Clinical Trial Protocol
Iranian Registry of Clinical Trials

22 Nov 2026

The effect and durability of dual-task plyometric and complex training on neuromuscular and athletic performance in basketball players identified as ankle sprain copers

Protocol summary

Study aim

Comparison of the effect of dual-task plyometric and complex training on neuromuscular performance (muscle strength, explosive power, proprioception, and dynamic balance) and sports performance (functional ankle instability, landing quality, hopping, and technical skills) in Copper basketball players.

Design

a three-arm parallel randomized controlled trial with a computer-generated random sequence

Settings and conduct

This study will be conducted in sports sciences in Qazvin, with participants randomly assigned to one of three groups: dual-task plyometric training group, complex training group, or control. Assessments will occur in three phases: pre-test, after eight weeks of training, and after four weeks of detraining.

Participants/Inclusion and exclusion criteria

Inclusion criteria: female amateur basketball players aged 14–17, ≥3 years of regular training, history of lateral ankle sprain (>12 months ago, ≥1 week rest) with no giving-way episodes in the past year, no prior ankle rehab, specified scores on ankle instability measures, ability to squat with 150% body weight, stand on one leg and perform 25%/50% single-leg squats (eyes open/closed) for 30 s without tremor, and perform a standing long jump equal to height, with no musculoskeletal, visual, vestibular, or neuromuscular disorders affecting the study. Exclusion criteria: >2 consecutive or >3 non-consecutive absences, or any injury/physical complaint from training.

Intervention groups

Three groups will participate: the dual-task plyometric training group, the complex training group, and the control group. All sessions will begin with a standardized warm-up.

Main outcome variables

Muscle strength, explosive power, proprioception, dynamic balance, functional ankle instability, landing quality, technical skills, hopping.

General information

Reason for update

Acronym

IRCT registration information

IRCT registration number: **IRCT20260615069818N1**
Registration date: **2026-07-08, 1405/04/17**
Registration timing: **retrospective**

Last update: **2026-07-08, 1405/04/17**
Update count: **0**

Registration date

2026-07-08, 1405/04/17

Registrant information

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Recruitment status

Recruitment complete

Funding source

Expected recruitment start date

2026-06-22, 1405/04/01

Expected recruitment end date

2026-06-28, 1405/04/07

Actual recruitment start date

empty

Actual recruitment end date

empty

Trial completion date

empty

Scientific title

The effect and durability of dual-task plyometric and complex training on neuromuscular and athletic performance in basketball players identified as ankle sprain copers

Public title

The effect of dual-task plyometric and complex training on neuromuscular and athletic performance in basketball players

Purpose

Supportive

Inclusion/Exclusion criteria

Inclusion criteria:

Amateur female basketball players aged 14 to 17 years. At least three years of participation in regular basketball training at organized clubs. History of at least one lateral ankle sprain (requiring a minimum of one week of rest) that occurred more than 12 months ago. No history of ankle "giving way" (instability episodes) in the past 12 months. No participation in an ankle rehabilitation program. Achieving a score of 25 or higher on the Cumberland Ankle instability instrument. Achieving a score of less than 5 on the ankle measurement tool. Ability to perform a squat with 150% of body weight to qualify for plyometric training. Ability to stand on one leg and perform 25% and 50% single-leg squats, with eyes open and closed, for 30 seconds each, without tremors or wobbling. Ability to perform a standing long jump equal to the individual's height. Absence of musculoskeletal abnormalities in the trunk, upper extremities, or lower extremities that could affect the research. Absence of visual, vestibular, or neuromuscular disorders that could affect the research.

Exclusion criteria:

More than two consecutive absences or three non-consecutive absences during the study. Occurrence of injury (any physical complaint) resulting from training.

Age

From **14 years** old to **17 years** old

Gender

Female

Phase

N/A

Groups that have been masked

No information

Sample size

Target sample size: **48**

Randomization (investigator's opinion)

Randomized

Randomization description

Eligible participants will be randomly assigned to one of three groups: a dual-task plyometric training group, a complex training group, or a control group. Randomization will be performed using a computer-generated sequence created at https://www.randomizer.org with a 1:1:1 allocation ratio using random permuted blocks of sizes 3 and 6 to ensure balanced group sizes throughout the trial. The randomization sequence will be generated prior to the commencement of the study by an independent researcher not involved in participant recruitment, baseline assessments, or intervention delivery. The allocation sequence will be concealed using sequentially numbered, opaque, sealed envelopes. After completion of all baseline assessments, the assessor will open the next envelope in sequence to reveal the participant's group assignment. The researcher responsible for generating the sequence and preparing the envelopes will not participate in any subsequent data collection or intervention. Therefore, both outcome assessors and intervention providers will remain blinded to the allocation sequence, ensuring adequate allocation concealment and minimizing selection bias.

Blinding (investigator's opinion)

Not blinded

Blinding description

Placebo

Not used

Assignment

Parallel

Other design features

Secondary Ids

empty

Ethics committees

1

Ethics committee

Name of ethics committee

Research Ethics Committees of University of Guilan

Street address

5th Kilometer of Persian Gulf Highway, Rasht, Guilan Province, Iran

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Approval date

2026-05-25, 1405/03/04

Ethics committee reference number

IR.GUILAN.REC.1405.033

Health conditions studied

1

Description of health condition studied

Sprain of ankle

ICD-10 code

S93.4

ICD-10 code description

Sprain of ankle

Primary outcomes

1

Description

Dynamic Balance

Timepoint

Measurements will be performed at three time points: baseline (before the intervention), immediately after the eight-week intervention period, and at follow-up (three weeks after the cessation of training).

Method of measurement

Dynamic balance will be assessed using the Y Balance Test. The participant stands on one leg at the center of the device and reaches with the other leg in three directions: anterior, posteromedial, and posterolateral. The reach distance is recorded in centimeters and normalized to the participant's limb length. The test is performed on both right and left legs, and the average of three successful trials for each direction is recorded as the final score.

2

Description

Muscle Strength

Timepoint

Measurements will be performed at three time points: baseline (before the intervention), immediately after the eight-week intervention period, and at follow-up (three weeks after the cessation of training).

Method of measurement

Muscle strength of the ankle plantarflexor, dorsiflexor, and evertor muscles will be measured using a hand-held dynamometer. The participant performs a maximal voluntary isometric contraction against the dynamometer for five seconds, and the peak force is recorded in Newtons. Three trials are performed for each muscle group, and the average of the three trials is used for analysis.

3

Description

Muscle Power

Timepoint

Measurements will be performed at three time points: baseline (before the intervention), immediately after the eight-week intervention period, and at follow-up (three weeks after the cessation of training).

Method of measurement

Muscle power will be assessed using the countermovement jump test performed on a force plate or jump mat. The participant starts from a standing position, performs a rapid countermovement to a self-selected depth, and then jumps vertically as high as possible. Jump height is calculated from flight time or ground reaction force data, and the highest of three trials is recorded.

4

Description

Functional Ankle Instability

Timepoint

Measurements will be performed at three time points: baseline (before the intervention), immediately after the eight-week intervention period, and at follow-up (three weeks after the cessation of training).

Method of measurement

Functional ankle instability will be assessed using the Cumberland Ankle Instability Tool, a validated nine-item questionnaire that evaluates ankle function, giving sensation, and perceived instability during daily and sporting activities. The total score ranges from 0 to 30, with lower scores indicating greater instability.

5

Description

Landing Quality

Timepoint

Measurements will be performed at three time points: baseline (before the intervention), immediately after the eight-week intervention period, and at follow-up (three weeks after the cessation of training).

Method of measurement

Landing quality will be assessed using the Landing Error Scoring System, a standardized observational tool that evaluates jump-landing biomechanics. The participant performs a drop-jump from a 30-cm box, immediately followed by a maximum vertical jump, and lands with both feet. The movement is video-recorded from the frontal and sagittal planes, and trained assessors score specific errors, including knee valgus, trunk flexion, and foot placement. Lower total error scores indicate better landing quality.

6

Description

Knee Joint Position Sense (Proprioception)

Timepoint

Measurements will be performed at three time points: baseline (before the intervention), immediately after the eight-week intervention period, and at follow-up (three weeks after the cessation of training).

Method of measurement

Knee joint position sense will be assessed using a joint position sense test performed on an isokinetic dynamometer. The participant's knee is passively moved to a target angle (e.g., 30° or 60° of flexion), held for five seconds, and then returned to the starting position. The participant is then asked to actively reproduce the target angle. The absolute angular error between the target angle and the reproduced angle is recorded in degrees. Three trials are performed for each target angle, and the average error is used for analysis.

7

Description

Hopping Performance

Timepoint

Measurements will be performed at three time points: baseline (before the intervention), immediately after the

eight-week intervention period, and at follow-up (three weeks after the cessation of training).

Method of measurement

Hopping performance will be assessed using the triple hop test. The participant stands on the test leg and performs three consecutive maximal forward hops, landing on the same leg each time. The total distance covered from the starting line to the final landing point is measured in centimeters. Two trials are performed on each leg, and the longest distance for each leg is recorded for analysis.

8

Description

Technical Skill

Timepoint

Measurements will be performed at three time points: baseline (before the intervention), immediately after the eight-week intervention period, and at follow-up (three weeks after the cessation of training).

Method of measurement

Technical skills will be evaluated using sport-specific tests appropriate to the participants' competitive level. These include a passing accuracy test (number of successful passes to a target out of 10 attempts), a dribbling speed test (time to complete a slalom course), and a shooting accuracy test (number of successful shots on target out of 10 attempts). All tests are performed three times, and the average score is used for analysis.

Secondary outcomes

empty

Intervention groups

1

Description

Intervention group: Complex training group: Participants will perform an 8-week complex training protocol, two sessions per week, 60 minutes each session. Each session includes 4 complexes (4 resistance exercises and 4 plyometric exercises), with warm-up and cool-down.

Category

Rehabilitation

2

Description

Intervention group: Dual-task plyometric training group: Participants will perform an 8-week protocol, two sessions per week, 45 minutes each session, combining plyometric exercises with a cognitive task (backward counting in 4 difficulty levels), including warm-up and cool-down.

Category

Rehabilitation

3

Description

Control group: The control group received no additional intervention, except for the same warm-up as the other groups, and continued their regular basketball training.

Category

Other

Recruitment centers

1

Recruitment center

Name of recruitment center

Faculty of Physical Education and Sports Sciences, University of Guilan Complex, Persian Gulf Highwa

Full name of responsible person

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Sponsors / Funding sources

1

Sponsor

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Grant name

Grant code / Reference number

Is the source of funding the same sponsor organization/entity?

Yes

Title of funding source

University of Guilan

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
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Full name of responsible person
Hassan Daneshmandi

Position
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Latest degree
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Other areas of specialty/work
Sport Science

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

Informed Consent Form
Yes - There is a plan to make this available

Clinical Study Report
Yes - There is a plan to make this available

Analytic Code
Not applicable

Data Dictionary
Not applicable

Title and more details about the data/document
Some of the images used in the study will be corrupted.

When the data will become available and for how long
From 01/09/2026 to 12 months later

To whom data/document is available
Researcher

Under which criteria data/document could be used
An official email should be used to contact the corresponding author.

From where data/document is obtainable
corresponding author.

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

official email

Comments