Short-Term Effect of Muscle Energy Technique on Pain in Individuals with Non-Specific Lumbopelvic Pain: A Pilot Study

NOELLE M. SELKOW, MEd, ATC¹; TERRY L. GRINDSTAFF, PT, DPT, ATC, SCS, CSCS²; KEVIN M. CROSS, MEd, ATC, PT²; KELLI PUGH, MS, ATC, CMT²; JAY HERTEL, PhD, ATC, FACSM³; SUSAN SALIBA, PhD, ATC, MPT⁴

Muscle energy technique (MET) is a common conservative treatment for pathology around the spine, particularly lumbopelvic pain (LPP). MET is considered a gentle manual therapy for restricted motion of the spine and extremities¹ and is an active technique where the patient, not the clinician, controls the corrective force². This treatment requires the patient to perform voluntary muscle contractions of varying intensity, in a precise direction, while the clinician applies a counterforce not allowing movement to occur². For many years, MET has been advocated to treat muscle imbalances of the lumbopelvic region such as pelvis

asymmetry. The theory behind MET suggests that the technique is used to correct an asymmetry by targeting a contraction of the hamstring or the hip flexors on the painful side of the low back and moving the innominate in a corrected direction. It is worth noting however, that evidence suggests that non-symptomatic individuals have also been shown to have pelvis asymmetries. Despite this, MET is frequently used by manual therapy clinicians.

Unfortunately, few studies have examined the effectiveness of MET. Previous research has found that MET of the low back improved self report of disability when used with supervised neuro-

muscular reeducation and resistance exercise training², but the effect of MET as an isolated treatment has not been determined. Cervical range of motion increased after 7 MET sessions, which consisted of four 5-second contractions over a 4-week period, and lumbar extension increased after 2 sessions per week for 4 weeks^{4,5}. Five-second contractions have shown greatest results with application at the atlanto-axial joint⁶ and the thoracic spine¹. While MET was successful in two studies, the effect of one treatment session was not reported and only range of motion was assessed. Roberts⁷ indicated the short-term effects of MET as decreased pain, increased range of motion, decreased muscle tension and spasm, and increased strength. However, these effects seemed to last only a few seconds to minutes, indicating that for continued benefit, MET would have to be applied multiple times throughout the day⁷. At present, the treatment window and lasting effect of a single MET session is undefined^{1,2,4-11}.

Evidence to support the use of lumbar manipulation in patients with acute lumbopelvic pain with moderate severity has been reported^{12,13}, yet, because the treatment pattern of manually trained clinicians varies, we were interested to determine if MET offered similar benefits (albeit, short-term) in patients with acute LPP. Subsequently, the purpose of this

ABSTRACT: Muscle energy technique (MET) is a form of manual therapy frequently used to correct lumbopelvic pain (LPP), herein the patient voluntarily contracts specific muscles against the resistance of the clinician. Studies on MET regarding magnitude and duration of effectiveness are limited. This study was a randomized controlled trial in which 20 subjects with self-reported LPP were randomized into two groups (MET or control) after magnitude of pain was determined. MET of the hamstrings and iliopsoas consisted of four 5-second hold/relax periods, while the control group received a sham treatment. Tests for current and worst pain, and pain with provocation were administered at baseline, immediately following intervention and 24 hours after intervention. Separate 2x3 ANOVAs were used to assess results as change scores. Visual analog score (VAS) for worst pain reported in the past 24 hours decreased for the MET group ($4.3\text{mm} \pm 19.9$, $p=.03$) and increased for the sham (control) group ($17.1\text{mm} \pm 21.2$, $p=.03$). Subjects receiving MET demonstrated a decrease in VAS worst pain over the past 24 hours, thereby suggesting that MET may be useful to decrease LPP over 24 hours.

KEYWORDS: Inclinometer, Lumbopelvic Pain, Manual Therapy, Pain Provocation Tests

¹Doctoral Student, University of Virginia, Charlottesville, Virginia; ²Assistant Athletic Trainer, University of Virginia, Charlottesville, Virginia; ³Associate Professor, University of Virginia, Charlottesville, Virginia; ⁴Assistant Professor, University of Virginia, Charlottesville, Virginia

Address all correspondence and requests for reprints to: Noelle M. Selkow, nmp4p@virginia.edu

study was to determine the effectiveness of a single treatment of MET immediately and 24 hours after treatment when used on subjects with LPP.

Methods

A double-blind, randomized control trial was used for this study. The independent variables were treatment condition (MET or control) and time (pretest, immediately following treatment, and 24 hours after treatment). The dependent variables were 1) current pain, 2) worst pain over the past 24 hours, 3) which pain provocation test caused the most pain, and 4) pain produced during provocation testing.

Subjects

An email was sent to faculty, staff, and students which outlined the inclusion and exclusion criteria for the study and instructions to notify examiner 1 of their interest in the study. Subjects responded to the email and were deemed appropriate for the inclusion criteria if each self-reported an acute episode of LPP within the previous 6 weeks and demonstrated an anterior innominate rotation as defined by a bilateral difference of 2° or greater. We hypothesized that record of innominate rotation would improve the likelihood of a beneficial outcome with MET.

Pain provocation tests¹¹ were conducted to verify that the source of LBP was localized to the lumbopelvic region and the most painful test was recorded. Subjects were excluded if 1) acute episode of low back pain (LBP) lasted longer than 6 weeks; 2) pain radiated past the knee; 3) they had a history of previous back surgery; or 4) they had been diagnosed by a physician with a specific cause of LPP. All subjects read and signed an informed consent form approved for this study by the appropriate institutional review board and all subjects' rights were protected.

We targeted patients with acute LPP but with only moderate levels of severity. On a 10-point VAS score, subjects reported pain anywhere between the 1–6 range, with most occurring around 2–3.

These subjects did not feel that their pain was severe enough to consult a doctor and they felt that the pain would go away on its own.

Instruments

Visual Analog Scale

A visual analog scale (VAS) was used as the primary tool for pain quantification. A 100 mm line, with no markings, except no pain at the left and worst pain at the right end of the continuum, was used. Subjects were asked to mark a vertical dash on the horizontal line indicating their level of pain relative to the continuum. A line without numerical markings was used so the patient was less apt to remember previous markings.

PALM

The PALpation Meter (PALM) (Performance Attainment Associates, St. Paul, MN) was used to measure relative anterior innominate rotation. Reliability was found to have an ICC of .99 with intratester precision measurements within .91¹⁴. The PALM is a device used to measure pelvic malalignments, particularly, anterior innominate rotation¹⁴. ICC was found to be .99 with standard error of measure .44°–.47°, and precision of measurements were found to be less than 1°¹⁴.

Testing Procedures

All outcome measures were obtained by the same examiner (Examiner 1), who was blinded to treatment group allocation. All subjects who volunteered for the study met the inclusion criteria and there were no drop outs. Subjects completed a brief health history that included demographic information, an illustration area of LBP, and VAS indicating current pain and worst pain over the past 24 hours. Innominate rotation was measured using the PALM device by taking three measurements from the ASIS and PSIS on each side with the subject standing with feet shoulder width apart in the anatomical position (Figure 1).

After obtaining lower extremity alignment measurements, five SI-joint pain provocation tests were performed while the subjects reported pain (yes/no) with each test by indicating if the test reproduced familiar symptoms. Pain provocation tests included SI distraction, SI compression, thigh thrust, Gaenslen's, and Patrick's (FABER) tests¹⁵. This cluster of tests was used because of the high reliability and validity when used in a battery to determine lumbopelvic pathology^{16–19}. The subjects were also asked to indicate which provocation test caused the most pain and indicated that level of pain using the VAS.

Subjects were then randomly assigned by a third party unknown to Examiner 1 and 2, using a random number generator, to a MET or control (sham) intervention group. Group indication was placed in a sealed envelope that was opened after Examiner 1 had performed the initial assessment. Group indication was only known by Examiner 2. Subjects were also unaware of their group assignment. Both the control and MET intervention groups received treatment from a second provider (Examiner 2) while lying supine on a treatment table. Subjects assigned to the MET group placed their buttocks just off the edge of the table (Figure 2) with the leg of the anterior innominate rotation placed on the treatment provider's shoulder. The results from the initial evaluation by Examiner 1 were recorded on the outside of the sealed envelope, so Examiner 2 knew how to place the subject for treatment.

During the MET, the subject was asked to "push their leg into the examiner's shoulder" and "push up with the opposite leg into examiner's hand"²⁰. A total of four contractions were resisted by a force equal to the subject's, held for 5 seconds with 5 seconds rest between each contraction⁹. For subjects in the control group, the examiner placed the palms of the hands over both ASIS and maintained this position for 30 seconds while the subject lay supine. No pressure was exerted on the ASISs. Current pain was reassessed immediately following intervention, and all outcome measures were taken again at follow-up testing 24

FIGURE 1. Measurement of innominate rotation from ipsilateral anterior superior iliac spine and posterior superior iliac spine using the PALM.

FIGURE 2. Placement of subject during muscle energy technique. The leg of the anterior innominate was placed over the examiner's shoulder and the leg of the posterior innominate was placed under the examiner's hand. When an isometric contraction is produced, the anterior innominate will rotate posteriorly from the force of the hamstrings and the posterior innominate will rotate anteriorly from the force of the iliopsoas.

hours after the initial assessment by the same examiner (Examiner 1). Between the two testing sessions, subjects were instructed to only perform normal activities of daily living and avoid vigorous exercise or heavy lifting over the next 24 hours. They were also instructed to abstain from pain-relieving medications such as ibuprofen or acetaminophen.

Statistical Analysis

Subject demographics and baseline values for VAS current and worst pain were compared using independent t-tests. Independent variables were treatment group (MET or control) and time (pre-intervention, post-intervention, 24 post-intervention). Dependent variables were current pain (mm), worst pain (mm), pain provocation test causing most pain (mm), and number of positive pain provocation tests (yes/no). Separate 2x3 mixed model ANOVAs with repeated measures on time were used to analyze VAS scores (current, worst, and worst pain provocation test). The Mann-Whitney U test was used to examine difference in the number of

positive pain provocation tests before and after intervention. An a priori alpha level was set at $p \geq 0.05$, and post-hoc t-tests were used as indicated. Statistical analyses were performed with SPSS Version 14.0 (SPSS Inc., Chicago, IL).

Results

Enrolled subjects consisted of 16 males and 4 females [Age 24.1 ± 7.1 (MET), 29.7 ± 11.9 (control); height 174.6 ± 12.8 cm (MET), 174.0 ± 9.2 cm (control); mass 75.9 ± 19.0 kg (MET), 81.6 ± 9.8 kg (control)] (see mean scores in Table 1). There were no significant differences ($p > 0.05$) between any of the subject group demographics or baseline VAS values.

Pain

There was a significant time x group interaction for VAS worst pain ($F_{2,36} = 5.36$, $P = .03$). When MET and control were compared, pain increased for the control group from baseline ($18.1 \text{ mm} \pm 14.3 \text{ mm}$) to ($35.2 \pm 28.0 \text{ mm}$) 24 hours after treatment, whereas for MET, pain decreased from baseline ($29.3 \text{ mm} \pm$

19.1 mm) to ($25.0 \text{ mm} \pm 20.6 \text{ mm}$) 24 hours after treatment. There was not a time x group interaction for VAS current pain ($F_{2,36} = 3.93$, $P = .06$, $1-\beta = .47$), or VAS for worst pain provocation test ($F_{2,36} = 0.81$, $P = .46$, $1-\beta = .18$). There was a significant time main effect for VAS current pain ($F_{1,18} = 5.12$, $P = .04$) and VAS worst pain provocation test ($F_{2,36} = 5.79$, $P = .01$). When all subjects were compared as one group of 20 subjects, current pain decreased from $27.4 \text{ mm} \pm 21.4 \text{ mm}$ at baseline to $19.3 \text{ mm} \pm 19.8 \text{ mm}$, and the worst pain provocation test decreased from $30.0 \text{ mm} \pm 23.9 \text{ mm}$ at baseline to $22.5 \text{ mm} \pm 24.6 \text{ mm}$. VAS current pain scores significantly ($P = .04$) decreased for both groups between days. There was not a significant decrease in VAS worst pain provocation test scores immediately post-intervention ($P = .18$), but there was a significant decrease 24 hours following intervention ($P = .001$) compared to baseline. There was not a significant group main effect for VAS current pain ($F_{1,18} = 1.91$, $P = .18$, $1-\beta = .26$), VAS worst pain ($F_{1,18} = 0.004$, $P = .95$, $1-\beta = .05$), or VAS worst pain provocation test ($F_{2,36} = 0.96$, $P =$

.34, $1-\beta = .15$). In addition, no significant difference ($U = 40$, $P = .48$) in the number of positive pain provocation tests between days was found.

Discussion

The main finding of this study was that the MET group demonstrated a decrease ($4.3 \text{ mm} \pm 1.5 \text{ mm}$) in VAS worst pain over the past 24 hours while worst pain for the control group increased ($17.1 \text{ mm} \pm 13.7 \text{ mm}$). Although statistically significant, the change for the MET group was less than half a point on the 10-point pain scale. All subjects together showed decreased current pain ($8.1 \text{ mm} \pm 1.6 \text{ mm}$) and decreased worst pain provocation test ($7.5 \text{ mm} \pm 0.7 \text{ mm}$) 24 hours after treatment, which were statistically significant from baseline.

The small decrease in worst pain over the past 24 hours may have been due to a decrease in neurophysiological pain, thus decreasing the level of pain perceived by the patient. We hypothesized that during the patient interaction, manual contact with the patient may have resulted in alleviation of pain, through the neurophysiological mechanisms of applied movement. The decrease in pain across both groups could be associated with this effect of clinical touch on pain.

MET can be used to treat LPP, particularly low levels of pain. The touch of the clinician, along with stimulation of agonist and antagonist muscles, seems to alter perception of pain. This technique could be performed prior to other rehab techniques, such as strengthening exercises, to decrease pain and allow more efficient exercises to then be ex-

ecuted. This technique may be better than others in decreasing pain for several reasons. The time it takes to administer MET is very short (less than 1 minute). It also allows the clinician to have physical contact with the patient, helping the patient to trust the clinician. Lastly, MET is a low-force isometric contraction in a pain-free position. This technique can be accomplished without causing further pain or harm to the patient.

Limitations

There are several limitations to this study. The first was that the control group had higher VAS pain scores for current pain than worst pain over the past 24 hours. This finding may be because subjects were not allowed to see their previous markings made on the VAS. Although specific instructions were given regarding VAS markings, subjects may not have realized that if they were currently experiencing their worst pain in the last 24 hours, the same spot could be marked to accurately reflect their pain level. Another limitation was that only one intervention was used on subjects who had low levels of pain. The potential for floor effects has been discussed previously. The subjects were not currently seeking medical treatment for their pain and they were recruited out of the general population rather than from a clinical health-care setting. It was also possible that the pain in the low back was not related specifically to LPP. The pain may have been referred pain from other structures²¹ not targeted with the intervention or not addressed in the questionnaire. Finally, relatively small sample sizes must be addressed by

larger studies examining outcomes that have the potential for detectable changes.

Conclusion

When looking at the short-term effects of MET, worst pain over the past 24 hours seems to be the most significant, while current pain, worst pain provocation test, and answers to pain provocation tests showed no major changes in 24 hours. Future studies should examine the effect of multiple MET treatments within a single treatment session to determine how many treatments are needed to be effective in pain management. Additional studies are necessary to examine treatments on multiple days and then follow patients over a longer duration to determine if a cumulative reduction in pain and improvement in function occurs. The use of symptomatic patients who meet specific classification criteria would minimize floor effects and allow a more accurate description of effectiveness to occur.

REFERENCES

1. Lenehan KL, Fryer G, McLaughlin P. The effect of muscle energy technique on gross trunk range of motion. *J Osteopath Med* 2003;6:13-18.
2. Wilson E, Payton O, Donegan-Shoaf L, Dec K. Muscle energy technique in patients with acute low back pain: A pilot clinical trial. *J Orthop Sports Phys Ther* 2003;33:502-512.
3. Krawiec CJ, Denegar CR, Hertel J, Salvaterra GF, Buckley WE. Static innominate asymmetry and leg length discrepancy in asymptomatic collegiate athletes. *Man Ther* 2003; 8:207-213.
4. Schenk R. The effects of muscle energy technique on cervical range of motion. *J Man Manip Ther* 1994;2:149-155.
5. Schenk R. The effects of muscle energy technique on lumbar range of motion. *J Man Manip Ther* 1997;5:179-183.
6. Freyer G, Ruszkowski W. The influence of contraction duration in muscle energy technique applied to the atlanto-axial joint. *J Osteopath Med*. 2004;7:79-84.
7. Roberts BL. Soft tissue manipulation: Neuromuscular and muscle energy techniques. *J Neurosci Nurs* 1997;29:123-127.
8. Ballantyne F, Fryer G, McLaughlin P. The effect of muscle energy technique on ham-

TABLE 1. Subject demographics broken down by intervention group

	Control* (n=10)	Muscle Energy Technique* (n=10)
Age	29.7 (11.9)	24.1 (7.1)
Height (cm)	174.0 (9.2)	174.6 (12.8)
Mass (kg)	81.6 (9.8)	75.9 (19.0)

*Values are mean (SD).

- string extensibility: The mechanism of altered flexibility. *J OsteopathMed* 2003;6:59–63.
9. Burns DK, Wells MR. Gross range of motion in the cervical spine: The effects of osteopathic muscle energy technique in asymptomatic subjects. *J Am Osteopath Assoc* 2006;106:137–142.
 10. Cassidy JD, Lopes AA, Yong-Hing K. The immediate effect of manipulation versus mobilization on pain and range of motion in the cervical spine: A randomized controlled trial. *J Manipulative Physiol Ther* 1992; 15:570–575.
 11. Gibbons P, Tehan P. Muscle energy concepts and coupled motion of the spine. *Man Ther* 1998;3:95–101.
 12. Flynn T, Fritz J, Whitman J, et al. A clinical prediction rule for classifying patients with low back pain who demonstrate short-term improvement with spinal manipulation. *Spine* 2002;27:2835–2843.
 13. Childs JD, Fritz JM, Flynn TW, et al. A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: A validation study. *Ann Intern Med* 2004;141:920–928.
 14. Krawiec CJ, Denegar CR, Hertel J, Salvaterra GF, Buckley WE. Static innominate asymmetry and leg length discrepancy in asymptomatic collegiate athletes. *Man Ther* 2003;8:207–213.
 15. Magee D. *Orthopedic Physical Assessment*. 4th ed. New York: Saunders, 2002.
 16. Kokmeyer DJ, van der Wurff P, Aufdemkampe G, Fickenschier TC. The reliability of multitest regimens with sacroiliac pain provocation tests. *J Manipulative Physiol Ther* 2002;25:42–48.
 17. Laslett M, Aprill CN, McDonald B, Young SB. Diagnosis of sacroiliac joint pain: Validity of individual provocation tests and composites of tests. *Man Ther* 2005;10:207–218.
 18. van der Wurff P, Hagmeijer RH, Meyne W. Clinical tests of the sacroiliac joint. A systematic methodological review. Part 1: Reliability. *Man Ther* 2000;5:30–36.
 19. van der Wurff P, Meyne W, Hagmeijer RH. Clinical tests of the sacroiliac joint. *Man Ther* 2000;5:89–96.
 20. Hoban P. The basics of sacroiliac mobilizations: Applied techniques of manual therapy. *Biomechanics and Integrated Orthopedic Seminars*, 1999.
 21. Slipman CW, Jackson HB, Lipetz JS, Chan KT, Lenrow D, Vresilovic EJ. Sacroiliac joint pain referral zones. *Arch Phys Med Rehabil* 2000;81:334–338.