Clinical Trial Protocol
Iranian Registry of Clinical Trials

27 Jun 2026

Is there a difference in knee biomechanics due to fatigue of the quadriceps versus hamstrings during landing on a single limb? Three-dimensional analysis study

Protocol summary

Study aim

The study aimed to clarify the contribution of quadriceps induced-fatigue and hamstring-induced fatigue separately on the knee joint biomechanics during a forward-drop jump with a single-leg landing.

Design

A randomized, single-blinded, two-arm, parallel-group clinical trial

Settings and conduct

The eligible and enrolled athletes for the induced-fatigue protocol will be directed to the biomechanics lab in the College of applied medical sciences, Prince Sattam Bin Abdulaziz University, Saudi Arabia. They will be randomly assigned to intervention group 1 and intervention group 2 through simple randomization. This clinical trial will be single-blinded so the outcomes assessors/investigator researchers will not be aware of the study groups.

Participants/Inclusion and exclusion criteria

Inclusion criteria: 1-Age ranged from 20-25 years. 2-A minimum of five-year experience in the participant's recorded sport was required. Exclusion criteria: 1-History of cardiovascular disorders. 2-History of respiratory disorders. 3-History of neurological disorders. 4-Previous lower extremity injury. 5-The athlete suffered from a previous anterior cruciate ligament injury.

Intervention groups

The study has two intervention groups: the Quadriceps group (intervention group 1) and the hamstring group (intervention group 2). The three-dimensional (3D) kinematic and kinetic data of the knee joint will be analyzed before and after the fatigue protocol of quadriceps and hamstring muscles during a forward-drop jump with a single-leg landing. A 3D motion analysis system and Isokinetic dynamometer will be used to measure the knee's Kinematics and Kinetics and fatigue level of quadriceps and hamstring muscles, respectively.

Main outcome variables

Peak knee flexion angle. Peak vGRF (vertical ground reaction force). Proximal tibial anterior shear force. Knee flexion-extension moments. Knee valgus-varus moment.

General information

Reason for update

Acronym

IRCT registration information

IRCT registration number: **IRCT20230329057784N1**
Registration date: **2023-05-05, 1402/02/15**
Registration timing: **registered_while_recruiting**

Last update: **2023-05-05, 1402/02/15**
Update count: **0**

Registration date

2023-05-05, 1402/02/15

Registrant information

Name
Waleed Mahmoud
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Prince Sattam bin Abdulaziz University
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Saudi Arabia
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Recruitment status

Recruitment complete

Funding source

Expected recruitment start date

2023-05-01, 1402/02/11

Expected recruitment end date

2023-08-31, 1402/06/09

Actual recruitment start date

empty

Actual recruitment end date

empty

Trial completion date

empty

Scientific title

Is there a difference in knee biomechanics due to fatigue of the quadriceps versus hamstrings during landing on a single limb? Three-dimensional analysis study

Public title

The difference between fatigue of quadriceps and hamstrings muscles on knee biomechanics during landing on one limb

Purpose

Screening

Inclusion/Exclusion criteria

Inclusion criteria:

The age ranged from 20-25 years. A minimum of five-year experience in the recorded sport was required.

Exclusion criteria:

History of cardiovascular problems. History of respiratory problems. History of neurological disorders. History of neurological problems. Anterior cruciate ligament injury. Previous lower extremity injury.

Age

From **20 years** old to **25 years** old

Gender

Male

Phase

N/A

Groups that have been masked

- Outcome assessor

Sample size

Target sample size: **90**

Randomization (investigator's opinion)

Randomized

Randomization description

Each of the 108 athletes was given a number. A researcher not involved in the study performed the randomization using sealed envelopes. Each envelope was labeled as either a Quadriceps group "Intervention group 1" or a Hamstring group "Intervention group 2". Each athlete was requested to choose a sealed envelope using a 1:1 simple randomization. The examining researcher/assessor was not included in the randomization process and was unaware of the group allocation. Athletes will be asked not to report their treatment allocation to the examiner/researcher during their assessment.

Blinding (investigator's opinion)

Single blinded

Blinding description

The athletes were recruited and assigned randomly into one of the two groups. Based on the simple randomization design 1:1 ratio, A researcher not involved in the study performed the randomization using sealed envelopes. Each envelope was labeled as either a Quadriceps group "Intervention group 1" or a Hamstring group "Intervention group 2". Each athlete was requested to choose a sealed envelope. The examining researcher/assessor was not included in the randomization process and was unaware of the group allocation so, the outcome assessor/investigator researcher will examine the outcome measures without knowing the study groups.

Placebo

Not used

Assignment

Parallel

Other design features

Secondary Ids

empty

Ethics committees

1

Ethics committee

Name of ethics committee

The Standing Committee of Bioethics Research (SCBR).

Street address

King Abduallah Abdulaziz street

City

Al-Kharj

Postal code

11942

Approval date

2023-01-10, 1401/10/20

Ethics committee reference number

No: 002/2023.

Health conditions studied

1

Description of health condition studied

the effects of the fatigued quadriceps muscle.

ICD-10 code

T73.3XXA

ICD-10 code description

Exhaustion due to excessive exertion, initial encounter

2

Description of health condition studied

2- We will study the effects of the fatigued hamstring muscle.

ICD-10 code

T73.3XXA

ICD-10 code description

Exhaustion due to excessive exertion, initial encounter

Primary outcomes

1

Description

The peak knee flexion angle (in degrees).

Timepoint
Pre- and post-fatigue program.
Method of measurement
3D motion analysis system (Vicon).

2

Description
The peak vGRF (expressed in BW) at initial contact.
Timepoint
Pre- and post-fatigue program.
Method of measurement
Force plate forms (Vicon).

3

Description
The proximal tibial anterior shear force was measured in (Nm/Kg).
Timepoint
Pre- and post-fatigue program.
Method of measurement
3D motion analysis system (Vicon).

4

Description
The knee flexion-extension moments.
Timepoint
Pre- and post-fatigue program.
Method of measurement
3D motion analysis system (Vicon).

5

Description
Knee valgus-varus moment were measured in (Nm/Kg*m).
Timepoint
Pre- and post-fatigue program.
Method of measurement
3D motion analysis system (Vicon).

Secondary outcomes

empty

Intervention groups

1

Description
In Intervention Group 1 (quadriceps muscle group), the 3D kinematic and kinetic data of the knee joint will be collected before and after the fatigue protocol applied to the quadriceps muscle during a single-leg landing in a forward-drop jump task. The 3D motion analysis system consists of the 12 infrared cameras (100Hz) of motion capture system Vicon (Oxford Metrics Limited UK), and two ground reaction forces collect synchronously at 2000 Hz with an AMTI GEN–5 force plate (Watertown, MA, USA). The participant will stand over a 30-cm height box, which will be placed 20 cm behind the force plate form, and perform a forward drop jump onto the force plate, landing on the forefoot (metatarsal heads) with a dominant single leg. The peak torque of quadriceps muscles will be determined by an isokinetic dynamometer (CSMI Humac 2009, Cybex II, II+, version 129, USA) to measure maximal voluntary concentric contraction (MVCC) at 120°.s-1 and the range of motion, in which the measured peak torque, is available from 10 to 90 degrees of knee flexion. The fatigue protocol commences with performing three consecutive repetitions of knee extension of MVCC at 300°.s-1 (16) until the torque measured in the quadriceps declines below 50% of the participant's baseline peak torque value. A 30-second rest will be provided to the participant who will be asked again to replicate MVCC of knee extension until the baseline of peak torque of quadriceps muscle drops to 50% of its value. The cycle of MVCC and rest will be repeated. If five consecutive cycles decrease the baseline of quadriceps' baseline of peak torque to 50%, fatigue is achieved.
Category
Diagnosis

2

Description
In Intervention Group 2 (hamstrings muscle group), the 3D kinematic and kinetic data of the knee joint will be collected before and after the fatigue protocol applied to the hamstrings muscle during a single-leg landing in a forward-drop jump task. The 3D motion analysis system consists of the 12 infrared cameras (100Hz) of motion capture system Vicon (Oxford Metrics Limited UK), and two ground reaction forces collect synchronously at 2000 Hz with an AMTI GEN–5 force plate (Watertown, MA, USA). The participant will stand over a 30-cm height box, which will be placed 20 cm behind the force plate form, and perform a forward drop jump onto the force plate, landing on the forefoot (metatarsal heads) with a dominant single leg. The peak torque of hamstrings muscles will be determined by an isokinetic dynamometer (CSMI Humac 2009, Cybex II, II+, version 129, USA) to measure maximal voluntary concentric contraction (MVCC) at 120°.s-1 and the range of motion, in which the measured peak torque, is available from 10 to 90 degrees of knee flexion. The fatigue protocol commences with performing three consecutive repetitions of knee flexion of MVCC at 300°.s-1 (16) until the torque measured in the hamstrings declines below 50% of the participant's baseline peak torque value. A 30-second rest will be provided to the participant who will be asked again to replicate MVCC of knee flexion until the baseline of peak torque of hamstrings muscle drops to 50% of its value. The cycle of MVCC and rest will be repeated. If five consecutive cycles decrease the baseline of hamstring's baseline of peak torque to 50%, fatigue is achieved.
Category
Diagnosis

Recruitment centers

1

Recruitment center

Name of recruitment center
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Email
alshullaclub@ alshullaclub.net
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Sponsors / Funding sources

1

Sponsor

Name of organization / entity
Prince Sattam Bin Abdulaziz University
Full name of responsible person
Mohammed Alshehri
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Grant name
Prince Sattam Bin Abdulaziz University
Grant code / Reference number
2022/03/22477
Is the source of funding the same sponsor organization/entity?
Yes
Title of funding source
Prince Sattam Bin Abdulaziz University
Proportion provided by this source
100
Public or private sector
Public
Domestic or foreign origin
Domestic
Category of foreign source of funding
empty
Country of origin
Type of organization providing the funding
Academic

Person responsible for general inquiries

Contact

Name of organization / entity
Prince Sattam Bin Abdulaziz University
Full name of responsible person
Waleed Salah Eldin Mahmoud
Position
Associate Professor
Latest degree
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Other areas of specialty/work
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Sharing plan

Deidentified Individual Participant Data Set (IPD)

Yes - There is a plan to make this available

Study Protocol

Yes - There is a plan to make this available

Statistical Analysis Plan

Yes - There is a plan to make this available

Informed Consent Form

Yes - There is a plan to make this available

Clinical Study Report

Undecided - It is not yet known if there will be a plan to make this available

Analytic Code

Undecided - It is not yet known if there will be a plan to make this available

Data Dictionary

Undecided - It is not yet known if there will be a plan to make this available

Title and more details about the data/document

Patient information sheet, raw data, results

When the data will become available and for how long

After publication

To whom data/document is available

Public

Under which criteria data/document could be used

Statistical analysis

From where data/document is obtainable

Researchgate

What processes are involved for a request to access data/document

via email. research gate

Comments