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Efficacy of tilt table standing training combined with body weight supported treadmill training in patients with ankle fracture

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Registration date 10/07/2026	**Overall study status** Completed	[_] Statistical analysis plan [_] Results
Last Edited 03/07/2026	**Condition category** Surgery	[_] Individual participant data [X] Record updated in last year

Plain English summary of protocol

Background and study aims

Ankle fractures are one of the most common lower limb fractures worldwide. Postoperative long-term immobilization and restricted weight-bearing often lead to disuse muscle atrophy, ankle joint stiffness, osteoporosis, delayed functional recovery, and impaired daily activity capacity, imposing physical and economic burdens on patients. Traditional postoperative rehabilitation relies on conservative passive training, while early weight-bearing interventions, including Tilt Table Standing Training (TTST) and Body Weight Supported Treadmill Training (BWSTT), have shown promising rehabilitation potential for lower limb injuries, yet their combined application after ankle fracture surgery lacks sufficient clinical evidence.

This study aims to evaluate the effectiveness of standard rehabilitation combined with early TTST plus BWSTT versus routine standard rehabilitation alone in patients with surgically treated Weber B/C ankle fractures. We will compare pain, ankle swelling, ankle range of motion, ankle muscle strength, ankle proprioception, and ankle function between two groups at postoperative day 2, week 4, and week 8 to find out whether the combined early weight-bearing training can better relieve pain, reduce joint dysfunction, improve neuromuscular control, and accelerate overall functional recovery after ankle fracture surgery.

Who can participate?

Patients aged 18 to 65 years with Weber type B or C ankle fracture who have received open reduction and internal fixation surgery for ankle fracture and are physically capable of receiving standardized postoperative rehabilitation training

What does the study involve?

If you agree to participate, you will be allocated to either the control group or the experimental group according to your admission date.

Part 1: Unified standard rehabilitation for all participants

Rehabilitation training is divided into three phases:

Weeks 0–2: Active toe flexion/extension, straight leg raise, quadriceps isometric contraction, hip passive/active range of motion training

Weeks 2–4: Soft tissue massage of foot and calf, ankle pump exercises, ankle inversion-eversion mobility training
Weeks 4–8: Progressive short-distance weight-bearing walking, resistance band ankle strength training for dorsiflexion, plantarflexion, inversion and eversion

Part 2: Additional training for the experimental group only
Tilt Table Standing Training (TTST): Started at postoperative week 1. The tilt angle and training duration will increase gradually weekly based on your tolerance, with a target of 70–80° tilt for 20–30 minutes per session by week 4. Vital signs will be continuously monitored during training;
Body Weight Supported Treadmill Training (BWSTT): Started at postoperative week 4. Initial partial body weight support (25%–40%) and slow walking speed (1.0–2.0 km/h), 10 minutes per session, 3 times weekly. Weight support will be reduced and training time extended weekly as your physical condition improves.

Part 3: Standardized outcome assessments
All participants will undergo baseline data collection and three standardized outcome assessments at postoperative day 2, postoperative week 4, and postoperative week 8 to measure pain, ankle swelling, ankle range of motion, ankle muscle strength, ankle proprioception, and ankle function. All assessments will be performed by a professional physical therapist independent from the rehabilitation trainers.

Part 4: Safety monitoring
Throughout all training sessions, therapists will monitor your pain, vital signs, gait, and perceived exertion. Training will be suspended or terminated immediately if safety thresholds are reached. All adverse events and training adjustments will be fully documented.

What are the possible benefits and risks of participating?
Potential benefits:
1. You will receive systematic, standardized postoperative ankle fracture rehabilitation guidance free of additional study-related charges
2. If assigned to the experimental group, you will receive early progressive weight-bearing training (tilt table + body weight supported treadmill), which may relieve postoperative pain faster, improve ankle mobility, muscle strength, proprioception and overall ankle function more effectively than routine rehabilitation
3. You will receive professional objective joint function assessments at three critical recovery stages, which can help clinicians fully grasp your rehabilitation progress and adjust personalized training plans timely
4. Your participation will generate clinical evidence to optimize early rehabilitation protocols for ankle fracture patients, which will benefit future patients with similar injuries
Potential risks and discomforts:
1. Temporary mild pain or muscle soreness: Training may trigger transient ankle or calf muscle ache; training intensity will be reduced or suspended if pain exceeds the safety threshold
2. Transient dizziness, nausea, or palpitations during tilt table standing: Vital signs are monitored in real time, and training will stop immediately if you report such discomfort
3. Minor fatigue during treadmill training: Training duration and weight support will be adjusted according to your subjective fatigue score
4. Rare adverse risks: Wound swelling aggravation, abnormal joint reaction, or unstable fracture fixation (strict inclusion criteria and real-time safety monitoring minimize this risk; training will be terminated and medical intervention arranged immediately if relevant signs occur)
All adverse reactions encountered during the study will receive free clinical evaluation and corresponding medical treatment from our hospital’s rehabilitation and orthopedic team.

Where is the study run from?
The First Affiliated Hospital of the University of Science and Technology of China

When is the study starting and how long is it expected to run for?
July 2023 to July 2025

Who is funding the study?
Major Project of Natural Science Research Fund of Universities in Anhui Province (China)

Who is the main contact?
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Study information

Scientific Title
Application of ERAS in patients undergoing perioperative treatment of ankle fractures

Study objectives
This study evaluated a combined rehabilitation protocol for improving recovery after Weber B/C ankle fracture surgery, compared to standard care.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 04/05/2023, Ethics Committee of the First Affiliated Hospital of the University of Science and Technology of China (IRB, Institutional Review Board) (The First Affiliated Hospital of USTC, Division of Life Sciences and Medicine, University of Science and Technology of China, Hefei, 230001, China; +86 (0)62282931; 505509758@QQ.com), ref: XJS 2023-1-38 NK

Primary study design
Interventional

Allocation
Non-randomized controlled trial

Masking
Blinded (masking used)

Control
Active

Assignment
Single

Purpose
Treatment

Study type(s)

Health condition(s) or problem(s) studied

Recovery after Weber B/C ankle fracture surgery

Interventions
In this non-randomized trial, 144 patients were assigned to a control group (CG, standard rehabilitation) or an experimental group (OG, standard rehab plus the combined protocol). The combined rehabilitation protocol involved tilt-table standing initiated at 1 week postoperatively plus body-weight-supported treadmill training from week 4.

Intervention Type
Procedure/Surgery

Primary outcome(s)
1. Pain severity measured using the 10-cm visual analogue scale (VAS) at postoperative day 2, postoperative week 4, and postoperative week 8

2. Ankle swelling severity measured using bilateral ankle circumference difference with a flexible tape measure at postoperative day 2, postoperative week 4, and postoperative week 8

3. Ankle function measured using the American Orthopaedic Foot & Ankle Society (AOFAS) scoring scale at postoperative day 2, postoperative week 4, and postoperative week 8

4. Ankle proprioception measured using the Biodex System 4 dynamometer via active joint position reproduction testing at postoperative day 2, postoperative week 4, and postoperative week 8

5. Ankle range of motion (ROM) measured using a universal goniometer for active dorsiflexion-plantarflexion and inversion-eversion movements at postoperative day 2, postoperative week 4, and postoperative week 8

6. Ankle muscle strength (peak isometric torque) measured using the Biodex System 4 dynamometer at postoperative day 2, postoperative week 4, and postoperative week 8

Key secondary outcome(s)

Completion date
02/11/2025

Eligibility

Key inclusion criteria
1. Clear history of trauma, with preoperative Weber B/C ankle fractures confirmed by X-ray or CT examination
2. Received open reduction and internal fixation and was able to participate in early standardized rehabilitation
3. Willing to undergo postoperative rehabilitation training and follow-up assessments, and able to provide signed informed consent

Healthy volunteers allowed
No

Age group

Mixed

Lower age limit
18 Years

Upper age limit
65 Years

Sex
All

Total final enrolment
144

Key exclusion criteria
1. Pathological fractures due to tumors, infections, lower extremity thrombosis, metabolic bone diseases
2. Skeletally immature patients with open physis (age <16 years)
3. History of previous ipsilateral ankle surgery, fracture sequelae, or pre-existing ankle osteoarthritis
4. Associated injuries affecting lower limb rehabilitation (e.g., ipsilateral tibial fracture, spinal or neural injuries)

Date of first enrolment
01/07/2023

Date of final enrolment
01/07/2025

Locations

Countries of recruitment
China

Study participating centre
The First Affiliated Hospital of the University of Science and Technology of China
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Sponsor information

Organisation
The First Affiliated Hospital of the University of Science and Technology of China

Funder(s)

Funder type

Funder Name
Major Project of Natural Science Research Fund of Universities in Anhui Province: Research on the Mechanism of Lianjin Manipulation in Treating Knee Osteoarthritis Based on TLR/NF-κB Signaling Pathway, KJ2021ZD0062

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not expected to be made available