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Comparing the effects of different exercise sequences on shoulder recovery in male racket sport players

Submission date
27/03/2026

Recruitment status
No longer recruiting

Registration date
30/03/2026

Overall study status
Completed

Last Edited
30/03/2026

Condition category
Musculoskeletal Diseases

[_] Prospectively registered
[_] Protocol
[X] Statistical analysis plan
[_] Results
[_] Individual participant data
[X] Record updated in last year

Plain English summary of protocol

Background and study aims
Racket sports like tennis and badminton place high mechanical demands on the shoulder, often causing discomfort and injury. Recent rehabilitation approaches suggest that whole-body coordination, especially from the pelvis and core, is vital for shoulder recovery. This study aims to find the most effective sequence of exercises by comparing two rehabilitation programs: one starting with pelvic-lumbar (core) coordination exercises followed by shoulder stabilization, and the other performing the reverse order.

Who can participate?
Adult male recreational racket-sport participants who have experienced persistent shoulder discomfort.

What does the study involve?
Participants are randomly divided into two groups. Both groups complete the same two 20-minute exercise sessions (a pelvic-lumbar core program and a shoulder stabilization program) but in opposite orders. The two sessions are separated by a 24-hour rest period. Shoulder movement and coordination are evaluated using a smartphone camera (motion analysis) at three time points: 5 minutes before the first program, 5 minutes after the first program, and 5 minutes after the second program.

What are the possible benefits and risks of participating?
The possible benefits include improvements in shoulder mobility, function, and whole-body coordination during movements. The risks are minimal, primarily involving temporary mild muscle fatigue or soreness typical of standard exercise rehabilitation programs.

Where is the study run from?
The study is run from the Republic of Korea, involving researchers from Seoul National University and Ajou University, with ethical approval from Jeonbuk National University.

When is the study starting and how long is it expected to run for?
March 2025 to July 2025.

Who is funding the study?
Investigator initiated and funded.

Who is the main contact?
Dr. Donghwi Suh, donghwisuh@hanmail.net

Contact information

Type(s)
Public, Scientific, Principal investigator

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Study information

Scientific Title
The effects of a lumbar-shoulder exercise rehabilitation sequence compared to a shoulder-lumbar sequence on shoulder joint function recovery in male recreational racket sport participants with shoulder discomfort

Acronym
CSAT

Study objectives
To compare the effects of two exercise rehabilitation sequences (pelvic-lumbar coordination training followed by shoulder stabilization, and the reverse order) on shoulder joint function and coordination recovery in male recreational racket-sport participants.

Ethics approval required
Ethics approval required

Ethics approval(s)

Approved 05/03/2025, Institutional Review Board of Jeonbuk National University (567, Baekje-daero, Deokjin-gu, Jeonju-si, Jeollabuk-do, 54896, Republic of Korea, 3rd Floor, Jeonbuk National University Main Building, Jeonju, 54896, Korea, South; +82-063-270-4889; ahnth2@jbnu.ac.kr), ref: 2025-02-021-001

Primary study design
Interventional

Allocation
Randomized controlled trial

Masking
Open (masking not used)

Control
Active

Assignment
Crossover

Purpose
Treatment

Study type(s)

Health condition(s) or problem(s) studied
Shoulder discomfort

Interventions
Participants were randomly assigned to the groups using a computer-generated random number sequence. The allocation sequence was concealed and implemented using sealed opaque envelopes.
LS Group: Completes a 20-minute lumbar-focused program (Core Stabilization Adjustment Training) first, followed by a 24-hour rest, and then a 20-minute shoulder-focused stabilization program.
SL Group: Completes a 20-minute shoulder-focused stabilization program first, followed by a 24-hour rest, and then a 20-minute lumbar-focused program (Core Stabilization Adjustment Training). The total duration of the intervention for each participant spans two days, with testing conducted 5 minutes before and after each session.

Intervention Type
Behavioural

Primary outcome(s)
1. Dominant and non-dominant shoulder Range of Motion (ROM) during discrete and continuous movements measured using a video-based motion analysis (calculating joint angles using MediaPipe Pose Landmarker to extract 3D joint coordinates) at 5 minutes before the first program (pre-test), 5 minutes after the first program (post-test 1), and 5 minutes after the second program (post-test 2)

Key secondary outcome(s)
1. Dynamical degrees of freedom (DDOF) during discrete and continuous movements measured using a Principal Component Analysis (PCA) of 3D joint angles extracted via video-based motion analysis (MediaPipe Pose) at 5 minutes before the first program, 5 minutes after the first program, and 5 minutes after the second program

2. Biomechanical degrees of freedom (BDOF) during discrete and continuous movements measured using the total number of unique joint motions across significant principal components calculated from video-based motion analysis at 5 minutes before the first program, 5 minutes after the first program, and 5 minutes after the second program

Completion date
31/07/2025

Eligibility

Key inclusion criteria
1. Adult male recreational racket-sport participants.
2. Individuals who have received medical clearance to engage in shoulder rehabilitation exercises following the onset of shoulder pain.
3. Individuals reporting persistent shoulder discomfort lasting at least three months prior to study participation.

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
32 Years

Upper age limit
44 Years

Sex
Male

Total final enrolment
32

Key exclusion criteria
1. Individuals with neurological disorders.
2. Individuals with biomechanical alterations resulting from pathological conditions.

Date of first enrolment
05/03/2025

Date of final enrolment
31/07/2025

Locations

Countries of recruitment
Korea, South

Sponsor information

Organisation
Daegu Catholic University

ROR
https://ror.org/04fxknd68

Funder(s)

Funder type

Funder Name
Catholic University of Daegu

Alternative Name(s)
Daegu Catholic University, , DCU, CU

Funding Body Type
Private sector organisation

Funding Body Subtype
Universities (academic only)

Location
Korea, South

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not expected to be made available

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?

Statistical Analysis Plan	30/03/2026	No	No