Case reports

A case series evaluating the accuracy of manual muscle testing for predicting fetal sex

Kristopher B. Peterson DC^a, Caroline D. Peterson DC, PhD, MPH, CPM^{b,*}

^a Director, Peterson Clinic, Hermiston, OR 97838

^b Chiropractic Physician and Midwife, Private Practice, Portland, OR 97214

Received 8 February 2011; received in revised form 15 June 2011; accepted 20 June 2011

Key indexing terms:

Chiropractic;
Muscles;
Diagnosis;
Neurology;
Pregnancy

Abstract

Objective: The purpose of this study was to evaluate if manual muscle testing (MMT) could identify fetal sex in women who did not know the sex of their babies. The null hypothesis was that MMT is no more accurate than chance.

Methods: A prospective case series of 27 sequential pregnant patients who did not know the sex of their fetus were included in this study. The examiner was also blind to the sex of the fetus. Manual muscle testing was evaluated after the mother stated “I am having a boy.” Likelihood ratios, specificity, sensitivity, positive predictive value, and negative predictive value were calculated.

Results: Fourteen girl babies and 13 boy babies were born. Manual muscle testing accurately predicted the sex 13 times. The positive likelihood ratio was 0.92 (95% confidence interval, 0.42–2.03), sensitivity was 0.40, specificity was 0.54, positive predictive value was 0.46, and negative predictive value was 0.44.

Conclusion: Manual muscle testing was no better than chance at predicting fetal sex in this case series.

© 2012 National University of Health Sciences.

Introduction

Manual muscle testing (MMT) is used by a variety of practitioners to putatively identify neurologic, physiologic, and other health problems.¹ For example, orthopedic MMT, which is a well-accepted type of

muscle testing, is used to determine the strength of a muscle on a 0 to 5 scale where 5 is normal and indicates a muscle that has complete range of motion against gravity with full resistance, whereas 0 indicates a muscle that has no evidence of contractility.²

Two additional uses of MMT are more contentious, though used in alternative medicine. The first is conjectured to enlist MMT as a functional neurology test to determine cognitive dissonance with auditory or physical stimuli. It is thought that this type of MMT is evaluating the distractibility of the brain and that a

* Corresponding author. 2881 NE Kelly Place, Gresham, OR 97030. Tel.: +1 503 367 1172; fax: +1 503 224 2129.

E-mail address: imcarolinep@gmail.com (C. D. Peterson).

weak muscle indicates a delayed firing command to a muscle in the voluntary nervous system.³ Chiropractic techniques such as Applied Kinesiology and Neuro Emotional Technique posit that MMT is used in their systems as functional neurology.³⁻⁵ The third use of MMT is as a subconscious lie detector test. In this paradigm, MMT functions to determine an unknown truth. Techniques such as Body Talk,⁶ Neuromodulation Technique,⁷ and others^{8,9} suggest that MMT is a detector of “subconscious truths”. Many studies have been conducted evaluating aspects of nonorthopedic MMT; but most studies of this nature are of poor quality, and few evaluate MMT as a diagnostic modality.^{10,11}

This article investigates the diagnostic accuracy of the third type of MMT that uses MMT to determine an unknown truth. It is important to consider the diagnostic accuracy of this type of nonorthopedic MMT because clinicians who use it consider it to be an accurate and inexpensive diagnostic tool that can also be used to guide intervention.⁴ We identified only one case report that demonstrated that MMT used in this way could produce positive clinical outcomes.¹² However, this article does not seek to evaluate clinical outcomes, but rather the diagnostic accuracy.

Several research studies have attempted to test MMT’s ability to discern noncognitive facts and have shown poor validity and reliability.^{13,14} In one study, 4 practitioners and 7 study participants were double blinded to the contents of 20 bottles. Muscle testing was used to determine the content of each bottle. Correct responses occurred 51.9% of the time with a reliability of 0.03, approximating that of chance.¹⁵ Although MMT has not been shown to accurately identify masked substances, a well-designed crossover trial of 89 healthy college students found that semantic stimuli of known characteristics (ie, the study participant’s name and nationality) allowed the study participant to exert 17% more strength on a computerized dynamometer and to maintain pressure longer than when exposed to an incorrect statement ($P < .001$).¹⁶ Thus, a participant who said her correct name responded differently on the computerized dynamometer reading than when she said an incorrect name. This finding suggests the possibility that the nervous system responded differently to the 2 inputs and that difference can be measured with muscle strength. Although the test might appear to evaluate the truthfulness of the statements, other possibilities exist. Another possibility is that participants might have altered their performance based upon knowledge of the accuracy of the statement because the study was not blinded. A separate possibility is that the test was

accessing memory systems of the body and thus comparing the input information (ie, semantic stimulus) against stored memory.

This prospective case series was designed to test the ability of MMT to identify unknown facts using semantic stimuli, similar to the way that MMT is used by practitioners who seek to identify subconscious truths. This small case series reports on the ability of MMT to correctly predict fetal sex based upon a blinded semantic query (ie, “I am having a boy”). We selected this scenario not to replace other diagnostic means, but as a unique situation in which the answer is dichotomized, unchanging, and blinded to both the participant and the subject. No previous studies were identified that attempted to determine the accuracy of MMT response to a semantic stimuli relating to a noncognitive experience. The null hypothesis of our study is that MMT is able to predict the sex of the fetus no differently than chance (50%).

Methods

Participants

This case series took place in a chiropractic clinical practice in the rural Pacific Northwest, United States, between January 27, 2004, and October 26, 2007. All pregnant women who came to the clinic for health care between these dates were screened for eligibility. The inclusion criterion was pregnancy. The exclusion criterion was knowledge of the fetus’ sex from a previous ultrasound or genetic testing. Participants could participate at any point in pregnancy. Women who were eligible were informed that the case study was attempting to determine the ability of the body to identify the sex of the unborn child. They were also informed of the associated level of risk for themselves and for their fetuses, which was negligible. All participants gave written informed consent to participate in this case series.

Data collection and analysis

The primary author who collected the data has more than 25 years of experience using MMT. Manual muscle testing was conducted with the participant supine on the treatment table. The right deltoid muscle was tested at a 45° angle by instructing the participant to resist the downward pressure of the examiner. Only muscles that demonstrated full range of motion, normal

strength, and the absence of pain with resistance to the examiners pressure were used. After the muscle was determined to be orthopedically sound, MMT ensued. A muscle that remained strong against downward pressure after semantic stimuli was interpreted to be a positive test result. A muscle that weakened against downward pressure after semantic stimuli was interpreted to be a negative test result.

Before beginning the test, the participant practiced MMT with the following statements: “I am ok with being pregnant,” “I am ok with having a boy,” “I am ok with having a girl,” and “I am ok with knowing the difference between a girl and boy.” Once the participant was comfortable with the testing procedure, the sex identification questions were asked. A positive response to the statement “I am having a boy” was interpreted to be a muscle that did not weaken against pressure. A positive response to the statement “I am having a girl” was interpreted to be a muscle that did not weaken against pressure. The participants were blind to the interpretation of the MMT response and thus did not know what to expect in regard to changes in muscle strength or how to interpret the meaning of strength change. Both the researcher and participant were blind to the actual sex of the fetus. Although the researcher was blinded to the first test (“I am having

a boy”), he was not blinded to the second test (“I am having a girl”) because he knew the response to the first test. Thus, it is possible that information from the first test informed the conduct of the second test and that consistency between responses to the first and second test might be influenced by researcher unblinding in the second test. Likelihood ratios, specificity, sensitivity, positive predictive value, and negative predictive value were calculated. The study was funded by The ONE Foundation, which played no role in the design, conduct, or analysis of this study.

Results

All pregnant women who presented at this rural chiropractic internal medicine clinic were screened for the study over the course of 4 years. Of those, 29 women did not know the sex of their baby. No eligible woman refused to participate (Fig 1). Of these, 2 women were eliminated from analysis. One woman had a miscarriage in which the sex was not identifiable, and one woman gave birth to twins. One Asian woman and 28 white women participated. Screening occurred between 6 and 32 weeks’ gestation; the mean gestational age was

Fig 1. Sample selection, MMT prediction, and birth outcomes.

Table 1 Trimester of MMT

Trimester testing done	No. of women (%)
1st	14 (52%)
2nd	8 (30%)
3rd	2 (7%)
Missing	3 (11%)

13 weeks (Table 1). Twelve (41%) of the 29 participants had sex determination by ultrasound at some point after the MMT procedure was performed. Two ultrasounds were inconclusive, and 10 (100%) correctly predicted the sex of the baby. One additional woman had sex prediction through amniotic fluid detection. No adverse events were experienced by study participants as a result of the MMT.

Manual muscle testing predicted 14 girl babies and 13 boy babies (Table 2). Fourteen girl babies and 13 boy babies were born. The second MMT test (“I am having a girl”) was always opposite of the first test (“I am having a boy”), thus suggesting that the results of the second test were informed by the results of the first. Of the 27 babies, sex was correctly predicted 13 times. The girl sex was accurately predicted 7 times, and the boy sex was accurately predicted 6 times. The positive likelihood expresses the odds that the diagnostic test will accurately predict the outcome. The positive likelihood ratio was 0.92 (95% confidence interval, 0.42-2.03), indicating that MMT performed no better than chance for determination of infant sex. Additional validity indices confirmed these findings. The sensitivity was 0.40, specificity was 0.54, positive predictive value was 0.46, and negative predictive value was 0.44. Thus, MMT was no better than chance at predicting fetal sex in this group of patients.

Discussion

Our study was the first identified semantic-driven study of MMT used as an evaluation of subconscious truths in which both practitioner and participant were blind to the characteristic being tested. We found that semantic-driven MMT was about as accurate as chance for discerning the unknown variable of fetal sex. This finding is similar to what was found for blinded testing of substance identification.^{14,15} Although MMT is probably not evaluating the veracity of statements or unknown substances, little is understood about what the differential muscle responses might be indicating. Haas

et al¹⁰ have suggested that differential muscle responses might be due to distraction or to discomfort. Additional possible explanations for differential response are clinician or patient fatigue, inadequate training of the clinician, autonomic responses, limbic motor responses, automatisms (entrained ideomotor responses), or random events.¹⁶⁻¹⁹ Although MMT does not appear to accurately predict truth, it might be useful as an assessment of functional neurology. Several small studies have demonstrated clinical results using MMT as an evaluation of functional neurology.²⁰⁻²²

Limitations and future directions

Our study is limited by its small sample size; the lack of blinding of the researcher to the test outcomes; the variability in gestational age; and the absence of any biomarkers, neuroimaging, or electrophysiological testing to evaluate associated processes in the nervous system. Manual muscle testing could be clinically meaningful as a functional neurology assessment, although it might not be clinically accurate as a detector of subconscious truths, and thus merits further investigation. As a functional neurology assessment, MMT could be identifying specific neurologic responses yet to be understood. One possibility is that MMT is a neurologic tool only appropriate for the assessment of memories of perception. Thus, unknown truth is not possible to ascertain through MMT because it is not related to memory. However, MMT might be able to evoke emotional or declarative memories (ie, factual memory such as “The sky is blue”). The possibility that emotional or declarative memory could be accessed using MMT is illustrated by the studies on phobia by Peterson²² and Jensen et al²³ and by the study on facts by Monti et al.¹⁶ Participants in the studies by Peterson and by Jensen et al relied on emotional memory, whereas those in the study by Monti et al used declarative memory pathways.

Both emotional memory and declarative memory are mediated through the medial temporal lobe. Emotional

Table 2 Sex prediction by muscle testing and birth outcome

Predicted boy	Born boy		Total
	Yes	No	
Yes	6	7	13
No	7	7	14
Total	13	14	

memory primarily involves the amygdala, whereas declarative memory primarily involves the hippocampus-entorhinal pathways.²⁴⁻²⁶ The amygdala tracts associated with emotional memory have projections into the rostral cingulate motor cortex. Somatotopic mapping has revealed that the amygdala fires into the M3 and M4 rostral and caudal cingulate motor cortex. The M3 and M4 motor regions fire into the facial nucleus and spinal cord including the brachial plexus.²⁷ The hippocampus-entorhinal network, associated with declarative memory, has projections into the parietal lobe including the caudal cingulate M4 motor region. The caudal cingulate motor cortex M4 has projections into the face nucleus, arm, and leg motor system.²⁸ Thus, both emotional memory and declarative memory are neurologically linked to motor cortexes. However, the relationship between this apparent neurologic connection and MMT is unknown.

We suggest 4 main questions for future research of MMT: (1) Can MMT accurately and reliably measure activation of the emotional memory pathway? (2) Can MMT accurately and reliably measure activation of the declarative memory pathway? (3) Can neuroimaging, biochemical, and electrophysiological evidence help explain MMT findings for emotional or declarative memory? (4) Do dynamometer testing and MMT evaluate similar neurologic pathways?

Conclusions

Our case series found that MMT was not able to accurately predict fetal sex. No other studies were identified wherein MMT was able to predict reality accurately or with reliability. Therefore, there is insufficient evidence to suggest that MMT should be used to predict truth for fetal sex. Large well-designed studies are necessary to further evaluate the appropriateness of MMT as a clinical tool and the possibility that it is accessing memory systems in the body.

Funding sources and potential conflicts of interest

This study was funded by The ONE Foundation, which has an interest in MMT techniques and is associated with Neuro Emotional Technique. Both authors have affiliations with ONE Foundation, through receiving grants or providing donations.

References

- Schmitt WH, Yanuck SF. Expanding the neurological examination using functional neurologic assessment: part II neurologic basis of applied kinesiology. *Int J Neurosci* 1999;97(1):77-108.
- Gatterman MI. *Chiropractic management of spine related disorders*. Philadelphia: Lippincott Williams & Wilkins; 2004.
- Walther D. *Applied kinesiology*. Pueblo, CO: Systems DC; 1988.
- Cooperstein R, Gleberzon BJ. *Technique systems in chiropractic*. Philadelphia: Churchill Livingstone; 2004.
- Brown BT, Bonello R, Pollard H, Graham P. The influence of a biopsychosocial-based treatment approach to primary overt hypothyroidism: a protocol for a pilot study. *Trials* 2010;11:106.
- International Body Talk Association. A body talk session. 2011. [cited 6/2/2011]; Available from: <http://www.bodytalksystem.com/learn/bodytalk/session.cfm>.
- Neuromodulation Technique. The axioms of NMT. 2006. [cited 6/2/2011]; Available from: <http://www.nmt.md/AxiomsOfNMT.cfm>.
- Hawkins DR. *Power vs. force: the hidden determinants of health*. Carlsbad, CA: Hay House; 2002.
- Diamond J. *Your body doesn't lie*. New York: Warner Books; 1979.
- Haas M, Cooperstein R, Peterson D. Disentangling manual muscle testing and Applied Kinesiology: critique and reinterpretation of a literature review. *Chiropr Osteopat* 2007;15:11.
- Cuthbert SC, Goodheart GJ. On the reliability and validity of manual muscle testing: a literature review. *Chiropr Osteopat* 2007;15:4.
- Feinberg LS, Stephan RB, Fogarty KP, Voortman L, Tiller WA, Cassiani-Ingoni R. Resolution of cavitation osteonecrosis through NeuroModulation Technique, a novel form of intention-based therapy: a clinical case study. *J Altern Complement Med* 2009;15(1):25-33.
- Rybeck CH, Swenson R. The effects of oral administration of refined sugar on muscle strength. *J Manipulative Physiol Ther* 1980;3:155-161.
- Stahle HJ, Koch MJ, Pioch T. Double-blind study on materials testing with applied kinesiology. *J Dent Res* 2005;84(11):1066-9.
- Ludtke R, Kunz B, Seeber N, Ring J. Test-retest reliability and validity of the kinesiology muscle test. *Complement Ther Med* 2001;9:141-5.
- Monti DA, Sinnott J, Marchese M, Kunkel EJS, Greeson JM. Muscle test comparisons of congruent and incongruent self-referential statements. *Percept Mot Skills* 1999;88(3 pt 1):1019-28.
- Rawson KA, Middleton EL. Memory-based processing as a mechanism of automaticity in text comprehension. *J Exp Psychol* 2009;35(2):353-70.
- Spengler S, von Cramon DY, Brass M. Was it me or was it you? How the sense of agency originates from ideomotor learning revealed by fMRI. *NeuroImage* 2009;46:290-8.
- Haas M, Peterson D, Hoyer D, Ross G. Muscle testing response to provocative vertebral challenge and spinal manipulation: a randomized controlled trial of construct validity. *J Manipulative Physiol Ther* 1994;17(3):141-8.
- Bablis P, Pollard H, Bonello R. Neuro Emotional Technique for the treatment of trigger point sensitivity in chronic neck pain sufferers: a controlled clinical trial. *Chiropr Osteopat* 2008;16:4.

21. Monti DA, Stoner ME, Zivin G, Schlesinger M. Short term correlates of the Neuro Emotional Technique for cancer-related traumatic stress symptoms: a pilot case series. *J Cancer Surviv* 2007;1:161-6.
22. Peterson K. The effects of spinal manipulation on the intensity of emotional arousal in phobic subjects exposed to a threat stimulus: a randomized, controlled, double-blind clinical trial. *J Manipulative Physiol Ther* 1997;20:602-6.
23. Jensen AM, Ramasamy A. Treating spider phobia using Neuro Emotional Technique: findings from a pilot study. *J Altern Complement Med* 2009;15(12):1363-74.
24. Ahs F, Pissiota A, Michelgard A, Frans O, Furmark T, Appel L, et al. Disentangling the web of fear: amygdala reactivity and functional connectivity in spider and snake phobia. *Psychiatry Res* 2009;172:103-8.
25. Spedding M, Jay T, Costa e Silva J, Perret L. A pathophysiological paradigm for the therapy of psychiatric disease. *Nat Rev Drug Discov* 2005;4(6):467-76.
26. Viskontas IV. Advances in memory research: single-neuron recordings from the human medial temporal lobe aid our understanding of declarative memory. *Curr Opin Neurol* 2008;21:662-8.
27. Morecraft RJ, McNeal DW, Stilwell-Morecraft KS, Gedney M, Ge J, CSchroeder CM, et al. Amygdala interconnections with the cingulate motor cortex in the Rhesus monkey. *J Comp Neurol* 2007;500:134-65.
28. Vincent JL, Snyder AZ, Fox MD, Shannon BJ, Andrews JR, Raichle ME, et al. Coherent spontaneous activity identifies a hippocampal-parietal memory network. *J Neurophysiol* 2006;96:3517-31.