1993

Anatomical Study of Vastus Medialis Obliquus Orientation in Relation to the Superior Pole of the Patella

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University of North Dakota

ANATOMICAL STUDY OF VASTUS MEDIALIS OBLIQUUS ORIENTATION IN RELATION TO THE SUPERIOR POLE OF THE PATELLA

by

Wade A. Burd
Bachelor of Science in Physical Therapy, University of North Dakota, 1993

An Independent Study

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, 1993

This Independent Study, submitted by Wade A. Burd 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 Faculty Preceptor, Advisor, and Chairperson of Physical Therapy whom the work has been done and is hereby approved.

(Faculty Preceptor)

(Graduate School Advisor)

(Chairperson, Physical Therapy)

PERMISSION

Title	Anatomical Study of Vastus Medialis Obliquus Orientation in Relation to the Superior Pole of the Patella
Department	Physical Therapy
Degree	Master of Physical Therapy

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Signature 

Date 3/27/94

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ACKNOWLEDGEMENTS

I would sincerely like to thank my instructors, Arnie Keck and Erin Simunds, who helped organize this study and spent much of their valuable time working with me on this project.

Also, I would like thank Wanda Weber who provided her time and resources for the photographs taken.

ABSTRACT

Purpose. The purpose of this study was to determine an optimal electrode site of the vastus medialis obliquus (VMO) from a predetermined landmark on the patella. **Subjects.** Twelve cadavers (6 male, 6 female), aged 30 to 86 years (x = 66.3), from Anatomy: PT 322 lab were utilized for data collection. **Methods.** The following three measurements were taken on the lower extremities of the cadavers using a transparent double axis grid: 1) distance from the superior patellar pole to the adductor magnus tendon 2) distance from the superior patellar pole to the center point of the VMO and 3) the number and location of 1 cm2 boxes that would definitely correspond to VMO fibers. The origin (0,0) was superimposed over the superior patellar pole with the x axis parallel and the y axis perpendicular to the long axis of the femur. A second data collection on 12 of the same specimens was used to analyze intratester reliability. **Results.** The Pearson Product Moment Correlation Coefficient for the first distance produced an r value of .42 and an r value of .84 for second distance. The average length from the superior patellar pole to the adductor magnus tendon was 6.40 cm (s = .59) and the average length from the superior patellar pole to the center point of the VMO was 4.58 cm (s = .67). The percentage of the total distance from the superior patellar pole to the adductor magnus tendon which corresponded to the center point of VMO fibers on the y axis was 71.6%. Therefore, the optimal electrode site on the VMO was determined to be at the 71.6% mark on the y axis and one and a half cm along the x axis from this point. **Conclusion.** Several factors appeared to have affected the reliability scores, however this was the initial trial for the device utilized and more research with this method is required. An optimal site for electrode placement on the VMO was determined which may prove beneficial for further studies in this area.

CHAPTER I

INTRODUCTION

Much has been said about a commonly occurring condition known as patellofemoral pain (PFP) syndrome.[1] Research undertaken on PFP has focused on such aspects as incidence in the population, etiology, diagnosis, and, of particular interest to physical therapy, the effectiveness of treatment procedures. The interest with PFP stems from the frequency with which this condition occurs. According to Fox[2], derangement of the patellofemoral (PF) mechanism is one of the most commonly encountered anomalies involving the knee joint. Wise et al[1] found PFP syndrome to be one of the most familiar ailments cited in sports medicine practices, possible affecting as high as one in four in the general population with an increased occurrence in the athletic population.[3]

PFP syndrome occurs with such frequency due in part to the various ailments associated with this broad diagnostic category. The following differential diagnoses listed are all associated with PFP syndrome: anterior knee pain, PF malalignment, extensor mechanism malalignment, extensor mechanism dysfunction, runner's knee, chondromalacia patella, patellar subluxation, patellar dislocation, plica syndrome, patellar tendinitis, quadriceps tendinitis, Osgood-Schlatter's disease, Sinding-Larsen-Johansson disease[4], bursitis, fat pad syndrome, meniscal lesions, ligamentous lesions, jumper's knee, and systemic synovitis[5]. With such a broad diagnostic category it is not surprising that numerous predisposing factors exist in the etiology of PFP syndrome.

PFP syndrome results from improper tracking of the patella within the femoral groove. Since patellar tracking relies upon various passive and active stabilizers, an imbalance of one or more of these may result in PFP.[1] Passive stabilizers consist of

the lateral femoral condyle, depth of the PF groove, and the Q-angle (quadriceps angle). Of these the Q-angle is often regarded as the most important contributor to PFP.[6] This angle tends to place a valgus vector force on the patella resulting in lateral patellar tracking[2] and is increased with lower extremity dysfunctions of genu valgum, external tibial torsion, femoral anteversion,[7] and lateral displacement of the tibial tubercle.[6] Other mechanical alignment factors affecting patellar tracking include compensatory pronation, and patella alta or baja.[5] In addition, several dynamic stabilizers affect patellar alignment. Muscular tightness in the rectus femoris, iliotibial band, hamstrings and gastrocnemious[5] as well as ligamentous tightness in the lateral retinaculum[8] are considered in this grouping. However important as these factors may be, most of the emphasis on improper patellar tracking has focused on vastus medialis obliquus (VMO) insufficiency.

The focus on the VMO stems from a discrepancy in the ratio between the VMO and the vastus lateralis (VL) of PFP patients compared to the same ratio of normal subjects. Since it is proposed that the VMO and VL oppose each other in a critical balance[9] a disruption of the normal VMO:VL activity may result in abnormal patellar tracking and ultimately PFP.[6,10,11] The normal VMO:VL ratio has been suggested to be 1:1 with a tonically active VMO, yet PFP sufferers may demonstrate a less than 1:1 ratio with a phasically active VMO.[5] Thus with a decrease in the VMO activity, the balance between the two patellar stabilizers is offset toward the VL and results in lateral excursion of the patella. Therefore, retraining the VMO is thought to be an essential component of the rehabilitative process for certain cases of PFP patients.

With the McConnell treatment program a main focus in the rehabilitation for PFP is to promote proper patellar alignment by changing the timing, not just magnitude, of VMO contractions.[1,5] This technique involves the use of tape over the patella to correct deviations in patellar alignment and is often augmented by electromyographic (EMG) biofeedback to enhance VMO activation patterns.[5,6,12,13] The tape is

utilized to correct physical abnormalities of the patella (glide, tilt, rotation) and sometimes to inhibit the VL while the biofeedback component is utilized to retrain the VMO through visual and auditory feedback.[5] In this sense, VMO retraining is regarded as the acquisition of a motor skill instead of a strengthening parameter.[13,14]

It is through the augmentation of EMG biofeedback and exercises that a subject is able to gain control over the VMO. Studies suggest that individuals have the ability to selectively control the VMO in attempts to correct malalignment of the patella.[1,15] In one of the studies performed by Wise et al[1], six PFP patients were enrolled in a three phase EMG biofeedback and exercise program. Phase 1 consisted of an orientation to the biofeedback device and instruction in quadricep sets, straight leg raises, and a home program. Phase 2 integrated the use of the biofeedback device with the following exercises: quadricep sets, straight leg raises, terminal knee extensions, progressive resistive exercises, along with a home program routine. The goal of this stage was to selectively enhance the muscle activity of the VMO in comparison to the VL. The third and final phase incorporated the use of functional skills with the increased VMO activity. Upon comparing the initial EMG activity with the final EMG results, the electrical activity of the VMO increased more than that of the VL in five of the six cases. In the case of subject 6 the reversal was true because the VL produced less microvolt activity during the initial recording and consequently increased its microvolt activity more than the VMO. However, all subjects demonstrated a lowered VMO:VL ratio, more closely approximating a 1:1 ratio thought to be associated with pain-free quadriceps function. Ingersoll and Knight also support the use of EMG biofeedback over the VMO to medially align the patella to prevent lateral patellar subluxation as was demonstrated on subjects in their study.[16]

This idea of selectively retraining the VMO relies upon the distinction of the VMO as a separate muscle from the vastus medialis (VM). Bose et al[17] provided anatomical evidence of the separation of these muscles, designating the inferior portion of the VM as the VMO. They found that the fibers of the VMO originated

from the adductor longus and magnus tendons as well as from the medial intermuscular septum and inserted obliquely on the medial margin of the patella. Lieb and Perry[18] also provided anatomical support of VMO separation from the VM stating that "fibers of the vastus medialis follow two distinctly different alignments which are anatomically distinct." In a previous study Lieb and Perry[9] noted the distal VM fibers were oriented 50 to 55 degrees medially in the frontal plane compared to only 15 to 18 degrees in the same plane for the upper VM fibers. Not only were the muscle fibers aligned in a different plane but the authors suggested the possibility of separate nerve supplies.

Data from another anatomical study by Thiranagama[19] separated the VM into three parts: 1) upper lateral third 2) middle third and 3) lower one third which corresponded to the VMO. Results showed that the VM was innervated by two nerves from the posterior branch of the femoral nerve. One branch supplied the upper third of the VM while the other branch innervated the middle and lower third. A major portion of the latter branch "continued as a discrete bundle" which gave numerous projections to the lower third, the VMO. This separate innervation led to the notion that the VMO can function independently[9,18,20] and supported the use of EMG as a tool in training this muscle in PFP patients.

Application of EMG biofeedback electrodes generally involves the use of surface electrodes to determine the relative activity of the VMO as compared to the VL. Placement of the electrodes is essential in order to adequately detect the activity of the desired muscle, thus when determining these electrode sites certain standards should be met to conform to several requirements: 1) consistent recordings 2) consideration of individual body dimensions and 3) high signal yield.[21] In the literature, electrode placements are defined with reference to anthropometrical landmarks, are given in relation to individual body dimensions, and are generally located over the muscle bulk parallel to the muscle fibers.[21] Basmajian and Blumenstein[22] indicated that the greatest EMG response is gathered from the center of the target muscle mass. Consequently, proper electrode placement relies on a

specific location on the target muscle. However, upon researching the aspects of McConnell's PF taping treatments no specific guidelines for electrode placement were found. Other sources indicated that the geographical location of the electrode site influenced the recorded EMG[23] and consistent electrode placement in the same manner and location is required to make observations regarding the "participation of the muscle(s) during a given movement pattern."[24] Therefore, it appears that a standard measurement from a certain anatomical landmark would facilitate appropriate electrode placement over the VMO. The purpose of this study is to determine an optimal electrode site of the VMO from a predetermined landmark on the patella that will yield a clinically useful indicator to enhance electrode placement.

CHAPTER II
METHODOLOGY

Subjects

Twelve cadavers were utilized for data collection. Dissection of cadavers was performed by first year physical therapy students under the supervision of Anatomy: PT 322 instructor Arnie Keck, PT. Each lower extremity of the cadavers was considered a specimen, creating a total sample size of n = 24. The age of subjects ranged from 30 to 86 ($\bar{x}$ = 66.3, s = 18.5). The age and gender distribution of the subjects is shown in Table 1. Use of the cadavers was conducted in accordance with guidelines from University of North Dakota Institutional Review Board (Appendix A).

Instrumentation

Prior to data collection a transparent grid with one centimeter (cm) intervals (resembling transparent graph paper) was attached to a pre-built frame. The grid was divided into quadrants with an x and y axis; the x axis ran on the center horizontal line and the y axis ran on the center vertical line. Thus each quadrant had 1 cm increments horizontally and vertically, creating 1 cm2 boxes. The grid was then labeled with the appropriate values having an origin at (0,0) and increments of whole numbers either positive or negative depending upon direction from the origin (Figure 1).

Procedure

Initially, the researchers positioned the cadavers supine and the principal investigator placed a pin at the superior patellar pole for identification of this anatomical landmark. Next, the same individual held the grid along the medial thigh parallel to the VMO fibers as close to the muscle fibers as possible. The origin (0,0) was superimposed over the superior pole of the patella with the x axis parallel and

TABLE 1. Subject Demographics

Subject	Age	Sex
1	53	F
2	63	F
3	75	M
4	72	M
5	30	F
6	65	M
7	84	M
8	36	M
9	82	M
10	77	F
11	86	F
12	73	F

$\bar{x} = 66.3$, $s = 18.5$

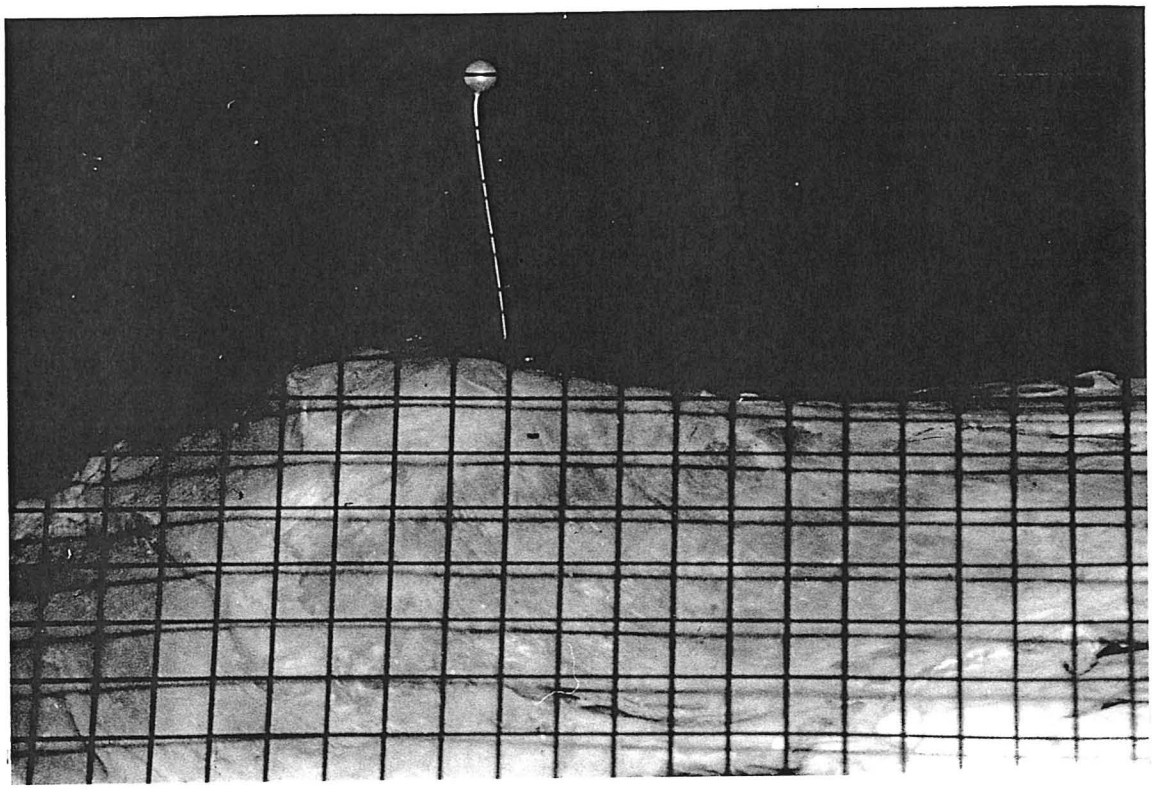


Figure 1. Recording placement with two dimensional grid aligned on right knee

the y axis perpendicular to the long axis of the femur (Figure 2). The principal investigator held the grid in place and reported the three components for data collection while another researcher recorded the information. The researcher reporting the data stood approximately three feet from the setup observing the grid in approximately the same plane as the VMO fibers.

Data Collection

Data collection consisted of: 1) the total distance from the superior pole of the patella to the adductor magnus tendon (along the y axis) 2) the distance from the superior pole of the patella to a center point of the VMO fibers on the y axis (this point corresponded to a spot where, in a cephalad direction, the greatest concentration of VMO fibers was observed) and 3) the number and location of 1 cm2 boxes that would definitely correspond to VMO fibers. The last set of information was gathered by counting down on the y axis in centimeter increments, then at each centimeter level the number of 1 cm2 boxes corresponding to pure VMO fibers was counted horizontally. Only whole boxes were recorded as the grid did not allow documentation of partial boxes occupied by VMO fibers. Knowledge that the whole box corresponded to VMO fibers ensured certainty that electrode placement would pick up VMO activity from these locations.

The anatomical landmarks used were chosen for specific reasons. The superior pole of the patella was selected because patellar taping often covers a majority of the patella, leaving only the superior pole exposed. Thus, this landmark could be used for further reference in a clinical setting with the tape applied. Also, the majority of VMO fibers will be located in a cephalad direction from the transverse plane connecting the superior patellar pole with the insertion point of the adductor magnus tendon. The adductor magnus tendon was chosen as the other landmark because it can be easily palpated and it provides a lower boundary from which to measure the requisite distances.

Following the initial data collection on all 24 specimens another session entailed a compilation of the same values from 12 specimens. This information was

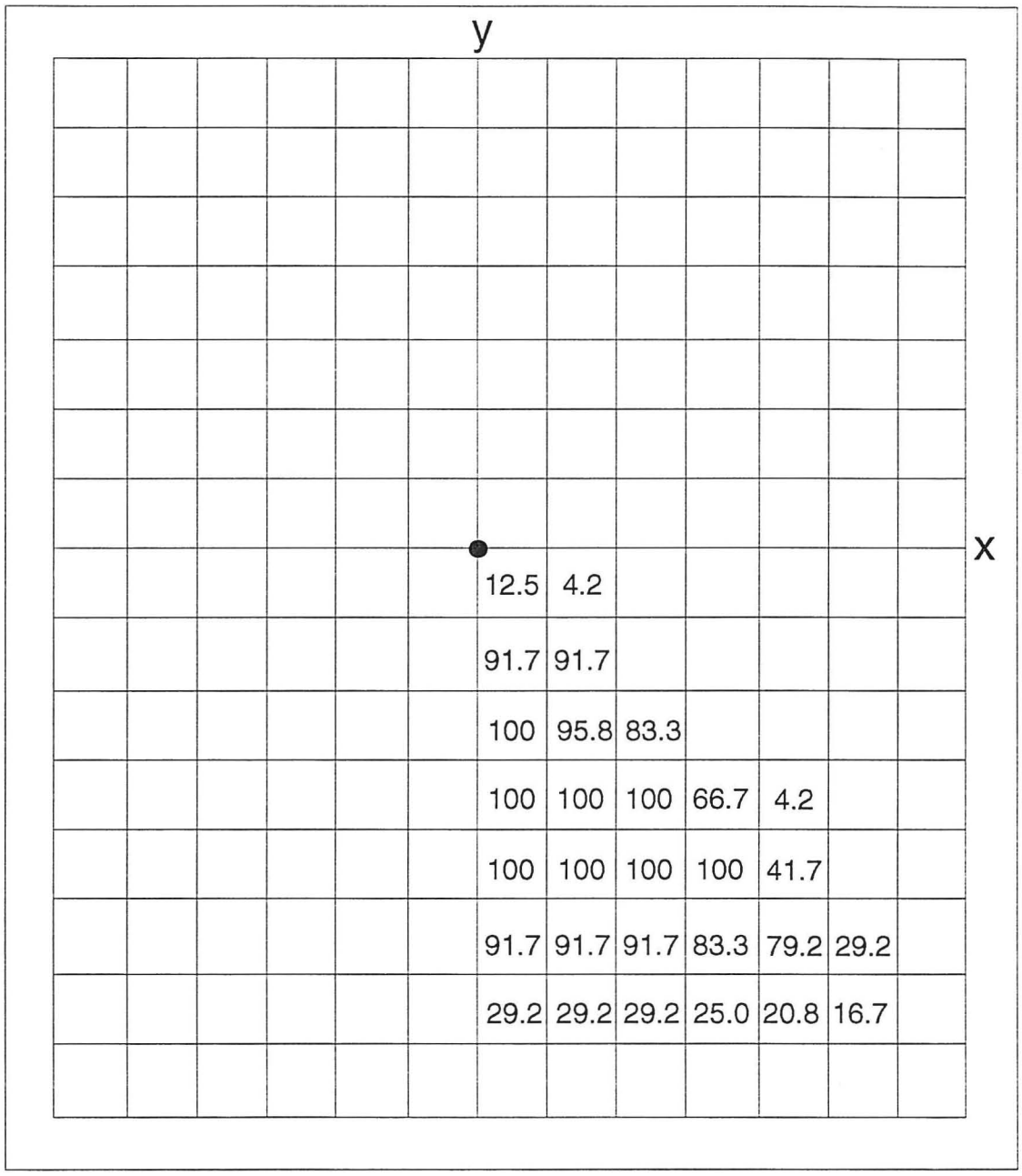


Figure 2. Percentages of 1cm^2 boxes containing VMO fibers (n=24).

recorded for a reliability test.

Data Analysis

A study of reliability was performed on measurements taken from the superior patellar pole to the adductor magnus tendon and the distance from the superior patellar pole to the center point of the VMO. Data analysis for the reliability tests was performed by comparing a second sample size (n = 12) with the same 12 specimens of the original sample (n = 24). The Pearson Product Moment Correlation Coefficient was utilized to assess the reliability of the measurements.

The information collected from this study was analyzed with measures of central tendency (mean values) which were converted into a percentage. Instead of stating the distance from the superior patellar pole in centimeters, we expressed it as a percentage of the total distance between the superior patellar pole and the adductor magnus tendon. This percentage was calculated with the following equation:

$$\% = \frac{\text{avg. length superior patellar pole to center point of VMO}}{\text{avg. length superior patellar pole to adductor magnus tendon}}$$

By expressing this distance in percentage form, the results can be extrapolated beyond this sample, as it corresponds to proportion of the total distance and not a specified number which would tend to vary between individuals.

CHAPTER III

RESULTS

Reliability assessment of measurements between the first and second sessions of data collection was performed with the Pearson Product Moment Correlation. Correlation coefficients for this test were found to be $r = .42$ ($r^2 = .17$) for the distance from the superior patellar pole to the adductor magnus tendon and $r = .84$ ($r^2 = .71$) for the distance from the superior patellar pole to the center point of the VMO fibers.

Calculations of the average distance from the superior patellar pole to adductor magnus tendon equaled 6.40 cm ($s = .59$) and from the superior patellar pole to center point of VMO fibers was 4.58 cm ($s = .67$). From these results, a percentage of 71.6% was calculated as the proportion of the total distance the center of the VMO is from the adductor magnus tendon on the y axis from the superior pole of the patella.

The site determined as the optimal center spot for electrode placement was 71.6% the distance from the superior patellar pole to the adductor magnus on the y axis and one and a half boxes (1.5 cm) horizontally on the x axis. This corresponded to the point we determined as the central site of all the 1 cm2 boxes that represented areas of pure VMO fibers. A graphic representation of the percentage and location of 1 cm^2 boxes that corresponded to VMO fibers is presented in Figure 2. An estimated site for VMO electrode placement was determined from the above data and is illustrated in Figure 3.

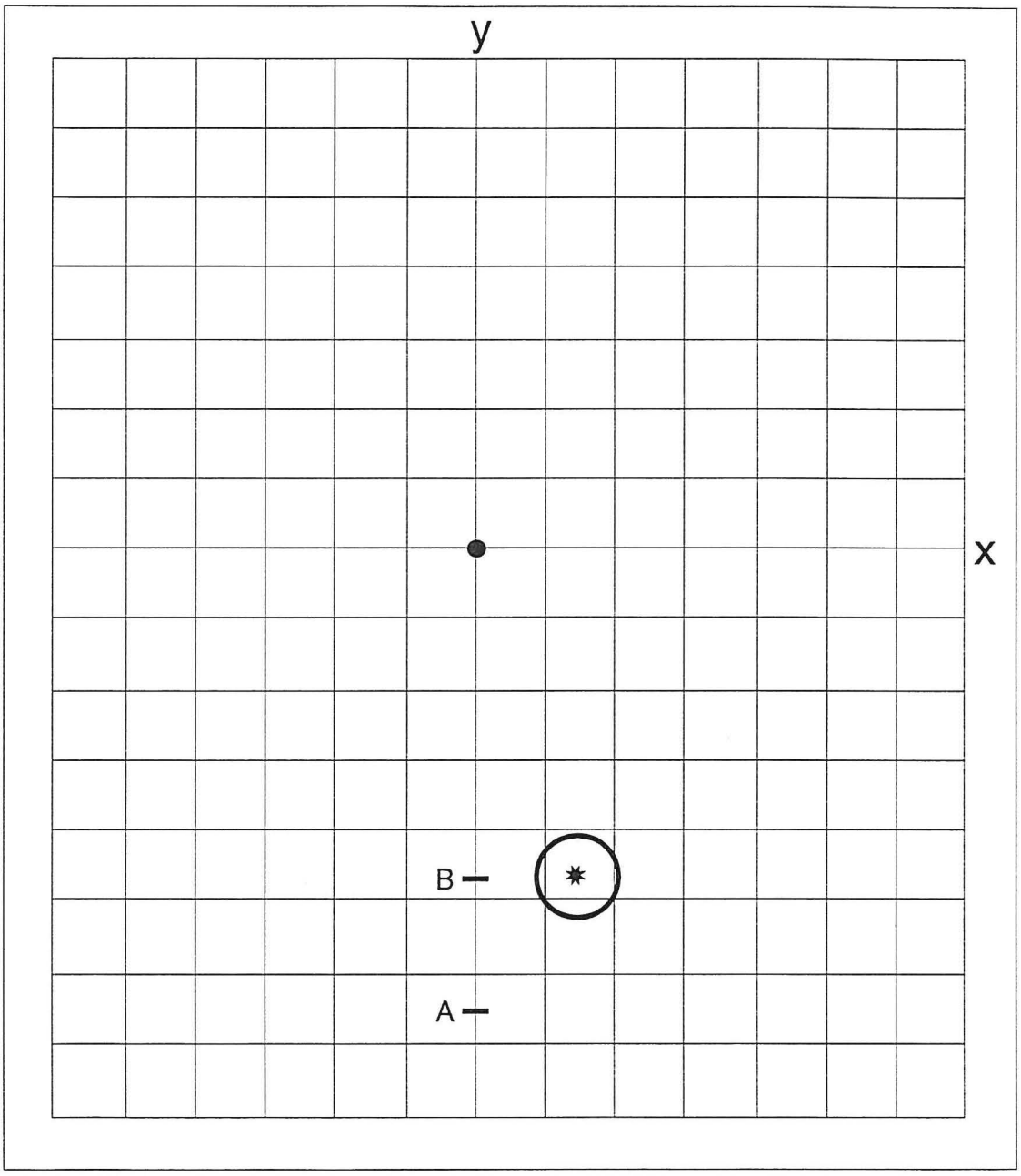


Figure 3. Distance means and proposed electrode site. 'A' shows the average length from the superior patellar pole to adductor magnus tendon (6.4 cm); 'B', average length from superior patellar pole to the center point of the VMO (4.58 cm); ' ✸ ', proposed electrode site centered over the highest concentration of the VMO fibers.

CHAPTER IV
DISCUSSION

The present study was intended to provide information on the location of the VMO in relation to a palpable anatomical landmark, the superior patellar pole. It was undertaken in an attempt to provide clinically relevant data on surface EMG (sEMG) electrode placement. The relevant data is not necessarily the whole area of the VMO muscle. Instead it is the location that corresponds to a center point on the VMO where sEMG electrodes could be positioned to monitor optimal activity from these fibers. The efforts of this study initiated an attempt to devise a relatively simple method for the clinician to locate an area for proper placement of sEMG electrodes in monitoring VMO biofeedback.

Upon examining the reliability of the measurements according to the Pearson Correlation we found poor reliability for the measurement from the superior patellar pole to the adductor magnus tendon ($r = .42$) while good reliability was evident for the measurement from the superior pole to the center point of the VMO ($r = .84$).[25] In reviewing these results there appears to be some discrepancy in the ability of the observer to reliably determine the measurements of these distances with the double-axis grid. However, comparing the data utilized in calculating the Pearson coefficient (Tables 2 and 3) we find very similar results for both variables measured, indicating that on the average the values measured with the grid were relatively close. Analysis of the raw data for the first distance (Table 2) illustrates the amount of actual agreement there was between observations. Although an r value of .42 was calculated, half of the observations were actually in exact agreement while others varied within only one-half to one centimeter. Also, the mean values for the two distances of both samples demonstrate relatively similar values. A difference of .32 cm resulted between the two observed means for the distance from the superior

TABLE 2. Pearson Product Moment Correlation Coefficient: Raw Data (distance from superior patellar pole to adductor magnus tendon)

Subject identification	Initial observation measurement (cm)	Second observation measurement (cm)
4(L)	5.5	6.0
5(L)	6.0*	6.0
6(L)	6.5	6.0
7(L)	6.0	6.5
8(L)	5.5*	5.5
9(L)	7.0*	7.0
10(R)	7.0	6.0
11(R)	6.0*	6.0
12(R)	7.0	6.0
13(L)	7.0	6.0
14(L)	6.0*	6.0
15(L)	6.0*	6.0

* indicates exact agreements on measurements (r = .42)
L = left lower extremity
R = right lower extremity

TABLE 3. Pearson Product Moment Correlation Coefficient: Raw Data (distance from superior patellar pole to center point of VMO)

Subject identification	Initial observation measurement (cm)	Second observation measurement (cm)
4(L)	4.0*	4.0
5(L)	4.0*	4.0
6(L)	4.0*	4.0
7(L)	5.0*	5.0
8(L)	4.0*	4.0
9(L)	5.0	6.0
10(R)	5.0*	5.0
11(R)	5.0	4.5
12(R)	5.0	4.0
13(L)	5.0*	5.0
14(L)	4.0	5.0
15(L)	4.0*	4.0

* indicates exact agreements on measurements (r = .84)
L = left lower extremity
R = right lower extremity

patellar pole to the adductor magnus tendon. The two observed means for the distance from the superior patellar pole to the center point of the VMO demonstrated even less discrepancy with a difference of only .04 cm.

The difference noted in the reliability scores illustrates the difficulty involved in determining an anatomical site from subject to subject. In the present study, observations were being done with exposed muscle bellies allowing easy detection of the VMO fibers, yet the intratester reliability was not consistently high. Relating this to the clinic we can see the difficulty or the possible error involved when attempting to palpate or determine the electrode site for optimal VMO activity. Certain factors, such as subcutaneous tissue, come into play and may hamper the accuracy of palpating the electrode site. A small sample size (n = 12) may have been one limitation affecting the reliability scores as a larger sample would tend to decrease the amount of variability. In addition, factors such as difficulty determining exact boundaries of VMO fibers with no anatomical separation from the VM muscle belly and possible variations in grid placement or lower extremity positioning may have influenced results. It must also be kept in mind that inexperience with the grid may have added to the discrepancy, as this was the initial trial for the device.

Although reliability was not consistently high and limitations may have existed, the importance of this study was emphasized by the lack of electrode placement parameters provided in McConnell's plan for VMO retraining with patellar tape applied.[5] Studies utilizing biofeedback devices with sEMG electrodes provided only a general description of electrode placement over the VMO. Descriptors such as "over the area of greatest muscle bulk"[1] or "over the distal aspect of the VM"[10] were used. Furthermore, Basmajian and Blumenstein[22] provide only a description of the VM electrode site with no mention of VMO electrode positioning. Studies with fine wire EMG electrodes appear to be more descriptive as Reynolds et al[26] and Hanten and Schulthies[15] provide distances from the patellar landmarks to electrodes placement in the VMO. In lieu of these findings and the controversy regarding electrode placement following McConnell patellar

taping, it is believed this study will provide useful data for VMO rehabilitation. The importance of these results is demonstrated by the fact that sEMG is known to pick up cross talk and noise from muscles other than the targeted structure.[27] Therefore, proper electrode placement is indeed essential to adequately monitor the desired muscle activity.

This study provides a preliminary technique for electrode placement over the VMO, incorporating the following steps:

> Step 1: on the subjects's skin, mark the superior pole of the patella and the adductor magnus tendon (to locate this structure resist adduction while palpating the medial thigh near the adductor tubercle).
>
> Step 2: with the subject supine, align the grid along the medial aspect of the knee (close to the surface as possible) with the origin superimposed over the superior patellar pole; the x axis should be parallel and the y axis perpendicular to the long axis of the femur.
>
> Step 3: record the distance from the superior of the patella to the adductor magnus tendon.
>
> Step 4: measure down along the y axis 71.6% of the distance measured in step 3 and mark this location.
>
> Step 5: measure over 1.5 cm horizontally from the spot produced in step 4 and mark this site (this will correspond to the optimal location for electrode placement).

This study's intent was to initiate research on the VMO location in relation to sEMG electrode placement responding to controversy surrounding sEMG usage in patellar taping techniques. Further research will be required to gain a larger data base for the method used as well as to become more proficient with the device used. The results produced from this study can be seen as an important building block for future studies. The researchers developed and utilized a new device for determining the location of the VMO which for the time being has only been used on cadavers but with more research may be implemented in the clinical setting. Follow-up cadaver studies could lead to a larger sample base, more representative of the population, increasing the accuracy of the values reported and possibly affecting the reliability of the observations. The next step with this method would not only be

further cadaver studies but actual application of the grid and the proposed electrode site to subjects with patellar tape applied. This could be used to demonstrate if the proposed optimal electrode site would be obstructed by the McConnell taping.

CHAPTER V
CONCLUSION

Controversy exists regarding electrode placement over the VMO during patellar taping. Therefore, the need arises to develop an appropriate and accurate method in determining the proper electrode site. This need is supported by the high incidence of PFP syndrome reported in the population as well as by the precision required with sEMG electrode placement.

With this study the researchers employed a unique instrument developed to counter the need for accurate measurements of electrode location over the VMO. A precise measurement produces a more accurate representation of the VMO's electrical activity, enhancing the rehabilitative process. An optimal site was determined on the double axis grid that may yield useful information for later studies and clinical application. The propose technique represents a preliminary method to describe a replicable electrode site over the VMO and requires further investigation to develop improved reliability measurements. In addition, future studies may provide a greater compilation of data required to strengthen the average values found in this study.

APPENDIX A

UNIVERSITY OF NORTH DAKOTA'S
INSTITUTIONAL REVIEW BOARD

DATE: September 10, 1993

NAME: Wade Burd **DEPARTMENT/COLLEGE** Physical Therapy

PROJECT TITLE: Anatomical Study of Vastus Medialis Obliquus Orientation in Relation to the Superior Pole of the Patella

The above referenced project was reviewed by a designated member for the University's Institutional Review Board on September 10, 1993 and the following action was taken:

☐ Project approved. **EXPEDITED REVIEW NO.** _____.
Next scheduled review is on _____.

☒ Project approved. **EXEMPT CATEGORY NO.** 4. No periodic review scheduled unless so stated in REMARKS SECTION.

☐ Project approved **PENDING** receipt of corrections/additions in ORPD and approval by the IRB. **This study may NOT be started UNTIL IRB approval has been received.** (See REMARKS SECTION for further information.)

☐ Project approval **deferred. This study may not be started until IRB approval has been received.** (See REMARKS SECTION for further information.)

☐ Project **denied.**
(See REMARKS SECTION for further information.)

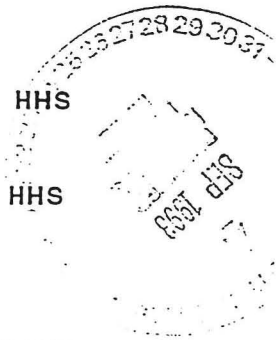
REMARKS: Any changes in protocol or adverse occurrences in the course of the research project must be reported immediately to the IRB Chairman or ORPD.

cc: A. Keck, Adviser
Dean, Medical School

Signature of Chairperson or designated IRB Member — Date
UND's Institutional Review Board

9/10/93

If the proposed project (clinical medical) is to be part of a research activity funded by a Federal Agency, a special assurance statement or a completed 596 Form may be required. Contact ORPD to obtain the required documents. (7/93)



X EXPEDITED REVIEW REQUESTED UNDER ITEM 8 (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: Wade Burd B.S.,P.T. TELEPHONE: 772-8967

DATE: 9/8/93

ADDRESS TO WHICH NOTICE OF APPROVAL SHOULD BE SENT: Dept. of Physical Therapy
SCHOOL/COLLEGE: Medicine DEPARTMENT: Physical Therapy

PROJECT DATES: 9/23/93 to 12/13/93

PROJECT TITLE: Anatomical Study of Vastus Medialis Obliquus Orientation in Relation to the Superior Pole of the Patella

FUNDING AGENCIES (IF APPLICABLE): N/A

TYPE OF PROJECT:

___ NEW PROJECT __ CONTINUATION __ RENEWAL __ DISSERTATION OR RESEARCH PROJECT X STUDENT RESEARCH PROJECT

__ CHANGE IN PROCEDURE FOR A PREVIOUSLY APPROVED PROJECT

DISSERTATION/THESIS ADVISER, OR STUDENT ADVISER: Arnie Keck P.T.

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 (>18 YEARS) _ UND STUDENTS

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

1. **ABSTRACT** (Limit to 200 words or less and include justification or necessity for using hum subjects.)

McConnell Patellofemoral Treatment Plan, a relatively new program for the rehabilitation of patellofemoral (PF) pain, primarily involves taping the patella to promote proper alignment within the trochlear groove. This procedure attempts to alleviate PF pain and provide an environment for Vastus Medialis Obliquus (VMO) muscle re-training. In addition to this taping procedure, electromyographic (EMG) biofeedback is utilized by placing surface electrodes over the VMO. The focus of this EMG biofeedback is to provide the subject with additional sensory input in the re-training of the VMO, which will eventually promote proper patellar alignment without taping support. Although this treatment has demonstrated relief of PF pain, controversy exists regarding the actual electrode placement over the VMO during periods of taping. The purpose of this study is to obtain data on the actual location of VMO fibers from cadaver specimens to aid in the understanding of muscular activity from surface EMG electrodes during McConnell's patellar taping procedure.

This study will collect data on the location of VMO fibers from 12 cadavers. Dissection of the VMO muscle will be required to get an accurate measurement of the muscle fibers. A predetermined landmark on the body will provide a reference point from which a double axis grid can be aligned before and after dissection. The grid will measure the VMO fibers along an x-y axis, in increments of centimeters, and photographs will be used to record this data before and after removal of skin from the cadavers. This information will yield descriptive statistics (measures of central tendency) for the average location of the VMO.

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

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

This research project will involve the use of twelve human cadavers which equates to twenty four specimens (each leg will serve as one specimen) from which to collect data. The following procedure will be utilized for each specimen. Initially, the cadaver will be properly draped with only the knee area exposed for examination. The subjects will be positioned supine on the table with an abductor splint between the thighs if the legs are too closely aligned to prevent proper examination of the medial thigh. At this time the superior pole of the patella will be palpated and a marker will be placed on this landmark as a reference point. Next, a grid with an x-y axis will be aligned with the patellar landmark on the medial aspect of the knee. The grid will be positioned on the table at a specific distance from the landmark and at an angle ninety degrees to the plane of the medial knee. Photographs will then be taken with the camera, positioned on a tripod, at a predetermined distance from the grid as well as at an angle ninety degrees to the grid and medial knee.

Following the collection of this data students from the Physical Therapy Dept. enrolled in PT 322: Anatomy will be allowed to dissect the specimens, as is required for the course, under the instruction and supervision of PT 322 instructor, Arnie Keck. After the students have completed dissection of the required area, the cadaver will again be properly positioned and draped as mentioned above. The patellar landmark will then be relocated and distinguished by a marker. Further dissection of the Vastus Medialis Obliquus muscle fibers and surrounding area will also be performed to remove any extraneous materials if necessary. Next, the grid will be positioned at the same sight as before and photographs of the exposed VMO fibers will be taken from the same parameters as previously mentioned. This will conclude data collection from the specimens. No further dissection or examination of the cadavers will be performed for this research project, however the students from PT 322 will continue to utilize the cadaver for further examination/dissection.

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

The benefits from this research project include, yet are not limited to, additional research for the field of anatomy and more importantly additional research in the area of patellofemoral pain management utilizing the McConnell taping technique. This data will provide needed information on the actual location of the VMO, in terms of an average, and may be viewed as data to utilize when examining muscle activity from surface EMG electrodes with McConnell tape in place. In doing so, this project may serve as an incentive to further research in this area of study.

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 coul prove harmful or embarrassing to the subject if associated with him or her, then describe the method to be used to insure the confidentiality of data obtained, including plans for final disposition or destruction, debriefing procedures, etc.)

Risks to the subjects are not applicable to this research project as the specimens utilized will be cadavers. The only possible risk involved would be the release of the specimens' identity to those not involved with the study. However, in an effort to maintain confidentiality, the specimens' identity will be preserved. The identity of the specimens will be unknown to the principal investigator, and consequently will not be included in any part of the write-up or be mentioned to those not involved with the study.

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 rights will not occur. Describe where signed consent forms will be kept and for what period of time.

Not applicable to this research project.

6. For **FULL IRB REVIEW** forward a signed original and thirteen (13) copies of this complete 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
Box 8138, University Station
Grand Forks, North Dakota 58202

On campus, mail to: Office of Research & Program Development, Box 134, or drop it off at Room 10 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.

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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:

Wade A. Burt **DATE:** 9/10/03.
Principal Investigator

Annie Keck **DATE:** 9/10/93.
Project Director or Student Adviser

DATE:.
Training or Center Grant Director

(Revised 8/1992)

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