**Research Proposal**

**Title: Electromyography Analysis of Maximal Vertical Jumps on a Rigid and Sand Surface**

**Principal Investigator and Contact Information:**

Mike Guerrero, Graduate Student

Phone: (512) 585-6006 Email: [jg1405@txstate.edu](mailto:jg1405@txstate.edu)

**Summary/Synopsis of the Research Project**

The research conducted in this study will attempt to enhance the knowledge previously obtained on the differences between participating in jumps on a rigid and sand surface. Electromyography readings will provide information of lower extremity muscle output between the two surfaces during a jumping sequence. Results of this study will help strength and conditioning professionals to train individuals according to kinematic features discovered from movements in the sand. In addition, identification of potential biomechanical and strength benefits of sand training will aid in healthcare professionals’ development of rehabilitation techniques.

**Research Plan**

**Introduction/Background**

The 2008 Beijing Olympics exposed the sport of beach volleyball to millions worldwide.1 Estimates of 800 million people play volleyball recreationally.3 Indoor volleyball represents the second ranked sport in the National Collegiate Athletic Association (NCAA).8 Recently the NCAA approved sand volleyball for varsity competition for the 2010-11 academic year.10 Sand volleyball provides a versatile style of play that helps develop all skills necessary in the game.5

Research has identified that one particular skill, the jump, differentiates between a rigid and sand surface.2, 4, 7 Triple extension of the ankle, knee, and hip joints on a rigid surface provides an efficient force application during jump takeoff.11-12 Several studies have identified a reduction of jump height on a sand surface compared to a rigid surface.2, 4, 7 Sand surfaces create a challenge in developing ground reaction forces necessary to plant the foot during takeoff.12 Studies done on movement in the sand report a decreased center of mass creating an increased energy expenditure.6 Electromyography analysis of running on a sand surface revealed greater hamstring activity and a significant increase in hip and knee flexion kinematics.9 Further research on the electromyography analysis of jumping on both a rigid and sand surface will contribute to information on jump height, force application, and energy expenditure mechanisms of the lower extremities.

**Objective/Specific Aim**

The aim of the study will be to analyze the effect of a rigid and sand surface electromyography activity on the lower extremity muscles of the hamstring, quadriceps, and calf muscle groups during three different maximal voluntary contraction jumps. It is hypothesized that electromyography activity of the lower extremity muscles, the hamstrings, quadriceps, and calf muscles, will increase in duration of output due to stabilizing factors developing ground reaction forces in the sand surface.

**Participant Selection**

**Study Population**

Subjects will be recruited online through a website (www.atxvb.com) constructed to gather interested participants to play volleyball on specific dates in the Austin, Texas area. The sample will be selected from approximately 500 registered participants from the website group ranging in ages from 20-45 years old, both male and female, of all ethnic backgrounds.

**Eligibility Criteria**

Inclusion criteria will consist of subjects participating in sand volleyball at least once per week for the past 3 months prior to testing.

**Ineligibility Criteria**

Participants who do not have previous experience participating in sand volleyball and are not familiar with the associated movements will not be allowed to test.

**Recruitment/Registration**

The principal investigator will recruit participants by posting a flyer (see appendix) online and at courts where the atxvb.com group members play sand volleyball. All pertinent information will be detailed on the flyer. Participants who contact the principal investigator will receive further information regarding scheduling and administration of the research study test. Each participant will receive information about the components of the study. A letter or e-mail that describes the protocol and significance of the study, along with an informed consent, will be given to all subjects.

**Protocol Details**

**Research Design and Methods**

Testing will be conducted in one individualized session for each subject at the Biomechanics Supplemental Research Lab located in Jowers Center on the campus of Texas State University-San Marcos. The research laboratory contains the required equipment necessary to test, including a BIOPAC 4-Channel Electromyography Telemetry System, an inForm Sport Training System accelerometer, a wooden pit (120x180x20cm) filled with dry, compact sand, and maximum jump device with 40 freely movable vanes. Warm-up and cool-down will occur for 10 minutes with a treadmill.

**Participant Assessment and Data**

Data will be collected from output results from the BIOPAC 4-Channel Electromyography Telemetry System. Placement of the leads will be put on the following four muscles of the right leg: tensor fascia latae, biceps femoris, vastus lateralis, and medial gastrocnemius. The skin must be shaved prior to testing and cleaned with alcohol wipes before lead placement.

The inForm Sport Training System accelerometer will be secured around the waist of the participant with a belt and turned on prior to jumping. Data from the accelerometer will provide information on force and confirm jump height. Jump height will also be measured with a maximum jump device with 40 freely movable vanes. The subject will attempt to reach with their preferred hand and push away the highest reachable vane in order to receive a measure of standing jump height. Upon completion of the jump and displacement of vanes, the lowest vane remaining at the initial position will be recorded for maximum jump height. After each jump the vanes will be reset to the original setup.

The three separate jumps to be performed will consist of the following: countermovement jump, side-step countermovement jump, and approach countermovement jump. Each jump represents similar jumps that occur during competition. The countermovement jump represents the setup for a block jump. A side-step countermovement jump involves a lateral movement to the subject’s preferred side, followed by a block jump. The approach countermovement jump sets up similar to the movements for a spike jump, with a step forward followed by a countermovement jump. Jumps will be randomly assigned and subjects will perform each jump 3 times on both surfaces. After each jump on the sand, the sand will be combed with a rake to ensure consistency while the subject rests for 90 seconds between jump attempts.

**Statistical Design and Analysis**

Statistical analysis will be done using Statistical Packages for the Social Sciences (SPSS). This analysis will provide information to compare to previous studies regarding the kinematic and energy expenditure differences between jumping on a rigid and sand surface.

**Informed Consent Document**

(See Appendix)

**Risks/Benefits**

The potential risks for this experiment are minimal because the subjects will be supervised by the principal investigator during the duration of the study; however, with any exercise there are potential risks for injury. Participants with any current lower body injury or abnormality will be exempt from participation in this study. Subjects will be required to jump vertically without any deviation or unusual discomforts associated with regular activity or recreational sport. Risks will be minimized by warming up prior to the testing protocol and cooling down after testing.

Measurements conducted on the sand surface will take place in a sand box. The box will have an adequate depth of 13cm of dry, compact sand that will be raked evenly after each jump to ensure consistency and safety. The principal investigator will be present to tend to the sand box and spot participants during each maximal voluntary jump. Gymnastic mats will be placed around the testing surfaces to provide a cushioned support system.

If a medical emergency occurs during testing, emergency services will be contacted. The primary investigator will assist with all emergency situations until EMS arrives on scene. If a minor emergency occurs, the Biomechanics Supplemental Research Lab is located next to the Athletic Training Lab with on-site accredited Athletic Trainers available to provide support if needed. The primary investigator also has experience in conducting vertical jump tests through assisting research conducted by professors in the Health, Physical Education and Recreation Department at Texas State University-San Marcos.

Benefits of this investigation will provide participants information about muscle output activity, jump height, and force of the leg on a rigid and sand surface.

**Student Investigator/Requestor**

This will be the thesis work for a graduate student. The work completed for this thesis will aid in the requirement to fulfill the M.Ed. degree in Exercise Science at Texas State University-San Marcos, Department of Health, Physical Education and Recreation.

**Supervising Faculty Members**

Dr. Robert Pankey, Professor

Phone: (512) 245-2958 Email: [rpankey@txstate.edu](mailto:rpankey@txstate.edu)

Dr. John Walker, Professor

Phone: (512) 245-8106 Email: [jw18@txstate.edu](mailto:jw18@txstate.edu)

Dr. Kevin McCurdy, Assistant Professor

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**Appendices**

Please see the attached recruitment flyer (A), consent form (B), and medical health questionnaire form (C).

**Funding**

Funding by a federal or private agency will not be provided.

**References**

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12. Smith, R. (2006, October). Movement in the sand: training implications for beach volleyball. *Strength and Conditioning Journal, 28*(5), 19-21.

**Appendix A**

Texas State University Research Study

You are invited to participate in a study of the differences between jumping on a rigid and sand surface.

*Seeking sand volleyball players between the ages of 20-45 years*

* The study will be conducted on the campus of Texas State University-San Marcos, Jowers Center, Biomechanics Supplemental Research Lab
* Testing will last approximately 30 minutes
* Participation involves jumping on both a rigid and sand surface
* Electrodes placed on the right leg will register muscle output
* Subjects will be informed of lower leg strength, force output, and jump height

*If interested, please contact Mike Guerrero at jg1405@txstate.edu.*

**Appendix B**

**Consent Form to Participate in Research**

**Electromyography Analysis of Vertical Jumps on a Rigid and Sand Surface**

**Principal Investigator and Contact Information:**

**Texas State University – Exercise Science Program**

* Mike Guerrero, Graduate Student

Phone: 512-585-6006 Email: [jg1405@txstate.edu](mailto:jg1405@txstate.edu)

**Introduction**

You are being asked to participate in a research study. This form provides you with information regarding the research being conducted. Please read this form and ask any questions you may have regarding participation in this study. Participation is entirely voluntary. You will be evaluated in the Biomechanics Supplemental Research Lab located in the Jowers Center at Texas State University-San Marcos. Read the information below and ask questions about anything you do not understand prior to deciding whether or not to participate.

**Purpose**

The purpose of this research is to analyze the effects of a rigid and sand surface during three different maximal voluntary jumps of the leg muscles.

**Procedures**

You must first fill out a form about your health history using the Medical Health Questionnaire Form attached to the back of this Consent Form. Participants may choose to not answer any of the Medical Health Questionnaire Form questions if they do not feel comfortable doing so.

Each subject will be instructed to wear athletic clothing including a t-shirt, gym shorts and tennis shoes. Workout clothing is necessary for locating specific areas to attach electromyography leads for muscle output analysis. The following procedures will take about 30 minutes to complete.

1. Subject height and weight will be measured privately with only the principal investigator present.
2. The principal investigator will locate and mark specific areas of the right leg including the hip, hamstring, quadriceps, and calf muscles to measure muscle output.
3. Subjects will be given a new shaving implement to remove hair from specific marked spots on the right leg in order to place electromyography leads.
4. Prior to testing, subjects will complete a 5-10 minute warm up jogging on a treadmill machine and complete low-level plyometrics.
5. After warm up, subjects will clean with alcohol wipes the surface of the skin previously marked for electromyography leads.
6. Electromyography leads will be placed on the clean surface of the marked skin on the right leg.
7. Subjects will be instructed, by the principal investigator, on how to complete each jump that will be conducted.
8. Leads will be hooked up with conduction wires to the BIOPAC 4-Channel Electromyography Telemetry System.
9. An inForm Sport Training System accelerometer will be secured around the waist of the participant with a belt.
10. Subjects will randomly jump each of the 6 possible jumps, 3 times each on both a rigid or sand surface.
11. Upon test completion, subjects will conduct a walking cool down around the laboratory and be instructed to stretch their leg muscles.

**Potential Risks or Discomforts**

The potential risks for this experiment are minimal because the subjects will be supervised by the principal investigator during the duration of the study; however, with any exercise there are potential risks for injury. Participants with any current lower body injury or abnormality will be exempt from participation in this study. Subjects will be required to jump vertically without any deviation or unusual discomforts associated with regular activity or recreational sport. Risks will be minimized by warming up prior to the testing protocol and cooling down after testing.

Measurements conducted on the sand surface will take place in a sand box. The box will have an adequate depth of 13cm of dry, compact sand that will be raked evenly after each jump to ensure consistency and safety. The principal investigator will be present to tend to the sand box and spot participants during each maximal voluntary jump. Gymnastic mats will be placed around the testing surfaces to provide a cushioned support system.

If a medical emergency occurs during testing, emergency services will be contacted. The primary investigator will assist with all emergency situations until EMS arrives on scene. If a minor emergency occurs, the Biomechanics Supplemental Research Lab is located next to the Athletic Training Lab with on-site accredited Athletic Trainers available to provide support if needed. The primary investigator also has experience in conducting vertical jump tests through assisting research conducted by professors in the Health, Physical Education and Recreation Department at Texas State University-San Marcos.

**Possible Benefits**

The benefits of this investigation will provide you information about:

* Muscle output activity in the leg while jumping on a rigid and sand surface
* Jump height while jumping on a rigid and sand surface
* Force applied when jumping on a rigid and sand surface

**Confidentiality**

Each subject will be issued a number to differentiate results found between subjects and to maintain the confidentiality of subject’s information. A subject's name, social security number, telephone number, etc. are not required to participate in this study. Results from the study may be used for future research. If consent form material is needed for research purposes, subjects will be contacted for additional release of consent of information. All data will be kept in the primary investigator’s office for 2 years in a locked cabinet in order to preserve confidentiality of subjects.

**Participation**

Participation in the study is completely voluntary and you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at anytime without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed. You may request a copy regarding the results of this study anytime upon completion of the study. Please contact the principal investigator, Mike Guerrero at (512) 585-6006 or [jg1405@txstate.edu](mailto:jg1405@txstate.edu) in order to arrange delivery of the results. If you have any other questions regarding the research, research participants’ rights, and/or research-related injuries to participants, please contact the IRB chair, Dr. Jon Lasser at (512) 245-3413, lasser@txstate.edu or to Ms. Becky Northcut, Compliance Specialist at (512) 245-2102.

**Authorization**

Texas State University-San Marcos, Department of Health, Physical Education and Recreation supports the practice of protection for human subjects participating in research and related activities. The consent form is provided so that you can decide whether or not to participate in the present study.

“I have read the above statement and have been fully advised of the procedures to be used in this project. I have been given sufficient opportunity to ask any questions I had concerning the procedures and know that I am free to ask questions as they may arise. I likewise understand that I can withdraw from the study at any time without being subjected to reproach.”

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Participant Name Printed (18 years or older) Phone #

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Signature Date (mm/dd/year) Date

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Principle Investigator Signature Date (mm/dd/year) Date

**Appendix C**

Medical Health Questionnaire Form

|  |  |  |
| --- | --- | --- |
| Yes | No | Current Activity Level |
| 🔿 | 🔿 | Are you physically active (i.e., do you get at least 30 minutes of physical activity on at least 3 days per week)?  Please list the activities that you do for physical activity (i.e., aerobic exercise, weights, sport activities, etc). |
| 🔿 | 🔿 | Have you participated in sand volleyball activities for at least once a week for the past 3 months? |
|  | | |
| Yes | No | Symptoms – Do you: |
| 🔿 | 🔿 | Experience chest discomfort with exertion? |
| 🔿 | 🔿 | Experience unreasonable breathlessness or unusual fatigue at rest, with mild exertion, or during usual activities? |
| 🔿 | 🔿 | Experience dizziness, fainting, or blackouts? |
| 🔿 | 🔿 | Experience difficulty breathing when lying flat or when asleep? |
| 🔿 | 🔿 | Experience ankle swelling? |
| 🔿 | 🔿 | Experience forceful or rapid heartbeats? |
| 🔿 | 🔿 | Experience numbness in legs or arms from time to time? |
|  | | |
| Yes | No | Other health issues that may warrant physician approval before engaging in physical activity. |
| 🔿 | 🔿 | Have you ever been told not to exercise by a health care provider? |
| 🔿 | 🔿 | Do you have problems with your muscles, bones, or joints? |

Please provide an Emergency Contact: **Name**: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**\_\_\_\_\_\_\_\_\_\_\_\_\_

**Phone Number**: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**\_\_\_\_\_\_\_\_\_

I certify that the information included on this form is correct.

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**Date Signature of Participant**

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**Date Signature of Primary Investigator**