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Perception of the Treatment Efficacy of Therapeutic Magnets on Pain Control of Exercise Induced Muscle Soreness in the Non-Dominant Wrist and Forearm in High School Athletes

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PERCEPTION OF THE TREATMENT EFFICACY OF THERAPEUTIC MAGNETS ON PAIN CONTROL OF EXERCISE INDUCED MUSCLE SORENESS IN THE NON-DOMINANT WRIST AND FOREARM IN HIGH SCHOOL ATHLETES

by

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The purpose of the study was to determine if patient perceptions had a significant influence on the perceived success of therapeutic magnets. Volunteer subjects included 33 (14=Female, 19=Male) high school athletes. The subjects were divided into a control group and two treatment groups. Treatment group 1 received Nikken-Kenko Magnetic Promo Pad (2.15"x 3.23") and treatment group 2 received a placebo magnet. Treatment groups underwent an exercise induced muscle soreness protocol for the non-dominant wrist. The test groups completed a pain questionnaire every 12 hours for 96 hours. A post-test questionnaire was administered to the test groups at the conclusion of the study to assess the athletes' perceptions of the magnets. No significance was found between treatment groups when comparing strength, range of motion, and pain perception. However, on a post-test questionnaire, subjects reported the therapeutic magnets were effective in decreasing pain associated with delayed onset muscle soreness. In conclusion, the subjects participating in this study felt therapeutic magnets were effective without substantial physiological evidence to support the claims.

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CHAPTER 1

INTRODUCTION

Magnetic therapy is a form of modality that has been used for thousands of years. This form of treatment has gone through little evolution over time and is still used for some of the same conditions today as it was in times of ancient Greece (Ratterman, Secrest, Norwood, & Chien, 2002). Researchers are looking for answers to why this modality has retained its popularity over time (Basford, 2001) even though no physiological changes to human tissues have been discovered, yet there is a high degree of reported patient satisfaction with magnet therapy. To date, research has not evolved to examine psychological implications that may affect the treatment efficacy.

Effectiveness of therapeutic magnets is supported by personal testimonials reported by consumers and unpublished, non-peer reviewed research of the magnet manufacturers. However, past scientific research disputes the claims made by the therapeutic magnet manufacturers. Therapeutic magnets have been ineffective in increasing strength of hand-grip and thumb-forefinger pinch (Chaloupka, Kang, & Mastrangelo, 2002), altering skin or deep tissue temperatures (Sweeney, Merrick, Ingersoll, & Swez, 2001) and decreasing pain in patients suffering from low back pain (Collocott, Zimmerman, White, & Rindone, 2000).

Magnet therapy has been used to treat a variety of medical conditions including delayed onset muscle soreness (DOMS) following exercise (Chaloupka et al., 2002). DOMS generally develops 12 hours or longer following unaccustomed

muscle activity (Nosaka & Newton, 2002). It is thought to be a result of microscopic tearing of the muscle fibers (Ross, 1999). Signs and symptoms associated with DOMS include pain, strength loss, and decreased range of motion of the affected muscles (Nosaka & Newton, 2002).

Research focusing on subjects' perception of pain transmission and pain control is growing in the subject of magnetic therapy. Studies conducted by Borsa and Liggett (1998); Hinman, Ford, and Heyl (2002); Valbona, Hazlewood, and Jurida (1997); Segal et al. (2001); and Collocott et al. (2000) used patient perceptions of pain to rate the success of magnet therapy. Each of these studies focused on patient perceptions rather than physiological effects of magnetic therapy. The results are conflicting as each study used different parameters (i.e., strength of magnetic field, duration of treatment, frequency of treatment) and different populations.

There are two considerations that must be taken into account for a modality to be an effective form of treatment. The modality's physiological effect on the affected tissues and the psychological response of the patient to the modality must be considered. If a patient believes the modality will be effective prior to its use, then some degree of success will be experienced regardless of the physiological effects (Kaptchuk, 1998). The opposite is also true; if the patient does not believe in the treatment it is unlikely that a high degree of success will be experienced.

Research in the field of athletic training and other allied health professions fail to recognize psychological factors of the patient that may affect the treatment

outcome of such modalities as therapeutic magnets. The importance of patient perceptions of treatment efficacy is most obvious in non-traditional modalities, such as magnetic therapy, because of the lack of physical evidence supporting its success.

Statement of the Problem

The purpose of this study is to determine the perceptions held by high school athletes on the treatment efficacy of therapeutic magnets in regards to pain control associated with exercise-induced muscle soreness in the non-dominant wrist and forearm.

Significance of the Study

Therapeutic magnets have been found to be effective in the treatment of rheumatoid arthritis (Segal et al., 2001), pain associated with postpolio syndrome (Vallbona et al., 1997), and chronic knee pain (Hinman et al., 2002). Therapeutic magnets have been found to be ineffective in the treatment of pain as a result of muscle microinjury (Borsa & Liggett, 1998) and chronic low back pain (Collocott et al., 2000). While no research has reported physiological changes as a result of therapeutic magnets, the use of therapeutic magnets continues to be used as form of treatment for a variety of medical conditions and musculoskeletal injuries especially in the field of sports medicine.

Research Hypotheses

The research hypothesis of the study include the following:

1. Subjects in the treatment groups will not believe therapeutic magnets are effective in decreasing signs and symptoms of delayed onset muscle soreness.
2. Dependent measures (Total Range of Motion, Hand-Grip Strength, and Pain Perception) will not be affected by therapeutic magnets.
3. Dependent measures (Total Range of Motion, Hand-Grip Strength, and Pain Perception) will be affected following administration of an exercise induced muscle soreness protocol.

Limitations and Delimitations

The limitations of this study include the following:

1. Tester Validity and Accuracy: Active range of motion of wrist extension and wrist flexion was measured with a goniometer. Results may have been affected by inconsistent landmarking for the fulcrum, stationery arm, and movable arm of the goniometer.
2. Subject noncompliance: Subjects not following the exact instructions made by the principle investigator while wearing the magnet.

The delimitations of the study as set by the investigator include:

1. Condition of the subject: Athletes from all sports of the fall season were invited to participate in the study. These athletes might have

different levels of physical condition based on which sport they participated.

2. Exercise-Induced Muscle Soreness Protocol: The protocol used for the study may not have affected the subjects equally. Some subjects may have experienced more soreness than others.

Operational Definitions

Concentric Contraction. An overall shortening of the muscle occurs as it generates tension and contracts against resistance.

Commercial Flexible Magnet. A modified and simplified version of the original electromagnetic field unit model. These magnets produce a low-level static magnetic field usually below a field strength of 1,000 gauss (G) and at this strength are not regulated by the Food and Drug Administration.

Eccentric Contraction. Overall lengthening of the muscle occurs as it develops tension and contracts to control motion against the resistance of an outside force.

Gauss (G). A unit of measure that indicates the strength of a magnetic field. For a given magnetic-pole design, the higher the gauss, the greater the field extends out from the surface of the magnet.

Goniometer. An instrument for measuring angles and determining range of joint motions.

Hand-Grip Dynamometer. A device used for measuring strength in the hand and forearm.

McGill Pain Questionnaire. One of many pain rating scales, a method using pictures, scales, and words to describe the location, type, and magnitude of pain.

Non-Dominant Wrist/Forearm. The wrist/forearm opposite the side the subject would use to hold a writing utensil.

Pain Threshold. The level of noxious stimulus required to alert the individual to possible tissue damage.

Pain Tolerance. The amount of time an individual can endure pain.

Physical Activity Readiness Questionnaire (Par-Q). A pre-participation screening questionnaire recommended by the American College of Sports Medicine (1995) as a minimal standard for entry into moderate-intensity exercise programs. Designed to identify the small number of adults for whom physical activity might be inappropriate or those who should receive medical advice concerning the most suitable type of activity.

Placebo Effect. Improvement in a condition not related to the effect of a treatment or medication.

Range of motion, active. Movement within the unrestricted range of motion for a segment that is produced by an active contraction of the muscles crossing that joint.

Self-Efficacy. Beliefs in one's capabilities to organize and execute the courses of actions required to produce given attainments.

Treatment Efficacy. The ability of a modality or treatment regimen to produce the intended effects.

Visual Analog Scale (VAS). A consistent and reliable method of gaining an objective measurement of a subject's subjective response to pain. It allows the investigator to measure the increases and decreases in the levels of pain felt by the subject. It can be used before and after treatments to measure the effectiveness of treatment or day to day to measure a subject's progress.

Wrist Extension. From the anatomical position; movement in a posterior direction approximating the dorsum of the hand toward the posterior surface of the forearm.

Wrist Flexion. From the anatomical position; movement in an anterior direction approximating the palmar surface of the hand toward the anterior surface of the forearm.

CHAPTER 2

REVIEW OF LITERATURE

Historical Background

The use of therapeutic magnets can be traced back to ancient Greece, when Hippocrates reportedly used magnetic rock lodestone to treat sterility (Hawkins, 1998). Greek, Persian, and Chinese physicians used magnetic energy to treat such conditions as gout and muscle spasms (Borsa & Liggett, 1998). By the end of the Middle Ages, magnets were being used to cure baldness, purify wounds, and were thought to be successful in the treatment of arthritis (Basford, 2001). Paracelsus (1493-1542) researched the effects of magnets and found them to be an effective form of treatment for epilepsy, diarrhea, and hemorrhage. He also proposed a theory model that suggested the poles of a magnet would act to "push-pull" disease from the body (Basford, 2001).

Magnetic therapy has evolved in more recent times to traditional units used to deliver electromagnetic fields using either a pulsed or static mode, depending on the type of unit and prescribed dosage (Borsa & Liggett, 1998). The use of commercially produced flexible magnets has become a popular modality of allied health professionals in the treatment of musculoskeletal injuries such as rotator cuff tendonitis, osteoarthritis and rheumatoid arthritis, nonunion fractures, arthodesis, and failed total knee arthroplasties (Borsa & Liggett, 1998). Manufacturers of flexible magnets report that the use of their product may increase muscle strength, muscle endurance, oxygen use, and resistance to disease (Chaloupka, Kang, & Mastrangelo,

2002). It has also been used to decrease muscle soreness following exercise, pain associated with chronic headaches and arthritis, and relieving effects of some sleep disorders (Chaloupka et al., 2002).

Magnetic Fields and Their Effects

All magnets consist of two poles, positive and negative. Two like poles repel each other and opposite poles are attracted. The negative pole, also referred to the northern pole, is said to normalize and calm the body (Ratterman, Secrest, Norwood, & Chien, 2001). It has been proposed that the northern pole can reduce fluid retention, increase cellular oxygen, reduce inflammation, and normalize acid base balance (Ratterman et al., 2001). The southern, or positive pole opposes actions of the northern pole such as increasing intracellular edema, decreasing cellular oxygen, increasing inflammation, and causing more acidity in pH levels (Ratterman et al., 2001).

The strength of a magnet is measured in gauss (G) units, which represents the number of lines of magnetic force passing through an area of 1 square centimeter (Ratterman et al., 2001). Refrigerator magnets usually have a G measurement between 35 and 200 while therapeutic magnets range from 300-5,000 G (Ratterman et. al, 2001). However, most commercially available therapeutic magnets measure less than 1,000 G (Borsa & Liggett, 1998). The Food and Drug Administration places no restrictions on the use of magnetic fields with a strength less than 1000 G (Borsa & Liggett, 1998).

Proposed Theories of Therapeutic Magnets

Although the actual mechanism of action is unknown, researchers continue to investigate possible theories regarding the effects of magnet therapy and pain relief. Several theories have been proposed to explain the effect therapeutic magnetic modalities have on human tissues. However, none of the theories are commonly accepted by the scientific community.

In 1879, Edwin Hall of Johns Hopkins University discovered that when a strip of gold carrying an electric current was placed perpendicularly in a magnetic field, the electric potentials located on the edges of the strip were altered (Trock, 2000). As a result of his work a theory of physics, the Hall effect, came into existence. The Hall effect refers to positively and negatively charged ions in the bloodstream that become activated while passing through a magnetic field. This activation produces heat, which causes vasodilation and an increased blood supply in the treated area (Ratterman et. al, 2002).

A theory reported by Ratterman et al. (2002) states that "magnets increase blood flow to the affected area by creating a pull on charged particles in bodily fluids, which in turn, boosts the level of oxygen and nutrients to damaged muscles and joints" (p. 349). He suggested that the increase in blood flow rids the affected area of toxins while bringing in white blood cells to help the body to control signs and symptoms of inflammation (Ratterman et al., 2002).

Physiological Effects

Manufacturers of therapeutic magnets claim that the use of their product will result in physiological changes including an increase in muscle strength, muscle endurance, and oxygen use while decreasing the effects of delayed onset muscle soreness (Chaloupka et al., 2002). Researchers have begun to test the claims made by the manufacturers by examining the physiological effects of therapeutic magnets. Chaloupka et al. (2002) and Sweeney, Merrick, Ingersoll, and Swez (2001) negated the claims made by the manufacturers through their research.

Sweeney et al. (2001) examined the effects of therapeutic magnets on skin surface and deep tissue temperatures (1 cm below the adipose layer) and detected no significant differences between treatments, skin surface or deep tissue, using magnets or sham devices. Chaloupka et al. (2002) investigates the claim made by magnet manufacturers that an increase of strength will result from using therapeutic magnets. The results of the study showed no statistically significant mean differences for strength among any of the treatments: control, sham, or test magnet.

According to Chaloupka et al. (2002), therapeutic magnets have not been found to physiologically alter tissue, disputing claims made by the manufacturers that state magnets can increase muscle strength, muscle endurance, oxygen use, and resistance to disease. Despite these manufacturer claims, the use of therapeutic magnets continues to flourish in many arenas including athletics.

Patient Perceptions

Researchers commonly use the Visual Analog Scale (VAS) as a tool to objectify the subjects' rating of pain and/or signs and symptoms related to the condition (Hinman, Ford, & Heyl, 2002; Vallbona, Hazlewood, & Jurida, 1997; Borsa & Liggett, 1998; and Collacott, Zimmerman, White & Rindone, 2000). The VAS has been validated as a ratio scale measure for both chronic and experimental pain (Price, McGrath, Rafii, & Buckingham, 1983).

Hinman et al. (2002) examined the application of unipolar static magnets with a high magnetic force rating would decrease pain and improve physical function in a group of subjects with chronic knee pain. Results showed that subjects wearing magnets demonstrated greater improvements in their pain, physical function, and gait speed over the 2-week period. Borsa and Liggett (1998) conducted a similar study in which patient perceptions of therapeutic magnets were assessed following an exercise induced muscle soreness protocol. In this study, therapeutic magnets were used as an aid to decrease signs and symptoms of delayed onset muscle soreness. However, no significant therapeutic effect of the therapeutic magnets on pain perception and muscular dysfunction when treatments were compared over time was found (Borsa & Liggett, 1998). Collacott et al. (2000) also found no significant therapeutic effects of therapeutic magnets on the decrease of pain in patients suffering from chronic low back pain.

Several studies regarding the efficacy of therapeutic magnets focus on subject samples including people diagnosed with a disease or pre-existing condition. Vallbona et al. (1997) conducted a pilot clinical trial that looked at the effects of magnetic therapy on reducing pain associated with active trigger points in fifty patients with postpolio syndrome. Results showed that static magnetic fields of an intensity of 300 to 500 G were effective in pain control in patients exhibiting signs and symptoms of postpolio syndrome. Segal et al. (2001) studied the effects of therapeutic magnets in patients diagnosed with active rheumatoid arthritis. Subjects reported a decrease in pain experienced from rheumatoid arthritis in the knee as a result of therapeutic magnets.

Contraindications of Therapeutic Magnets

Although magnet therapy has not been found to have harmful side affects, a therapeutic magnet manufacturer states that women in their first trimester of pregnancy and anyone with an implanted electronic device or an illness, should first consult their physician and/or their electronic-device manufacturer before using their product (Nikken, 2001). Ratterman et al. (2002) report, "Magnets should not be used in conditions such as immune system disorders, digestive problems, fevers, kidney failure, liver failure, impotence, or any life threatening disorder" (p. 348). Magnets should not be placed close to any transdermal drug delivery system or patch or any acute injuries including sprains or fresh wounds (Ratterman et al., 2001).

CHAPTER 3

METHODOLOGY

The purpose of this study is to determine the perceptions held by high school athletes on the treatment efficacy of therapeutic magnets in regards to pain control associated with exercise-induced muscle soreness in the non-dominant wrist and forearm.

Subjects

Thirty-three high school athletes (14 females, 19 males; mean age, 17.24 ± .71 years; range, 16-18 years) participated in this study. Each subject participated in a school sponsored varsity sport (17 football, 9 girls' basketball, 4 cross country, 2 tennis, and 1 boys' soccer) during the Fall of 2002 when testing occurred. An informed consent document was signed by a legal guardian of each subject and each subject signed a subject assent form prior to the initiation of the study (Appendix A). Each subject also completed and signed a Physical Activity Readiness Questionnaire (Par-Q) (American College of Sports Medicine, 1995), which was also signed by a legal guardian (Appendix B).

The exclusion criteria for participation in the study were significant injury to the non-dominant wrist one month prior to the study, or any subject who had an implanted electronic device. Female subjects were encouraged not to participate in the study if they were or thought they may be pregnant. The study was approved by the Human Subjects Institutional Review Board at Western Michigan University (Appendix C).

The subjects were randomly divided into two treatment groups and one control group. Treatment group 1 (n=11) received a magnet treatment and treatment group 2 (n=11) received a placebo treatment. The control group (n=11) did not receive any treatment. All subjects were unaware that a placebo test group existed. The researchers were blinded from which subjects were in each treatment group.

Baseline Measurements

Each subject reported to the test site to obtain several baseline measurements prior to the initiation of the study. A single trial hand-grip strength test was administered to each subject's non-dominant extremity using a hand-grip dynanometer as described by Mathiowetz, Kashman, Volland, Weber, Dowe, and Rogers (1985). Each subject was standing with the elbow placed in a neutral position. The subject was then instructed to maximally squeeze the hand-grip dynanometer. A single-trial was taken and the measurement was recorded.

Active range of motion for wrist flexion and wrist extension was measured in the non-dominant wrist with a goniometer using a procedure described by Norkin and White (1994). The subject was standing with the elbow fully extended and the wrist in a neutral position. The movable arm of the goniometer was aligned with the shaft of the 5^{th} metacarpal. The fulcrum was placed over the joint line of the articulation between the ulna and the carpal bones. The stationery arm of the goniometer was aligned along the shaft of the ulna. To measure active wrist extension, the subject was asked to maximally extend the wrist. The subject was asked to hold the maximal

movement while the investigator took a measurement. To measure wrist flexion each subject was asked to maximally flex the wrist. A measurement was taken when the subject reached a maximum degree of movement. A single trial was taken for both wrist flexion and extension and measurements were recorded.

Exercise Induced Muscle Soreness Protocol

Members of both treatment groups were administered an exercise induced muscle soreness protocol that was modified from Leger and Milner (2001) (Appendix D). The exercise induced muscle soreness protocol was designed to affect the wrist and finger flexors, which originate from the medial epicondyle of the humerus via the common flexor tendon and run along the anterior side of the forearm to their respective insertion points (Kendall, McCreary, & Provance, 1993). Each subject was seated with the non-dominant arm supported by an examination table. The hand was placed in a supinated position. The protocol began by having the subject maximally contract the forearm/hand/wrist against a tennis ball for 20 seconds. This procedure was repeated three times with a 30 second rest period between each set.

Each subject was then asked to perform one set of 15 repetitions using a 5-pound dumbbell and concentrating on the eccentric contraction of the forearm flexor muscle complex. Eccentric muscle activity is more likely to cause muscle damage than concentric muscle activity and was chosen for the exercise induced muscle soreness protocol (Nosaka & Newton, 2002). The researcher assisted each subject in bringing the weight to the starting point and then each subject slowly lowered the

weight to a point of maximal wrist extension as described by Leger and Milner (2001). Following the set, each subject was given a 30 second rest period. The subjects then performed one set of 15 repetitions using the following weights in the order listed: 10, 15, 20, 15, 10, 5. Between each set the subjects were given a 30 second rest period.

The final step of the exercise induced soreness protocol involved having each subject squeeze maximally against a tennis ball three times for 20 seconds with a 30 second rest period between each set as described in the beginning steps of the protocol. Upon completion of the protocol a single trial hand-grip dynanometer measurement was taken to note any muscle weakness experienced from the protocol.

Each subject from the treatment groups received either a Nikken-Kenko Magnetic Promo Pad (2.15" x 3.23") with reported field strength of 700 G or a sham magnet. The magnet/sham was placed over the anterior side of the forearm just distal to the elbow joint and the insertion point of the wrist flexor muscles as described by Chaloupka, Kang, and Mastrangelo (2002). The magnet treatment and sham treatment were of the same size, shape and appearance. Each magnet was coded from a master coding form to ensure the double-blind design of the study. The magnet or sham was held in place using an elastic bandage and subjects were instructed to keep the magnet in place at all times except when showering. The subjects were allowed to resume activities of daily living while avoiding vigorous exercise involving the wrist and forearm of the non-dominant extremity.

Testing Procedures

Both test groups and the control group reported to the test site at 24, 48, 72, and 96 hours following the exercise induced muscle soreness protocol. All subjects were re-tested at 24, 48, 72, and 96 hours using single trials for hand-grip strength and active range of motion for wrist flexion and extension as previously described in baseline measurements.

The treatment groups were administered a pain questionnaire (Appendix E) approximately every 12 hours following the completion of the exercise induced muscle soreness protocol through the final day of the study. The subjects were instructed to fill out the pain questionnaire either immediately before they went to bed or first thing after waking up in the morning. The pain questionnaire was a combination of a VAS and a McGill pain questionnaire. The VAS has been previously validated as a ratio scale for both chronic and experimental pain (Price, McGrath, Rafii, & Buckingham, 1983). On the fourth day of the study (96 hours), each treatment group subject was given a follow-up questionnaire (Appendix F) assessing the perception the subject had on the efficacy of the modality.

At the conclusion of the study, the investigator individually debriefed each subject from the treatment groups. The purpose of the debriefing was to inform each subject that they might not have had an actual magnet while participating in the study. It was the investigator's intent to undo any deception that might have occurred as a result of the subject using therapeutic magnets.

Statistical Analysis of Data

A repeated measures doubly-multivariate analysis of variance (p=.0001) was performed on each dependant variable, Total Wrist Range of Motion (ROM), Hand Grip Strength (Strength), and Pain Perception as determined by a Visual Analog Scale (VAS) over four post-exercise time periods: 24, 48, 72, and 96 hours post exercise for the placebo and magnet groups using Statistical Package for the Social Sciences (SPSS 11.0, Chicago, Illinois). Descriptive statistics for each of the dependant variables as well as answers given on a post-test questionnaire were also calculated and analyzed.

CHAPTER 4

RESULTS

Thirty-three high school athletes (14 females, 19 males; mean age, 17.24 ± .71 years; range, 16-18 years) participated in the study. Subjects were participants of a school-sponsored sport (17 football, 9 girls' basketball, 4 cross country, 2 tennis, and 1 boys' soccer) in the Fall of 2002 when the study was conducted. Subjects were randomly divided into three groups: Treatment Group 1 (magnet group), Treatment Group 2 (placebo group), and Control Group (Table 1).

Table 1

Demographics of the Magnet and Placebo Treatment Groups

	Magnet Group	Placebo Group
Gender		
Male	n=9	n=6
Female	n=2	n=5
Sport Participant		
Football	n=7	n=5
Girls' Basketball	n=1	n=3
Cross Country	n=1	n=3
Tennis	n=1	n=0
Boys' Soccer	n=1	n=0

On a pre-testing questionnaire, the two treatment groups were asked several questions regarding previous experience with using therapeutic magnets as well as experience using several other common therapeutic modalities. When asked about previous experience with magnet therapy, 90.9% (20 out of 22) of treatment group

subjects reported having no experience using this modality. Of the two treatment group subjects reporting previous experience with magnet therapy, one reported no beneficial effects from the product and one was unsure of results experienced from the therapeutic magnet. Subjects were asked if they considered themselves to have a high pain tolerance. 81.8% (18 out of 22) treatment group subjects answered they felt they had a high pain tolerance. Treatment group subjects were also asked if they had ever sustained a major injury to any part of their body and results showed 59.1% (13 out of 22) had in fact suffered a substantial injury.

A repeated measures doubly-multivariate analysis of variance (George & Mallery, 2001) on each dependant variable: Total Wrist Range of Motion (ROM), Hand Grip Strength (Strength), and Pain Perception as determined by a Visual Analog Scale (VAS) over four post-exercise time periods: 24, 48, 72, and 96 hours post exercise, for the treatment groups was performed. Means and standard deviations of each dependant variable are listed in Table 2. Figures 1, 2, and 3 depict the descriptive statistics of the dependant variables of the study.

The data was assessed for normality and homogeneity of variance. Mauchley's Test of Sphericity was significant for ROM ($p<.0001$) and VAS ($p<.0001$), indicating the assumption of multivariate normality was rejected, however, since Mauchley's statistic lacks power in small sample sizes (George & Mallery, 2001) the data can be interpreted with caution. Table 3 depicts results found from

Levene's Test of Equality of Error Variance. Despite equal sample sizes (n=11) for each group, homogeneity of variance was violated in five of the twelve variables.

Table 2

Descriptive Statistics for Range of Motion (ROM), Strength, and Pain (VAS)

	Magnet Group (n=11)		Placebo Group (n=11)	
	M	SD	M	SD
24 post ROM	130.18	11.09	125.18	23.56
48 post ROM	129.73	13.09	129.45	20.66
72 post ROM	136.00	11.63	130.64	15.17
96 post ROM	134.64	10.03	135.27	14.46
24 post Strength	44.91	7.23	42.00	13.33
48 post Strength	49.46	8.20	46.09	14.25
72 post Strength	48.82	7.87	46.09	13.10
96 post Strength	48.91	7.75	46.09	14.05
24 post VAS	1.59	.66	1.59	.63
48 post VAS	1.50	.59	1.23	.47
72 post VAS	1.27	.34	1.18	.25
96 post VAS	1.27	.34	1.14	.23

The repeated measures doubly-multivariate analysis of variance showed no interaction within subject measures of Time (ROM, Strength, VAS) by group. However, analysis of the multivariate effect of Time was significant ($p=.002$, $df=5$). Pairwise comparison using Bonferroni adjustment for multiple comparisons showed significant mean differences between Strength at 24 hours post-exercise and each of the other time measures: 48 hours post exercise ($p=.001$), 72 hours post exercise ($p=.002$) and 96 hours post exercise ($p<.0001$). Significant pairwise comparisons were also found for VAS at 24 hours post exercise and 72 hours post exercise ($p=.025$) and also between 24 hours and 96 hours post exercise ($p=.014$). Analysis failed to demonstrate any significant findings between the placebo and magnet treatment groups.

On the post test questionnaire, subjects from the treatment groups were asked whether or not they experienced pain during the study. Nine of the 11 (81.2%) subjects of treatment group 1 (Magnet Group) and eight of the 11 (72.7%) subjects of treatment group 2 (Placebo Group) reported that they experienced pain at some level during the study. Nine of the 11 (81.2%) subjects of treatment group 1 (Magnet Group) and six of the 11 (54.5%) subjects of treatment group 2 (Placebo Group) reported they felt the therapeutic magnets were effective in decreasing pain experienced in the wrist and forearm.

Figure 1

Comparative Data of Descriptive Statistics

Range of Motion (ROM)

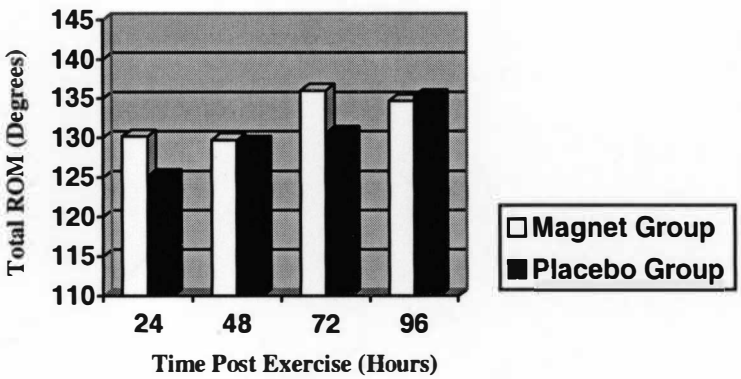


Figure 2

Comparative Data of Descriptive Statistics

Strength (Kilograms)

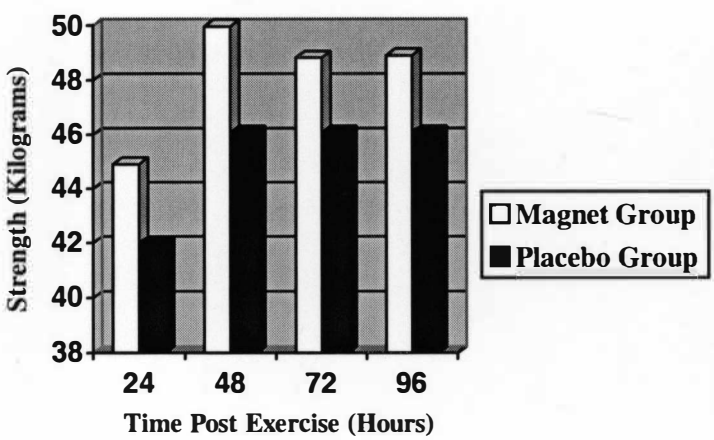


Figure 3

Comparative Data of Descriptive Statistics

Visual Analog Scale (VAS)

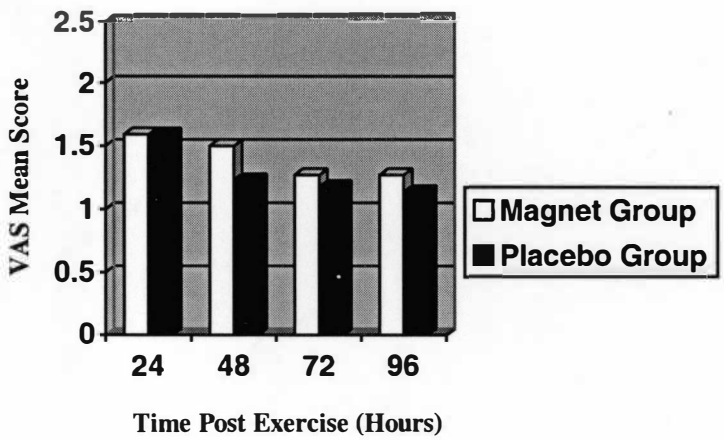


Table 3

Levene's Test of Equality of Error Variances

	F(1, 20)	p
24 post ROM	8.37	.009
48 post ROM	.15	.708
72 post ROM	.04	.851
96 post ROM	.58	.455
24 post Strength	5.23	.033
48 post Strength	7.26	.014
72 post Strength	10.01	.005
96 post Strength	7.27	.014
24 post VAS	.01	.922
48 post VAS	.04	.844
72 post VAS	1.88	.185
96 post VAS	3.37	.081

CHAPTER 5

DISCUSSION

The purpose of this study was to determine the perceptions held by high school athletes on the treatment efficacy of therapeutic magnets in the treatment of pain control associated with exercise-induced muscle soreness in the non-dominant wrist and forearm. The results of this study indicated no significant therapeutic benefits occurred as a result of using therapeutic magnets; however, the treatment group subjects perceived the therapeutic magnets to be effective in reducing signs and symptoms of delayed onset muscle soreness (DOMS). The results of this study reflect other studies researching subject perceptions of therapeutic magnets (Collacott, Zimmerman, White, & Rindone, 2001, Borsa & Liggett, 1998).

Demographics obtained of the treatment groups revealed that subjects perceived themselves to have a high pain tolerance (81.8%) while (59.4%) had previously suffered a major injury. These statistics show that most subjects had previously experienced pain through injury and the majority of treatment group subjects felt they had a high tolerance for pain. 90.9% of treatment group subjects had no previous experience using therapeutic magnets leading the researcher to believe that treatment group subjects did not have pre-conceived opinions regarding the treatment.

When a muscle group is subjected to unaccustomed eccentric muscle activity, common indicators of muscle injury include soreness, the sensation of stiffness, decreased range of motion, and weakness (Leger & Milner, 2001). In the present

study, an eccentric exercise induced muscle soreness protocol (adapted from Leger & Milner, 2001) was developed and administered to the subjects of the treatment groups. Active range of motion of wrist flexion and extension and hand-grip strength were measured to objectively measure the amount of soreness experienced.

The results of this study indicated a slight but not significant decrease in Total Active Range of Motion for wrist flexion and extension at 24 hours post exercise by both the magnet and placebo test groups. The results also indicated at 72 hours post exercise, the Total Active Range of Motion of wrist flexion and extension were recovered and exceeded initial measurements for both treatment groups. Leger and Milner (2001) reported a significant decrease in pain-free active range of motion for wrist flexion and extension following eccentric muscle activity, indicating the soreness experienced by subjects in the present study may not have been sufficient. Ross (1999) and Clarkson and Tremblay (1988) agreed that common indicators associated with muscle injury subsided 3-7 days without any special treatment following the exercise that induced the soreness. The initial slight loss of active range of motion and the recovery of the movement in the present study was well within the 3-7 day time frame that would be expected, regardless of the treatment applied to the affected muscle groups (Howell, Chleboun, & Conatser, 1993).

Hand-grip strength for both the placebo and magnet treatment groups showed mean increases from the measurement taken 24 hours post exercise through the measurement taken at 96 hours. Leger and Milner (2001) found a significant decline

in maximum voluntary force production in muscles subjected to strenuous eccentric exercise. The decline in force production was more significant on day 1 following the exercise induced muscle soreness protocol and returned to pre-exercise levels by day 4 (Leger & Milner, 2001). The results of the present study show that hand-grip strength was not affected over the course of the study, indicating that DOMS may not have occurred.

Subject perceptions of pain were measured by using a Visual Analog Scale (Price, McGrath, Rafii, Buckingham, 1983). Other studies examining subject perceptions of pain in regards to therapeutic magnets have used a similar format (Borsa & Liggett, 1998; Collacott et al., 2000; and Segal et al., 2001). In the present study, subjects were asked to rate pain on a 10-point scale (1 described no pain, 10 described intense pain). Subjects were asked to complete a VAS approximately every twelve hours. However, VAS scores were only statistically analyzed every twenty-four hours. VAS scores were only analyzed every 24 hours due to a lack of data every 12 hours. VAS scores were the only dependant measure to be obtained every 12 hours so there was no other data to compare. Both groups exhibited a higher VAS score 24 hours post exercise and the mean score decreased slightly over the 96-hour period. The mean VAS score for both treatment groups was not statistically significant. The mean VAS score failed to be higher than 1.59 (VAS scale of 1 to 10) for either group throughout the four-day testing period. Other studies using a VAS to assess perceived pain level report significantly higher scores reported by subjects

(Segal et al., 2001, Collacott et al., 2000, and Borsa & Liggett, 1998). Mean VAS scores reported by Collacott et al. (2000) were 4.8 (VAS scale 0 to 10). Analyzing VAS scores obtained from treatment group subjects indicates the exercise induced muscle soreness protocol used in the present study did not provide sufficient amounts of soreness.

Subjects from the treatment groups reported a high rate of efficacy of therapeutic magnets according to the post-test questionnaire (Table 4). However, the physiological (Pain Perception, VAS, and Hand-Grip Strength) results obtained from this study showed no significant differences between the treatment groups. This evidence supports the thought that psychological variables may affect the treatment efficacy of therapeutic magnets.

Table 4

Results from Post-Test Questionnaire

	Magnet Group		Placebo Group	
	Yes	No	Yes	No
Was pain experienced at any point throughout the study?	n=9 (81.2%)	n=2 (18.2%)	n=8 (72.7%)	n=3 (27.3%)
Was therapeutic magnet effective in reducing or preventing the onset of signs and symptoms of DOMS?	n=9 (81.2%)	n=2 (18.2%)	n=6 (54.5%)	n=5 (45.5%)

Conclusions

The original question asked by the investigator was if high school athletes perceived therapeutic magnets to be effective in the treatment of exercise-induced

muscle soreness. The post-test questionnaire administered to the treatment groups at the conclusion of the study indicated a high perception of efficacy of therapeutic magnets. Subjects from both treatment groups reported they felt the therapeutic magnets were effective in decreasing pain experienced in the wrist and forearm. It can then be concluded that the high school athletes participating in this study felt that therapeutic magnets were effective.

It is difficult to make conclusions on the physiological treatment efficacy of therapeutic magnets using the results of the present study. The placebo effect could be responsible for the low VAS scores and the non-significant changes detected for hand-grip strength and Total ROM in the placebo treatment group. The placebo effect has been shown to be a factor in medical and surgical treatments (Mayberg, Silva, Brannan, & Tekell, 2002). In the magnet treatment group, the therapeutic effects of the magnet could attribute to the scores found for the dependant measures. However, it is impossible to make these conclusions without making a comparison between the treatment groups and the control group.

Suggestions

Until consistent findings support or negate the effectiveness of therapeutic magnets, further research is required. To improve the quality of the present study, a safe and effective exercise-induced muscle soreness protocol needs to be developed for high school athletes. More soreness could be achieved by having subjects perform eccentric contractions until fatigue has been reached. By using this method,

different conditioning levels will be accounted for. It might be beneficial to use a Kin-Com or Bio-Dex versus free weights to administer the exercise induced muscle soreness protocol. This will allow for proper subject positioning at all times.

Active range of motion for wrist extension and flexion as well as hand-grip strength should be measured using the mean of three trials in order to obtain more accurate measurements. Larger sample sizes should be sought in order to make more accurate generalizations on the perceived efficacy of therapeutic magnets.

The study design could be improved by allowing for a thorough questionnaire pre and post-study to assess subject background and opinions of therapeutic magnets. By adding this feature to the study, it would be possible to assess the subject perceptions and why they have those perceptions of the effectiveness of therapeutic magnets in the treatment of exercise-induced muscle soreness.

The study design may be further improved by adding an additional group. In the present study the control group was not administered the exercise induced muscle soreness protocol; they simply participated in the study by having baseline measurements (Total Range of Motion and Hand-Grip Strength) taken. Along with the existing control group, an additional group should be created in which the exercise induced muscle soreness protocol is administered, but no magnet or placebo treatment is applied. This will allow the researcher to assess the amount of pain experienced by the subjects without being affected by the magnet or placebo treatments.

It is also suggested that variables other than delayed onset muscle soreness by used when researching the effectiveness of therapeutic magnets. Delayed onset muscle soreness will improve in 3-7 days regardless of the treatment applies (Ross, 1999). It is difficult to credit therapeutic magnets as the sole reason why the pain associated with delayed onset muscle soreness lessens over time. It is suggested that pre-existing or diagnosed conditions be used to assess the efficacy of therapeutic magnets.

APPENDIX A

WRITTEN INFORMED CONSENT DOCUMENTS

Western Michigan University
Department of Health, Physical Education, and Recreation

Principal Investigator: Dr. Michael G. Miller
Student Investigator: Stacy Schlumbohm

Written Informed Consent

You have been invited to participate in a research project entitled "Perception of the treatment efficacy of therapeutic magnets on exercise induced muscle soreness in the non-dominant wrist and forearm in high school athletes for pain control." This research is intended to examine the perceptions held by high school athletes on the efficacy of therapeutic magnets. This study will take place the 2nd week of November 2002. This research is being conducted for fulfillment of Stacy Schlumbohm's thesis requirements at Western Michigan University.

You will be asked to attend five sessions with Stacy. You will be asked to meet Stacy in the Athletic Training Room at Gull Lake High School. The first session will involve several baseline tests and an exercise protocol that will be **inducing soreness in your non-dominant wrist and forearm.** Following the exercise protocol you will be placed in one of two groups. One group will be receiving a magnet treatment and one group will be the control group which will not receive a magnet treatment. You will be asked to keep the magnet in place at all times for the remainder of the study unless you are showering. The magnet should stay in place even when you are sleeping. The first session should last approximately 1 hour. The following four days you will be asked to report to the testing site to have some follow-up testing to record your forearm strength, wrist range of motion, and pain level. Each of these sessions should take approximately ½ hour.

As in all research, there may be unforeseen risks to you. If an accidental injury occurs, appropriate emergency measures will be taken; however, no compensation or additional treatment will be made available to you except as otherwise stated in this consent form. There are possible foreseeable discomforts if you participate in this study. Foreseeable discomforts include **soreness and weakness of the muscles in the non-dominant wrist and forearm.** This soreness can be associated with that experienced by an individual just beginning an exercise program. You can expect the soreness to develop 12 hours or longer following the exercises performed in the protocol. The soreness should subside in 3-7 days.

There are no benefits to you by participating in this study.

Since the research is therapeutically related, there are alternate procedures you might choose instead of magnet therapy. Some alternatives may include ice or non-steroidal anti-inflammatories such as ibuprofen. You will be asked to not take non-steroidal anti-inflammatories (such as Advil, Motrin, Ibuprofen, Naproxen) or use ice over the sore forearm.

In order to maintain confidentiality the study will be focused on group data and an identification number (rather than your name) will be used to record data. Following the study, the primary investigator and the research committee will have access to the original data. The original data will be retained in a locked cabinet for a minimum of three years after the completion of the study in the

department of Health, Physical Education, and Recreation at Western Michigan University and then destroyed

The results of the research may be published but your name and identity will not be revealed.

The conditions that must be met in order for you to participate in this study include an injury-free non-dominant wrist and forearm for the previous one-month. You must be of ages 16-18 and a participant of a varsity sport at Gull Lake High School in Richland, Michigan. The Par-Q questionnaire will be used to screen out all people who should not participate in the study. The Par-Q should be filled out and returned the first day the study is conducted. Persons who feel they might be pregnant should not participate in this study.

You may withdraw from this study at any time without prejudice, penalty, or risk of loss of service you would otherwise receive. Should you have any questions prior to or during the study, you can contact the primary investigator, Stacy Schlumbohm, at 269.552.5587, or the committee chair, Dr. Michael Miller at 269.387.2728. You may also contact the Chair, Human Subjects Institutional Review Board (269.387.8293) or the Vice President for Research (269.387.8298) if questions arise during the course of the study.

Your signature below indicates that you have read the above information. The nature, demands, risks, and benefits of the project have been explained to you. You knowingly assume the risks involved. In signing this consent form, you are not waiving any legal claims, rights, or remedies.

_____

Please Print Your Name

_____ _____

Subject's Signature Date

Permission obtained by: _____ _____

Initials of researcher Date

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Subjects should not sign this document if the corner does not show a stamped date and signature.

Western Michigan University
Department of Health, Physical Education, and Recreation

Principal Investigator: Dr. Michael G. Miller
Student Investigator: Stacy Schlumbohm

Written Informed Consent for Minors

Your child has been invited to participate in a research project entitled "Perception of the treatment efficacy of therapeutic magnets on exercise induced muscle soreness in the non-dominant wrist and forearm in high school athletes for pain control." This research is intended to examine the perceptions held by high school athletes on the efficacy of therapeutic magnets. This study will take place the 2nd week of November 2002. This research is being conducted for fulfillment of Stacy Schlumbohm's thesis requirements at Western Michigan University.

Your permission for your child to participate means your child will be asked to attend five sessions with Stacy. Your child will be asked to meet Stacy in the Athletic Training Room at Gull Lake High School. The first session will involve several baseline tests and an exercise protocol that will be **inducing soreness in your child's non-dominant wrist and forearm**. Following the exercise protocol your child will be placed in one of two groups. One group will be receiving a magnet treatment and one group will be the control group that will not receive a magnet treatment. Your child will be asked to keep the magnet in place at all times for the remainder of the study unless showering. The magnet should stay in place even when sleeping. The first session should last approximately 1 hour. The following four days your child will be asked to report to the testing site to have some follow-up testing to record forearm strength, wrist range of motion, and pain level. Each of these sessions should take approximately ½ hour.

As in all research, there may be unforeseen risks to your child if allowed to participate in the study. If an accidental injury occurs, appropriate emergency measures will be taken; however, no compensation or additional treatment will be made available to you or your child except as otherwise stated in this consent form. There are possible foreseeable discomforts if your child participates in this study. Foreseeable discomforts include **soreness and weakness of the muscles in the non-dominant wrist and forearm**. This soreness can be associated with that experienced by an individual just beginning an exercise program. Your child can expect the soreness to develop 12 hours or longer following the exercises performed in the protocol. The soreness should subside in 3-7 days.

There are no benefits to your child if allowed to participate in this study.

Since the research is therapeutically related, there are alternate procedures your child might choose instead of magnet therapy. Some alternatives may include ice or non-steroidal anti-inflammatories such as ibuprofen. Your child will be asked not to take non-steroidal anti-inflammatories (such as Advil, Motrin, Ibuprofen, Naproxen) or use ice over the sore forearm.

In order to maintain confidentiality the study will be focused on group data and an identification number (rather than your child's name) will be used to record data. Following the study, only the

primary investigator will have access to the original data. The original data will be retained in a locked cabinet for a minimum of three years after the completion of the study in the department of Health, Physical Education, and Recreation at Western Michigan University and then destroyed

The results of the research may be published but your child's name and identity will not be revealed.

The conditions that must be met in order for your child to participate in this study include an injury-free non-dominant wrist and forearm for the previous one-month. Your child must be of ages 16-18 and a participant of a varsity sport at Gull Lake High School in Richland, Michigan. The Par-Q questionnaire will be used to screen out all people who should not participate in the study. You should complete this questionnaire with your child, sign it, and return it with this document. The Par-Q should be filled out and returned the first day the study is conducted. Persons who feel they might be pregnant should not participate in this study.

Your child may withdraw from this study at any time without prejudice, penalty, or risk of loss of service your child would otherwise receive. Should you have any questions prior to or during the study, you can contact the primary investigator, Stacy Schlumbohm, at 269.552.5587, or the committee chair, Dr. Michael Miller at 269.387.2728. You may also contact the Chair, Human Subjects Institutional Review Board (269.387.8293) or the Vice President for Research (269.387.8298) if questions arise during the course of the study.

Your signature below indicates that you, as parent or guardian, can and do give your permission for _____ (*child's name*) to participate in the research study of Stacy Schlumbohm. The nature, demands, risks, and benefits of the project have been explained to you. You knowingly assume the risks involved. In signing this consent form, you are not waiving any legal claims, rights, or remedies.

_____

Please Print Child's Name

_____ _____

Legal Guardian Signature Date

Permission obtained by: _____ _____

Initials of researcher Date

This consent document has been approved for use for one year by the Human Subjects Institutional Review Board (HSIRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Subjects should not sign this document if the corner does not show a stamped date and signature.

APPENDIX B

PAR-Q QUESTIONNAIRE

Par-Q Questionnaire

Please read the questions carefully and answer each one honestly. Check YES or NO.

YES	NO	
		1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
		2. Do you feel pain in your chest when you do physical activity?
		3. In the past month, have you had chest pain when you were not doing physical activity?
		4. Do you lose your balance because of dizziness or do you ever lose consciousness?
		5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?
		6. Is your doctor currently prescribing drugs for your blood pressure or heart condition?
		7. Do you know of any other reason you should not do physical activity?

YES	NO	
		8. Have you injured your non-dominant wrist or forearm in the previous 1 month?
		9. Are you a Varsity athlete in a Fall sport at Gull Lake High School in Richland, Michigan? Which sport do you particpate in? _____
		10. Do you have an electrically implanted device in your

body (such as a pacemaker, etc..)?

11. Have you ever used magnet therapy prior to this study?

12. If you have used magnet therapy, did you have a positive experience?

13. Have you ever used any of these modalities:
    ultrasound?
    electric stimulation?
    hot or cold whirlpool?
    hot moist pack?
    ice massage?
    paraffin bath?

14. Do you consider yourself to have a high pain tolerance?

15. Have you ever sustained a major injury to any of your body parts?

I have read, understood, and completed this questionnaire. Any questions I had were answered to my full satisfaction.

Name_____ Date_____

Signature_____Witness_____

Signature of legal guardian_____

APPENDIX C

HUMAN SUBJECTS INSTITUTIONAL REVIEW BOARD LETTER OF APPROVAL

WESTERN MICHIGAN UNIVERSITY

Centennial 1903-2003 Celebration

Human Subjects Institutional Review Board

Date: October 22, 2002

To: Michael Miller, Principal Investigator
Jody Brylinsky, Co-Principal Investigator
Stacey Schlumbohm, Student Investigator for thesis

From: Mary Lagerwey, Chair *Mary Lagerwey*

Re: HSIRB Project Number 02-09-01

This letter will serve as confirmation that your research project entitled "Perception of the Treatment Efficacy of Therapeutic Magnets on Exercise Induced Muscle Soreness in the Non-dominant Wrist and Forearm in High School Athletes" has been approved under the full category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: October 16, 2003

Walwood Hall, Kalamazoo MI 49008-5456
PHONE: (616) 387-8293 FAX: (616) 387-8276

APPENDIX D

EXERCISE INDUCED MUSCLE SORENESS PROTOCOL

Exercise Induced Soreness Protocol
Wrist/Forearm Flexors

Subject #:_____ Non-Dominant: L R

____ Tennis Ball Squeeze x 20 seconds

____ Rest x 30 seconds

____ Tennis Ball Squeeze x 20 seconds

____ Rest x 30 seconds

____ Tennis Ball Squeeze x 20 seconds

____ Rest x 30 seconds

____ 5 lb. Dumbbell 1x15 repetitions

____ Rest x 30 seconds

____ 10 lb. Dumbbell 1x15 repetitions

____ Rest x 30 seconds

____ 15 lb. Dumbbell 1x15 repetitions

____ Rest x 30 seconds

____ 20 lb. Dumbbell 1x 15 repetitions

____ Rest x 30 seconds

____ 15 lb. Dumbbell 1x15 repetitions

____ Rest x 30 seconds

____ 10 lb. Dumbbell 1x15 repetitions

____ Rest x 30 seconds

____ 5 lb. Dumbbell 1x 15 repetitions

____ Rest x 30 seconds

____ Tennis Ball Squeeze x 20 seconds

____ Rest x 30 seconds

____ Tennis Ball Squeeze x 20 seconds

____ Rest x 30 seconds

____ Tennis Ball Squeeze x 20 seconds

____ Rest x 30 seconds

____ Hand Dynanometer Reading _____

APPENDIX E

PAIN QUESTIONNAIRE

Take Home Pain Scale

Name:_____
Time to Complete:_____

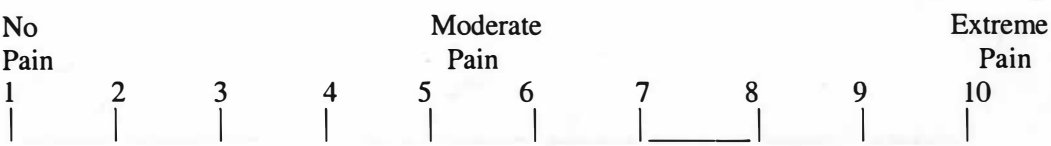
1. Have you noticed pain in your non-dominant wrist/forearm while performing Activities of Daily Living?

   YES NO

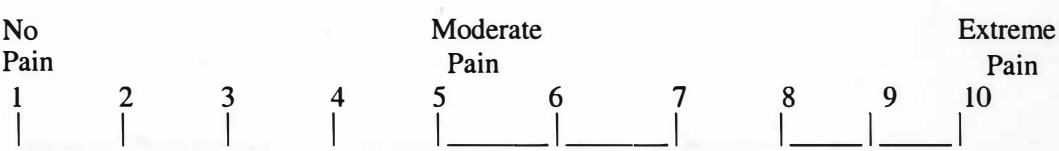
2. Does your pain increase with activity?

   YES NO

3. Rate your pain in your non-dominant wrist/forearm while your arm is at rest: by marking an "X" over the appropriate number.



4. Rate your pain in your non-dominant wrist/forearm while stretching your wrist in the following manner by marking an "X" over the appropriate number. Keep your elbow straight and your palm up. With your dominant hand, push your non-dominant wrist down.



5. PLEASE circle all the following words that would describe the feelings in your wrist/forearm of your non-dominant hand. Only mark words that most accurately describe your pain.

WEAKNESS	SHARP	DULL
ACHING	PIERCING	THROBBING
STINGING	FATIGUE	SHAKINESS
SHOOTING	CRAMPING	PINCHING
PULLING	HOT	TINGLING

APPENDIX F
POST-TEST QUESTIONNAIRE

Post-Test Questionnaire

Name:_____

Answer each question to the best of your knowledge.

	Yes	No
1. Did you experience pain at any level throughout the study?		

If you answered "yes" to Question 1, skip to Question 3, if you answered "no" to Question 1, answer Question 2 only.

2. If you did not experience any pain throughout the study, would you attribute that to the magnet you were wearing?

3. If you did experience pain at some point in the study, do you feel that the pain would have been worse if you did not have the magnet?

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