



<https://doi.org/10.17784/mtprehabjournal.2020.18.1186>

The immediate effects of prophylactic therapeutic massage on pain tolerance and threshold: A randomized trial

Kyle Knight, Erin Napier

University of Kentucky Physical Therapy Program, Lexington, (KY), USA

ABSTRACT

Background: For decades, therapeutic massage has been thought to reduce anxiety and increase relaxation in human patients. Many patients also turn to therapeutic massage following a sport or work-related activity in order to decrease muscle and joint pain. Studies dealing with pain usually rely on subjective measures reported by the subject but this study used objective data from a pain threshold and tolerance test. **Objective:** This study is meant to determine the immediate effects of therapeutic massage on pain tolerance and threshold. **Methods:** Fourteen subjects were recruited from a sample of convenience. Subjects were randomized to have either the massage or no-massage protocol on their initial visit with the remaining protocol on their following visit. All subjects completed two sessions with the pain-eliciting test, one with the massage protocol and one with the no-massage protocol. **Results:** All 14 subjects achieved a higher pain tolerance during the massage protocol compared to their own no-massage protocol. The pain tolerance difference between protocols was calculated by a paired T-Test (p value 0.0003) to be a significant difference. No significant difference was found for pain threshold between protocols. **Discussion:** It appears that therapeutic massage does have a likelihood of increasing pain tolerance when subjects are submitted to a painful stimulus immediately post-massage. This study validates the use of therapeutic massage as an adjunct treatment to improve pain tolerance before a potentially painful procedure. **Conclusion:** Prophylactic massage was shown to allow healthy participants to achieve a higher pain tolerance when subjected to a pain-eliciting test immediately after the massage was received.

Keywords: Massage; Therapeutic Massage; Benefits; Pain; Pain Phreshold; Pain Tolerance

BACKGROUND

For decades, therapeutic massage has been thought to reduce anxiety and increase relaxation in human patients. Many patients also turn to therapeutic massage following a sport or work-related activity in order to decrease muscle and joint pain. Studies dealing with pain usually rely on subjective measures reported by the subject but this study used objective data from a pain threshold and tolerance test. This study is meant to determine the immediate effects of therapeutic massage on pain tolerance and threshold. There is some evidence to suggest that therapeutic massage is useful in providing an analgesic effect.⁽¹⁻⁶⁾ To date, there has not been a study comparing the effectiveness of therapeutic massage against an actual pain threshold and tolerance test that has an objective outcome, making this study necessary. If enough evidence comes to light on the effects of prophylactic therapeutic massage in regards to the reduction of pain tolerance and threshold, this could result in a change in therapy practice when it comes time to make a decision on performing a therapeutic massage just before a typically painful treatment.

The Cold Pressor Test is commonly used in clinical settings to elicit pain and observe hemodynamic changes.⁽⁷⁾ This test measures pain threshold and pain tolerance. For the purposes of this study, pain threshold was the amount of time

before the subject began to feel pain and pain tolerance was the amount of time the subject overall withstood the pain before removing their hand from the pain stimulus. Pain was elicited by submerging a subject's entire hand, up to the wrist, in cold water.

This study relied on the assumption that our subjects were truthful about their ability to perform the test and that they completed the test to the best of their ability. Limitations to this study included a relatively small, homogenous sample size of healthy young adults all within 5 years of age of each other. Though the sample size was relatively small, it was large enough to determine a statistically significant difference. Additional data on older, healthy and non-healthy populations as well as younger non-healthy populations would serve to strengthen the research by making it more generalizable to a whole population.

It was expected that testing therapeutic massage (a specific technique to be outlined later) against objective data from a pain test will validate its practice. The goal of our research was to determine whether therapeutic massage has a measurable effect on pain threshold and tolerance. It was hypothesized that therapeutic massage performed prior to the onset of a pain stimulus test would result in the increase of both pain threshold and pain tolerance.

*Corresponding author: Kyle Knight. E-mail: kmknight91@gmail.com

Submission date 14 April 2020; Acceptance date 23 October 2020; Publication date 22 December 2020



Manual Therapy, Posturology & Rehabilitation Journal. ISSN 2236-5435. Copyright © 2020. This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License which permits unrestricted non-commercial use, distribution, and reproduction in any medium provided article is properly cited



METHODS

The use of human subjects in this study was approved by the Institutional Review Board at the University in which the study took place. Subjects were recruited from a sample of convenience. Students in their first and second year of the physical therapy program at the University in which the study took place were initially approached. Students were made aware of the study by a research representative going to one of the potential subject's lectures and introducing them to the prospective plan. Students were then asked to sign a sheet of paper and include their phone number and email if they were interested in being participants. Students were then contacted in the order they signed up on the sheet. In order for both genders to be equally represented, the first 7 male and 7 female volunteers on the list were contacted.

A time when the student, researcher, and lab were available was then determined. Upon arrival to the testing location, the participant was read aloud the exclusion criteria and given the opportunity to read the rest of the consent form. Exclusion criteria for this study included being younger than 18 or older than 45 years old, a current diagnosis of Reynaud's disease, decreased sensation anywhere on the body, current smoker, current pregnancy, current traumatic or non-traumatic edema anywhere on the body, or aversion to cold. After signing the consent form, the participant then blindly selected a piece of paper from a cup. The cup contained two slips of paper. One read "massage" and the other, "no massage." The paper drawn from the cup by the participant dictated which protocol they would receive that day. On the following visit the subject participated in the other protocol. Each participant completed both protocols. The following visit was to be in one week ± 2 days to allow for scheduling conflicts.

The no-massage protocol involved the participant completing the Cold Pressor Test, a pain threshold and tolerance test using cold water, without first receiving a therapeutic massage to their forearm. A small hand bath of cold water was created by filling an empty 20"x15"x5" tub with cool water from the tap. A gallon tub of ice was then added to the water and allowed to stand for one minute. A thermometer was placed in the tub to determine the temperature. Ice was either added or removed depending on what was needed in order to allow the temperature of the water bath to reach between 35-40° Fahrenheit. The participant was then instructed to fully submerge their hand, palm down, in the water so that their hand was approximately 1cm from the bottom of the tub. This was to allow convection to occur around the entirety

of their hand. Convection was maintained by the researcher stirring the water with the thermometer. Before submersion, the participant was instructed to tell the researcher when they first started to feel pain.

The amount of time elapsed since submersion was recorded by the researcher as pain threshold but was not shared with the participant. The participant was also instructed to take their hand out of the water when they could no longer stand the painful stimulus. At this point, the amount of time elapsed since submersion was recorded by the researcher as pain tolerance and was also not shared with the participant. Clocks were removed from the walls and the participants were asked to remove their watches so they weren't able to track their time. The participant was then handed a towel to dry their hand and the researcher inspected the hand for any adverse reactions. The participant then sat with the researcher for 5 minutes to ensure no adverse effects were incurred. This ended the no-massage protocol. Participants were not allowed to know their results during the course of the research.

The massage protocol involved the participant first receiving a prophylactic therapeutic massage followed by the Cold Pressor Test. The participant sat at a matted table with their arm supported on the surface of the table. The height of the table was adjusted for comfort of the participant if needed. The participant exposed their arm from the elbow to the fingertips and removed all jewelry. The researcher administered a massage that was completed distally-to-proximally in the following order: superficial strokes to the entire forearm, deep strokes to the entire forearm, one-handed palmar kneading of the entire forearm with subject's forearm stabilized by the massager's the other hand, bilateral thumb kneading of the forearm in strips until the entire forearm was addressed, bilateral transverse thumb motions over palmar surface of the hand, single thumb kneading of thenar and hypothenar eminences simultaneously, bilateral thumb kneading to the dorsum of hand, deep stroking to the entire forearm, superficial stroking to the entire forearm, massage completed⁽⁸⁾.

The participant's forearm was moved into pronation and supination by the researcher during different parts of the massage so that all parts of the forearm and hand were addressed. Massage cream was used during the massage and each massage lasted approximately 5 minutes. The researcher then wiped the massage cream from the subject's forearm with a towel and had the subject perform the Cold Pressor Test exactly as described in the paragraph above. This completed the massage protocol. After the participant completed both





protocols, they had completed the study. This study was not created to endorse any specific product. No funding or payment from any company was received based on the equipment used. The equipment was selected out of convenience. A Rubbermaid plastic tub was used as the submersion tub and a Leaktite gallon bucket was used to pour the ice into the submersion tub. A Cooper stainless steel dial thermometer was used to collect temperature data. PrePak Free-Up unscented massage cream was used for the massage protocol.

A total of 14 participants (7 male, 7 female) completed both protocols (100% adherence). Through randomization, 7 participants completed the massage protocol first and 7 completed the no-massage protocol first. None of the participants had adverse reactions lasting longer than 5 minutes. Most participants experienced redness on the hand up to the wrist. One participant reported reaching the numb stage while their hand was in the water. None of these reactions were out of the realm of possibility and all were disclosed as possible reactions in the informed consent. At that point they were instructed to remove their hand at the maximum cutoff of 2 minutes and 30 seconds of hand submersion.

The statistical design of this study was to determine if receiving a therapeutic massage resulted in a statistically significant improvement in pain threshold and/or pain tolerance. This was done using a paired T-Test across individual's pain threshold score between the massage and no-massage protocol and their pain tolerance score between the massage and no-massage protocol. Since values were being compared between the

same individual test subjects, a paired T-Test was appropriate.

RESULTS

Every participant had a higher measured pain tolerance on the day they participated in the massage protocol. This was regardless of the order of protocols or gender of the participant. The participant who reached the numb stage achieved numbness on the day they participated in the massage protocol but not on the day they participated in the no-massage protocol. The data regarding pain threshold was more varied and not as consistent. Table 1 and figure 1 and figure 2 represent the collected data.

The average increase in pain tolerance from the no-massage protocol to the massage protocol was 14.07 (± 10.34) seconds with no data point being determined an outlier ($\pm 1.5x$ above/below the interquartile range). Using a paired T-Test to compare each individual on the two protocols, a significant difference was found for improvement of pain tolerance (p value: 0.0003). No significant difference was found for improvement of pain threshold. Threshold data was varied with some participants having a higher threshold during the no-massage protocol and vice versa but in every case, the pain tolerance was higher during the massage protocol. Data was not compared amongst participants since the aim of the research was to identify a change in the individual from one protocol to the other.

Table 1. Massage protocol

Participant	Trial 1 Threshold (seconds)	Trial 1 Tolerance (seconds)	Trial 2 Threshold (seconds)	Trial 2 Tolerance (seconds)
1	31	58	24*	64*
2	18*	65*	24	58
3	15	36	11*	48*
4	16	114	23*	120*
5	9	38	9*	41*
6	52*	150**	25	120
7	25	41	17*	54*
8	10	30	8*	47*
9	23*	56*	8	25
10	12*	28*	10	21
11	15*	67*	11	39
12	19	41	21*	46*
13	15*	53*	10	27
14	13*	43*	20	37

Note: participant 6 reached the 2:30 cutoff due to numbness during the massage protocol, but not during the no-massage protocol



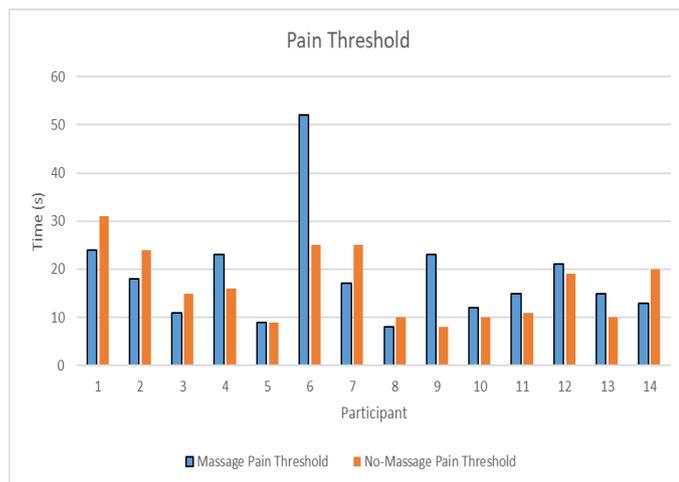


Figure 1. Massage pain threshold and No-Message threshold.

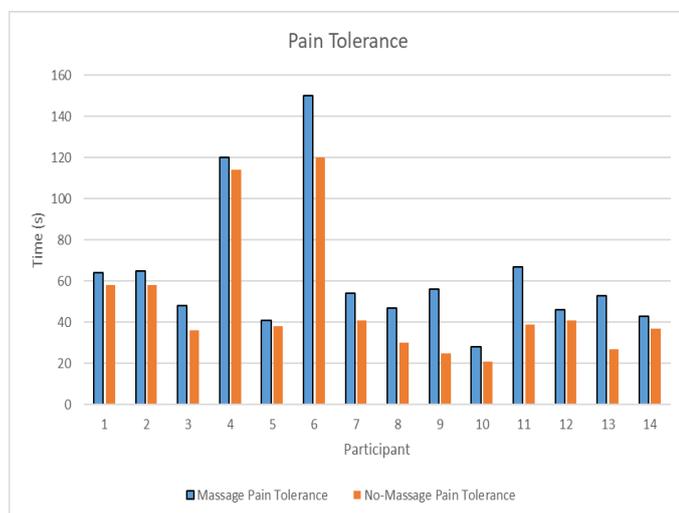


Figure 2. Massage pain tolerance and Non-Message tolerance.

DISCUSSION

According to the data presented in this study, it would appear that therapeutic massage does have a likelihood of increasing pain tolerance when subjects are submitted to a pain stimulus immediately post-massage. This study validates the use of therapeutic massage as an adjunct treatment to improve pain tolerance in young, healthy individuals and it does so using objective data gathered from a pain threshold and tolerance test.

This data supports the idea that therapeutic massage can potentially increase the pain tolerance, but not necessarily the pain threshold, of a young, healthy person. In regards to this study, this means that therapeutic massage may be able to increase the amount of maximum pain a patient can withstand, but likely doesn't have an effect on the amount of time it takes a patient to perceive the

onset of pain during a noxious stimulus. A more accurate hypothesis for this study would exclude any mention of pain threshold when it comes to the benefits of prophylactic therapeutic massage, as was originally hypothesized in this study. The original hypothesis for this study was in favor of prophylactic therapeutic massage increasing pain threshold and pain tolerance whereas the outcome was only in favor of increasing pain tolerance.

Further research should look at this concept with non-healthy patients and determine if similar results are achieved as this study was performed on a healthy population. This study also did not identify the physiological reason as to why the results were achieved. This was simply an initial proof of concept. Additional research could be done to determine patient attitudes and perception of the trials in hopes to identify if there was another reason they had an increased pain tolerance during the massage protocol.

One limitation of this study is that the water was not a specific temperature each time. The water was within five degrees of the same temperature from participant to participant due to the conditions of the study. This was an understood problem going into the study but one that could not be fixed with the resources readily available.

Another limitation is that one participant was able to reach the numb stage when their hand was submerged in the water and therefore ceased to experience pain. This was hoped to be avoided due to convection of the water causing an intense stimulus to the participant. This may have been related the small variances in water temperature and/or the inherent pain threshold and tolerance of that individual participant.

Due to the use of a sample of convenience, most of the participants know multiple other people who participated in the study. It is possible that there was talk between participants about perceived individual results and other aspects of the study. This could have had effects on participant's effort and desire to achieve a certain time as opposed to going on what they truly experienced. Every effort was made to blind participants to what their data was on each trial. Also due to the sample of convenience, all participants were in their early 20s.

Each researcher (current 3rd year PT students at the University in which the study took place) was in charge of 7 subjects. They performed both the massage and the no-massage protocol on all 7 of their subjects. This study could have been improved by one researcher performing all the massage protocols and the other researcher performing all the Cold Pressor Tests. This would have created better consistency in procedures. It also would have





created a situation where the researcher administering the Cold Pressor Test was blind to the protocol when measuring the data. However, this study seemed to have adequate interrater reliability since both researchers received comparable results and followed a detailed protocol outlined before the start of the study. Both researchers were also trained in the massage technique by the same instructor⁽⁸⁾ and proved competency with the technique via practical exam.

To further strengthen the research, the same study design could be paired with a different pain threshold/tolerance test to see if the improvements remain. The massage and pain stimulus could also be performed to a part of the body other than the forearm/hand.

CONCLUSION

This study, along with others, and the additional research mentioned above could potentially have an impact on clinical practice guidelines when performing physical therapy interventions that typically illicit a pain response. Based on the data gained from this study, there is some precedent to say that therapeutic massage is appropriate to administer just prior to performing traditionally painful interventions as it can improve the pain tolerance in specific tissue of young, healthy individuals.

In any case, this study shows that therapeutic massage, performed as outlined in the Methods and Procedures section, may have a positive impact on young, healthy patients in regards to improving pain tolerance immediately post-massage.

Acknowledgements: This research was conducted while both offers were still affiliated with the University of Kentucky. We would like to acknowledge the following people and departments for their assistance in completing this research.

- The University of Kentucky Physical Therapy Department, where the research was conducted
- The University of Kentucky Institutional Review Board
- Dr. Terry Malone, faculty advisor
- The subjects of the study which were composed of members of the University of Kentucky Doctor of Physical Therapy Classes of 2017 and 2018

Ethical Approval: The use of human subjects in this study was approved by the Institutional Review Board at the University of Kentucky. IRB#: 15-0650-P1H

Authors' contributions: Authors' contributions: KK defined the concept of the study, created the hypothesis and wrote the original proposal. KK, EN were involved in the critical review of the study proposal and the manuscript and Wrote this study protocol. All authors read and approved the manuscript

Financial support: None Declared.

Conflict of interest: The authors declare that there was no conflict of interests.

REFERENCES

1. Ferrell-Torry AT, Glick OJ. The use of therapeutic massage as a nursing intervention to modify anxiety and the perception of cancer pain. *Cancer Nursing*. 1993;16(2):93-101.
2. Cherkin DC, Eisenberg D, Sherman KJ, Barlow W, Kaptchuk TJ, Street J, et al. Randomized trial comparing traditional Chinese medical acupuncture, therapeutic massage, and self-care education for chronic low back pain. *Arch Intern Med*. 2001 Apr 23;161(8):1081-8.
3. Field T, Hernandez-Reif M, Taylor S, Quintino O, Burman I. Labor pain is reduced by massage therapy. *J of Psychosomatic Obstetrics & Gynecology* . 2009; 20(1):286-291.
4. Cherkin DC, Sherman KJ, Deyo RA, Shekelle PG. A review of the evidence for the effectiveness, safety, and cost of acupuncture, massage therapy, and spinal manipulation for back pain. *Ann Intern Med*. 2003 Jun 3;138(11):898-906.
5. Hernandez-Reif M, Field T, Krasnegor J, Theakston H. Lower back pain is reduced and range of motion increased after massage therapy. *Int J Neurosci*. 2001;106(3-4):131-45.
6. Preyde M. Effectiveness of massage therapy for subacute lowback pain: A randomized controlled trial. *Canadian Medical Association Journal*. 2000;162(13):1815-1820.
7. National Institute on Drug Abuse; Johns Hopkins University. Study of the treatment of experimental pain in opioid dependent persons on methadone or buprenorphine maintenance. In: *ClinicalTrials.gov* [Internet]. Bethesda (MD): National Library of Medicine (US). 2015- [cited 2015 Aug 19]. Available from: <https://clinicaltrials.gov/ct2/show/NCT01642030> NLM Identifier: NCT01642030.
8. Kelly D. Therapeutic massage of the forearm and hand. Lecture presented at: PT615 Basic Clinical Skills; 2015; University of Kentucky, Lexington, KY.

