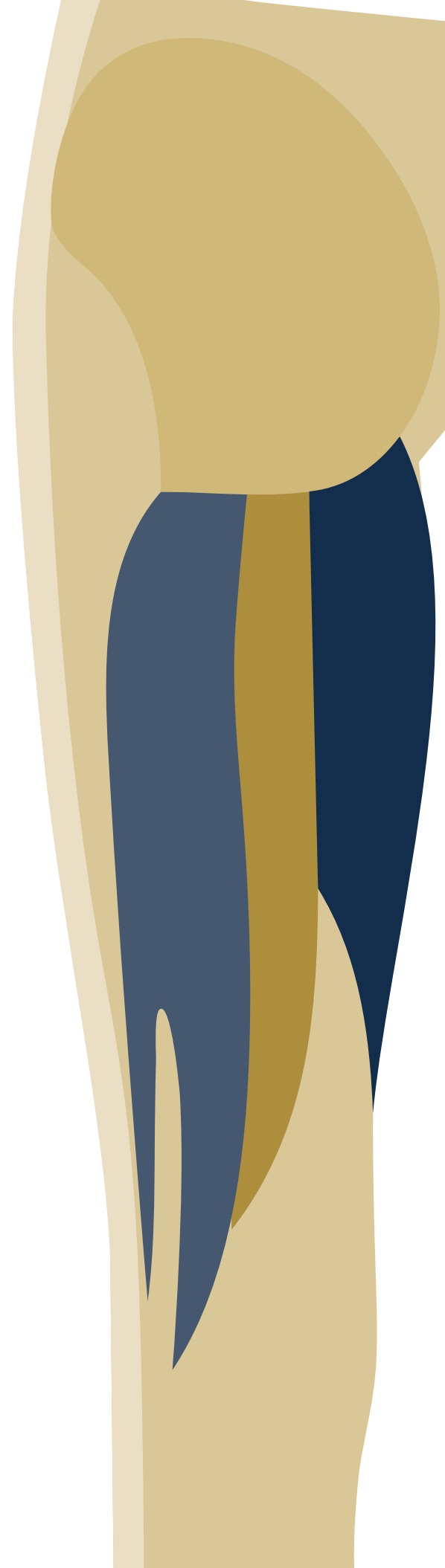


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Figure 1.



Introduction

Why Nordic Hamstring?

- Hamstrings are the most commonly injured muscle in sprinting and kicking sports (soccer, football and rugby). (1)
- Recurrent hamstring injuries lead to longer time loss than the original injury. (2-4)
- Despite the presence of preventative programs, research has not yet documented an effective, low-cost, widely accessible test to determine hamstring injury risk. (7)

A correlation exists between the Nordic Hamstring Test (NHT) break-point angle and eccentric knee-flexor peak torque. (7)

Identification & Injury Reduction

- Identifying athletes at risk for injury may help coaches and clinicians prescribe the Nordic Hamstring curl as an exercise for specific individuals.
- *The Nordic Hamstring curl, when incorporated into training, reduces hamstring injury by as much as 85%. (5)*
- *Despite the potential benefits, the NHT training program has not been globally adopted. (6)*

Hypothesis

The purpose of this study was to determine if the NHT could be used as a preseason screening tool to identify collegiate soccer players at risk for a time-loss hamstring injury. We hypothesize that athletes with a greater (NHT) angle would be at greater risk for injury.

Methods

Study Design

Prospective cohort study
July 2015 to Nov. 2015

Participants

Total of 73 male and female collegiate soccer athletes from George Fox University (Div. III) and University of Portland (Div. I).

Technology Specifications

- EXLIM EX-F1 digital high speed video camera.
- 300 frames per second (fps).
- Camera mounted 10 feet from the subject.
- Mov to Avi conversion software.
- MaxTRAQ Innovision System

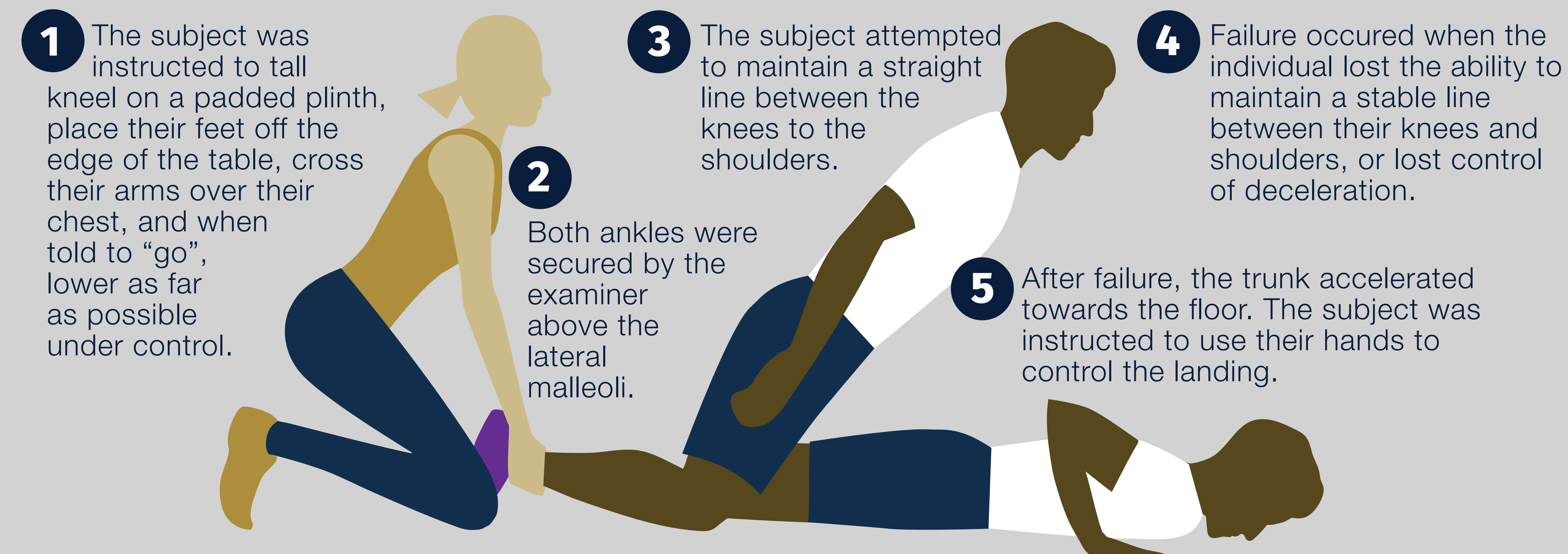
Data collection

- Exclusion criteria: under the age of 18 and those currently unable to play.
- Demographic data collected: age, weight, height, injury history, and player position.
- Fluorescent markers adhered over greater trochanter and joint space of lateral knee.
- Subjects verbally instructed (Figure 2).
- Participants performed three practice trials prior to data collection of three consecutive trials.
- Trials supervised by 2 DPT students, and conducted at self-selected pace with verbal encouragement.
- High-speed video analysis was performed by 5 DPT students using MAXTRRAQ software in order to determine the break point for each subject trial based on their biomechanical marker position.

The test-retest reliability for the Nordic Hamstring Test (NHT) was calculated during a pilot study prior to subject recruitment.

ICC_{3,3} 0.87 (0.54, 0.98)

Figure 2.



Discussion

- Mean break point angle for all subjects and per gender was used for risk stratification.
- A greater break point angle may have a protective effect (trend towards significance; $p=0.066$); however, assessment of more athletes needed.

- Visual assessment of Nordic break angle may have too much variability between reviewers, reducing accuracy of identifying break point angles.
- Study is underpowered for per gender analysis and will need 1-2 years of further data collection.
- If the current trend continues, it may reflect that NHT is not associated with future risk of injury or that lower Nordic break angle is associated with greater risk for injury.
- At this time, we are unable to determine the effectiveness of using the NHT as a diagnostic tool.

Future Research

- Continue subject recruitment.
- Collect additional data during the NHT, including load cell and accelerometer measures.
- iPhone application to increase access and prevent injury.

Results

Table 1. Baseline Characteristics and Break Point Angles of Collegiate Soccer Players

Characteristic	Total N=73	Females N=35	Males N=38
Age (y)	19.1(1.1)	19.1 (1.1)	19.1 (.9)
Yrs. in school	2.0 (1.0)	2.1 (1.1)	1.9 (.9)
Break point angle (°)	74 (6.9)	78.1 (6.5)	70.3 (4.8)

*Means ± SD

Table 2. Nordic Hamstring Test Scores for Collegiate Soccer Athletes

	N at Risk	Hamstring Injuries (%)	OR (95% CI)	p value
All Athletes (n=73)				
NBA 75° or more	38	(3)	0.1 (0.0, 1.1)	0.066
NBA 75° or less	35	(17)	1.0 Referent	
Male Athletes (n=38)				
NBA 70° or more	18	(11)	1.1 (0.1, 8.9)	0.9
NBA 69° or less	20	(10)	1.0 Referent	
Female Athletes (n=38)				
NBA 78° or more	19	(5)	0.5 (0.0, 4.7)	0.4
NBA 77° or less	16	(13)	1.0 Referent	

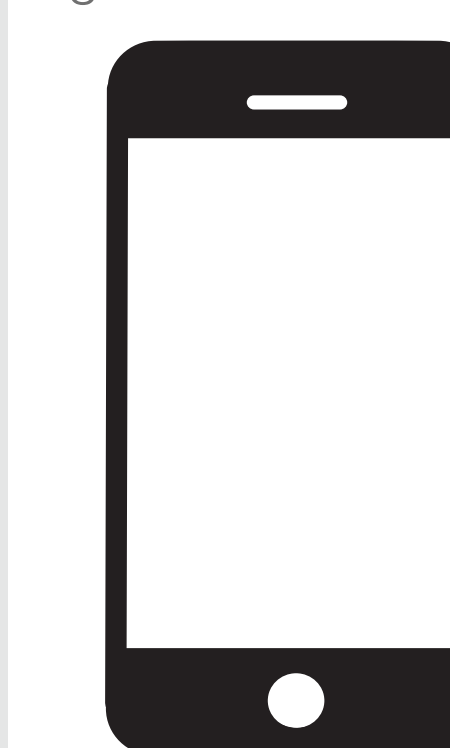
*OR = Odds Ratio.

*NBA = Nordic Break Angle.

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Figure 3.



iPhone Application

- Break angles derived from research are used in algorithms to determine the risk for hamstring injury.
- Calculates the test subjects acceleration, rotation, and tilt about the X, Y, and Z axes.
- Application language - SWIFT.
- Utilizes the Bosch BMA280 three-axis accelerometer and six-axis InvenSense MPU6700 combination gyroscope-accelerometer.