PROJECT TITLE PAGE

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Project Title: The influence of kinesiology tape on breathing mechanics in healthy individuals

Date Submitted: 

Grant Type (please circle): Category I (Faculty-Student Research) Category II (External Funding Development)

Principal Investigator (or Co-Principal Investigators):

Kelly Lindenberg__________________________________________
Name (Please Type) Physical Therapy__________________________
Department (Please Type)

________________________________________
Signature

________________________________________
Name (Please Type) Department (Please Type)

________________________________________
Signature

Co-Investigator(s) (including student investigators):

Nancy Shipe ________________________________
Name (Please Type) Physical Therapy__________________________
Department (Please Type)

________________________________________
Signature

Ronald Peacock______________________________
Name (Please Type) Physical Therapy__________________________
Department (Please Type)

________________________________________
Signature

Graduate Student____________________________
Position (Faculty, Graduate/Undergraduate Student)

Courtney Lichtenfels________________________
Name (Please Type) Physical Therapy__________________________
Department (Please Type)

________________________________________
Signature

Graduate Student____________________________
Position (Faculty, Graduate/Undergraduate Student)
A. Abstract/Project Overview.

Kinesiology Tape (KT) has been used clinically to improve posture, range of motion, muscle activation, and muscle strength. However, limited research has investigated the effect of KT on respiratory function, such as rib and spine mobility or diaphragm and intercostal muscle activity. The purpose of this pilot study is to investigate the influence of KT on chest wall excursion (CWE), diaphragm strength, and respiratory muscle activation. A convenience sample of 20 subjects between the ages of 18 and 25 will be recruited from the general university population. Subjects will be stratified by gender and randomly assigned to one of two groups: KT group or sham tape (ST) group. Data collection will occur over two sessions. During session one baseline measurements will be taken, then KT or ST will be applied to each subject based on the group assignment. Ten minutes after the tape application each objective measure will be repeated. Subjects will continue to wear the tape and return approximately 48 hours later to participate in a final round of the same measurements. Repeated measures ANOVAs will be used to determine the influence of tape at baseline, immediately post-taping, and 48 hours post-taping between the KT and ST groups. Paired T-tests will be used for any post hoc analyses.

B. Background.

Orthopedic taping is a commonly used method for joint stabilization and injury prevention. Kinesiology tape (KT) is unique in that it mimics the skin in both its physical and functional properties. It is an elastic adhesive tape that can stretch up to 140% its original length.1 When KT is applied to the surface of the skin it exerts a tensile force, which promotes awareness of body position,2 postural correction,3 and muscle stimulation.4-7

Research into the influence of KT on muscle performance has demonstrated significant clinical findings. Studies have found that KT could play a role in the rehabilitation of individuals with postural deficits,3 improved lower trunk range of motion,9 modulated muscle activity and overall muscle function.2,4-7,10-12 Significant increases in muscle activity, correlated to the application of KT, have been noted using electromyography (EMG) in studies.4-7

Despite the large number of research studies looking at the influence of KT on muscle activity, current research studying its effects on respiratory muscle function, breathing mechanics, or aerobic performance is lacking. One study investigated the effect of KT on respiratory muscle strength and found no significant improvement in maximal muscle strength. However, only the acute effects of the specific taping methods were studied.8 It has been reported that KT may influence muscle strength up to 48 hours after application.5 Another study investigated whether the elasticity of KT applied to the thorax would augment an increase in expiratory volumes by enhancing the efficiency of respiratory musculature. The researchers found a significant increase in expired tidal volume and mechanical efficiency (ME) during maximal exercise with KT vs a non-KT control group.1

KT has been shown to improve posture, ROM, muscle activation, and muscle strength throughout the body.2-7,9-12 Similar effects altering thoracic posture, rib and spine ROM, diaphragm and intercostal muscle strength, and overall respiratory performance could have profound effects on patients with lung diseases. Physical therapists could use KT during training and rehabilitation of athletes to enhance aerobic capacity and efficiency. A great deal more research is needed to investigate the benefits of KT on respiratory function.

C. Goals and objectives.

The long-term vision of the investigators is to determine the most effective protocol for the use of KT to improve respiratory function in patient populations with pulmonary dysfunctions as well as in athletes. This study will be the initial step and will investigate the
effects of KT on chest wall expansion (CWE), strength of diaphragmatic contraction, and activation of respiratory muscles.

The expected outcomes for this research proposal include:
- Evaluate the efficacy of KT on respiratory performance
- Compare KT to a sham taping control
- Address the question of duration of KT application on respiratory performance left unanswered by a previous study
- Gain support for future research proposals on the use of KT for the enhancement of respiratory function
- Expose student researchers to the rigors of formal research

D. Justification for research project.

1. This proposed research project will involve faculty-graduate student research (Category I) and meet the following goals of the research grant program:
   A. Enrich teaching and learning by providing opportunities for students to experience the process of scholarly exploration and discovery under the mentorship of faculty.
   B. Promote appreciation of the role of diverse areas of inquiry and ways of knowing in academic fields of study.
   C. Encourage the pursuit of advanced academic study.

2. This proposed research project will benefit the College of Health, Environment, and Science by addressing its mission and several goals:

   MISSION
   The mission of the College of Health, Environment, and Science is to provide student-centered education, with emphases on quality teaching, student-faculty research, scholarly activity, service, and the global community.

   GOALS
   - To provide opportunities for students to learn and apply knowledge, skills, and abilities in diverse practical settings.
   - To provide a working and learning environment that supports diversity, collaboration, and divergent viewpoints.
   - To provide a working and learning environment that supports research as integral to learning, thinking, and advancing knowledge.
   - To provide an environment where students will graduate as life-long learners, able to make ethical evidence-based decisions that consider the welfare of the greater good.

Regional and national presentation of the study findings will promote SRU and CHES as an institution that contributes to the physical therapy profession by enhancing evidence-based clinical practice.

3. The proposed research project will advance the potential for board certification in cardiopulmonary physical therapy by the project director, Kelly Lindenberg, meeting one of the criteria for advanced certification. It will advance the scholarly agenda, publication and presentation potential for both faculty investigators. Student investigators will have the opportunity to develop, execute, analyze and present clinical research that may improve physical therapy management of patients. This activity may foster a commitment to continued involvement in clinical research and advancement of the profession.

E. Methodology.
Sample selection and size:
Twenty subjects from the general university population will be recruited via convenience sampling to participate in the study. Subjects will be stratified by gender and randomly assigned to either the kinesiology tape (KT) group or the sham tape (ST) group. Anticipated age range of university population is 18-25. Exclusion criteria will exclude individuals with current lung pathology, disorders that alter mobility of the ribs, severe skin sensitivity to adhesives, or any contraindications identified by the manufacturer of the materials being used. Informed consent will be received prior to any subject’s participation in any aspect of the research activities.

Design:
A randomized block design will be utilized with a test group (KT) and sham group (ST). Subjects will be blinded to group assignment. The KT group will receive a kinesiology taping technique that has been previously demonstrated\(^1\) and intended to activate the diaphragm during inspiration. The ST group will receive the same taping technique; however, the material used will be an adhesive bandage that lacks the structure and elastic properties of kinesiology tape that would promote muscle recruitment.

Independent variables
- Taping material – kinesiology tape vs sham tape

The dependent variables
- Chest wall excursion (CWE)
- Peak muscle activation of the diaphragm bilaterally, intercostal muscles on the right anterior lower chest wall, and the anterior scalene muscles bilaterally
- Maximal inspiratory pressure (MIP).

All dependent measures will take place during a maximal inspiration and expiration effort by the subject at rest.

Instrumentation will include:
1. KinesioTex Gold (Kinesio Holding Corp, Albuquerque, NM) will be used for the KT group.
2. Cover Roll Stretch Tape (BSN Medical, Luxembourg) will be used for the ST group.
3. Surface electrodes and wireless telemetric electromyography (EMG) system (Telemyo DTS desktop receiver; Noraxon, AZ) will be used to capture peak muscle activation
4. Pony FX Desktop Spirometer with MIP/MEP accessory (COSMED, Rome, Italy) will be used to measure Maximal Inspiratory Pressure (a measure of diaphragm strength).
5. Circumferential Tape Measure will be used to measure chest wall excursion.
6. Statistical analysis will be performed using the SPSS Statistical Software Package, version 18.0 (SPSS Inc, Chicago, IL).

The investigators are confident that the study will be completed as planned with the equipment and supplies to be purchased through this grant and with funds provided by the Graduate School of Physical Therapy.

Collection of Data:
Data collection will take place in the Motion Analysis Lab in the Physical Therapy Building at Slippery Rock University. After informed consent is attained, initial demographic data will be gathered including gender, age, height, weight, and current activity level (exercise quantity). These data are important variables necessary to interpret pulmonary function values.\(^13\) CWE will be measured in centimeters (cm) using a circumferential tape measure. CWE
is defined as the measurement of chest circumference at maximal inspiration minus the chest circumference at maximal expiration.

Maximal inspiratory pressure (MIP) will be measured using a desktop spirometer with a MIP measurement accessory (Pony Fx, COSMED, Italy). This unit consists of a cylindrical mouthpiece, antibacterial filter, turbine flowmeter, and pressure line and transducer board that are connected to a computer with software capable of recording air flow volumes and pressures.

Peak muscle activation during the breathing efforts will be measured using a desktop wireless telemetry system (Telemyo, Noraxon, AZ) connected to a laptop with the software capable of recording electrical muscle activity. Surface electrodes will be placed on the skin over the muscles to be recorded: anterior scalene muscles bilaterally, intercostal muscle in the 6th intercostal space 2 cm to the right of the sternum (to avoid cardiac signal, no electrode will be placed on the left), and diaphragm (electrodes placed at anterior axillary line at the 7th intercostal space bilaterally). The measurements will be performed five times with a 2-minute rest between trials. Each subject will practice the technique prior to the data collection. The three trials yielding the largest MIP will be averaged and used for analysis.

Following baseline data collection, the taping intervention will be implemented. The specific tape material (KinesioTex vs Cover Roll) used will be based on random experimental group assignment of the subject. The taping technique will be identical for KT and ST. The subject will stand with the arms raised overhead and the trunk hyperextended. The 2” base of the tape will be applied without tension over the skin at the level of the xiphoid process. The two arms of the “I” strip will then be applied to the skin following ribs 9 and 10 with pull-off tension (inherent tension in the tape as the paper backing is removed and the tape is applied to the skin), which is defined as approximately 10% stretch for the KT tape and 0% stretch for the ST group. The subject will next stand with his or her trunk flexed forward with the arms crossed over the chest. The posterior tape strip 2” base will be applied without tension over the skin at the level of L1-L3. The two arms of the “I” strip will then be applied to the skin following ribs 9 and 10 with pull-off tension only. The subject will be given 10 minutes of rest to allow for proper adhesion and for acclimation to the tape. The breathing procedures described above will be repeated for 5 more trials with the same objective measures and rest intervals. The subject will keep the tape on for the next two days and return to the lab with the tape still intact after approximately 48 hours. The measurements will be repeated for five more trials. After the final measurements are taken, the tape will be removed.

Potential risks to the subjects participating in this study are expected to be rare and minimal. The exclusion criteria should eliminate individuals that would have difficulty with the breathing techniques; there is a small chance of exertional fatigue due to the large volume of air movement required. Subjects will be seated in a chair with a back and arm rests on which they can support themselves if they become tired or dizzy. The investigators are all trained in first aid and CPR. There is a small chance that the subject might have a skin reaction to the tape adhesive. The exclusion criteria should rule out any participants with known skin sensitivity. If a subject has an unexpected reaction, they will have contact information to allow for timely communication with the study coordinators. Participants will also have access to the university health center as needed.
F. **Data analysis.**

EMG data for peak activation of each muscle group will be reduced using the capabilities of the acquisition/analysis software program. The trials will be signal averaged and custom buffers will be created, thereby allowing the investigators to identify the dependent variables. The data will then be exported to a spreadsheet document (Microsoft, Redmond, WA) for organization. MIP data and CWE measurements will also be recorded in a spreadsheet. After all data reduction and organization, statistical analysis will be completed with a commercially available statistical software package (SPSS; Chicago, IL). Repeated Measures ANOVAs will be used to determine the influence of taping on CWE, EMG of diaphragm, EMG of intercostals, EMG of scalenes, and MIP between baseline, immediate post taping, and 48 hours post taping between the KT and ST groups. Paired T-tests will be used for all post hoc testing of significant findings. Alpha level will be set a priori at \( p \leq 0.05 \).

G. **Clear description of the role(s) of the students associated with the project.**

The student researchers are second year physical therapy students who have completed coursework on pulmonary function and have exposure to the use of KT. They have already participated in project planning and grant application preparation. The students will participate in pre-data collection preparation including ordering equipment, setting up lab space, training on equipment, practicing procedures, and recruiting/scheduling subjects.

Data collection will require 2 research personnel to be present for each subject. These duties will be performed by both the student and faculty investigators. The students will also participate in post-data collection activities including data synthesis/organization, data analysis and interpretation, manuscript/presentation preparation, and participation in platform/poster presentation.

H. **Plan for dissemination of research results. Be as specific as possible.**

The information will be used to better define future research goals and provide necessary ground work for future funding opportunities. An abstract will be submitted for consideration of presentation at the American Physical Therapy Association’s Combined Sections Meeting. A manuscript will be submitted for publication in a relevant peer-reviewed journal such as *Physical Therapy Journal* or *Cardiopulmonary Physical Therapy*.

I. **Project Timeline.**

March 2017- apply for IRB approval via expedited review process; April-May 2017-acquisition of supplies/equipment, set-up lab space, on-going literature searches, training on equipment; June-November 2017- subject recruitment and data collection (large portion of subject pool will not return to campus until September, thus the long window); December-June 2018- data analysis, abstract submission for presentation, manuscript development.

J. **References**


## Project Budget Page

**PI** Kelly Lindenberg  
**Project Name** The influence of kinesiology tape on breathing mechanics in healthy individuals

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**Totals:** $2,000  
$1,055  
$3,055  
$0

### Dean Only

**IRB Approval**  
**IACUC Approval**

**Dean’s Signature**  
**Date**
Budget Justification

Equipment and Supplies

Desk Spirometer
Will be used to measure maximal inspiratory pressure and inspiratory volume. The spirometer will be a key component to this current project and all future projects for the PI’s research agenda.

Cost breakdown:
- Base unit: $2795
- Shipping: $260
- Total: $3055

Dr. Carol Martin-Elkins has agreed that the Department of Physical Therapy will support the cost of equipment beyond the $2000 awarded in the grant.

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Principal Investigator/Project Director Kelly Lindenberg

Department/College Physical Therapy/CHES Phone:x4368

Project Title: The influence of kinesiology tape on breathing mechanics in healthy individuals

RFP Title: CHES Research Grant

Type of Activity: Research [X] Graduate Instruction [ ] Undergraduate Instruction [ ]

Public Service [ ] Other [ ] Please specify

Proposed Project Period: Start date: 04/01/2017 End date: 06/30/2018

Duration: 14 months

**Budget Considerations**

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**Budget Summary**
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**Compliance Considerations**

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Signature of Principal Investigator

Date 02/21/2017

Signature of Department Chair*

Date

Signature of Dean/Director*

Date

*NOTE: The signatures of the Department Chair and Dean indicate that they approve the project and agree to budget proposed, including providing matching funds for the project, if necessary.
Kelly M. Lindenberg, MSPT, PhD  
215 Physical Therapy Building  
Graduate School of Physical Therapy  
Slippery Rock University  
Slippery Rock, Pennsylvania 16057-1326  
(724) 738-4368

**Education:**

<table>
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<td>December 2009</td>
<td>May 2002</td>
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<td>Rehabilitation Science</td>
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<td>Doctor of Philosophy</td>
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**EMPLOYMENT AND POSITIONS HELD:**

- Associate Professor: Graduate School of Physical Therapy  
  Slippery Rock University  
  Slippery Rock, PA  
  08/09 – present

- Casual Physical Therapist  
  Acute & Skilled Care  
  Butler Health System  
  Butler, PA  
  08/12-present

**PEER REVIEWED PUBLICATIONS:**


**PEER REVIEWED SCIENTIFIC AND PROFESSIONAL PRESENTATIONS:**


Dusi, J, Lindenberg K, Andreyo, E. Developing the collaborative relationship between physical therapy and physical therapy assistant students through the use of technology and shared case-study experiences. To be presented at APTA Combined Sections Meeting, Las Vegas, NV, February 2014.

Lindenberg KM, Carcia CR. The influence of heel height on vertical ground reaction force during landing tasks in recreationally active and athletic collegiate females. Presented at APTA National Conference, Salt Lake City, UT, June 2013.


Lindenberg KM, Carcia CR. Muscle response times between shoe and no shoe conditions following a weight bearing rotary perturbation are similar in females. 2008. Presented at Research Retreat IV-ACL Injuries: The Gender Bias. Abstract to appear in JOSPT.

**NON-PEER REVIEWED PUBLICATIONS:**

**RESEARCH ACTIVITY:**


Dusi, J, Lindenberg K. Developing the collaborative relationship between physical therapy and physical therapy assistant students through the use of technology and shared case-study experiences. Grant submission via California University of Pennsylvania; Slippery Rock University as collaborative school. Sponsor: PASSHE Foundation: Highmark Healthcare Academic Program Development. Award granted in the amount of $5758; 1/23/12 to 12/30/12.

Lindenberg KM, Moore S. The influence of heel height on muscle recruitment during landing tasks in recreationally active collegiate females: A Pilot Study. Funding: Faculty-Student Research Grant in the amount of $1238; 1/9/12 to 12/31/12. Data used to write NIH AREA grant submission. Not funded.

Billek-Sawhney B, Shipe NK, Lindenberg KM. Physical Therapy Exercise Compliance. Funding: Faculty-Student Research Grant in the amount of $4983; 12/18/11 to 12/17/12. Manuscript in progress.