

Comparison of Blood Flow Changes with Soft Tissue Mobilization and Massage Therapy

Andrea Portillo-Soto, MS, LAT, ATC, Lindsey E. Eberman, PhD, LAT, ATC,
Timothy J. Demchak, PhD, LAT, ATC, and Charles Peebles, CMT, CMATI, MAT

Abstract

Objectives: Instrument-assisted soft tissue mobilization and massage therapy are manual techniques that claim to increase blood flow to treated areas, yet no data on these techniques are available. This study sought to compare the effects of the Graston Technique® (GT) and massage therapy on calf blood flow, using skin temperature measures on the lower leg.

Design: Single-blinded prospective, longitudinal, controlled, repeated-measures design.

Setting: Research laboratory.

Participants: Twenty-eight participants (mean age, 23 ± 3 years; 14 men and 14 women; mean calf girth, 39.5 ± 4.31 cm; calf skinfold thickness, 27.9 ± 5.6 cm).

Interventions: Each participant received 10-minute treatments (massage or GT) on two separate sessions, with the untreated leg as a control.

Outcome measures: Baseline skin temperature of the calf was measured before treatment and again every 5 minutes after treatment for a total of 60 minutes. Differences between the 4 treatment conditions (GT, GT control, massage, and massage control) performed 13 times were evaluated with a repeated-measures analysis of variance. Significance was set *a priori* at $p < 0.05$.

Results: Significant differences with Greenhouse-Geisser corrections were seen between conditions ($F_{2,4,61.2} = 39.252$; $p < 0.001$; effect size [ES] = 0.602) and time ($F_{2,1,54.4} = 192.8$; $p < 0.001$; ES = 0.881), but the main effect was not significant ($F_{2,1,53.5} = 2.944$; $p = 0.060$; $1 - \beta = 0.558$). The massage condition ($32.05 \pm 0.16^\circ\text{C}$) yielded significantly higher skin temperatures than did massage control ($30.53 \pm 0.14^\circ\text{C}$; $p < 0.001$), GT ($31.11 \pm 0.20^\circ\text{C}$; $p < 0.001$), and GT control ($30.32 \pm 0.14^\circ\text{C}$; $p < 0.001$) conditions. Significant differences in time occurred: The temperatures at 5 minutes ($30.21 \pm 0.12^\circ\text{C}$), 10 minutes ($31.00 \pm 0.30^\circ\text{C}$), and 15 minutes ($31.65 \pm 0.12^\circ\text{C}$) showed significant increases ($p < 0.001$). Peak temperature was achieved at 25 minutes after treatment ($31.76 \pm 0.12^\circ\text{C}$).

Conclusion: Massage and GT increased skin temperature. A rise in temperature theoretically indicates an increase in blood flow to the area.

Introduction

INSTRUMENT-ASSISTED SOFT TISSUE mobilization and massage therapy are manual therapy techniques aimed at increasing blood flow to areas in the body treated by a clinician.^{1–8} Many researchers and clinicians have investigated the effects of massage on blood flow, but the results have been controversial and inconclusive.^{1–3,9,10} No studies in humans have investigated the effect of instrument-assisted soft tissue mobilization techniques on blood flow.

Instrument-assisted soft tissue mobilization uses instruments to apply a force and detect soft tissue lesions during treatment. It was originated thousands of years ago with the development of *gua sha*, a scraping technique leading to light bruising.^{8,11–13} Massage involves different strokes and hand motions per-

formed to achieve a therapeutic goal.^{9,14–16} These goals range from increasing blood flow to tissues, helping to prevent blood clotting, reducing swelling, reducing discomfort associated with muscle spasms, improving flexibility, increasing skin and muscle temperature, and decreasing the effects of delayed-onset muscle soreness.^{1,14,15–17} Instrument-assisted and massage therapy techniques are used frequently to break down myofascial adhesions in the connective tissue in the body. These restrictions usually involve the adhesion of two structures that do not allow for normal fiber mobility and circulation to occur.^{18–21} Therefore, by breaking down myofascial adhesions, theoretically blood flow is increased.^{6,8,18–21} However, this clinical effect in humans has yet to be determined.

Previous research on instrument-assisted mobilization research in rodents found improved healing.²² In that study,

the Graston Technique,[®] a method of instrument-assisted soft tissue mobilization performed with stainless steel instruments (potentially a variation of up to six instruments), was performed 1 week after injury for three sessions each week for 3 weeks. The rodents were observed for the effects of healing and collagen formation on ligaments.²² No significant changes were found at 5, 10, 15, and 20 minutes post-treatment, but a significant change was found 24 hours post-treatment and 1 week after the final treatment session.²² These results demonstrated a change in collagen fibers and healing, which suggest an increase in blood flow to the areas treated with the Graston Technique.

Several studies have attempted researching the effects of blood flow after massage, but the outcomes are controversial because of the measurement techniques used.^{1-3,9,10,23} When the effects of massage and light touch on skin temperature were investigated, the researchers measured skin temperature changes using dynamic infrared thermography in the neck and shoulders.¹ The skin temperature changes were significant for the massage group when compared with the control and light touch groups. In a study using subdermal thermistors placed in the vastus lateralis to evaluate three different massage conditions (5, 10, and 20 min) and a 5-minute ultrasound treatment, the massage conditions indicated a significantly greater temperature change (at 1.5 and 2.5 cm deep) compared with the 5-minute ultrasound treatment.²⁴

Few studies have compared massage with instrument-assisted soft tissue techniques. Therefore, the purposes of the current study are to (1) study the effects of the Graston Technique and massage therapy on calf blood flow after treatment applied to the lower leg and (2) compare any differences in calf blood flow measures between the two treatment groups.

Materials and Methods

Participants

Twenty-eight healthy volunteers participated in the study (mean $\pm$ standard deviation, 23 ± 3 years; 14 men and 14 women; calf girth, 39.5 ± 4.31 cm; calf skinfold thickness, 27.9 ± 5.6 cm). Participants were excluded if they had had any lower leg injuries in the past 6 months or possessed any absolute or relative contraindications for instrument-assisted soft tissue mobilization and massage therapy. All participants provided written informed consent and completed a health history questionnaire before participating. Every participant scheduled two visits that took place a minimum of 3 days apart. The university's institutional review board approved this study.

Procedures

This study used a single-blinded prospective, longitudinal, controlled, repeated-measures design. During the first session, each participant was randomly assigned to the Graston Technique or to massage therapy (Fig. 1). In a similar manner, each participant's treatment leg was randomly selected while the other leg served as the control leg. Each participant was asked to return a minimum of 3 days after the first treatment. During both sessions, the contralateral leg was used as the control. During the first visit, calf skinfold and calf girth measurements were taken for both legs. Skinfold thickness was measured by using a Harpenden skinfold caliper, and the calf muscle's greatest girth was measured to the nearest millimeter. Calf girth was measured by using a standard measuring tape and was also taken to the nearest millimeter. For both skinfold and girth measurements, participants were

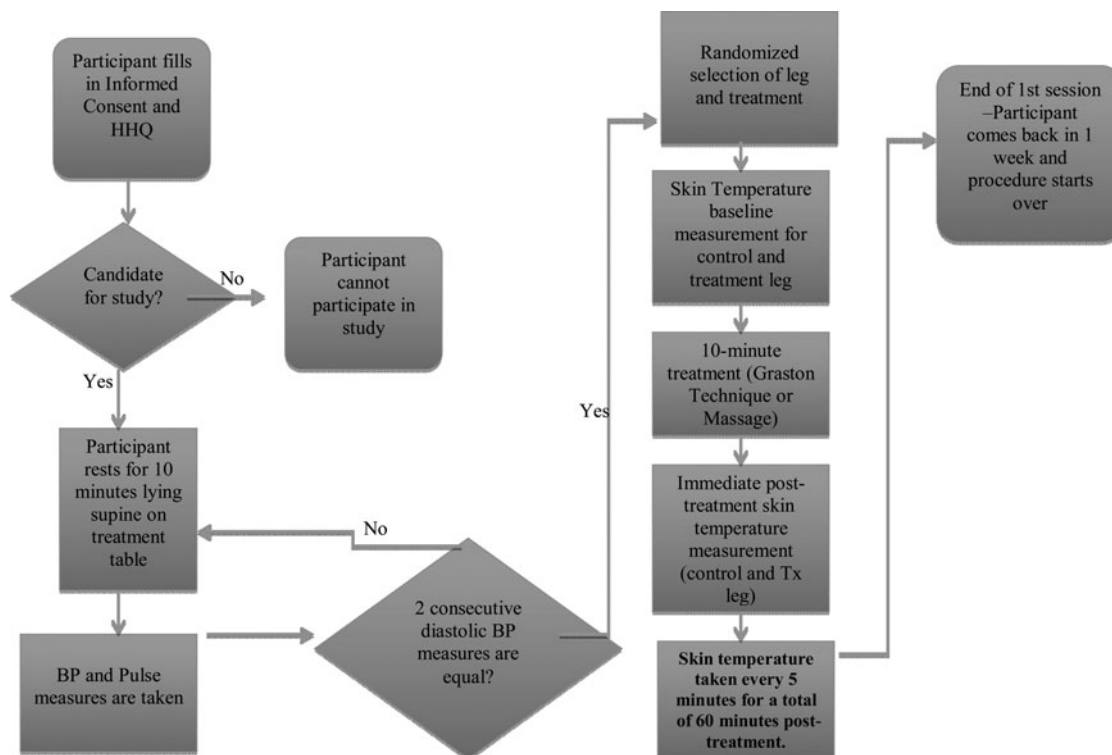


FIG. 1. Methods flowchart. BP, blood pressure; HHQ, health history questionnaire.

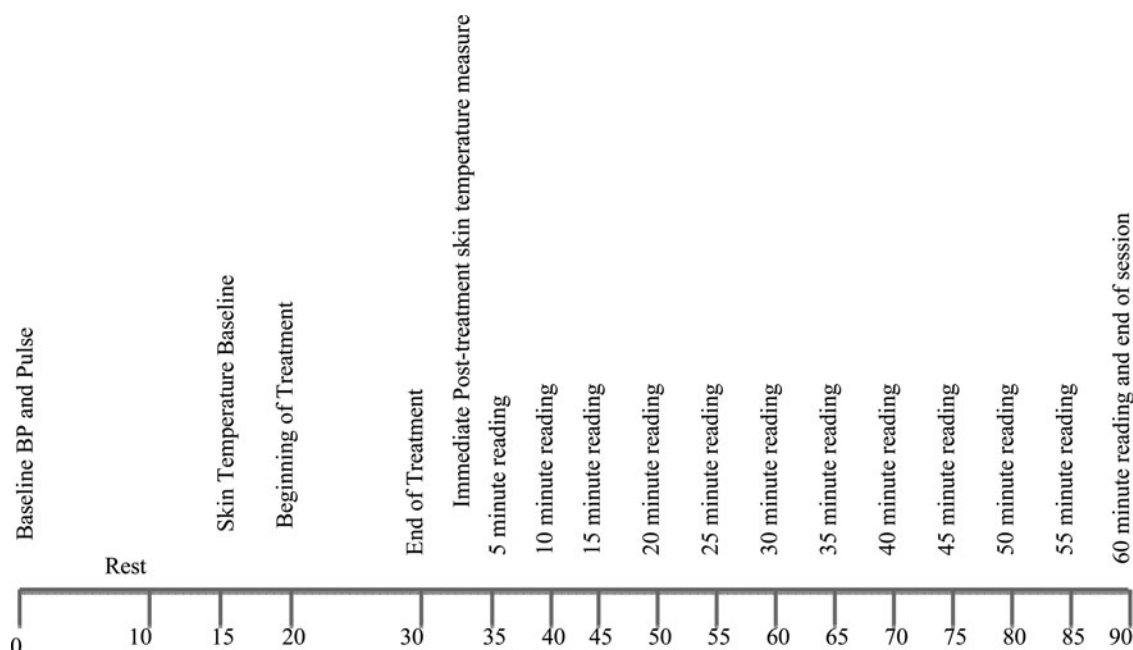


FIG. 2. Procedures timeline.

seated on a stool with both feet on the ground; their knees were relaxed and at approximately 90° of flexion. All participants were barefoot, and measurements were taken three times; the average value was calculated and recorded.

During each visit (Fig. 2), participants' pulse and blood pressure were measured to make sure treatment began at resting values. A standard blood pressure cuff and stethoscope were used for blood pressure measurements. Participants rested prone on a treatment table, and the calf area was cleaned with an alcohol pad. Skin temperatures of both legs were measured by placing a wireless VitalSense® (BMedical, Milton, Australia) dermal temperature patch on the midpoint of the gastrocnemius on each leg. The VitalSense monitor was used to activate each new VitalSense dermal temperature patch. Each dermal temperature patch had a unique ID number and an internal battery. For each patch skin temperature data were tracked and recorded approximately every 5 minutes.

After the baseline skin temperature value was recorded, the patch was removed and a 10-minute treatment (Graston Technique [Fig. 3] or massage therapy) was performed on the randomly chosen leg. The participant's calf was cleaned with a towel to remove the emollient, and the skin temperature patch was placed again on the mid-calf section. Skin temperatures were measured immediately after treat-

ment and every 5 minutes thereafter for a total of 60 minutes after treatment. The first session was concluded after the 60-minute post-treatment measurement. During the second data collection session, the treatment and control legs were the opposite of those used during the first treatment session.

Statistical analysis

As noted above, baseline skin temperature on the calf was measured before treatment, and again every 5 minutes after treatment for a total of 60 minutes. Differences were evaluated between conditions (4) and time (13) with a repeated-measures analysis of variance. Significance was set at $p < 0.05$ *a priori*. A Greenhouse-Geisser correction was used to correct for violations of sphericity (an assumption that the differences between all possible pairs are equal). Data were analyzed using Statistical Package for Windows (SPSS 20; IBM, Armonk, New York).

Results

Significant differences with Greenhouse-Geisser corrections were identified between conditions ($F_{2,4,61.2} = 39.252$; $p < 0.001$; $ES = 0.602$) and time ($F_{2,1,54.4} = 192.8$; $p < 0.001$; $ES = 0.881$), but no significant main effect was achieved ($F_{2,1,53.5} = 2.944$; $p = 0.060$; $1 - \beta = 0.558$). The massage condition ($32.05 \pm 0.16^\circ\text{C}$) yielded significantly higher skin temperatures compared with the massage control ($30.53 \pm 0.14^\circ\text{C}$; $p < 0.001$), Graston Technique (31.11 ± 0.20 ; $p < 0.001$), and its control (30.32 ± 0.14 ; $p < 0.001$) condition. Only the control conditions were not significantly different from one another ($p = 0.189$). Significant differences in time were seen; the baseline temperature ($25.83 \pm 0.30^\circ\text{C}$) acquired before treatment was significantly lower than all other temperature measurements ($p < 0.001$). Moreover, temperatures at 5 minutes ($30.21 \pm 0.12^\circ\text{C}$), 10 minutes ($31.00 \pm 0.30^\circ\text{C}$), and 15 minutes ($31.65 \pm 0.12^\circ\text{C}$) showed significant increases ($p < 0.001$).



FIG. 3. Graston Technique instruments (Graston Technique LLC, Indianapolis, IN). U.S. Patent 5231977 in 1993.

After 15 minutes, the skin temperatures continued to rise and each time point was statistically different from the baseline and up to the 25-minute peak temperature ($31.76 \pm 0.12^\circ\text{C}$), but these differences were not clinically significant differences ($<0.80^\circ\text{C}$).²⁵

Discussion

This study demonstrated that massage and Graston Technique increased skin temperature. A rise in skin temperature theoretically indicates an increase in blood flow to the area. Massage had a higher temperature increase compared with Graston Technique, but both techniques increased temperature consistently for up to 25 minutes after treatment. The key finding of this study was that the massage condition produced clinically significant, higher skin temperatures when compared with all other conditions. Significant changes were also found between the control and Graston Technique conditions. These results suggest that a 10-minute soft tissue mobilization treatment (regardless of whether instruments are used) can increase skin temperature and peripheral blood flow to areas receiving treatment and surrounding areas. For both techniques, the changes in skin temperature increased immediately after treatment; they continued to increase and peaked at 25 minutes after treatment (Fig. 4). Skin temperatures never returned to baseline after 60 minutes of data collection. They remained 5–6°C higher than pretreatment temperatures in all conditions.

The control conditions did not differ significantly from one another, and even though treatment was not directly applied, both increased in temperature immediately alongside the treatment leg. The massage treatment legs ($33.041 \pm 0.179^\circ\text{C}$) caused a 1.77°C (5.4%) increase in skin temperature difference from the massage condition legs ($31.267 \pm 0.129^\circ\text{C}$). The legs treated with the Graston Technique ($31.831 \pm 0.205^\circ\text{C}$) caused a 0.84°C (2.6%) increase in skin temperature difference from the control condition ($30.988 \pm 0.139^\circ\text{C}$). The changes and increase in temperatures for the control legs did

not result from heat conducted directly from the massage therapist's hands or the instruments to the leg, but instead suggest an increase in blood flow and peripheral perfusion to surrounding areas and the limb opposite the one treated. According to Goats, when massage or connective tissue massage is applied to one limb, blood flow will increase on the other one because of a manual stimulation and triggering of cutaneovisceral reflexes that cause vasodilation.¹⁴ Goats and Barr et al. suggest an effect on the sympathetic autonomic system and physiologic effects that are independent of any change in blood flow occurring on the opposite limb and areas surrounding the treatment site.^{26,27}

The other studies of both Graston Technique and massage have demonstrated increased tissue temperature, although the means for measurement have differed.^{1,14,24,26,27} Some of the other investigations also saw increases in tissue temperature, including tissue temperature rises in related areas as well.¹ These findings are consistent with ours, yet further exploration of these physiologic effects is warranted.

Limitations

This study measured skin temperature as an indirect measure of peripheral blood flow. The findings suggest that blood flow is increasing in the area treated, yet more direct methods of assessment may corroborate the findings. Further, the depth of tissue temperature changes was unknown. Future research is needed to study the effects of massage and the Graston Technique or other instrument-assisted techniques on blood flow during treatment.

Conclusion

This study demonstrated that a 10-minute massage and Graston Technique treatment increase skin temperature on the body part being treated. A rise in temperature theoretically indicates an increase in blood flow to the area. An increase in blood flow stimulates nutrients and oxygen to

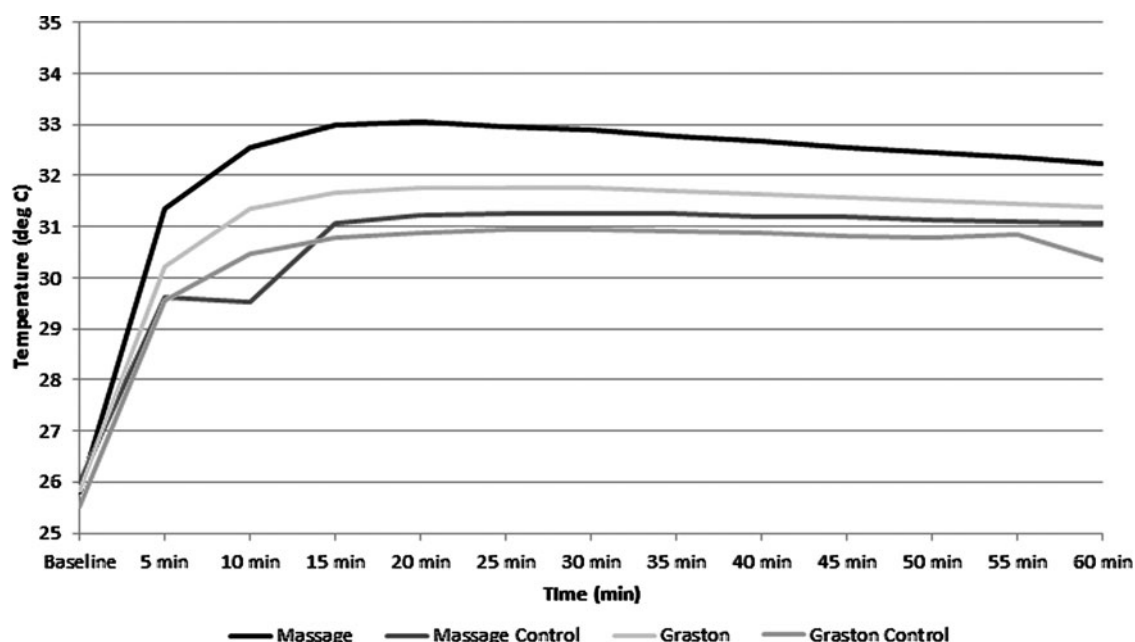


FIG. 4. Comparison of mean skin temperature and treatment conditions over time.

tissues in the body, as well as increases tissue mobility and flexibility. Massage demonstrated a higher temperature increase than did the Graston Technique, but both techniques increased temperature consistently for up to 25 minutes after treatment. Further research is needed to conclude how deeply this temperature and blood flow increase is occurring in the muscle tissue. Potential future research ideas could include the comparison of instrument-assisted techniques and massage with an active warm-up or passive methods of thermotherapy. This study suggests that if a clinician's therapeutic goal is to increase temperature and blood flow, both massage and Graston Technique would be good treatment choices, with massage yielding significantly higher temperature and blood flow.

Author Disclosure Statement

No competing financial relationships exist.

References

- Sefton JM, Yarar C, Berry JW, Pascoe DD. Therapeutic massage of the neck and shoulders produces changes in peripheral blood flow when assessed with dynamic infrared thermography. *J Altern Complement Med* 2010;16:723–732.
- Mori H, Ohsawa H, Tanaka TH, et al. Effects of massage on blood flow and muscle fatigue following isometric lumbar exercise. *Med Sci Monit* 2004;10:173–178.
- Hinds T, McEwan I, Perkes J, Dawson E, Ball D, George K. Effects of massage on limb and skin blood flow after quadriceps exercise. *Med Sci Sports Exerc* 2004;36:1308–1313.
- Paolini J. Review of myofascial release as an effective massage technique. *Athletic Ther Today* 2009;14:30–34.
- Weerapong P. The mechanisms of massage and effects on performance, muscle recovery and injury prevention. *Sports Med* 2005;35:235–256.
- Loghmani MTC. Instrument-assisted cross fiber massage improves blood flow in healing knee ligaments suggesting enhanced angiogenesis. American Physical Therapy Association Combined Sections Meeting: Orthopedic Section Platform Presentation. 2010.
- Carey-Loghmani MT, Schrader JW, Hammer WI. Graston Technique M1 Instruction Manual. 3rd ed. Indianapolis, IN: TherapyCare Resources Inc, 2010.
- Bayliss AJ, Klene FJ, Evelina L, Gundeck EL, Loghmani MT. Treatment of a patient with post-natal chronic calf pain utilizing instrument-assisted soft tissue mobilization: a case study. *J Man Manip Ther* 2011;19:127–134.
- Wiltshire EV, Poitras V, Pak M, et al. Massage impairs postexercise muscle blood flow and “lactic acid” removal. *Med Sci Sports Exerc* 2010;42:1062–1071.
- Shoemaker PM. Effleurage massage, muscle blood flow and long-term post-exercise strength recovery. *Int J Sports Med* 1995;16:478–483.
- Nielsen A. Gua Sha: A Clinical Overview. *Chinese Medicine Times* 2008;3.
- Xu QY, Yang JS, Zhu B, et al. The effects of scraping therapy on local temperature and blood perfusion volume in healthy subjects. *Evid Based Complement Alternat Med* 2012;2012:490292.
- Lauche R, Wübbeling K, Lüdtke R, et al. Randomized controlled pilot study: pain intensity and pressure pain thresholds in patients with neck and low back pain before and after traditional East Asian “gua sha” therapy. *Am J Chin Med* 2012;40:905–917.
- Goats GC. Massage—the scientific basis of an ancient art: part 2. Physiological and therapeutic effects. *Br J Sports Med* 1994;28:153–156.
- Goats GC. Massage—the scientific basis of an ancient art: part 1. The techniques. *Br J Sports Med* 1994;28:149–152.
- Brummit J. The role of massage in sports performance and rehabilitation: current evidence and future direction. *N Am J Sports Phys Ther* 2008;3:7–21.
- Pornratshanee Weerapong PAH, Kolt GS. The mechanisms of massage and effects on performance, muscle recovery and injury prevention. *Sports Med* 2005;35: 235–256.
- Findley T, Chaudhry H, Stecco A, Roman M. Fascia research—a narrative review. *J Bodyw Mov Ther* 2012;16: 67–75.
- Myroslava Kumka JB. Fascia a morphological description and clasification. *J Can Chiropr Assoc* 2012;56:179–191.
- Myers TW. *Anatomy Trains*. 2nd ed. New York: Churchill Livingstone, 2008.
- Salvi Shah AB. Myofascial release. *Int J Health Sci Res* 2012;2:69–77.
- Loghmani MT, Warden SJ. Instrument-assisted cross-fiber massage accelerates knee ligament healing. *J Orthop Sports Phys Ther* 2009;39:506–514.
- Shoemaker PM. Effleurage massage, muscle blood flow and long-term post-exercise strength recovery. *J Sports Med* 1995;16:478–483.
- Drust B, Atkinson G, Gregson W, French D, Binningsley D. The effects of massage on intra muscular temperature in the vastus lateralis in humans. *Int J Sports Med* 2003; 24:395–399.
- Pascoe DD, Mercer JB, de Weerd L. Physiologies of thermal signals. In: Bronzino JD, ed. *Medical Devices and Systems*. Boca Raton, FL: CRC Press, 2006.
- Goats GC, Kier K. Connective tissue massage. *Br J Sports Med* 1991;25:131–133.
- Barr JS, Taslitz N. The influence of back massage on autonomic functions. *Phys Ther* 1970;50:1679–1691.

Address correspondence to:
 Lindsey E. Eberman, PhD, LAT, ATC
 Indiana State University
 567 N. Main Street, Room 257
 Terre Haute, IN 47809
 E-mail: leberman@indstate.edu

Copyright of Journal of Alternative & Complementary Medicine is the property of Mary Ann Liebert, Inc. and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.