



2002

The Effect of Hip Taping on Hip and Knee Muscle Activity

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THE EFFECT OF HIP TAPING ON HIP AND KNEE MUSCLE ACTIVITY

by

Kyle Barker
Greg Charlton
Grant Goven
Daren Martin

Bachelor of Science in Physical Therapy
University of North Dakota
May 2001



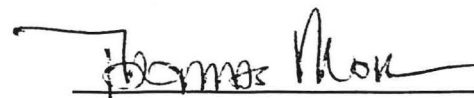
A Scholarly Project Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota

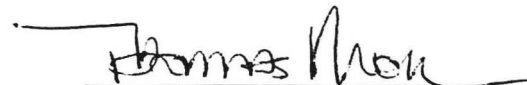
in partial fulfillment of the requirements for the degree of

Master of Physical Therapy

Grand Forks, North Dakota
May, 2002

This Scholarly Project, submitted by Kyle Barker, Greg Charlton, Grant Goven, and Daren Martin in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.


(Graduate School Advisor)


(Chairperson, Physical Therapy)

PERMISSION

Title: THE EFFECT OF HIP TAPING ON HIP AND KNEE MUSCLE
ACTIVITY

Department Physical Therapy

Degree Master of Physical Therapy

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Signature(s) Daren S. Martin
Kyle Barber
Craig M. Clark
Grant J. Larson

Date 12/9/01

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ACKNOWLEDGEMENTS

First and foremost, we would like to thank Thomas Mohr for all his assistance with setting up our study and the personal time he took to help us run our subjects and complete our graduate scholarly project. We would also like to thank Clifford Lafreniere for providing us with an original topic to study and a testing protocol as well as the entire University of North Dakota Physical Therapy faculty for providing us with all the necessary resources we will use in our careers. A special thanks goes out to our families for all the support they've given us throughout our academic careers.

ABSTRACT

Background and Purpose:

It has been hypothesized that patellofemoral pain may be precipitated by weak hip abductor musculature that does not pull the pelvis and femurs into correct alignment during gait activities. The misalignment at the pelvis leads to misalignment down the kinetic chain, eventually affecting the knees. It is theorized that hip taping may aid in supporting the pelvis, thus reducing the EMG activity of the hip abductors and normalizing the alignment of the knees. The purpose of this study is to describe muscle activity and joint motion during a step-down test in subjects with and without the hip tape in place.

Methods:

Twenty healthy subjects (9 men, 11 women) with no history of hip or knee pathology performed a step-down test with and without hip tape in place. The EMG activity of the gluteus medius and the tensor fascia lata was recorded via surface electrodes while tibio-femoral joint valgus angles were measured using video-analysis. Data was analyzed using a paired samples t-test.

Results:

There was no significant difference in EMG activity of the gluteus medius for males ($p=.603$), females ($p=.256$), or males and females together ($p=.840$). There was also no significant difference in the EMG activity of the tensor fascia lata for males ($p=.221$), females ($p=.876$), or males and females together ($p=.239$).

There was no significant difference in hip adduction values between taped and non-taped males ($p=.060$). There were, however, significant differences in hip adduction values between taped and non-taped females ($p=.000$) and taped and non-taped males and females together ($p=.000$).

Conclusion:

Hip taping may reduce the amount of hip adduction in patients and allow for a more efficient action at the patella, thus reducing anterior knee pain in patients. More studies, employing larger sample sizes, are needed to support the efficacy of hip taping in decreasing anterior knee pain.

CHAPTER I

INTRODUCTION

Anterior knee pain is a common complaint, especially among young adult athletes. One factor that has been theorized to precipitate anterior knee pain is weakness of the hip abductor muscles, especially the gluteus medius. Physical therapists have employed a number of interventions for patients with anterior knee pain including: patellar taping to hold the patella in place, bracing to stabilize the patella, and exercises to increase the strength of the anterior knee muscles. Recently, a new technique utilizing hip taping has been developed and used clinically to provide optimal biomechanical alignment of the lower extremity kinetic chain.

Problem Statement

According to Clifford Lafraniere (personal communication), the efficacy of hip taping to treat anterior knee pain has been supported by positive clinical outcomes. However, the exact mechanisms by which taping techniques work are difficult to determine. Furthermore, it appears there is no known published data regarding the effectiveness of hip taping or the mechanism by which it affects the lower extremities.

Purpose

The purpose of this study is to analyze the effect of hip taping on lower extremity muscle activity and hip adduction movement during weight bearing.

Significance

Treating anterior knee pain has been a clinical challenge for decades, and physical therapists have employed a number of different techniques to resolve this pain and increase patient function. Evidence supporting hip taping as an effective intervention for reducing biomechanical malalignment of the lower extremity may give physical therapists another potential treatment option for patellofemoral pain.

Research Questions

1. Does hip taping alter EMG activity of the gluteus medius or the tensor fascia lata?
2. Does hip taping help control hip adduction during step-up and step-down activities?
3. Are there gender differences in hip muscle EMG activity with and without hip taping?

Hypotheses

Null₁: There is no significant difference in EMG activity of the gluteus medius and/or the tensor fascia lata between taped and non-taped conditions while performing a step-down activity.

Null₂: There is no significant difference in joint alignment of the hip between taped and non-taped conditions while performing a step-down activity.

Alternate₁: There is a significant difference in EMG activity of the gluteus medius and/or tensor fascia lata between taped and non-taped conditions while performing a step-down activity.

Alternate₂: There is a significant difference in joint alignment of the hip between taped and non-taped conditions while performing a step-down activity.

CHAPTER II

LITERATURE REVIEW

Anterior knee pain, commonly known as patellofemoral pain (PFP), can stem from many different places in the body. One such cause may be from weak hip abductors.¹ Other authors have suggested multiple biomechanical and muscular factors contributing to PFP including: increased femoral anteversion, increased Q-angle ($>20^\circ$), patellar malalignment, tightened soft tissue, chondromalacia patella, osteochondritis dissecans, and trauma.²⁻⁷ However, malalignment and patellar tracking problems are the main focus of physical therapy rehabilitation programs.

Physical therapy is aimed at correcting patellar malalignment through the use of taping techniques, bracing, and selective training of muscles. As described by Jenny McConnell,⁵ founder of the McConnell taping techniques, patellar taping passively corrects patellar subluxation, tilt, and rotation, to obtain a pain free range of motion necessary for quadriceps strengthening exercises.

It is also hypothesized that muscular imbalances or altered timing between the vastus medialis oblique (VMO) and vastus lateralis (VL) contribute to the patellar maltracking.^{3,5} In a study performed by Gilleard, McConnell, and Parsons,³ the effect of patellar taping on VMO and VL activity in subjects with PFP was examined. Subjects tested in the taped condition had an earlier onset of VMO activity during ascending and

descending activities when compared to the control group. They theorized that taping either increased cutaneous stimulation, or changed the position of the patella itself, causing the altered muscle activity.

In a related study performed by Cerny,⁴ conflicting results were found regarding patellar taping and its affect on VMO activity over VL activity. The author suggested that for the VMO to be selectively trained, it would require EMG biofeedback, not just patellar taping. There was no evidence found suggesting that the tape could maintain the patellar position during activity.

Although the theory behind patellar taping appears to be biomechanically plausible, there is little consensus among experts explaining why the taping techniques work. Whether the tape holds the patella in better alignment, facilitates VMO activity, or provides additional sensory feedback, it seems to have a positive affect on the relief of PFP.

Another treatment technique advocated to improve patellar tracking and decrease pain associated with exercise, is bracing.^{5,8,9,10} Palumbo¹⁰ found that 93% of subjects with PFP reported a decrease in pain while using a dynamic patellar brace which provided a medially oriented force on the patella to improve alignment.

Along with taping and bracing, more conservative approaches have also been used to treat PFP. For the immediate relief of pain, relative rest and anti-inflammatory drugs are indicated.⁷ As the pain subsides, a general conditioning program can be initiated by incorporating stretching and progressive strengthening.

Joints other than the knee need to be assessed when evaluating patients with PFP. The pelvis, hips, knees, ankles, and feet all contribute to a kinetic chain, which act to

dissipate the various ground reaction forces the body encounters during weight bearing.¹¹

The hip abductors, especially the gluteus medius (GM), play a crucial role in the structural alignment of the pelvis and lower extremities. The main function of the gluteus medius is to stabilize the pelvis on the weight-bearing side and prevent excessive lateral tilt of the pelvis during single leg stance of gait. If excessive lateral tilt is present at the pelvis, increased adduction at the hip will occur. Therefore, hip abductor strengthening is important to provide the necessary muscular support for optimal kinematic functioning.^{7,12,13}

We hypothesize that if the GM is weak, the pelvis will not be properly stabilized/aligned during weight bearing.^{7,12,13} This, in turn, may cause faulty biomechanics at the knee, which could ultimately lead a PFP syndrome.

CHAPTER III
METHODOLOGY

An Institutional Review Board (IRB) form describing the purpose and format for this study was completed by the researchers and approved by the University of North Dakota (see Appendix A).

Subjects

Twenty healthy subjects (9 men, 11 women) were selected and gave their written consent for this study. The subjects were selected based upon the following criteria: 1) between the ages of 18 and 40 and 2) no previous hip or knee pathology.

Table 1. Descriptive Statistics of Subjects

	Mean	Range	Standard Deviation
Age	22.6 (years)	20-25	1.46
Height	67.2 (inches)	60.5-75.0	3.02
Weight	150.6 (lbs.)	177.0-199.0	19.83

Subject Preparation

Each subject was prepared in a separate room from testing; preparation of each subject was broken down into five distinct segments. First, each subject's personal information was taken (height, weight, and age) and then they were given a consent form to read and sign. Second, a small mark was placed directly over the left greater trochanter to allow for increased reliability when taping the subjects. Third, prior to placing the electrodes, the skin was prepared by cleansing it with rubbing alcohol. Electrodes were placed parallel to the muscle fibers at a point $1/3$ of the distance from the iliac crest to the greater trochanter for the gluteus medius (GM).¹⁴ For the tensor fascia lata (TFL), electrodes were placed parallel to the muscle fibers at a point 2 cm inferior to the anterior iliac spine.¹⁴ The ground electrode was placed on the right PSIS of all subjects. Fourth, a foot switch was then taped to the plantar surface of the right heel. Fifth, each subject was then taken through three practice trials of the step-down sequence.

Subjects were then taken to the testing room where eight reflective markers were placed bilaterally on the following points: acromion, ASIS, mid-patella, and central distal tibia just proximal to talocrural joint. Each marker was illuminated during the trials, captured on tape, and then digitized to allow coronal motion of these points to be analyzed.

Prior to testing, each subject had to draw a piece of paper out of a hat. The order in which the subjects were tested was determined by a lottery. This was done to provide randomization and decrease bias or learning effects. Each piece of paper had a specific mark (T=taped, U=untaped) which indicated when they were taped. If a subject drew a

U, they performed their first two trials untaped, and if they drew a T, the left hip was taped for their first two trials.

At the end of testing, the subject was then positioned on a plinth in short sitting with a gait belt around his/her distal thigh, allowing only 4 inches between each knee. The subject was then asked to forcefully abduct the hips and hold for three seconds. The highest EMG values of the GM and TFL were recorded as the maximum voluntary contractions (MVC). The MVC were considered to be 100% EMG activity and used as a reference when compared to our trial data.

Taping Protocol

With the subject standing erect, the feet placed shoulder width apart and facing forward, the left hip was taped using the following protocol (Figure 1). One strip of 2 inch wide Cover Roll® was applied with no tension. Starting two centimeters superior to the left posterior superior iliac spine, the cover roll was applied directly posterior to greater trochanter and wrapped around the anterolateral thigh towards the medial femoral condyle. The strip ended approximately three to four inches superior to the patella (over the VMO muscle belly).

Next, subject was instructed to place his/her left hand over the right greater trochanter and look over the right shoulder positioning the subject's left hip in external rotation. Then, one strip of one and one-half inch wide Leukotape® was applied in a distal to proximal direction over the Cover Roll® using moderate tension, ending at the left posterior superior iliac spine.

After the tape was applied, the subject was instructed to flex the left hip to 90° in standing. A standard goniometer was then used to measure left hip flexion. If the subject

was not able to reach 90° hip flexion, the Leukotape® was removed and reapplied using less tension. If the subject's left hip was able to flex past 90° with ease, the Leukotape® was removed and reapplied using more tension.

Instrumentation

Electromyography

Electromyographic (EMG) information was collected by a Noraxon Telemyo 8 telemetry unit (Noraxon USA, 13430 North Scottsdale Rd., Scottsdale, AZ 85254). This information was then transmitted to a Noraxon Telemyo 8 Receiver and then digitized by an analog digital interface board in the Peak Analog Module (Peak Performance Technologies, 7388 S. Revere Parkway, Suite 601, Englewood, CO 80112-9765). The video data and EMG data was then synchronized using the Peak Event Synchronization Unit. EMG data collection consisted of three phases: The first phase began when the subject, standing on a ten-inch footstool, depressed the footswitch on the right heel. The second phase consisted of the subject stepping off the stool with the right foot and depressing another footswitch on the floor. The third phase involved the return of the right foot back up to the stool and depressing the heel footswitch again. A trigger switch controlled by one of the researchers allowed the footswitch circuit to be closed only during the EMG collection period. (see Figure 2)

Video

Eight reflective markers were placed on each subject. The camera used to film each subject's step test was a Peak High-Speed Video (Peak Performance Technologies, 7388 S. Revere Parkway, Suite 601, Englewood, CO 80112-9765), which was set to run at a frequency of 60 Hz and shutter speed of 1/250 of a second. Each trial was recorded

using a JVC model BR-S378U videocassette recorder (JVC of America, 41, Slater Drive, Elmwood Park, MD 07407), and encoded with a SMPTE time code generator.

Following the recording of all trials, the subjects' movements were then digitized using the Peak Motus Software package. The tapes were played back on a Sanyo Model GVR-S955 (Sanyo, 1200 W. Artesia Boulevard, Campton, CA 90220) videocassette recorder for the purpose of digitization and calculating the maximum hip adduction angle (MHAA) each subject achieved while performing the step-down test. These angles were used to analyze the motion analysis data.

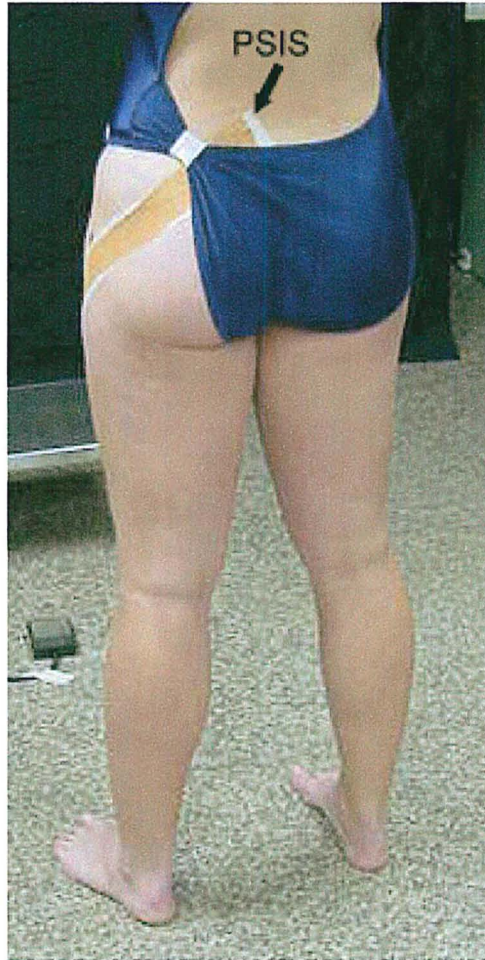
Data Analysis

The EMG data was analyzed using the MyoResearch software package to make comparisons between the muscle activity during the step-down activity. The EMG data was quantified by the software which analyzed the three (3) second period of contiguous data values that occurred during the MVC. First, the MVC for the GM and TFL was quantified and that data was saved in a temporary stack (file) on the computer hard drive. Then, the GM and TFL EMG activity occurring during the step-down test was analyzed. The software automatically calculated the percent of MVC by comparing the muscle activity of the step-down test with the muscle activity during the MVC.

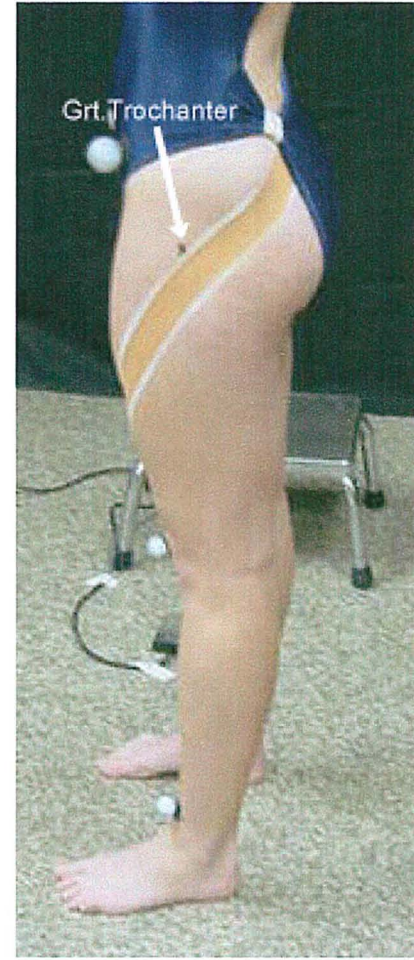
Following the quantification of the EMG data, the percent MVC values were entered into the SPSS 10.0 software package for statistical analysis using paired t-tests with an alpha level of 0.05.



A.

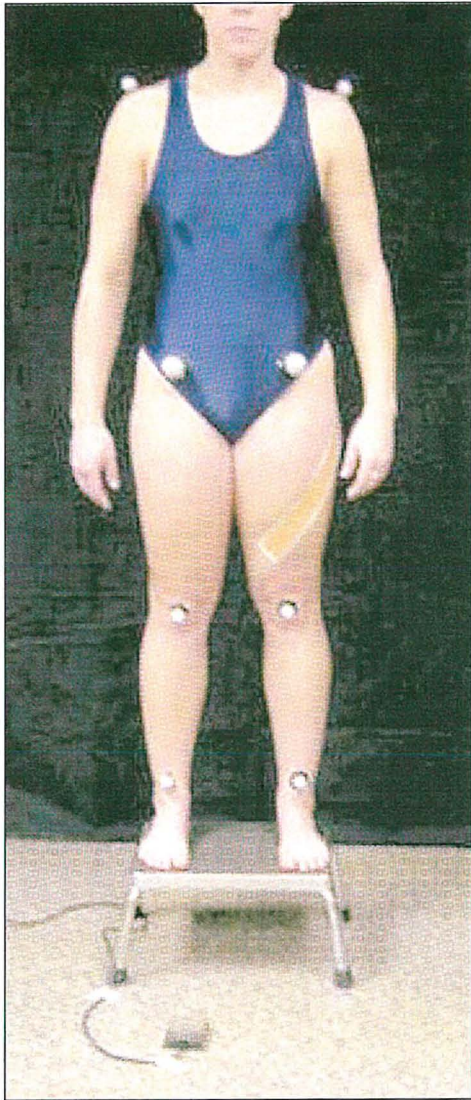


B.



C.

Figure 1. Hip taping procedure. A, Anterior view. B, Posterior view. C, Lateral view.



A.



B.

Figure 2. Step down test: A, Starting and ending position (taped). B, Toe touch position.

CHAPTER IV

RESULTS

Electromyography

The percent MVC data from the step-down test were used to determine if a significant difference exists between muscle activity of either the GM or the TFL under the following conditions: 1) taped versus non-taped males, 2) taped versus non-taped females, 3) and taped versus non-taped males and females. There was no significant difference ($p < 0.05$) in EMG activity when comparing the taped versus non-taped GM or TFL EMG activity (Tables 2, 3, 4).

Motion Analysis

Next, the MHAA (reflective of knee valgus) occurring at the hip joint during the step-downs were analyzed to determine if a significant difference exists between the following conditions: 1) taped versus non-taped males, 2) taped versus non-taped females, 3) and taped versus non-taped males and females. The male subjects did not show a significant difference in MHAA between the taped and non-taped conditions during the step-down test (Table 5). The females did show a significant difference in MHAA between the two conditions (Table 6). When the male and female data was calculated together, there was a significant difference in MHAA between the two conditions (Table 7).

Table 2. Results of *t* Tests for Paired Samples Comparing the Means of EMG Activity During the Step-Down Test for Males

Muscle & Condition	n	Percent Maximal Voluntary Contraction		t	df	p
		Mean	Standard Deviation			
GM* Without Tape	9	61.30	26.03	-.54	8	.603 ^a
GM With Tape	9	63.80	25.58			
TFL* Without Tape	9	17.03	8.80	1.33	8	.221 ^b
TFL With Tape	9	15.28	6.45			

*GM = Gluteus medius *TFL=Tensor fascia lata

^{a,b} Probability value not significant at P .05.

Table 3. Results of *t* Tests for Paired Samples Comparing the Means of EMG Activity During the Step-Down Test for Females

Muscle & Condition	n	Percent Maximal Voluntary Contraction		t	df	p
		Mean	Standard Deviation			
GM* Without Tape	11	52.13	12.05	1.20	10	.256 ^a
GM With Tape	11	49.16	8.70			
TFL* Without Tape	11	12.78	6.58	.16	10	.876 ^b
TFL With Tape	11	12.68	5.67			

*GM = Gluteus medius *TFL=Tensor fascia lata

^{a,b} Probability value not significant at P .05.

Table 4. Results of *t* Tests for Paired Samples Comparing the Means of EMG Activity During the Step-Down Test for Males and Females

Muscle & Condition	n	Percent Maximal Voluntary Contraction		t	df	p
		Mean	Standard Deviation			
GM* Without Tape	20	56.26	19.59	.204	19	.840 ^a
GM With Tape	20	55.75	19.27			
TFL* Without Tape	20	14.70	7.75	1.216	19	.239 ^b
TFL With Tape	20	13.85	6.02			

*GM = Gluteus medius *TFL=Tensor fascia lata

^{a,b} Probability value not significant at P .05.

Table 5. Results of *t* Tests for Paired Samples Comparing the Means of Hip Adduction During the Step-Down Test for Males

Condition	n	Degree of Adduction During Step-down		t	df	p
		Mean	Standard Deviation			
Without Tape	9	14.31	4.68	2.19	8	.060 ^a
With Tape	9	10.34	5.28			

^a Probability value not significant at P .05.

Table 6. Results of *t* Tests for Paired Samples Comparing the Means of Hip Adduction During the Step-Down Test for Females

Condition	n	Degree of Adduction During Step-down		t	df	p
		Mean	Standard Deviation			
Without Tape	11	20.51	4.90	6.17	10	.000 ^a
With Tape	11	12.66	5.00			

^a Probability value significant at P .05.

Table 7. Results of *t* Tests for Paired Samples Comparing the Means of Hip Adduction During the Step-Down Test for Males and Females

Condition	n	Degree of Adduction During Step-down		t	df	p
		Mean	Standard Deviation			
Without Tape	20	17.72	5.65	5.38	19	.000 ^a
With Tape	20	11.62	5.13			

^a Probability value significant at P .05.

Figure 3 shows hip adduction during the entire step-down test cycle. The hip angles were similar at the start and end of the test, however, at the point of toe touch there was a mean difference of 6 degrees between the taped and untaped subjects.

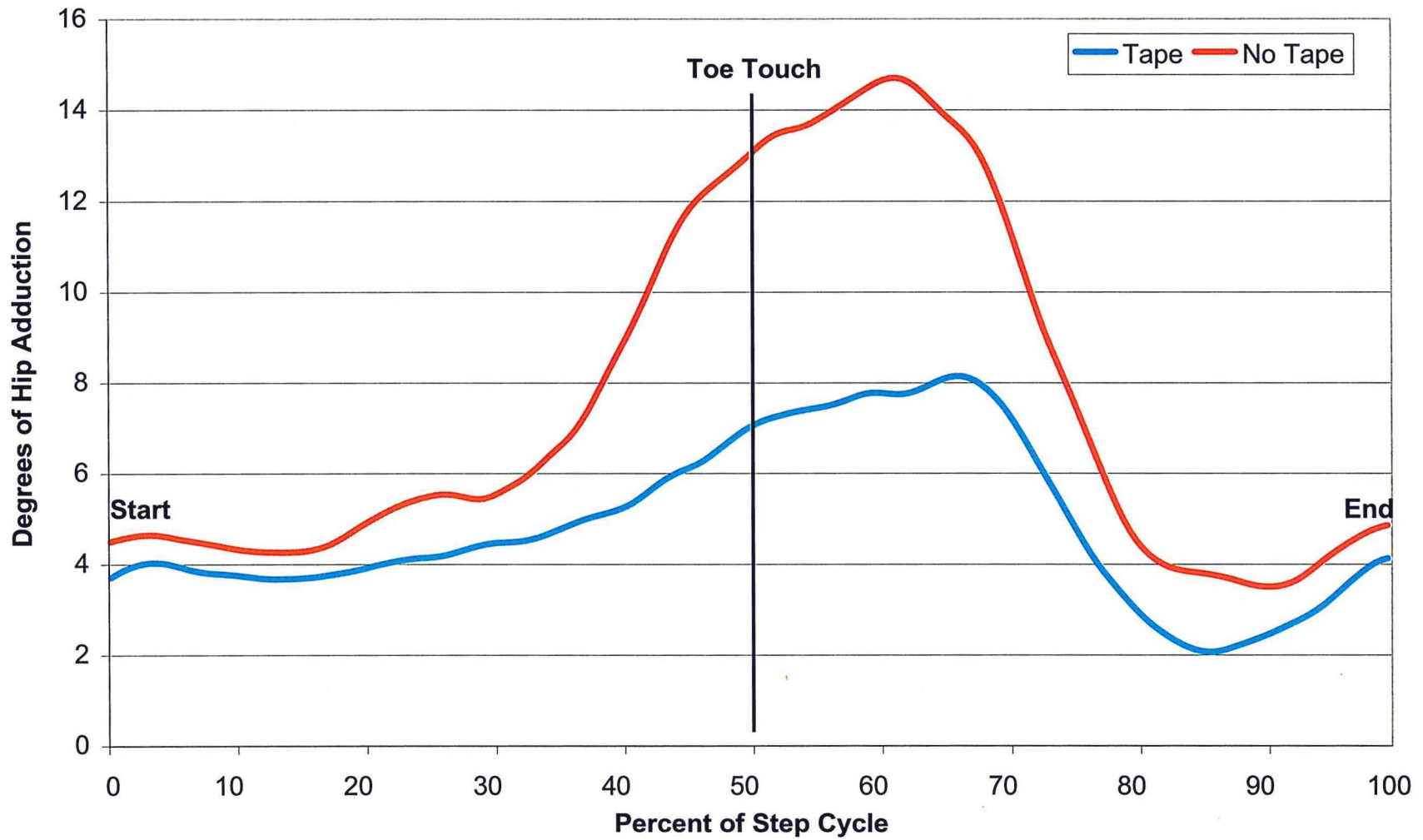


Figure 3. Graph showing hip adduction angle during step cycle. At toe touch (50%) there is a difference of 6 degrees of hip adduction

CHAPTER V

DISCUSSION

Our research questions focused on whether there was a significant difference in EMG activity of the hip abductors and if there were differences in joint alignment of the pelvis/hip for subjects who were either taped or non-taped while performing the step-down activity. We also studied any changes in EMG or hip adduction between males and females.

There were no significant differences in EMG activity of the hip abductors between taped and non-taped conditions. Due to the GM and TFL contribution to hip stabilization during single leg stance,^{7,12,13} we proposed that hip taping would cause a decrease in hip abductor EMG muscle activity. With the tape acting as a functional brace for the pelvis, the hip musculature would not have to work as hard, in turn, resulting in decreased EMG activity. We are not certain why there were no differences in EMG activity between males and females in the taped versus non-taped conditions.

A direct relationship exists between lateral pelvic tilt and hip adduction.^{12,13} As lateral pelvic tilt increases, hip adduction also increases. The muscles responsible for controlling hip adduction during single leg stance are the hip abductors (GM and TFL). As a result, if there is weakness of the hip abductors, excessive lateral tilt/drop of the pelvis occurs. Acting in a kinetic chain,¹¹ this causes the ipsilateral lower extremity to adduct, in turn, accentuating knee valgus during single leg stance. We hypothesize that

taping the hip on the stance leg adds stability to the pelvis, decreasing lateral pelvic tilt. Excessive lateral pelvic tilt is prevented, helping to control ipsilateral hip adduction and knee valgus of the stance limb.

Our results for the taped versus non-taped condition with males alone showed no significant difference for MHAA. The fact that males have a smaller average Q-angle than females¹¹ may have contributed to the non-significant findings for males. Females may have more hip adduction due to the direct relationship between hip adduction and Q-angle. Therefore, it is more likely that significance would be found in the female population between the taped and non-taped conditions.

Overall, the results showed a significant difference in joint alignment of the hip; however, no significant difference was found for EMG activity of the hip abductors. Although our results were not significant for EMG activity, hip abductor musculature may still play a role in preventing PFP. Muscle strength is needed to maintain the body's joints in proper alignment; therefore if weakness is present, abnormal alignment occurs. Previous studies have shown that females tend to have a lower strength to body weight ratio compared to males.¹⁵ Therefore, we hypothesize that the females in this study may have demonstrated weaker hip abductors than the males in the study (i.e. hip abductor strength to body weight) and this may have lead to a greater increase in hip adduction during the step-down test. The tape may have helped "brace" the hip and aided the hip abductors in female subjects more than the male subjects.

Limitations

One of the limitations to our study was the small sample size (n=20). When using a small sample, if extreme values are found during testing (outliers) standard deviations

increase, which makes finding significant differences more difficult. Analyzing more subjects would allow for a closer approximation to a normal distribution or population and would also reduce the standard error of the study.¹⁶ Only normal subjects were tested. To truly examine the efficacy of hip taping, patients with PFP need to be assessed to determine more accurate baseline values.

Conclusion

In conclusion, the hip taping technique used showed no significant effect on muscle activity for the GM or TFL, however, it did help to control and reduce hip adduction in the subjects tested. This technique should, in theory, be helpful in treating patients with PFP. By stabilizing the pelvis, increased hip adduction and increased knee valgus will be prevented. As a result, the muscles acting at the hip and knee will regain their biomechanical efficiency and abnormal stresses will be avoided.

This taping technique is to be used in conjunction with a strengthening program. The purpose of the tape is to act as a “brace” to prevent excessive hip adduction (lateral pelvic tilting) during functional activities. Once the hip abductor musculature has sufficient strength to support the pelvis during gait activities and single leg stance, the use of tape should be discontinued.

To our knowledge this is the first study to objectively measure the effects of hip taping; therefore, more research should be conducted to support the efficacy of hip taping.

APPENDIX

EXPEDITED REVIEW REQUESTED UNDER ITEM 3 (NUMBER[S]) OF HHS REGULATIONS
 EXEMPT REVIEW REQUESTED UNDER ITEM _____ (NUMBER[S]) OF HHS REGULATIONS

UNIVERSITY OF NORTH DAKOTA HUMAN SUBJECTS REVIEW FORM
FOR NEW PROJECTS OR PROCEDURAL REVISIONS TO APPROVED
PROJECTS INVOLVING HUMAN SUBJECTS

PRINCIPAL

INVESTIGATOR: Thomas Mohr, Kyle Barker, Daren Martin, Grant Goven, Greg Charlton, and Clifford Lafreniere TELEPHONE: 777-2831

DATE: 4/10/01

ADDRESS TO WHICH NOTICE OF APPROVAL SHOULD BE SENT: PO Box 9037, Dept. Of Physical Therapy, UND

SCHOOL/COLLEGE: Medicine & Health Sciences DEPARTMENT: Physical Therapy PROJECT DATES: 4/30/01 to 5/1/02
(Month/Day/Year)

PROJECT TITLE: The Effect of Hip Taping on Hip and Knee Muscle Activity

FUNDING AGENCIES (IF APPLICABLE): None

TYPE OF PROJECT (Check ALL that apply):

NEW PROJECT CONTINUATION RENEWAL DISSERTATION OR THESIS RESEARCH STUDENT RESEARCH PROJECT
 CHANGE IN PROCEDURE FOR A PREVIOUSLY APPROVED PROJECT

DISSERTATION/THESIS ADVISER, OR STUDENT ADVISER: Thomas Mohr, PT, PhD

PROPOSED PROJECT: INVOLVES NEW DRUGS (IND) INVOLVES NON-APPROVED USE OF DRUG INVOLVES A COOPERATING INSTITUTION

IF ANY OF YOUR SUBJECTS FALL IN ANY OF THE FOLLOWING CLASSIFICATIONS, PLEASE INDICATE THE CLASSIFICATION(S):

MINORS (< 18 YEARS) PREGNANT WOMEN MENTALLY DISABLED FETUSES MENTALLY RETARDED
 PRISONERS ABORTUSES UND STUDENTS (> 18 YEARS)

IF YOUR PROJECT INVOLVES ANY HUMAN TISSUE, BODY FLUIDS, PATHOLOGICAL SPECIMENS, DONATED ORGANS, FETAL MATERIAL, OR PLACENTAL MATERIALS, CHECK HERE

IF YOUR PROJECT HAS BEEN/WILL BE SUBMITTED TO ANOTHER INSTITUTIONAL REVIEW BOARD(S), PLEASE LIST NAME OF BOARD(S):

Status: _____ Submitted; Date _____ Approved; Date _____ Pending

1. ABSTRACT: (LIMIT TO 200 WORDS OR LESS AND INCLUDE JUSTIFICATION OR NECESSITY FOR USING HUMAN SUBJECTS.)

Anterior knee pain is a common complaint especially with young adult athletes. Anterior knee pain can arise from a variety of factors including trauma, arthritis, as well as structural defects. One factor that has been theorized to precipitate anterior knee pain is weakness of the hip abductor muscles, especially the gluteus medius. Weakness of this muscle can cause the hip to excessively adduct (knee valgus) when load is placed on the lower limb. This causes the knee to move inward which increases the tendency to dislocate the patella in a lateral direction. Lateral movement of the patella can cause pain as the patella moves over the anterior femur. Repetitive motion can cause excessive wearing to the cartilage on the patella which causes a "grating" effect between the patella and femur which manifests itself as pain during weight bearing. Physical therapists have employed a number of interventions for patients with anterior knee pain including taping techniques which are used to hold the patella in place, bracing to stabilize the patella, exercises to increase the strength of the anterior knee muscles and now a newer technique of taping the hip. In theory, taping the hip helps stabilize the femur (thigh) during weight bearing and thus prevents excessive knee valgus, which decreases the pain the patient normally experiences during these activities. Although hip taping has been in use clinically for several years, there is no published data regarding its effect or effectiveness. Therefore the purpose of this study is to analyze the effect of hip taping on lower extremity muscle activity and movement during weight bearing.

Both normal, healthy, adult subjects as well as subjects with a history of knee pain or hip abductor weakness will be used. Human subjects are needed for this research study in order to determine the effect of the taping.

PLEASE NOTE: Only information pertinent to your request to utilize human subjects in your project or activity should be included on this form. Where appropriate attach sections from your proposal (if seeking outside funding).

2. PROTOCOL: (Describe procedures to which humans will be subjected. Use additional pages if necessary.)

Subjects:

It is anticipated that we will recruit 30 subjects (both male and female) between the ages of 18 and 40. The subjects for the study will be recruited from university students and the community. These subjects will participate voluntarily. These subjects will be chosen because of their age and health status. We anticipate using 15 normal, healthy subjects and 15 subjects who are experiencing anterior knee pain or gluteus medius weakness. Subjects recruited with knee pain and/or hip muscle weakness will have been screened by a physical therapist (Clifford Lafreniere) at HealthSouth in Grand Forks.

The project will be completed at the University of North Dakota Physical Therapy Department in Grand Forks. Prior to performing the study, each subject will be asked to complete a consent form. The subjects will not be compensated.

Methods:

During the trial, we will measure EMG activity in the gluteus medius, vastus lateralis, vastus medialis and tensor fascia latae muscles. We also measure the trunk and lower extremity motion by filming the subjects during the exercises. The study will be performed by Thomas Mohr, chairman of the physical therapy department, Clifford Lafreniere (part time faculty member) and four graduate students: Kyle Barker, Daren Martin, Grant Goven, and Greg Charlton.

To record EMG activity, adhesive electrodes will be placed over each muscle. The precise electrode placement will be determined from standard electrode placement charts. Prior to placing the EMG electrodes, the skin over each placement site will be prepared by cleansing the skin with alcohol. The EMG signals will be transmitted to a receiver unit and then fed into a computer for display and recording of data. Prior to beginning the experimental trial, each subject will be asked to elicit a maximal voluntary contraction from each muscle being monitored in this study. The muscle activity recorded during the maximal voluntary contraction will be considered as a 100% EMG activity level to which the EMG activity during the three abdominal exercises can be compared. This procedure is done to normalize the EMG data for later analysis.

The hip taping procedure requires that adhesive tape be applied to the subject's skin. The skin will first be covered by a pre-wrap tape to help adherence of the adhesive tape. The adhesive tape will be applied from the patient's midback (sacrum) around the thigh and anchored to the medial side of the knee.

Video analysis will be used to measure lower extremity and trunk range of motion during the activity. Reflective markers will be attached to the trunk and extremities using double-sided adhesive tape. We anticipate placing markers on the shoulders, hip, knee and ankle. Video cameras will be placed on the sides of the subject and will film the subject's trunk and extremity markers and motion during the experimental trial. This will be recorded on videotape and will be transferred to a computer for analysis.

Prior to data collection, each subject will be asked to perform a maximal voluntary contraction of the muscles against resistance in order to establish a baseline of activity. This baseline will be used to normalize the data. The subjects will also be orientated to the test procedure. A visual analog scale will be used to rate the patient's knee pain (if present) before, during and following the procedure.

For the test procedure, the subjects will be asked to perform a series of five step up and step down exercises on an eight (8) inch high stool. A metronome will be used to time the rate of the step ups and will be set at a slow pace. The muscle activity and joint range of motion will be recorded during the procedure. In order to compare the effect of the intervention, the subjects will be asked to perform the procedure with hip tape in place and without hip tape.

Data analysis:

Descriptive statistics describing the subjects' anthropometric profiles will be provided. The mean activity of each monitored muscle will be calculated. The EMG data collected during the experimental trials will be expressed as a percentage of the EMG activity recorded during the maximal contraction prior to the experimental trials (i.e. normalized). The video image will be converted to a stickman-like figure, from which we can determine joint angles and limb velocity. The EMG data is synchronized with the video data to determine the level of EMG activity during the test procedure.

3. BENEFITS: (Describe the benefits to the individual or society.)

The data collected throughout this research study will be analyzed to determine the effect of hip taping on muscle activity, range of motion and pain. The data should provide information on the effectiveness of hip taping. This information will provide the basis for prescribing hip taping for patients with anterior knee pain or hip abductor weakness. The benefit to the participant will be the experience of being involved in a scientific study, and knowing that they will be contributing to the body of knowledge in exercise physiology and physical therapy.

4. RISKS: (Describe the risks to the subject and precautions that will be taken to minimize them. The concept of risk goes beyond physical risk and includes risks to the subject's dignity and self-respect, as well as psycho-logical, emotional or behavioral risk. If data are collected which could prove harmful or embarrassing to the subject if associated with him or her, then describe the methods to be used to insure the confidentiality of data obtained, including plans for final disposition or destruction, debriefing procedures, etc.)

The risks involved in this research project are minimal. The EMG and video analysis equipment causes no discomfort to the subject, since they are both monitoring devices. Because the video information is converted to stickman-like diagrams, the actual subject's video is not used in data reporting. Therefore, the subject is not recognizable.

The process of physical performance testing does impose a potential risk of injury to the muscle. The testing will occur in a controlled setting, and because only healthy subjects will be used, the risk of any injury is extremely low. The participant will be closely observed throughout the procedure to decrease the potential of harm. The investigator or participant may stop the experiment at any time if the participant is experiencing discomfort, pain, fatigue, or any other symptoms that may be detrimental to his/her health. Since the electrodes are used for recording only, there is no risk of injury from them. There may be a slight redness of the skin following removal of the electrodes, but this will only be temporary. The procedures used are similar to those used in many PT clinics and should pose no undue risk to the subject.

In the event that this research activity (which will be conducted at the University of North Dakota Physical Therapy Department) results in a physical injury, medical treatment will be available, including first aid, emergency treatment and follow up care as it is to a member of the general public in similar circumstances. Payment for any such treatment must be provided by the subject's third party payor, if any.

The subjects' names will not be used in any reports of the results of this study. Any information that is obtained in connection with this study and that can be identified with the subject will remain confidential and will be disclosed only with the subject's permission. The data will be identified by a number known only by the investigator.

All of the raw data will be stored in electronic format (computer files), in the Department of Physical Therapy for a period of three (3) years. After that time, the data will be erased. Some of the processed data and the consent forms will be in stored in paper format, in the Department of Physical Therapy for a period of three (3) years. After that time they will be shredded.

5. **CONSENT FORM:** A copy of the **CONSENT FORM** to be signed by the subject (if applicable) and/or any statement to be read to the subject should be attached to this form. If no **CONSENT FORM** is to be used, document the procedures to be used to assure that infringement upon the subject's rights will not occur.

Describe where signed consent forms will be kept and for what period of time.

Consent forms will be kept in the Physical Therapy Department at the University of North Dakota for a period of three (3) years, after which time they will be shredded.

6. For **FULL IRB REVIEW** forward a signed original and thirteen (13) copies of this completed form, and where applicable, thirteen (13) copies of the proposed consent form, questionnaires, etc. and any supporting documentation to:

Office of Research & Program Development
University of North Dakota
Grand Forks, North Dakota 58202-7134

On campus, mail to: Office of Research & Program Development, Box 7134, or drop it off at Room 105 Twamley Hall.

For **EXEMPT** or **EXPEDITED REVIEW** forward a signed original and a copy of the consent form, questionnaires, etc. and any supporting documentation to one of the addresses above.

The policies and procedures on Use of Human Subjects of the University of North Dakota apply to all activities involving use of Human Subjects performed by personnel conducting such activities under the auspices of the University. No activities are to be initiated without prior review and approval as prescribed by the University's policies and procedures governing the use of human subjects.

SIGNATURES:

Principal Investigator

Date

Project Director or Student Adviser

Date

Training or Center Grant Director

Date

INFORMATION AND CONSENT FORM

TITLE: The Effect of Hip Taping on Hip and Knee Muscle Activity

You are being invited to participate in a study conducted by **Kyle Barker, Daren Martin, Grant Goven, Greg Charlton, Clifford Lafreniere (HealthSouth) and Thomas Mohr from the physical therapy department at the University of North Dakota**. The purpose of this study is to study muscle activity in your hip and knee muscles while you are stepping up and down on a stool. We will also be measuring pain (if present) and the angles of the joints of the lower extremity and trunk while you are stepping. We hope to describe the muscle activity that occurs during the stepping activity, with and without hip tape in place. Only normal, healthy subjects or subjects with knee pain or hip weakness will be asked to participate in this study. Subjects who have knee pain or hip weakness will be screened by a therapist from HealthSouth prior to participation. The benefit to you, as a participant, will be the experience of being involved in a scientific study and knowing that you will be contributing to the body of knowledge in exercise physiology and physical therapy.

You will be asked to perform step up and step down exercises in two different ways: 1) with no hip tape in place, or 2) with hip tape in place. You will be asked to do five repetitions of each stepping procedure. In addition you will be asked to perform a maximal voluntary contraction with your lower extremity muscles. You will be given a rest period between trials and you will be allowed to warm-up prior to performing the exercises. In addition, you will be orientated on the procedure prior to the actual experiment.

The study will take approximately one hour of your time on the day of the study. You will be asked to report to the Physical Therapy Department at the University of North Dakota at an assigned time. You will then be asked to change into gym shorts for the experiment. We will first record your age, gender, height and weight. During the experiment, we will be recording the amount of muscle activity and the angles of your joints when you perform the stepping exercises. In addition, we will ask you to rate your pain (if present) prior to, during and following the stepping procedure.

Although the process of physical performance testing always involves some degree of risk, the investigators in this study feel that the risk of injury or discomfort is minimal. In order for us to record the muscle activity, we will be placing electrodes on your hip and thigh. The recording electrodes are attached to the surface of the skin with an adhesive material. We will also attach reflective markers at various points on your arm, leg and trunk. These devices only record information from your muscles and joints, they do not stimulate the skin. We will also be placing a strip of adhesive tape on your skin that will run from your low back area, around the hip and then attaching to the inside of your knee. After we get the electrodes and markers attached, we will give you a brief training session to familiarize you with the procedure. The amount of exercise you will be asked to perform will be moderate. There may be a slight redness following removal of the electrodes and tape but this will only be temporary.

Your name will not be used in any reports of the results of this study. The video taped data will be analyzed by a computer and the markers placed on your body will be used to construct a "stick man" like figure. Your real, photographic image will not be used in reporting of the findings of the study. The computer files, and consent forms are kept in the physical therapy department for a period of three (3) years. After that time, the electronic media is erased and the paper files are shredded. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. The data will be identified by a number known only by the investigator. The investigator or participant may stop the experiment at any time if the participant is experiencing discomfort, pain, fatigue, or any other symptoms that may be detrimental to his/her health. Your decision whether or not to participate will not prejudice your future relationship with the Physical Therapy Department or the University of North Dakota. If you decide to participate, you are free to discontinue participation at any time without prejudice.

The investigator involved is available to answer any questions you have concerning this study. In addition, you are encouraged to ask any questions concerning this study that you may have in the future. Questions may be asked by calling Dr. Thomas Mohr at (701) 777-2831. A copy of this consent form is available to all participants in the study. If you have any ethical concerns regarding this study, contact the UND Institutional Review Board Chair at the Office of Research and Program Development, 701 7774279.

In the event that this research activity (which will be conducted at UND Physical Therapy) results in a physical injury, medical treatment will be available, including first aid, emergency treatment and follow up care as it is to a member of the general public in similar circumstances. Payment for any such treatment must be provided by you and your third party payer, if any.

ALL OF MY QUESTIONS HAVE BEEN ANSWERED AND I AM ENCOURAGED TO ASK ANY QUESTIONS THAT I MAY HAVE CONCERNING THIS STUDY IN THE FUTURE. MY SIGNATURE INDICATES THAT, HAVING READ THE ABOVE INFORMATION; I HAVE DECIDED TO PARTICIPATE IN THE RESEARCH PROJECT.

I have read all of the above and willingly agree to participate in this study explained to me by one of the investigators.

Participant's Signature

Date

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