Effect of Instruction on EMG Activity of the Rectus Abdominis during a Crunch on a Swiss Exercise Ball

Tina J. Boyer  
University of North Dakota

Suzanne S. Hammer  
University of North Dakota

Tyler L. Jepson  
University of North Dakota

Eric G. Thompson  
University of North Dakota

Follow this and additional works at: https://commons.und.edu/pt-grad

Part of the Physical Therapy Commons

Recommended Citation
https://commons.und.edu/pt-grad/61

This Scholarly Project is brought to you for free and open access by the Department of Physical Therapy at UND Scholarly Commons. It has been accepted for inclusion in Physical Therapy Scholarly Projects by an authorized administrator of UND Scholarly Commons. For more information, please contact zeinelbyousif@library.und.edu.
EFFECT OF INSTRUCTION ON EMG ACTIVITY OF THE
RECTUS ABDOMINIS DURING A CRUNCH ON A SWISS EXERCISE BALL

Tina J. Boyer
Suzanne S. Hammer
Tyler L. Jepson
Eric G. Thompson
Doctor of Physical Therapy
University of North Dakota 2006

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
Doctor of Physical Therapy

Grand Forks, North Dakota
May 2006
This Scholarly Project, submitted by Tina Boyer, Suzanne Hammer, Tyler Jepson, Eric Thompson in partial fulfillment of the requirements of the Degree of Doctor 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.

Dr. Cindy Flom-Meland
Graduate School Advisor

Dr. Thomas Mohr
Chairperson, Physical Therapy
PERMISSION

Title
Effect of Instruction on EMG Activity of the Rectus Abdominis During a Crunch on a Swiss Exercise Ball

Department
Physical Therapy

Degree
Doctor of Physical Therapy

In presenting this Scholarly Project in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I (we) agree that the Department of Physical Therapy shall make it freely available for inspection. I (we) further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my work or, in his/her absence, by the Chairperson of the department. It is understood that any copying or publication or other use of this independent study or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and the University of North Dakota in any scholarly use which may be made of any material in my Scholarly Project.

Tina J. Boyer

12-16-05

Suzanne S. Hammer

12-16-05

Tyler L. Jepson

12-16-05

Eric G. Thompson

12-16-05
TABLE OF CONTENTS

List of Figures ................................................................. vi
List of Tables ................................................................. vii
Acknowledgements ............................................................. viii
Abstract ................................................................................ ix
Chapter I: Introduction ........................................................ 1
Chapter II: Literature Review .................................................. 4
Chapter III: Methods ............................................................. 9
Chapter IV: Results .............................................................. 14
Chapter V: Discussion ........................................................... 16
Appendix .............................................................................. 20
References ............................................................................ 32
LIST OF FIGURES

Figure 1: Electrode placement for trunk muscles.........................11
Figure 2: Testing position for maximal voluntary contraction of rectus abdominis..................................................11
Figure 3: Starting position for crunch on a ball..........................12
Figure 4: End position for crunch on a ball..............................12
LIST OF TABLES

Table 1:  $t$-values for the Rectus Abdominis Before and After Instruction........14

Table 2:  $t$-values for the Upper and Lower Rectus Abdominis Before and After Instruction..............................................................15
ACKNOWLEDGEMENTS

We would like to personally acknowledge and thank the faculty and staff of the University of North Dakota Physical Therapy department for sharing their knowledge and supporting us both professionally and personally over the past three years.

Special thanks to Dr. Renee Mabey for her assistance with statistical analysis. Extreme gratitude to Dr. Cindy Flom-Meland, our graduate advisor, and Dr. Thomas Mohr, Chairperson of the Physical Therapy department, for all their help in every aspect of this project.

We would also like to acknowledge our families for their support, encouragement, and love. Thank you!
Abstract

Purpose: The purpose of this study was to assess the benefit of instruction from a physical therapist in participant performance of an abdominal crunch on a Swiss ball, determined through electromyography (EMG) of the rectus abdominis.

Subjects: Our subjects included male (n=15) and female (n=15) college students between the ages of 18-50 years old. Exclusion criteria included a history of low back pain, prior spine surgery, pregnancy, previous formal instruction of crunches on a Swiss ball, and an allergic reaction to rubbing alcohol.

Instrumentation: EMG biofeedback was used to test rectus abdominis muscle activity. This activity was transmitted by a Noraxon Telemyo8 telemetry unit (Noraxon USA, 13430 North Scottsdale Rd., AZ 85254). Data was collected by the Noraxon Telemyo8 receiver. The peak Notus5 system (Peak Performance, Englewood, CO) was used to store and analyze the EMG data.

Procedure: Participants performed a manual muscle test of the rectus abdominis muscle and the EMG activity was recorded and used for baseline data. The subjects were then asked to perform 10 abdominal crunches on the ball without any instruction. This data was recorded, and then verbal instruction on proper technique of an abdominal crunch on the ball was given. Following instruction, participants had one minute to rest, and then perform an additional 10 crunches using the new correct posture.
Data Analysis: For statistical analysis, a repeated-measures t-test was used with an alpha level of .05. Results: There was no significant difference when comparing the mean values of EMG muscle activity of the upper rectus abdominis pre and post instruction and lower rectus abdominis pre and post instruction. (78.05 and 76.14 --70.50 and 69.73 respectively)

Conclusions and Clinical Implications: In conclusion our study results did not support a significant difference in rectus abdominis muscle activity after instruction measured through EMG analysis. Injury due to over training, muscle imbalances or muscle strains could be avoided when patients are given instructions and demonstrate proper technique.
CHAPTER I

INTRODUCTION

When instructing patients, physical therapists use varying forms of educational methods ranging from instruction to demonstration to handouts. All methods vary in importance and effect for the patient dependent on his/her individual learning style. Reo and Mercer\(^1\) found that live and videotaped modeling are more effective than a handout alone. They used this for performance accuracy measured by two retention tests taken at different times.

As back pain is becoming more prevalent in the United States every year, the first lines of treatment include anti-inflammatory drugs and physical therapy. Not only are patients seeking physical therapy, back pain is also the second most common reason for visits to primary care physicians. It is estimated that back pain costs the American economy between $50-75 billion per year.\(^2\)

Many different variations of abdominal exercises have been introduced to the public as a way of treating low back pain. Some of the most recent ones to hit the market include Pilates, the Ab Roller, Total Gym, and Abswing just to name a few. There is not a lot of research to prove effectiveness, however, proper use and knowledge of the equipment can be a main component of preventing injury and recruiting appropriate muscle activity.
Problem Statement

Limited studies have looked at the ability of a patient to benefit from formal instruction by a physical therapist before performing an exercise. The profession of physical therapy is moving into evidence based practice to support chosen interventions. Obtaining evidence on the use of instruction will better help us appropriately educate our patients.

Purpose of the Study

The purpose of this study was to assess the benefit of instruction from a physical therapist in participant performance of an abdominal crunch on a Swiss ball, determined through electromyography (EMG) of the rectus abdominis.

Significance of the Study

The study assessed the activity of the rectus abdominis through EMG results. EMG of the rectus abdominis was recorded during the crunch on the Swiss ball before participant instruction, and when the crunch was performed after participant instruction. These values were then compared and analyzed to determine the possible effects instruction had on patient performance.

Research Question

Does formal instruction from a physical therapist increase EMG activity of the rectus abdominis during an abdominal crunch on a Swiss ball?

Null Hypothesis

There is no significant difference between the EMG data of the “instruction” abdominal crunch and the “no instruction” abdominal crunch conditions ($\mu_1 \leq \mu_2$).
Alternative Hypothesis

There is a significant difference between the EMG data of the "instruction" abdominal crunch and the "no instruction" abdominal crunch conditions ($\mu_1 > \mu_2$).
CHAPTER II
LITERATURE REVIEW

Why do people do crunches? Why do people stop doing crunches? These are two common questions in today's society. For many people the main purpose of doing abdominal exercises is to get the "attractive" type of body structure with a six-pack. Abdominal exercises can strengthen the abdominal muscles and may alleviate lower back strain. They also may improve muscular imbalances that go along with having weak abdominal muscles. Individuals with weak abdominal muscles and poor back flexibility often find crunches both complicated and tedious; therefore, it is tough to stay motivated to stick to an exercise program.

The following information will go through the basic background information on the targeted muscles of the abdomen, Swiss ball usage and its body placement while being used for crunches, and the purpose and benefit of proper instruction.

Rectus Abdominis

The rectus abdominis is one of the two vertical muscles of the anterior abdominal wall that are within the rectus sheath (the other muscle is the pyramidalis). The rectus muscle originates on the pubic symphysis and medial to
the pubic tubercle (pubic crest) and inserts on the xiphoid and costal cartilages 5-7.³

The rectus muscle, which is anchored by attachment to the anterior layer of the rectus sheath, is connected at three or more intersections that can give it the “6-pack” appearance. The anterior and posterior layers of the rectus sheath connect in the anterior median line to form the linea alba.³

The main function of the rectus abdominis muscle is trunk flexion, other functions include: 1) formation of a strong, flexible support for the anterolateral abdominal wall, 2) protection of the abdominal viscera from injury, 3) compress the abdominal contents (elevating the diaphragm during respiration, 4) help increase or maintain intra-abdominal pressure and, 5) maintain posture.³

Nerves that innervate the anterolateral abdominal wall include the iliohypogastric and ilioinguinal nerves (L1), subcostal nerves (T12), and thoracoabdominal nerves (T7-T11). Some of the sensory locations include:

- T7-T9 ~ skin superior to the umbilicus
- T10 ~ skin around the umbilicus
- T11, T12, L1 ~ skin inferior to the umbilicus

Two muscles that assist the rectus abdominis in trunk flexion are the internal and external oblique muscles. Their main actions are to rotate the trunk to the same side and opposite sides, respectively. They also aid in lateral trunk flexion or side bending. The internal oblique muscle is a thin, muscular sheet that fans out anteromedially. The external oblique muscle is the most superficial and largest muscle of the three flat anterolateral abdominal muscles (external
oblique, internal oblique, and transverse abdominal). It shares the same attachment at the pubic tubercle (pubic crest) as the rectus abdominis. 3

Swiss Ball

The Swiss ball has been used as a means of therapy and as a means of sport specific training. The Swiss ball is an unstable or labile surface. It is thought to increase muscle activation through increased efforts by the body for stabilization. Anderson and Behm 4 had individuals perform a dumbbell chest press on both a stable surface, and unstable surface (Swiss ball) and measured the maximum force output. They found the maximum force output to be significantly less (59.6%) than that of the stable surface. They also determined that the EMG muscle activity during the two conditions did not differ. Anderson and Behm 4 propose there was a reduction in the maximum force output and not the EMG muscle activity due to the increased efforts of the muscles to stabilize the body. This increase in muscle activity that is associated with training on unstable surfaces can also be generalized to the abdominal muscles, specifically the rectus abdominis. Marshall and Murphy 5 looked at core stabilization exercises done on a stable surface and on a Swiss ball. They reported that there was a significant increase in the rectus abdominis activation when performing exercises on the Swiss ball compared to a stable surface. Clark et al 6 looked at the electromyographic comparison of the upper rectus abdominis and the lower rectus abdominis during six different abdominal exercises. They found that there was significantly higher activation of both the upper and lower rectus abdominis during only one of the exercises, the Swiss ball curl up. Current research
supports the use of the Swiss ball to increase rectus abdominis muscle activity during abdominal exercises.

Instruction

Similar to the study conducted by Anderson and Behm,\textsuperscript{4} researchers Vera-Garcia, Grenier, McGill\textsuperscript{7} also concluded exercise on an unstable surface increases muscle activity. Of the four exercises performed, the three completed on the unstable surface demonstrated increased muscle activity compared to the curl up done on a stable surface. Another factor influencing the EMG activity of muscles is exercise specific instructions. Karst and Willett\textsuperscript{8} performed a study relating specific exercise instructions to the EMG activity of the targeted muscles. They found simple instructions could indeed increase the patient’s ability to increase muscle output of targeted muscles and were able to retain that ability when retested one week later.

Another important reason for proper instruction is to prevent patient injury caused by improper technique. Prapavessis and McNair\textsuperscript{9} conducted a randomized control trial to determine the effect of instruction on jumping technique and sensory feedback in assisting individuals in landing softly from a jump. They concluded that high-ground reaction forces can be associated with injury and tissue damage, therefore benefiting from the decreased force followed by instruction.

Physical therapists must also consider the best method for relaying those instructions. Reo and Mercer\textsuperscript{1} compared using videotape, live modeling or
handouts only. They concluded the use of videotape and live modeling instructions proved more effective during immediate and delayed retention tests.
CHAPTER III

METHODOLOGY

Subjects

Our subjects included male (n=15) and female (n=15) college students between the ages of 18-50 years old. Subjects were excluded if they had a history of low back pain, prior spine surgery, were pregnant, had previous formal instruction of crunches on a Swiss ball, or were allergic to rubbing alcohol. All participants performed the same activity with and without formal instruction. The subjects were also given a consent form prior to their participation, which they signed and dated.

Instrumentation

EMG biofeedback was used to test rectus abdominis muscle activity. This activity was transmitted by a Noraxon Telemyo8 telemetry unit (Noraxan USA, 13430 North Scottsdale Rd., AZ 85254). Data was collected by the Noraxon Telemyo8 receiver. The peak Notus5 system (Peak Performance, Englewood, CO) was used to store and analyze the EMG data.

Procedure

Participants signed up for half hour time slots. During their scheduled time, they first read through the consent form. They had the opportunity to ask any questions regarding the information and then signed the form. Next, the skin
over the rectus abdominis muscle (around the umbilicus) was cleaned with rubbing alcohol and shaved when necessary. The area was left to dry for two minutes and then the electrodes were placed two centimeters to the right and left of the umbilicus, and two centimeters above and below the umbilicus. Two electrodes were used at each point (eight electrodes total) and a ground electrode was placed at the left ASIS (Figure 1). Participants then performed a manual muscle test of the rectus abdominis muscle and the EMG activity was recorded and used for baseline data (Figure 2). The subjects were then asked to perform 10 abdominal crunches on the ball without any instruction. This data was recorded, and then verbal instruction on proper technique of an abdominal crunch on the ball was given. Following instruction, participants had one minute to rest, and then perform an additional 10 crunches using the new correct posture (Figures 3 and 4). The data was again recorded with the previous EMG output. Each set of crunches was performed at 60 beats per minute, using a metronome (two beats on the way up and two beats on the way down) to standardize the activity.
Figure 1. Electrode placement for trunk muscles.

Figure 2. Testing position for maximal voluntary contraction of rectus abdominis.
Figure 3. Starting position for abdominal crunch on a ball.

Figure 4. End position for crunch on a ball.
Data Analysis

Manual muscle test of the rectus was used to normalize data. The independent variable of the study was whether or not the patient was given instruction prior to abdominal crunch on a ball. The dependent variable was the recorded EMG muscle activity. For statistical analysis, a repeated-measures t-test was used with an alpha level of .05.
CHAPTER IV

RESULTS

The results of this study were used to determine the benefit of instruction from a physical therapist in participant performance of an abdominal crunch on a Swiss ball, determined through electromyography (EMG) of the rectus abdominis. The number of subjects, means, standard deviations, degrees of freedom, t-statistics, and levels of significance (p) are reported in Table 1. There was no significant difference when comparing the mean values of EMG muscle activity of the upper rectus abdominis pre and post instruction and lower rectus abdominis pre and post instruction.

Table 1: t-values for the Rectus Abdominis Before and After Instruction.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>x</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>RU before</td>
<td>28</td>
<td>81.14</td>
<td>50.66</td>
<td>.914</td>
<td>27</td>
<td>.369</td>
</tr>
<tr>
<td>LU before</td>
<td>28</td>
<td>74.96</td>
<td>38.89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL before</td>
<td>28</td>
<td>69.63</td>
<td>23.30</td>
<td>-1.12</td>
<td>27</td>
<td>.275</td>
</tr>
<tr>
<td>LL before</td>
<td>28</td>
<td>71.36</td>
<td>26.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RU post</td>
<td>28</td>
<td>77.45</td>
<td>35.92</td>
<td>.637</td>
<td>27</td>
<td>.530</td>
</tr>
<tr>
<td>LU post</td>
<td>28</td>
<td>74.82</td>
<td>34.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RL post</td>
<td>28</td>
<td>68.59</td>
<td>22.63</td>
<td>-1.03</td>
<td>27</td>
<td>.313</td>
</tr>
<tr>
<td>LL post</td>
<td>28</td>
<td>70.86</td>
<td>25.28</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p>.05 in all cases
Rectus Abdominis

There were four electrode placements on the rectus abdominis: the left upper rectus abdominis (LU), the right upper rectus abdominis (RU), the left lower rectus abdominis (LL), and the right lower rectus abdominis (RL).

Table 2: t-values for the Upper and Lower Rectus Abdominis Before and After Instruction.

<table>
<thead>
<tr>
<th>Pair Means</th>
<th>Mean</th>
<th>N</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper before</td>
<td>78.05</td>
<td>28</td>
<td>41.47</td>
<td>.262</td>
<td>27</td>
<td>.795</td>
</tr>
<tr>
<td>Upper after</td>
<td>76.14</td>
<td>28</td>
<td>33.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower before</td>
<td>70.50</td>
<td>28</td>
<td>24.35</td>
<td>.133</td>
<td>27</td>
<td>.895</td>
</tr>
<tr>
<td>Lower after</td>
<td>69.73</td>
<td>28</td>
<td>23.27</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER V
DISCUSSION

Due to the increasing popularity of abdominal workouts for treatment of low back pain, it is important to investigate the effects of instruction on appropriate exercise technique. The purpose of this study was to assess the benefit of instruction from a physical therapist in participant performance of an abdominal crunch on a Swiss ball, determined through EMG of the rectus abdominis. When initiating the current study, our alternative hypothesis was that rectus abdominis muscle activity would be greater after proper instruction on performing a crunch on a Swiss ball than before instruction. Upon completion of the study, we accepted the null hypothesis. Although there was not a statistically significant difference, the upper rectus abdominis had higher EMG muscle activity during abdominal crunches on a Swiss ball in both pre and post instruction scenarios than the lower rectus abdominis. The upper and lower rectus abdominis recorded higher EMG activity pre instruction than post instruction, although no significant difference was found. When a 2-tailed t-test was run, there was no significant difference in rectus abdominal muscle activity pre and post instruction. These values are represented in Table 2.
Our results do not agree with Karst and Willett\(^8\) who found that indeed instruction can improve a patient’s ability to increase muscle activation measured through EMG analysis.

Limitations

Some possible reasons that instruction failed to produce greater muscle activity include: study population’s comprehensive knowledge of proper body mechanics, a possible learning curve allowing the subject to be more stable on the Swiss ball for the second trial, the use of oral instructions only, or variability of the EMG equipment.

The studied population consisted solely of physical therapy students whose education is focused on correct body mechanics and posturing. Our study population was also chosen out of convenience instead of using random sampling. The majority of our subjects were healthy young adults. The methodology of instruction may not have been effective in teaching each individual due to varying learning styles. These factors may have influenced the statistical significance of our results.

Another possible limitation would be the learning curve of the subject. After the first testing without instruction, the subject may have been able to achieve a greater level of skill when performing the exercise. Couple this with proper instruction; the subject may have been in a more balanced position on the Swiss ball, resulting in an overall decrease in the recruitment of the rectus abdominis. Andersen and Behm\(^4\) found that by decreasing the stability of the surface a subject is on, a resultant increase in muscle activity will occur. The
decrease in the EMG activity recorded after instruction on proper positioning could be a possible result from theoretically making the subject more stable on an unstable surface. This increase in stability could have also resulted in less background EMG interference from accessory muscles working to stabilize the subject during a crunch post instruction.

The method of instruction could also have affected the results of this study. Depending on the learning style of each participant our chosen method of verbal instruction may not have been appropriate for each individual. Other methods such as demonstration or video may have produced better results for subjects who are more visual learners.

Variability of EMG equipment is another possible limitation of our study. EMG may not provide a completely accurate picture of our results. Body composition may mask accurate EMG readings and is a factor that varies greatly with each individual subject. External factors such as room noise and lights may also produce inaccurate readings.

Clinical Implications

The results of this study were not statistically significant, but do have some clinical implications. During the instruction phase the subject was asked to demonstrate a crunch on the Swiss ball. If incorrect movement patterns were recognized during the crunch after instruction, the subject was asked to correct their technique. The subjects were able to develop a kinesthetic awareness of proper positioning and movement while performing crunches. This would allow
subjects to continue independently and safely with an exercise program of
crunches on a Swiss ball.

Injury due to over training, muscle imbalances or muscle strains could be
avoided when patients are given instructions and demonstrate proper technique.
Individuals that exercise within safe parameters will maximize the benefits and
minimize the risk factors.

The subject population that already has extensive knowledge of body
mechanics and body position, such as physical therapy students, may not require
the same amount of instruction needed increase muscle activity during exercise.

Conclusion

In conclusion our study results did not support a significant difference in
rectus abdominis muscle activity after instruction measured through EMG
analysis. This does not show that instruction is not of benefit to a subject.
Although the results of this study indicate that muscle activity was not increased
due to proper instruction, the participants may have gained proper
alignment/positioning on the Swiss ball and a more biomechanically sound
crunch. These benefits would potentially prevent future injuries of a repetitive
nature from occurring.

Further research may be needed to evaluate whether or not combining
multiple forms of instruction would be more beneficial to a subject and any effects
on the EMG data this would have. Further investigation on whether or not the
decrease in muscle activity after instruction was due to an increase in stability on
the Swiss ball combined with sound biomechanical motion is warranted.
APPENDIX
REPORT OF ACTION: EXEMPT/EXPEDITED REVIEW
University of North Dakota Institutional Review Board

Date: 5/27/2005  Project Number: IRB-200505-398

Principal Investigator: Flom-Meland, Cindy; Boyer, Tina; Hammer, Suzanne; Jepson, Tyler; Thompson, Eric

Department: Physical Therapy

Project Title: Efficacy of Formal Instruction from a Physical Therapy Student on Patient Performance of an Abdominal Crunch on a Swiss Ball Measured Through EMG Activity of the Rectus Abdominis

The above referenced project was reviewed by a designated member for the University's Institutional Review Board on May 31, 2005 and the following action was taken:

☑ Project approved. Expedited Review Category No. 4

Next scheduled review must be before: May 30, 2006

☑ Copies of the attached consent form with the IRB approval stamp dated May 31, 2005 must be used in obtaining consent for this study.

Project approved. Exempt Review Category No.

☐ This approval is valid until ______________________ as long as approved procedures are followed. No periodic review scheduled unless so stated in the Remarks Section.

☑ Copies of the attached consent form with the IRB approval stamp dated ______________________ must be used in obtaining consent for this study.

☐ Minor modifications required. The required corrections/additions must be submitted to RDC for review and approval. This study may NOT be started UNTIL final IRB approval has been received. (See Remarks Section for further information.)

☐ Project approval deferred. This study may not be started until final IRB approval has been received. (See Remarks Section for further information.)

REMARKS: Any unanticipated problem or adverse occurrence in the course of the research project must be reported within 72 hours to the IRB Chairperson or RDC by submitting an Unanticipated Problem/Adverse Event Form.

Any changes in protocol or Consent Forms must receive IRB approval prior to being implemented. You must submit a Protocol Change Form with all revised research documents to include changes to protocol, consent forms, or supportive materials, with the appropriate signatures, to Research Development and Compliance for review and approval.

PLEASE NOTE: Requested revisions for student proposals MUST include adviser's signature. All revisions MUST be highlighted.

☐ Education Requirements Completed. (Project cannot be started until IRB education requirements are met.)

cc: Chair, Physical Therapy; Dean, School of Medicine

Signature of Designated IRB Member
UND's Institutional Review Board Date

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 310 Form may be required. Contact RDC to obtain the required documents.

(Revised 07/2004)
University of North Dakota Human Subjects Review Form

All research with human participants conducted by faculty, staff, and students associated with the University of North Dakota, must be reviewed and approved as prescribed by the University's policies and procedures governing the use of human subjects. It is the intent of the University of North Dakota (UND), through the Institutional Review Board (IRB) and Research Development and Compliance (RD&C), to assist investigators engaged in human subject research to conduct their research along ethical guidelines reflecting professional as well as community standards. The University has an obligation to ensure that all research involving human subjects meets regulations established by the United States Code of Federal Regulations (CFR). When completing the Human Subjects Review Form, use the "IRB Checklist" for additional guidance.

Please provide the information requested below:

Principal Investigator: Cindy Flom-Meland, Tina Boyer, Suzanne Hammer, Tyler Jepson, Eric Thompson
Telephone: 701-777-2831 E-mail Address: cfmeland@medicine.nodak.edu
Complete Mailing Address: School of Medicine and Health Sciences, PO BOX 9037, Grand Forks, ND 58202-9037
School/College: University of North Dakota Department: Physical Therapy

Student Adviser (if applicable): Cindy Flom-Meland
Telephone: 701-777-2831 E-mail Address: cfmeland@medicine.nodak.edu
Address or Box #: PO BOX 9037, Grand Forks, ND 58202-9037
School/College: University of North Dakota Department: Physical Therapy

Project Title: Efficacy of formal instruction from a Physical Therapy student on patient performance of an abdominal crunch on a Swiss ball measured through EMG activity of the rectus abdominis

Proposed Project Dates: Beginning Date: May 3, 2005 Completion Date: December 15, 2005 (Including data analysis)

Funding agencies supporting this research:

(A copy of the funding proposal for each agency identified above MUST be attached to this proposal when submitted.)

Does the Principal Investigator or any researcher associated with this project have a financial interest in the results of this project? If yes, please submit, on a separate piece of paper, an additional explanation of the financial interest (other than receipt of a grant)

YES or X NO

If your project has been or will be submitted to other IRBs, list those Boards below, along with the status of each proposal.

<table>
<thead>
<tr>
<th>Date submitted:</th>
<th>Status: Approved</th>
<th>Pending</th>
</tr>
</thead>
</table>

Type of Project: Check “Yes” or “No” for each of the following.

X YES or ___ NO New Project
___ YES or X NO Continuation/Renewal
___ YES or X NO Dissertation/Thesis
___ YES or X NO Student Research Project

Is this a Protocol Change for previously approved project? If yes, submit a signed copy of this form with the changes bolded or highlighted.

YES or X NO

Does your project involve medical record information? If yes, complete the HIPAA Compliance Application and submit it with this form.

YES or X NO

Does your project include Genetic Research? If yes, refer to Chapter 3 of the Researcher Handbook for additional guidelines regarding your topic.

YES or X NO

Does your project include Internet Research? If yes, refer to Chapter 3 of the Researcher Handbook for additional guidelines regarding your topic.

YES or X NO

Will subjects or data be provided by Altru Health Systems? If yes, submit two copies of the proposal. A copy of the proposal will be provided to Altru.

YES or X NO

Will research subjects be recruited at another organization (e.g., hospitals, schools, YMCA) or will assistance with the data collection be obtained from another organization?

YES or X NO
The investigators will recruit subjects from the University of North Dakota by verbal recruitment and speaking with various classes on campus.

b) Describe your subject selection procedures and criteria, paying special attention to the rationale for including subjects from any of the categories listed in the “Subject Classification” section above.

It is anticipated that we will recruit twenty-five to thirty-five subjects (both male and female) between the ages of eighteen and fifty. The subjects of this study will be recruited from the student body of the University of North Dakota. These
students will participate voluntarily. These subjects will be chosen because of their age and health status. University of North Dakota students were chosen because they were easily accessible.

c) Describe your exclusionary criteria and provide a rationale for excluding subject categories.

All subjects who have a history of low back pain or surgery, allergies to rubbing alcohol, women that are pregnant or anyone that have had previous formal instruction for exercises on a Swiss ball. This criteria is to prevent any injury to participants and to obtain the best results.

d) Describe the estimated number of subjects that will participate and the rationale for using that number of subjects.

A total of twenty-five to thirty-five are required for this study in order to decrease the risk of research error.

e) Specify the potential for valid results. If you have used a power analysis to determine the number of subjects, describe your method.

We choose to use twenty-five to thirty-five subjects in order to decrease the risk of sampling error. Due to accurate testing procedures and computer analysis, the study results will be valid.

2. Description of Methodology.

a) Describe the procedures used to obtain informed consent.

Informed consent will be obtained through an information and consent form (see attached form). All individuals participating in this study will be competent and independent in their decision making and will sign the consent form in relation to participation in this study.

b) Describe where the research will be conducted. Document the resources and facilities to be used to carry out the proposed research. Please note staffing, funding, and space available to conduct this research.

Research will be conducted at the Physical Therapy Department, School of Medicine and Health Sciences, 501 N. Columbia Rd, Grand Forks, ND 58203. EMG biofeedback will be used to test rectus abdominis muscle activity. EMG activity will be transmitted by a Noraxon Telemetry telemetry unit (Noraxon USA, 13430 North Scottsdale Rd., AZ 85254). Data will be collected by the Noraxon Telemetry receiver. The peak Notus5 system (Peak Performance, Englewood, CO) will be used to store and analyze the EMG data. There will be on-site supervision during data collection and the University of North Dakota Physical Therapy Department will provide funding for equipment, staffing and space required to conduct research.

c) Indicate who will carry out the research procedures.

Tina Boyer, Suzanne Hammer, Tyler Jepson, Eric Thompson; UND PT graduate students who have completed biofeedback instrumentation classes. Student supervisor Cindy Flom-Meland and Dave Reling, a Physical Therapy faculty member assisting with EMG equipment.

d) Briefly describe the procedures and techniques to be used and the amount of time that is required by the subjects to complete them.

Participants will sign up for an hour time slot. When they are scheduled they will first read through their consent form. They will have opportunity to ask any questions regarding the information and then will sign the form. The skin over the rectus muscles will be cleaned with rubbing alcohol. The area will be cleaned in a circular pattern around the umbilicus and out to a 6 inch radius. The area will be left for 2 minute to dry and the then electrodes will be placed 1 inch lateral of the umbilicus, 1 inch superior, 2 inches superior, 1 inch inferior, and 2 inches inferior on the right and left. Participants will then perform a manual muscle test of the rectus and the EMG activity will be recorded and used for base line data. Then the participants will have 5 minutes to rest, and then again have a minute to practice prior to performing an additional 10 crunches. This data will be again recorded with the previous EMG output. Each set of crunches will be performed at 60 beats per minute (2 beats to crunch up, 2 to go down) using a metronome as to standardize the activity. A goiometer or switch will be utilized for each participants start and stop position.
e) Describe audio/visual procedures and proper disposal of tapes.

Not applicable as we are not using any audio or video taping.

e) Describe the qualifications of the individuals conducting all procedures used in the study.

Tina Boyer, Suzanne Hammer, Tyler Jepson and Eric Thompson are all Senior Physical Therapy students from the University of North Dakota. Cindy Flom-Meland and Dave Relling are professors in the University of North Dakota Physical Therapy Department.

f) Describe compensation procedures (payment or class credit for the subjects, etc.).

There will be no compensation received for participating in this study.

Attachments Necessary: Copies of all instruments (such as survey/interview questions, data collection forms completed by subjects, etc.) must be attached to this proposal.


a) Clearly describe the anticipated risks to the subject/others including any physical, emotional, and financial risks that might result from this study.

Abdominal exercises on a Swiss ball are commonly used for abdominal strengthening in Physical Therapy clinics; consequently there is very minimal risk of personal injury. An example of this type of injury may be a slight muscular strain. However, as mentioned below, these risks will be minimized through supervision. The investigators expect no such injury to occur during the course of this study. All subjects who are currently pregnant or those with low back injury or spinal surgery, allergic reactions to rubbing alcohol, and those with previous formal instructions on the use of Swiss balls for abdominal exercises are excluded from our study. Should a personal injury occur during exercise, the individual will be encouraged to seek prompt medical attention. All medical expense will be the responsibility of the individual and his/her third party payer.

b) Indicate whether there will be a way to link subject responses and/or data sheets to consent forms, and if so, what the justification is for having that link.

There will be no way to link subject response to the data/consent forms; the participants will be assigned a random identification number at the start of the research project.

4. Subject Protection.

a) Describe precautions you will take to minimize potential risks to the subjects (e.g., sterile conditions, informing subjects that some individuals may have strong emotional reactions to the procedures, debriefing, etc.).

Due to the nature of this research project there are very few emotional or physical risks expected. In the case of participants sustaining any psychological or physical injury further medical attention will be given by appropriate professionals. Biofeedback electrodes will be used once per patient eliminating the risk of contamination. Participants will be asked if they have any questions or concerns following completion of participation.

b) Describe procedures you will implement to protect confidentiality (such as coding subject data, removing identifying information, reporting data in aggregate form, etc.).

The information obtained for this study will be kept confidential. The subjects’ names and personal information will not be revealed at any time throughout the study. A hard copy of statistics of this study will be secured in a locked office in the University of North Dakota Physical Therapy department. Unless these records are required for future studies they will be destroyed three years after the study has ended. This will be reported in aggregate form.

c) Indicate that the subject will be provided with a copy of the consent form and how this will be done.

The subject will be asked to sign a consent form prior to testing and will be given a copy of the consent form upon request.

d) Describe the protocol regarding record retention. Please indicate that research data from this study and consent forms will both be retained in separate locked locations for a minimum of three years following the completion of the study.
Describe: 1) the storage location of the research data (separate from consent forms and subject personal data)
2) who will have access to the data
3) how the data will be destroyed
4) the storage location of consent forms and personal data (separate from research data)
5) how the consent forms will be destroyed

The information obtained for this study will be kept confidential. The subjects' names and personal information will not be revealed at any time throughout the study. A hard copy of statistics of this study will be secured in a locked office in the University of North Dakota Physical Therapy department. The consent forms and data will be stored separately. Access to the data form the study will only be accessible to the principle investigators. Unless these records are required for future studies they will be destroyed three years after the study has ended.

Describe procedures to deal with adverse reactions (referrals to helping agencies, procedures for dealing with trauma, etc.).

Should an adverse reaction occur during the testing, the subject will be asked to stop the exercise. All investigators are CPR certified. Medical treatment will be available including first aid, emergency treatment and follow-up care as it is available to a member of the general public in similar circumstances.

Include an explanation of medical treatment available if injury or adverse reaction occurs and responsibility for costs involved.

Should personal injury occur during exercise, the individual will be encouraged to seek prompt medical attention. All medical expenses will be the responsibility of the individual and his/her third party payer.

III. Benefits of the Study
Clearly describe the benefits to the subject and to society resulting from this study (such as learning experiences, services received, etc.). Please note: payment is not a benefit and should be listed in the Protocol Description section under Methodology.

The effects of this study will add to the current body of knowledge regarding spinal core stabilization and will specifically determine the recruitment of rectus abdominis using Swill ball crunches. Minimal scientific research exists relating the effects of instruction to muscle activity during an abdominal crunch on a Swiss ball. The goal of this study is to provide further information and create awareness of the effects of instruction on the muscle recruitment of the rectus abdominis during a crunch on a Swiss ball. Further benefits for the subjects include knowledge and training in the proper use of a Swiss ball for strengthening of the abdominis rectus.

IV. Consent Form
A copy of the consent form must be attached to this proposal. If no consent form is to be used, document the procedures to be used to protect human subjects. Refer to the RD&C website for further information regarding consent form regulations. Please note: Regulations require that all consent forms, and all pages of the consent forms, be kept for a minimum of 3 years after the completion of the study, even if the subject does not continue participation. The consent form must be written in language that can easily be read by the subject population and any use of jargon or technical language should be avoided. It is recommended that the consent form be written in the third person (please see the examples on the RD&C website), and at no higher than an 8th grade reading level. A two inch by two inch blank space must be left on the bottom of each page of the consent form for the IRB approval stamp. The consent form must include the following elements:

a) An introduction of the principal investigator
b) An explanation of the purposes of the research
c) The expected duration of subject participation
d) A brief summary of the project procedures
e) A description of the benefits to the subject/others anticipated from this study
f) A paragraph describing any reasonably foreseeable risks or discomforts to the subject
g) Disclosure of any alternative procedures/treatments that are advantageous to the subject
h) An explanation of compensation/medical treatment available if injury occurs.
i) A description of how confidentiality of subjects and data will be maintained. Indicate that the data and consent forms will be stored separately for at least three years following the completion of the study. Indicate where, in general, the
data and consent documents will be stored and who will have access. The following statement must be included in all consent forms and informational letters: "Only the researcher, the adviser, [if applicable] and people who audit IRB procedures will have access to the data." Please make appropriate additions to the persons that may have access to your research data. Indicate how the data will be disposed of. Be sure to list any mandatory reporting requirements that may require breaking confidentiality.

j) The names, telephone numbers and addresses of two individuals to contact for information (generally the student and student adviser). This information should be included in the following statement: "If you have questions about the research, please call (insert Principal Investigator’s name) at (insert phone number of Principal Investigator) or (insert Adviser’s name) at (insert Adviser’s phone number). If you have any other questions or concerns, please call Research Development and Compliance at 777-4279."

k) If applicable: an explanation of who to contact in the event of a research-related injury to the subject.

l) If applicable: an explanation of financial interest must be included.

m) Regarding participation in the study:

1) An indication that participation is voluntary and that no penalties or loss of benefits will result from refusal to participate.
2) An indication that the subject may discontinue participation at any time without penalty, with an explanation of how they can discontinue participation.
3) An explanation of circumstances which may result in the termination of a subject’s participation in the study.
4) A description of any anticipated costs to the subject.
5) A statement indicating whether the subject will be informed of the findings of the study.
6) A statement indicating that the subject will receive a copy of the consent form.

By signing below, you are verifying that the information provided in the Human Subjects Review Form and attached information is accurate and that the project will be completed as indicated.

Signatures:

(Principal Investigator) Date: 5/25/05

(Student Adviser) Date: 5/25/05

Requirements for submitting proposals:
Additional information can be found on the IRB web site at www.und.nodak.edu/dept/orpd/regucomm/IRB/index.html.

Original Proposals and all attachments should be submitted to Research Development and Compliance, P.O. Box 7134, Grand Forks, ND 58202-7134, or brought to Room 105, Twamley Hall.

Prior to receiving IRB approval, researchers must complete the required IRB human subjects’ education. Please go to http://www.und.nodak.edu/dept/orpd/regucomm/IRB/IRBEducation.htm for more information.

The criteria for determining what category your proposal will be reviewed under is listed on page 3 of the IRB Checklist. Your reviewer will assign a review category to your proposal. Should your protocol require full Board review, you will need to provide additional copies. Further information can be found on the RD&C website regarding required copies and IRB review categories, or you may call the RD&C office at 701 777-4279.

In cases where the proposed work is part of a proposal to a potential funding source, one copy of the completed proposal to the funding agency (agreement/contract if there is no proposal) must be attached to the completed Human Subjects Review Form if the proposal is non-clinical; 7 copies if the proposal is clinical-medical. If the proposed work is being conducted for a pharmaceutical company, 7 copies of the company’s protocol must be provided.

Please Note: Student Researchers must complete the “Student Consent to Release of Educational Record”. Revised 6/7/04
agreed that, in conducting research under the approval of the University of North Dakota Institutional Review Board, I will fully comply and assume responsibility for the enforcement of compliance with all applicable federal regulations and University policies for the protection of the rights of human subjects engaged in research. Specific regulations include the Federal Common Rule for Protection of the Rights of Human Subjects 45 CFR 46. I will also assure compliance to the ethical principles set forth in the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research document, The Belmont Report.

I understand the University's policies concerning research involving human subjects and agree to the following:

1. Should I wish to make changes in the approved protocol for this project, I will submit them for review PRIOR to initiating the changes.

2. If any problems involving human subjects occur, I will immediately notify the Chair of the IRB, or the IRB Coordinator.

3. I will cooperate with the UND IRB by submitting Research Project Review and Progress Reports in a timely manner.

I understand the failure to do so may result in the suspension or termination of proposed research and possible reporting to federal agencies.

\[\text{Signature}\]

\[\text{Date}\]
STUDENT RESEARCHERS: As of June 4, 1997 (based on the recommendation of UND Legal Counsel) the University of North Dakota IRB is unable to approve your project unless the following "Student Consent to Release of Educational Record" is signed and included with your "Human Subjects Review Form."

STUDENT CONSENT TO RELEASE OF EDUCATIONAL RECORD

Pursuant to the Family Educational Rights and Privacy Act of 1974, I hereby consent to the Institutional Review Board's access to those portions of my educational record which involve research that I wish to conduct under the Board's auspices. I understand that the Board may need to review my study data based on a question from a participant or under a random audit.

The study to which this release pertains is

Efficacy of Formal Instruction from a Physical Therapist on Patient Performance of an Abdominal Crunch on a Swiss Ball Measured Through EMG Activity of the Rectus Abdom

I understand that such information concerning my educational record will not be released except on the condition that the Institutional Review Board will not permit any other party to have access to such information without my written consent. I also understand that this policy will be explained to those persons requesting any educational information and that this release will be kept with the study documentation.

327308-3
353642-1
353481-2
353635-3
NAID #
Date 5-25-05

Eric Thompson
Tyler Jepson
Suzanne Hammer
Tina Boyer
Printed Name

Signature of Student Researcher

1Consent required by 20 U.S.C. 1232g.
Information and Consent Form

Efficacy of formal instruction from a Physical Therapist on patient performance of an abdominal crunch on a Swiss ball measured through EMG activity of the rectus abdominis

Principal Investigators: Tina Boyer, Tyler Jepson, Suzanne Hammer, Eric Thompson, and Cindy Flom-Meland from the Department of Physical Therapy at the University of North Dakota.

You are invited to participate in this study of abdominal muscle activity while performing a crunch on a Swiss ball. The purpose of this study is to assess the benefit of instruction from a Physical Therapist in participant performance of an abdominal crunch on a Swiss ball, determined through EMG of the rectus abdominis.

You were chosen because 1) your age (18-50 y.o.) 2) lack of history of low back pain 3) no allergic reaction to rubbing alcohol 4) no previous spine surgeries 5) you have stated you are not pregnant 6) you have not had supervised instruction or performance of abdominal crunches on the Swiss ball.

As a subject for this study, you will be asked to report to the second floor of the Physical Therapy department located in the School of Medicine and Health Sciences. Participants will sign up for an hour time slot. When they are scheduled they will first read through their consent form. They will have opportunity to ask any questions regarding the information and then will sign the form. Following this, you will be asked to expose your stomach to allow for application of electrodes. The skin over the rectus muscles will be cleaned with rubbing alcohol in a circular pattern around the umbilicus and out to a 6 inch radius and the four electrodes will be placed on the skin. Participants will then perform a manual muscle test of the rectus and the EMG activity will be recorded and used for base line data. After that they will be asked to perform 10 abdominal crunches on the ball with out any further instruction. This data will be recorded and then standardized instruction on proper technique of an abdominal crunch on the ball will be given. Following instruction, participants will have 5 minutes to rest, and then have a minute to practice prior to performing an additional 10 crunches. This data will be recorded with the previous EMG output. Each set of crunches will be performed at 60 beats per minute using a metronome as to standardize the activity.

Although the process of physical performance testing always involves some degree of risk, the investigators in this study feel that, because of your lack of risk factors and close supervision and training, the risk of injury or discomfort is minimal. Minor muscle soreness may result following the repeated activity.

Your name 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 you will remain confidential and will be disclosed only with your permission. The data
and consent forms will be stored separately for 3 years in locked files. Only the researchers, the advisor, and people who audit the IRB procedures will have access to the data. The data will be identified by a number known only to the investigators. The investigators 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 Physical Therapy Department at the University of North Dakota. If you decide to participate, you are free to discontinue participation at any time without prejudice.

The investigators involved are available to answer questions you have concerning the study. In addition, you are encouraged to ask questions concerning this study that you may have in the future. Questions may be asked by contacting the following:

Cindy Flom-Meland  
(701) 777-2831  
c/o Physical Therapy Department  
PO Box 9037  
Grand Forks, ND 58202  
cfmeland@medicine.nodak.edu

Suzanne Hammer  
(701) 240-5317  
shammer@medicine.nodak.edu

Eric Thompson  
(218) 791-6327  
ethompson@medicine.nodak.edu

Tina Boyer  
(701) 306-0415  
tboyer@medicine.nodak.edu

Tyler Jepson  
(218) 791-6884  
tjepson@medicine.nodak.edu

If you have any other questions or concerns, please call the Office of Research and Program Development at (701) 777-4279. At your request, you will be given a copy of this form and/or the study results.

In the event that this research activity results in a physical injury, medical treatment will be as available as it is to be a member of the general public in similar circumstances. You and your third party payer must provide payment for any such treatment.

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. I have read all of the above and willingly agree to participate in this study as it is explained to me by Tina Boyer, Suzanne Hammer, Tyler Jepson, or Eric Thompson.

Subjects Signature  Date
References


