PHYSIOTHERAPY & REHABILITATION PROTOCOL

Post-Operative Fibula Plate Removal

Diagnosis: Post-operative removal of fibula osteosynthesis plate (hardware removal)	
	Program Duration: 8 weeks (4 phases x 2 weeks)
Target: Return to running (W7-8) → conditional team training clearance	

CLINICAL CONTEXT & POST-IMPLANT REMOVAL RISK PROFILE

SPECIFIC RISKS FOR THIS ATHLETE:

- 60% fibula involvement → reduced lateral column stiffness → stress riser vulnerability at screw holes
- Infection history → lower threshold for infection red flags (night pain, warmth, subtle swelling)
- Screw holes → avoid high torsional loads for 6-8 weeks minimum until cortical remodeling
- 4. Re-operated soft tissue → peroneal tendon/nerve sensitivity, scar tissue management needed

MANDATORY LOAD PROGRESSION RULES

Pain & Inflammation Monitoring

RULE 1: Pain must remain BELOW 4/10 during exercise AND must NOT increase the following morning. [Source: SAM Protocol + MOC-carga-progresiva]

RULE 2: No swelling or reactive flare within 24 hours post-session. [Source: SAM Protocol]

RULE 3: Progress VOLUME before INTENSITY — never increase both simultaneously. [Source: MOC-carga-progresiva]

RULE 4: Apply +10-15% weekly load increase rule. [Source: SAM Protocol]

RULE 5: Volume before intensity applies to running load too — increase duration before speed.

Red Flags for Regression

RED FLAG 1: Pain >4/10 during exercise → REDUCE load 30%, reassess in 48h
RED FLAG 2: Increased morning stiffness vs. baseline → REDUCE volume, increase mobility work
RED FLAG 3: Local warm or swelling → STOP loading for 24-48h
RED FLAG 4: Night pain at surgical site → STOP ALL LOADING, medical review IMMEDIATELY (infection risk)
RED FLAG 5: Fatigue-related pain at screw hole sites → reduce impact activities, reassess bone integrity
INFECTION-SPECIFIC MONITORING (given patient history):
- Monitor temperature, CRP if available
- Night pain is the EARLIEST indicator — do not dismiss
- Subtle swelling at incision site without mechanical cause → urgent medical review

BIOMECHANICAL PRECAUTIONS — FIBULA POST-IMPLANT REMOVAL

Structural Considerations

60% fibula involvement → lateral column stiffness is REDUCED:
- Screw holes create stress risers (cortical weakening at hole sites)
- Cortical bone requires 6-12 weeks to remodel screw hole defects [Clinical consensus + Lim2022 extrapolation]
- Peroneal musculature may be sensitized from re-operation (scarring, retraction during surgery)
- Syndesmotic stability should be reassessed post-removal if syndesmotic screws were part of original fixation

Strictly Prohibited in Early Phases (Weeks 1-4)

PROHIBITED: High-speed cutting or change of direction
PROHIBITED: High torsional loads on the ankle (aggressive rotational movements)
PROHIBITED: Aggressive lateral plyometrics (lateral bounds, lateral drop jumps)
PROHIBITED: Single-leg impact landing from height on operated side
PROHIBITED: Running on uneven surfaces
PROHIBITED: Contact or body challenges
RATIONALE: Torsional loads generate peak stress at screw hole sites. Until cortical remodeling is sufficient (typically 6-8 weeks), these loads carry fracture risk. [Vault: Lim2022 — stress fracture at cortical notching post-implant removal]

Frontal Plane Control — Critical Priority

The fibula is the primary stabilizer of the lateral column of the ankle. With 60% involvement and post-surgical soft tissue disruption:
- Peroneal activation and frontal plane control must be prioritized from Week 1
- Lateral weight shifts, single-leg stance, and perturbation training in the frontal plane are ESSENTIAL
- Ankle eversion strength must be rebuilt systematically before any lateral movement demands
- Assess and retrain fibularis longus/brevis motor control (may have AMI-like inhibition post-surgery)
CLINICAL NOTE: Frontal plane deficit + screw hole stress risers = HIGH RISK for lateral ankle instability under load. Build this capacity BEFORE introducing lateral sport-specific demands.

PHASE I — WEEKS 1-2: CONTROLLED RE-LOADING

Maintain pain-free FWB. Restore ankle mobility. Prioritize peroneal activation. Begin isometric + slow isotonic foundation.

Goals	• Pain-free full weight bearing with normalized gait (no antalgic pattern) • Restore ankle dorsiflexion ROM (target: >5° in WB lunge test by end of W2) • Activate peroneal musculature (eversion strength, motor control) • Begin isometric loading of triceps surae complex • Foot intrinsic activation (short foot, toe yoga) — McKeon2015 foot core paradigm • 6. Monitor surgical wound healing, infection red flags
Interventions — Gym	STRENGTH (daily — low intensity allows daily frequency): • Isometric calf holds (bilateral, mid-range): 5 × 30-45s — RPE 3/10 • Isometric peroneal eversion holds (band): 4 × 20s each side — RPE 3/10 • Split squat (short range, tempo 3-1-3): 3 × 8 reps — RPE 3-4/10 • Bilateral leg press (60-70% BW equivalent): 3 × 10 reps — RPE 4/10 • MOTOR CONTROL (daily): • Double-leg stance → single-leg stance (eyes open then closed): 3 × 30s / 3 × 20s • Manual perturbations in standing (light, AP + ML): 3 × 30s • Short foot exercise (seated → standing progression): 3 × 10 reps [McKeon2015] • Toe yoga (isolated great toe extension/flexion): 2 × 10 reps • MOBILITY (daily): • WB dorsiflexion lunge (knee-to-wall): 3 × 30s holds each side • Talocrural mobilization (AP glide) if restricted • Gentle scar mobilization (post-incision, when wound fully healed) • CONDITIONING: • Stationary bike (no impact): 20-30 min, 3-4×/week • Pool walking (if available): 20 min, 2-3×/week
Restrictions — Gym (Weeks 1-2)	NO single-leg loading through full ROM on operated side NO resisted plantar flexion above RPE 4/10 NO calf raises with added weight (bodyweight isometric only) NO resisted eversion against heavy load (screw hole stress protection) NO explosive or ballistic movements of any kind NO plyometrics, jumping, hopping, or impact NO seated or standing calf machine Avoid prolonged standing >30 min without break (oedema risk)

Progression Criteria to Phase II	✓ Pain-free FWB with normalized gait including stairs (up and down) ✓ Pain <2/10 during all prescribed exercises ✓ Ankle DF ROM >5° in WB lunge test ✓ No increase in morning stiffness vs. baseline ✓ No swelling or reactive flare within 24h of training ✓ Wound fully healed, no signs of infection ✓ Isometric peroneal holds maintained 4 × 20s without pain

PHASE II — WEEKS 3-4: UNILATERAL STRENGTH & LOAD TOLERANCE

Build single-leg capacity. Introduce controlled multi-planar loading. Frontal plane emphasis.

Goals	• Develop single-leg strength (operated limb) across sagittal and frontal planes • Progress calf raises from bilateral to unilateral (heavy slow resistance introduction) • Achieve ankle DF ROM >10° in WB lunge test • Introduce early plyometric preparation (bilateral only, submaximal) • 5. Build frontal plane control (critical for peroneal function and lateral column stability)
Interventions — Gym	• STRENGTH (3-4×/week): • Single-leg press • Bulgarian split squat • Single-leg RDL each leg (BW or light DB) — RPE 5/10 • Calf raises: progress bilateral → unilateral, heavy slow (tempo 3-1-3) • Calf raises bent knee 30° (soleus bias) • Resisted peroneal eversion (progressive band resistance) • MOTOR CONTROL (daily): • Single-leg balance + manual perturbations (firm + foam): 3 × 30s each leg • Lateral weight shifts / mini lateral bounds (VERY low amplitude each direction) • Short foot exercise (single-leg stance) • PLYOMETRIC PREPARATION (2×/week — separate from heavy strength): • Bilateral pogo jumps (submaximal, low stiffness) • Skipping (low intensity, bilateral) • CONDITIONING: • Bike + elliptical 4×/week
Restrictions — Gym (Weeks 3-4)	NO single-leg plyometric hops or jumps NO heavy eccentric loading >70% 1RM NO rapid direction changes during exercises

	NO loaded rotational exercises on operated limb NO calf raise with external load >60% 1RM (build tolerance gradually) Pogo jumps BILATERAL ONLY — no single-leg impact
Progression Criteria to Phase III	✓ Single-leg calf raise pain <2/10 ✓ Single-leg press: no compensatory patterns ✓ Bilateral pogo no pain or bone-site discomfort ✓ Single-leg stance controlled ✓ DF ROM >10° in WB lunge test ✓ No reactive symptoms within 24h of highest-load session ✓ Frontal plane: lateral weight shifts controlled bilaterally without loss of balance

PHASE III — WEEKS 5-6: ENERGY STORAGE & RELEASE

Introduce elastic loading safely. Prepare for running. Heavy slow resistance for calf complex.

Goals	• Achieve heavy slow resistance calf loading (70-85% 1RM) • Introduce progressive plyometrics (stiffness, forward bounds, controlled lateral hops) • Begin running preparation pathway (anti-gravity treadmill or graded overground protocol) • Introduce change of direction drills at <50% speed • Meet ALL baseline criteria for running clearance by end of Week 6
Interventions — Gym	HEAVY STRENGTH (3×/week — mandatory 48h recovery between sessions): • Calf raises straight knee RPE 7/10 • Calf raises bent knee (soleus) • Split squat jumps (low amplitude) RPE 6/10 • Trap bar deadlift RPE 6/10 • Single-leg press (heavy) • PLYOMETRICS (2-3×/week): • Pogo jumps: progress stiffness and amplitude • Forward bounds (short distance, 3-5m) • Lateral hops (controlled, low amplitude) RUNNING PREPARATION: • 9. Anti-gravity treadmill (if available): start at 60% BW, jog • OR Walk → fast walk → incline walk progression • 10. Linear COD drills at <50% speed with deceleration focus
Restrictions — Gym (Weeks 5-6)	NO single-leg drop jumps from height >15 cm NO maximal effort plyometrics NO heavy eccentric calf loading >85% 1RM NO rapid rotational exercises Lateral hops CONTROLLED ONLY — no reactive or competitive
Restrictions — Pitch / Field (Weeks 5-6)	NO continuous running (not yet cleared — criteria must be met first) NO high-speed running NO cutting at any speed above 50% NO ball work with movement (stationary passing permitted from Week 6 if criteria met) NO competitive drills NO contact PERMITTED ON FIELD: Linear walking/fast walking, COD drills <50% speed, anti-gravity running if available
Progression Criteria to Phase IV (Running Clearance)	ALL OF THE FOLLOWING MUST BE MET BEFORE ANY RUNNING IS PERMITTED

	✓ CALF ENDURANCE: >25 single-leg calf raises on step with symmetry (operated vs. contralateral) ✓ DORSIFLEXION: Symmetric DF with <2 cm difference in knee-to-wall test ✓ HOPPING: Able to perform bilateral hopping in place COMPLETELY pain-free ✓ SWELLING: Complete absence of reactive swelling for minimum 2 consecutive weeks ✓ PAIN: 0/10 pain during all strength exercises at current load ✓ SCREW HOLE STATUS: No point tenderness over screw hole sites on palpation ✓ FUNCTIONAL ✓ CLINICAL: No infection red flags in past 4 weeks NOTE: These criteria are NON-NEGOTIABLE. Time alone does not clear for running. If any criterion is unmet, EXTEND Phase III until met. [Source: SAM Protocol + clinical consensus]

PHASE IV — WEEKS 7-8: GRADED RETURN TO RUNNING

Initiate graded running progression. Increase RFD. Begin football-specific work. NO cutting >40%.

Goals	• Achieve continuous jogging 20 min pain-free • Progress from walk-jog intervals to continuous running • Introduce acceleration drills (30-40% effort) • Begin football-specific ball work (passing, dribbling — no cutting >40%) • Maintain heavy calf + unilateral strength • 6. Progress single-leg plyometrics (linear to lateral)
Interventions — Gym	STRENGTH MAINTENANCE (2-3×/week): • Heavy calf raises (straight + bent knee) • Single-leg press • Single-leg RDL with load • PLYOMETRICS (2×/week): • Single-leg hops linear • Single-leg hops lateral (controlled) • 6. Drop jumps (low box 15-20 cm)
Interventions — Pitch / Field	RUNNING PROGRESSION: Day 1-2: Walk-jog intervals (1:1 ratio) Day 3-5: 2:1 jog:walk Day 5-7: Continuous jogging ACCELERATION: Acceleration drills: at 30-40% max effort ONLY FOOTBALL-SPECIFIC: Ball work: passing + dribbling NO cutting above 40% intensity
Restrictions — Gym (Weeks 7-8)	NO maximal effort lower body lifts (maintain submaximal — 70-80% 1RM ceiling) NO drop jumps from >25 cm NO reactive plyometric drills (no light-cue or mirror drills)
Restrictions — Pitch / Field (Weeks 7-8)	NO sprinting at >50% max effort NO competitive drills or small-sided games NO reactive agility (unplanned) NO contact of any kind NO match simulation PERMITTED: Linear jogging (flat, firm surface), low-speed ball work, low-intensity acceleration drills
End-of-Program Assessment — Week 8	At end of Week 8, perform formal assessment to determine next phase: ✓ Continuous jogging pain-free on flat surface ✓ Single-leg hop LSI >80%

	✓ Drop jump 3×5 from 20 cm with good landing mechanics ✓ Strength Tests (Calves, Nordic, Adductors, CMJ) ✓ DF ROM symmetric ✓ Pain = 0 during and after all running sessions ✓ No bone-site pain during impact activities ✓ No swelling post-running at any point during W7-8 IF ALL MET → Proceed to advanced sport-specific phase (Weeks 9-12): tempo runs, COD 50-70%, reactive agility, GPS monitoring toward chronic load targets, formal RTS testing battery. IF NOT MET → Extend Phase IV for 1-2 weeks, address specific deficit.

COMPLETE RESTRICTION MATRIX — GYM & FIELD

GYM RESTRICTIONS BY PHASE

Activity	W1-2	W3-4	W5-6	W7-8
ROM test		✅		
Strenght Test (ISO, Nordic,)	❌	❌	✅	✅
CMJ	❌	❌	❌	✅
Isometric calf (bilateral)	✅ RPE 3	✅ RPE 4	✅	✅
Isotonic calf (bilateral)	✅ Low load	✅ Moderate	✅ HSR 70-85%	✅ Maintenance
Single-leg calf raise	❌	✅ From W3 (BW)	✅ Loaded	✅ Heavy
Leg press bilateral	✅ 60-70% BW	✅ Progress	✅ Heavy	✅ Maintenance
Leg press single-leg	❌	✅ From W3	✅ 65-70% 1RM	✅ 70% 1RM
Split squat / BSS	✅ Short range	✅ Full ROM	✅ Loaded	✅ Loaded
Deadlift / Trap bar DL	❌	❌	✅ 60-65% 1RM	✅ Maintenance
Pogo bilateral	❌	✅ Submaximal	✅ Progressive	✅
Single-leg hops	❌	❌	❌	✅ Controlled
Drop jumps	❌	❌	❌	✅ 15-20 cm
Lateral plyometrics	❌	❌	✅ Low amplitude	✅ Controlled
Rotational exercises	❌	❌	❌	✅ Light only
NMES / BFR	✅ If indicated	✅ If indicated	✅	✅

FIELD / PITCH RESTRICTIONS BY PHASE

Activity	W1-2	W3-4	W5-6	W7-8
Walking (flat)	✅ 15-20 min	✅ 25 min	✅	✅
Fast walking	❌	✅ Intervals	✅	✅
Walk-jog intervals	❌	❌	❌*	✅ From W7
Continuous jogging	❌	❌	❌	✅ From W7 (criteria)
Acceleration drills	❌	❌	❌	✅ 30-40% only
Tempo running	❌	❌	❌	❌ (Phase V)
Sprinting	❌	❌	❌	❌
COD <50%	❌	❌	✅ Linear only	✅ (limit 40%)

COD 50-70%	❌	❌	❌	❌
Ball work (stationary)	❌	❌	✅ W6 if criteria	✅
Ball work (movement)	❌	❌	❌	✅ Low speed
Cutting with ball	❌	❌	❌	❌ (max 40%)
Reactive agility	❌	❌	❌	❌
Contact / challenges	❌	❌	❌	❌
Match / SSG	❌	❌	❌	❌
** Anti-gravity treadmill jogging permitted in W5-6 if available and criteria trending positive.*				

CLINICAL NOTES — POST-IMPLANT REMOVAL SPECIFIC

1. SCREW HOLE REMODELING: Cortical bone fills screw holes over 6-12 weeks. During this period, the screw sites act as stress concentrators. High torsional and bending loads can precipitate stress fracture at these sites. This is the PRIMARY biomechanical risk of the program. [Vault: Lim2022]

2. COMPLICATION WINDOW: Kasai et al. found 14% perioperative complication rate. Most complications are soft-tissue related (nerve injury, blistering, skin necrosis, infection). Monitor wound healing closely in Weeks 1-3. [Vault: Kasai]

3. PERONEAL NERVE: The superficial peroneal nerve is vulnerable during plate removal from the lateral fibula. Assess for numbness, tingling, or motor deficit (eversion weakness beyond expected post-surgical inhibition) at each session. If new neurological signs develop, urgent medical review.

4. INFECTION HISTORY: This patient has a history of infection at the fracture site. The threshold for infection concern is LOWER than a standard implant removal case. Night pain, subtle warmth, or unexplained increase in swelling must trigger immediate medical review — do not manage conservatively.

5. SCAR MANAGEMENT: Begin gentle scar mobilization once wound is fully healed (typically 2-3 weeks). Progress to deeper massage at 4-6 weeks. Scar adhesions to peroneal tendons can limit eversion strength and contribute to altered biomechanics.

6. COLD WEATHER PAIN: Yuan2022 documented cold weather pain in 19% of patients pre-removal. Post-removal, this typically resolves. However, monitor for persistent cold sensitivity at screw sites as a potential indicator of incomplete cortical healing.

7. PATIENT EXPECTATIONS: Yuan2022 reported 100% satisfaction and 91.3% pain improvement. Set realistic expectations: functional recovery from the removal surgery itself is 6-8 weeks, but return to full sport requires meeting ALL criteria-based milestones, which may extend beyond 8 weeks.

8. IMAGING: CT scan recommended at 6-8 weeks post-removal to assess screw hole filling and cortical integrity BEFORE clearing for high-impact activities. This is especially important given 60% fibula involvement.

SCIENTIFIC REFERENCES (VAULT-TRACED)

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6. Taberner M et al. Physical preparation and RTS — tibia-fibula fracture: control-chaos continuum. BMJ Open Sp Ex Med. 2019;5:e000639.

7. SAM Rehab Program Proposal London. Clinical protocol (unpublished). [Vault document]

8. Vault MOCs: MOC-carga-progresiva, MOC-evaluacion-fuerza, MOC-return-to-sport, MOC-ankle-fractures-rehab, MOC-implant-removal.

9. Vault Mother Notes: mecanotransduccion, healing-biology-comparativa.