high-quality evidence in the peer-reviewed literature supporting the clinical effectiveness of MET. This lack of research is not surprising

given that MET is typically used in conjunction with other techniques. There is, however, a growing body of evidence demonstrating that MET does increase the extensibility of muscles [10–16] and spinal range of motion [17–21].

The only RCT in the English language literature involving MET as the sole manual treatment showed that acute low back pain (LBP) patients treated with MET and a home exercise program had greater improvement in pain and disability than the sham treatment and home exercise program [22]. The only other report of specific MET treatment for LBP involved four case studies, with promising results

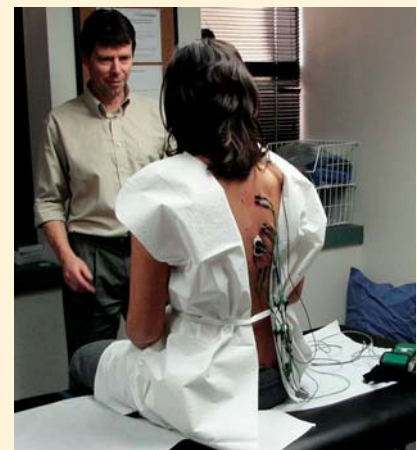


Fig. 1 Intramuscular and surface electromyography for investigation of paraspinal muscle activation during trunk rotation.

[23]. Several clinical trials investigating osteopathic management of spinal pain have included MET as a treatment component, providing additional support for MET as an effective treatment [24–26]. However, these few studies clearly indicate the need for further investigation of MET.

Diagnostic Concepts

Mitchell Sr. and Jr. integrated clinical and anatomical observations to based their approach on Fryette's physiological spinal coupling concept [27] and a pelvic dysfunction biomechanical model developed in conjunction with Paul Kimberley [28]. The following outlines recent evidence that raises questions concerning the predictability of spinal coupled motion and the validity and reproducibility of many diagnostic tests. The issues raised here are relevant to most manual approaches, but particularly to those which emphasize a mechanical model for joint diagnosis and treatment. The section "Implications for Clinical Practice" attempts to offer pragmatic solutions for these issues.

Assessment of the spine

The traditional paradigm for diagnosis and treatment is mechanical, where multiple planes of motion loss are determined and each restrictive barrier is engaged to increase the motion in all restricted planes [28–31]. The identification of motion restriction has been based on the spinal coupled motion model proposed by Fryette [27], which describes two types of coupled motion restriction: Type 1, also known as contralateral coupling, is based on spinal asymmetry in neutral, while Type 2, also known as ipsilateral coupling, is based on non-neutral spinal postures. Fryette's model has been criticized for its prescriptive diagnostic labelling and questionable inferences from static positional assessment [32, 33]. Further, it allows only three combinations of multiple plane motion restrictions, a neutral Type 1, a non-neutral Type 2 with flexion, or



Fig. 2 Resisted trunk extension as a task to normalize EMG signals of the deep and superficial back muscles.

a non-neutral Type 2 with extension. The model does not allow for other combinations, such as Type 1 coupling with extension.

Osteopathic texts advocate detection of dysfunctional spinal segments by using the diagnostic criteria of segmental tenderness, asymmetry, restricted range of motion, and altered tissue texture [28–31, 34, 35]. However, the validity, reliability, and specificity of detecting these clinical signs have been questioned [36–38]. For instance, only palpation for tenderness and pain provocation has had acceptable interexaminer reliability [37, 39, 40], while motion palpation [37, 39, 40] and static spinal asymmetry [41–43] have been reported to have poor reliability.

MET texts commonly advocate the assessment of static positional asymmetry of the spinal transverse process or sacral base with a comparison of the spine in neutral, flexion, and extension. Based on these findings, specific motion restriction combinations are diagnosed and treated with MET. However, with this approach, there is an assumption that a transverse process posterior or resistant to posterior-anterior springing represents a restriction of rotation to the opposite side. Although muscle and anatomical vertebral asymmetry are complicating factors, they

are not considered. Additionally, assessment of segmental static asymmetry has not been reliable [42], and spinal coupled motion in the lumbar, thoracic, and cervical spine is inconsistent, with variability between spinal levels and individuals [33, 44–49]. Although, one study suggests that coupled motion in the upper cervical region is more consistent [50]. Inconsistencies of coupled motion in the lumbar and thoracic regions invalidate the Fryette model as a means of predicting triplanar motion restrictions based on static asymmetry or single plane motion restriction, as recommended in many texts [28–30].

Assessment of the pelvis

Sacroiliac motions are small and complex, involving simultaneous rotation and translation [51, 52]. Further, the joint has no primary motion but acts passively to accommodate torsional stress during ambulation [51], and the axes of motion are dependent upon the surface topography of the joints, which may vary between individuals. Mitchell and others advocate sacroiliac motion testing in standing and seated flexion to determine dysfunction, and landmark asymmetry to determine the type of dysfunction [28–30, 34, 35, 53], but the usefulness of these tests are questionable and the proposed dysfunctions are hypothetical.

The reliability of sacroiliac motion tests are not supported by the literature [54–57]. Forward flexion tests have poor reliability and lack construct validity [58–60]. Similarly, the reliability of pelvic landmark asymmetry has been poor [43, 60–62], unless substantial asymmetry exists [63]. Clusters of sacroiliac tests, mainly pain provocation, appear to have clinical utility [54, 55, 57], but these tests are generally not recommended by MET texts and have utility for detecting a symptomatic joint, rather than sacroiliac dysfunction. The construct validity for pelvic asymmetry as an indicator of dysfunction is lacking, but there is some evidence that asymmetry may have functional implications [64, 65].

Whereas minor pelvic asymmetry is common, its relation to pain or dysfunction has not been established. Although pelvic torsion appears unrelated to LBP or positive clinical tests [66, 67], subtle pelvic torsion may create an asymmetrical load on the lumbar and thoracic tissues [64, 65].

The sacroiliac dysfunctions proposed by Mitchell have not been verified by objective means and remain clinical constructs, rather than definitive clinical entities. Given the absence of objective indicators of mechanical dysfunction of the sacroiliac joint and the poor reliability of motion tests claimed to detect it, sacroiliac dysfunction – whether according to the Mitchell model or others – is difficult to investigate and validate. Due to variability of sacroiliac anatomy and motion, it is conceivable that many of the described dysfunctions could occur in susceptible individuals. Pelvic asymmetry, however, may be secondary to myofascial imbalance. One study found that electrical activation of the pelvic floor muscles produced a large effect on pelvic alignment [68]. MET has been speculated to improve motor recruitment and therefore joint stability [32, 69] and it is possible that techniques which stretch and contract myofascial structures may therefore influence pelvic alignment and functional symmetry.

Therapeutic Mechanisms

Determining the physiological mechanisms of MET is ongoing, but available evidence does not support some of the commonly proposed theories for therapeutic effect. The underlying therapeutic mechanisms may involve a variety of neurological and biomechanical factors. MET may also have a physiological effect regardless of presence or absence of dysfunction [19, 20]. Hypoalgesia, altered proprioception and motor control, and changes in tissue fluid are likely to underlie the therapeutic effect of MET.



Fig. 3 Goniometer used for study which tested effectiveness of MET to increase trunk rotation.

Reflex muscle relaxation

Reflex muscle relaxation is commonly cited as the mechanism for length, range of motion (ROM), and tissue texture changes following MET [28, 30, 70, 71]. Muscle relaxation following isometric contraction is claimed to be mediated by the golgi tendon organ with its inhibitory influence on the α -motor neuron pool and by reciprocal inhibition from contraction of a muscle antagonists [71]. However, studies support increased tolerance to stretching (hypoalgesia), not reflex relaxation, as the primary mechanism for increasing muscle length [10, 13, 72, 73].

Support for reflex muscle relaxation comes indirectly from studies examining muscle contraction on electrophysiological parameters. Studies have demonstrated short-lived inhibition of the H-reflex (an indicator of α -motor neuron pool excitability) following isometric muscle contraction [74, 75], decreased electromyography (EMG) activity after a sudden stretch [76] and reduced response to transcranial magnetic stimulation of the motor cortex [77]. Although these studies support the potential of reflex relaxation as a mechanism, no evidence shows a decrease in EMG activity following MET.

An implicit assumption is that low-level motor activity, elevated in dysfunctional muscle, limits the passive stretch of muscles. Active motor activity does not appear to produce resistance to passive stretch, and increases in muscle length following passive stretching have occurred without change to the low-level EMG activity of the muscle [73, 78]. MET and similar techniques have increased, rather

than decreased, the low-level EMG activity during and following stretching [12–14, 79]. Although evidence of EMG disturbance in the paraspinal muscles of patients with LBP exists [80, 81], no study has investigated MET on EMG activity in the spine. Thus, it seems factors other than reflex muscle relaxation are responsible for muscle extensibility and ROM following these techniques.

Hypoalgesia

MET may be capable of influencing pain mechanisms and inducing hypoalgesia. Studies suggest MET and related post-isometric techniques reduce pain and discomfort of the spine [22] and myofascial structures [10, 13]. The exact mechanism is not known, but it may occur via central and peripheral mechanisms, such as activation of muscle and joint mechanoreceptors to involve centrally mediated pathways like the periaqueductal grey (PAG) in the midbrain or non-opioid serotonergic and noradrenergic descending inhibitory pathways. Animal and human studies have shown sympathoexcitation and localized activation of the lateral and dorsolateral PAG from induced or voluntary muscle contraction [82, 83], and activation of non-opioid descending inhibitory pathways from peripheral joint mobilization [84, 85].

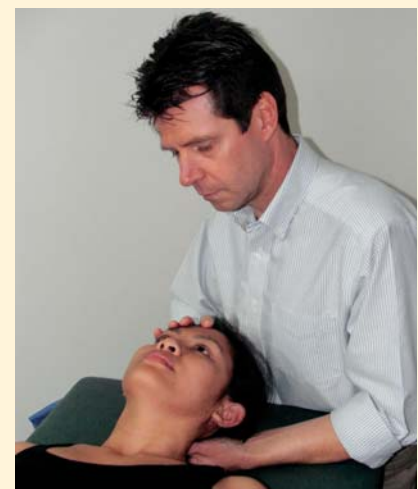


Fig. 4 Application of MET to cervical spine using pincer hold on articular pillars (particularly for restrictions of extension, side bending and rotation).

Additionally, increased fluid drainage may be associated with MET and potentially augment hypoalgesia. Rhythmic muscle contractions increase muscle blood and lymph flow rates [86], and mechanical forces acting on fibroblasts in connective tissues can change interstitial pressure and increase transcapillary blood flow [87]. Therefore, MET may reduce concentrations of pro-inflammatory cytokines and desensitize peripheral nociceptors.

Proprioception

Spinal pain produces disturbances in proprioception and motor control. Patients with pain have decreased awareness of spinal motion and position [88–92] and cutaneous touch perception [93, 94]. Spinal pain appears to inhibit the stabilizing paraspinal musculature, while causing superficial spinal muscles to overreact to stimuli [80, 81]. No study has investigated the effect of MET on proprioception or motor control, but limited evidence suggests benefit from other manipulative treatments [95–99]. Since MET actively recruits muscles, studies of proprioceptive feedback, motor control, and motor learning are strongly recommended.

Myofascial extensibility

Applications of MET to stretch and increase myofascial tissue



Fig. 5 Application of MET for stretching of the hamstrings muscles.

extensibility may potentially produce viscoelastic and structural change. Viscoelastic and plastic changes [100, 101], autonomic-mediated change in extracellular fluid dynamics [102], and fibroblast mechanotransduction [102, 103] have been proposed for the therapeutic effect of MET and similar approaches. Lasting changes in human muscle properties following stretching protocols, however, have not been demonstrated [72].

Most studies which have measured muscle length changes have not measured the pre and post stretch force, so increases in muscle extensibility cannot be attributed to biomechanical property change. Studies that have measured force (torque) show little viscoelastic change after passive or isometric stretching, and indicate muscle extensibility is due to increased tolerance to an increased stretching force [10, 13, 73]. Short- and medium-term application of stretching and MET does not appear to affect the biomechanics of healthy muscle, only the perception of pain, but studies are required for injured and healing muscle tissue.

Tissue fluid drainage

Texts have proposed that MET can improve lymphatic flow and reduce edema [28, 53], and evidence suggests muscle contraction influences interstitial tissue fluid collection and lymphatic flow [86, 104]. Physical activity increased lymph flow peripherally in the collecting ducts and centrally in the thoracic duct as well as within the muscle during concentric and isometric muscle contraction [105, 106]. MET may assist lymphatic flow and clearance of excess tissue fluid to augment hypoalgesia, and potentially change intramuscular pressure and the passive tone of the tissue.

Implications for Clinical Practice

The implications of research are presently more profound for theoretical concepts than clinical practice. Unfortunately, there is little



Fig. 6 Application of MET to hamstrings muscles in study that investigated which of two MET variations was most effective for lengthening the muscles

research to guide clinicians towards a more effective use of MET. A growing number of studies have examined the efficacy of technique variations [20, 107, 108], but few recommendations can yet be made. Available evidence, however, should make clinicians more circumspect about their structural diagnosis, and clinicians should not rely on isolated diagnostic tests and findings.

Due to the unpredictability of coupled motion in the spine, practitioners should address motion restrictions that present on palpation (despite the issues of reliability of motion palpation), rather than on static palpation and assumed coupled motion. If corrective motion is introduced in the primary planes of restriction, spinal coupling (in whatever direction) will occur automatically – due to the nature of conjunct motion – and without the need to be intentionally introduced by the practitioner. Therefore, the pragmatic approach recommended is to address the primary motion restriction(s), and coupled motions will look after themselves.

Despite the unestablished clinical utility of many of the pelvic and sacroiliac assessment methods, a pragmatic approach uses a cluster of tests, incorporating motion and provocative testing, and not relying on a single isolated finding. For flexion tests, an obvious difference between standing and seated observations may be significant, but indicate asymmetry in the lower extremity rather than sacroiliac dysfunction. Above all, clinicians should not assume every asymmetrical pelvis is dysfunctional and warrants treatment.

Osteopaths have emphasised sacroiliac dysfunction as a hypomobility lesion, but should also give due consideration to hypermobility as a potential aetiology for the painful joint [109]. MET may improve motor recruitment and stability [32, 69], but it would be prudent to consider the addition of motor control and stability training in these patients [110].

Little information on muscle flexibility in injured, painful, or healing muscle exists. In healthy muscles, the most efficacious techniques are agonist contract-relax, where the patient pushes into a barrier to actively lengthen the muscle, but the optimal use of contraction repetition, duration and intensity is unclear [72]. Given recent trends in research, it is likely that studies in

the near future will provide more clinically useful guidelines for clinicians who utilize MET.

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