

REHABILITATION PROTOCOL

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

Post-Operative Fibula Plate Removal — Detailed Exercise Prescription

CLINICAL CONTEXT & PHASE RATIONALE

Diagnosis: Post-operative fibula osteosynthesis plate removal. 60% fibula involvement.

Phase: II — Unilateral Strength & Load Tolerance (Weeks 3-4)

Preceding Phase: Phase I (Weeks 1-2) completed — FWB pain-free, ankle ROM initiated, peroneal activation achieved.

Phase Goal: Build single-leg capacity, introduce multiplanar controlled loading, prepare elastic loading.

Entry Criteria (from Phase I)

- FWB without pain or antalgic gait
- Ankle DF >5° (or within 3cm of contralateral in KTW test)
- Peroneal activation confirmed (manual testing ≥4/5, isometric eversion pain-free)
- Pain ≤2/10 during Phase I exercises
- No reactive swelling post-session (24h rule)
- Single leg stance ≥20 seconds with stable pelvis

MANDATORY LOAD PROGRESSION RULES — WEEKS 3-4

PAIN THRESHOLD: Pain must remain <4/10 during exercise. No increase at next morning assessment.

SWELLING RULE: No reactive swelling or effusion within 24 hours post-session.

VOLUME BEFORE INTENSITY: Increase repetitions/sets BEFORE adding load. Never both simultaneously.

WEEKLY INCREMENT: +10-15% load per week (Week 3 baseline → Week 4 = +10-15%).

RED FLAGS TO REGRESS: Pain >4/10 | Increased morning stiffness | Local heat/swelling | Night pain (infection monitoring).

WEEKLY STRUCTURE

Training Frequency: 5 sessions/week (3 gym + 2 field/pool)

Session Duration: 60-75 minutes (gym), 30-45 minutes (field)

Week 3 Focus: Introduce unilateral loading patterns at controlled tempo. Build volume.

Week 4 Focus: Progress load (+10-15%), increase complexity, introduce early plyometric preparation.

Note: Field sessions complement gym work with proprioceptive and gait-specific training. Pool sessions (if available) for deloaded running prep.

SESSION A — STRENGTH & LOADING (Monday / Wednesday / Friday)

EXERCISE	Sets	Reps	Load/RPE	Tempo	Rest	Clinical Notes / Cues
A. WARM-UP & ACTIVATION (10 min)						

EXERCISE	Sets	Reps	Load/RPE	Tempo	Rest	Clinical Notes / Cues
Stationary Bike (low resistance)	1	8 min	RPE 3-4	Steady	—	Light pedaling. Full ankle ROM through cycle. Monitor DF comfort.
Ankle CARs (Controlled Articular Rotations)	2	8/dir	BW	3s/rep	30s	Full available ROM. Slow, controlled circles. Pain-free range only.
Banded Ankle Eversion ISO Hold	3	20s	Light band	Hold	30s	Peroneal activation. Seated. Maintain neutral subtalar. No compensatory hip rotation.
Short Foot Exercise (McKeon2015)	3	10	BW	5s hold	30s	Dome the arch without toe flexion. Progress: seated → standing → single leg. Key foot core activation.
B. PRIMARY STRENGTH — LOWER LIMB (25 min)						
Single Leg Press (Leg Press Machine)	3	10	RPE 6-7	3-1-2-0	90s	W3: bilateral x1 set, SL x2 sets. W4: all SL. Full available ROM. Heel contact stable.
Bulgarian Split Squat (rear foot elevated)	3	8/leg	BW → 5-8kg DBs	3-1-2-0	90s	W3: BW only. W4: add 5-8kg DBs. Trunk upright. Front knee tracks 2nd toe. Depth: knee 90°.
Single Leg RDL (Romanian Deadlift)	3	8/leg	BW → 6-10kg DB	3-1-2-0	90s	W3: BW with wall touch for balance. W4: add DB. Hinge at hip. Maintain neutral spine. Hamstring lengthening focus.
Goblet Squat (bilateral)	3	12	8-12kg	3-1-2-0	60s	Complementary bilateral pattern. Full depth (parallel). Heels down. Core bracing.
C. CALF COMPLEX — GASTROCNEMIUS & SOLEUS (15 min)						
Standing Calf Raise (bilateral → SL)	4	12-15	BW → +5kg	3-2-2-0	60s	W3: bilateral all sets. W4: 2 bilateral + 2 SL. Full ROM: max PF → controlled DF. Slow eccentric critical.

EXERCISE	Sets	Reps	Load/RPE	Tempo	Rest	Clinical Notes / Cues
Seated Calf Raise (Soleus bias)	3	12-15	BW → +5kg	3-2-2-0	60s	Knee flexed 90°. Targets soleus specifically. W3: light. W4: add plate/DB on knee. Full ROM.
SL Calf Raise Isometric Hold (top)	3	15s/leg	BW	Hold top	45s	Max plantar flexion hold. Build endurance capacity. Monitor fatigue symmetry L vs R.
D. FRONTAL PLANE CONTROL — PERONEAL & LATERAL STABILITY (10 min)						
Lateral Band Walk	3	12/dir	Medium band	Controlled	45s	Band at ankles. Athletic stance. Maintain hip-knee-ankle alignment. No trunk lean.
Side-Lying Hip Abduction + Ankle Eversion	2	12/leg	BW	2-1-2-0	45s	Combined glute med + peroneal. Evert foot at top of hip abduction. Control frontal plane.
SL Balance on Unstable Surface	3	30s/leg	BW	Hold	30s	BOSU or foam pad. Eyes open W3, eyes closed W4. Hip strategy > ankle strategy. Peroneal reactivity.
Banded Peroneal Eversion (isotonic)	3	12/leg	Medium band	2-1-2-0	45s	Seated or standing. Full eversion against band resistance. Control return (eccentric). Critical for lateral column stability post-fibula.
E. COMPLEMENTARY EXERCISES (10 min)						
Toe Yoga (McKeon2015)	2	10/foot	BW	3s hold	30s	Big toe up / little toes down, then reverse. Intrinsic foot muscle differentiation. Neural control.
Tibialis Posterior ISO (arch lift in stance)	2	10	BW	5s hold	30s	Standing. Lift medial arch without toe gripping. Supports medial column stability.
Hip Flexor March (supine, banded)	2	10/leg	Light band	2-1-2-0	30s	Ipsilateral hip flexion against band. Core

EXERCISE	Sets	Reps	Load/RPE	Tempo	Rest	Clinical Notes / Cues
						anti-extension. Prepares running mechanics.
Dead Bug (anti-extension)	2	8/side	BW	3s hold	30s	Maintain lumbar contact. Contralateral arm-leg extension. Core stability for SL loading prep.
Nordic Hamstring Curl (assisted)	2	5	BW + band assist	5s ECC	90s	Eccentric-focused. Band assist to control descent. Begin W4 only if no knee/ankle symptoms. Injury prevention.

SESSION B — FIELD / PROPRIOCEPTION / GAIT (Tuesday / Thursday)

EXERCISE	Sets	Reps	Load/RPE	Tempo	Rest	Clinical Notes / Cues
A. WARM-UP — MOVEMENT PREPARATION (8 min)						
Walking Lunge (forward, controlled)	2	8/leg	BW	2-1-2-0	30s	Controlled ROM. No bouncing. Trunk upright. Monitor ankle DF tolerance.
A-Skip (low amplitude)	2	15m	BW	Rhythmic	Walk back	Low intensity. Focus on foot contact quality and rhythm. Not high knee drive yet.
Lateral Shuffle (low speed)	2	15m/dir	BW	Controlled	Walk back	Athletic stance. Push off lateral foot. Peroneal activation in function. <30% max speed.
B. PROPRIOCEPTION & NEUROMUSCULAR CONTROL (15 min)						
SL Stance Perturbations (partner/band)	3	30s/leg	BW + ext. perturbation	Reactive	30s	Partner pushes at hip/shoulders. Or hold band with resistance changes. Reactive ankle/hip strategy.
Y-Balance Reach Practice (anterior)	3	6/leg	BW	3s hold	45s	SL stance. Reach anterior with contralateral foot. Measure distance. Target: >90% contralateral at end W4.
Tandem Walk (heel-to-toe, forward + backward)	3	10m	BW	Slow	30s	Narrow base challenge. Forward W3, add backward W4. Vestibular + ankle proprioceptive input.
Step-Down Control (15cm step)	3	8/leg	BW	3-0-1-0	45s	SL on step. Controlled descent until contralateral heel taps floor. Knee tracks 2nd toe. Eccentric quad + ankle control.
C. GAIT RETRAINING & PRE-RUNNING (12 min)						

EXERCISE	Sets	Reps	Load/RPE	Tempo	Rest	Clinical Notes / Cues
Treadmill Walking (progressive incline)	1	8 min	BW	Steady	—	W3: 0-3% incline, 5.5-6 km/h. W4: 3-5% incline, 6-6.5 km/h. Focus: heel strike quality, push-off, no Trendelenburg.
Backward Walking (treadmill or overground)	2	3 min	BW	Slow	1 min	0% incline, 3-4 km/h. Quadriceps loading pattern. Ankle DF demand. Motor control challenge.
Fast Walk → Slow Jog Transition (W4 only)	2-3	30s jog / 60s walk	BW	—	Walk	W4 ONLY if all running clearance criteria met. Anti-gravity treadmill if available (60-70% BW). Monitor pain response.
D. EARLY PLYOMETRIC PREPARATION (8 min)						
Bilateral Pogo Hops (low amplitude)	3	10	BW	Quick	45s	Ankle-dominant. Minimal knee bend. Stiff ankle strategy. Contact time <250ms goal. W3: on spot. W4: forward travel.
Low Skipping (A-skip progression)	2	15m	BW	Rhythmic	Walk back	W4 only. Low amplitude. Focus on elastic recoil, not height. Achilles-calf complex loading.
Bilateral Drop Landing (10cm box)	3	6	BW	Stick 3s	60s	Step off box. Land bilateral. Absorb and stick. Quiet landing. Knee flexion 30-45°. Assess symmetry.
E. COOL-DOWN & TISSUE MANAGEMENT (5 min)						
Gastrocnemius Stretch (wall, 30s holds)	2	30s/leg	BW	Hold	—	Knee extended. Gentle sustained stretch. No bouncing. Pain-free.
Soleus Stretch (wall, knee bent)	2	30s/leg	BW	Hold	—	Knee flexed 20-30°. Targets soleus. Same wall position.

EXERCISE	Sets	Reps	Load/RPE	Tempo	Rest	Clinical Notes / Cues
Plantar Fascia Self-Release (ball)	2	90s/foot	BW pressure	Roll	—	Golf ball or lacrosse ball. Roll under arch. Medium pressure. Tissue mobility.

WEEK 3 → WEEK 4 PROGRESSION MATRIX

VARIABLE	WEEK 3	WEEK 4
SL Leg Press	2 SL sets + 1 bilateral (RPE 6)	3 SL sets (RPE 7)
Bulgarian Split Squat	BW only, 3x8	5-8 kg DBs, 3x8
SL RDL	BW + wall touch, 3x8	6-10 kg DB, 3x8
Standing Calf Raise	Bilateral all sets, BW	2 bilateral + 2 SL, +5kg
Seated Calf Raise	BW, 3x12	+5kg plate, 3x15
Pogo Hops	Bilateral on spot, 3x10	Bilateral forward travel, 3x10
SL Balance	Foam pad, eyes open, 30s	Foam pad, eyes closed, 30s
Treadmill Walk	0-3% incline, 5.5-6 km/h	3-5% incline, 6-6.5 km/h
Jog Introduction	NOT YET	30s jog / 60s walk x2-3 (if criteria met)
Nordic Curl	NOT YET	Assisted, 2x5 (eccentric only)
Skipping	NOT YET	Low amplitude A-skip, 2x15m
Drop Landing	10cm bilateral, stick 3s	10cm bilateral, stick 3s (assess quality)

PROGRESSION CRITERIA TO PHASE III (Weeks 5-6)

- **Pain 0-1/10** during all Phase II exercises and <2/10 post-session
- **No reactive swelling** at 24h post-session (entire Phase II)
- **SL Calf Raises:** ≥20 reps with symmetrical quality (target >25 by end Phase III)
- **KTW Dorsiflexion:** Deficit <3cm vs contralateral (target <2cm for running clearance)
- **SL Leg Press:** 3x10 at RPE 7 without pain or compensatory patterns
- **Bulgarian Split Squat:** 3x8 with 5-8kg DBs, controlled tempo, no trunk deviation
- **SL Balance:** ≥30s on unstable surface, eyes closed, without loss of balance
- **Y-Balance Anterior:** SSD <4cm (trending toward ≤2cm for running)
- **Bilateral Pogo Hops:** 3x10 pain-free with forward travel, symmetrical contact quality
- **Gait:** Normal heel-toe pattern at 6.5 km/h, 5% incline, no antalgic pattern
- **No infection signs:** No night pain, no subtle warmth, no fatigue-associated pain at surgical site
- **Psychological:** Athlete reports confidence ≥6/10 in single-leg loading and early impact tasks

CLINICAL NOTES — PHASE II SPECIFIC

Cortical Remodeling	Screw holes from plate removal create stress risers in cortical bone. Cortical remodeling takes 6-12 weeks (Lim2022). Weeks 3-4 are still within the early remodeling window. Avoid peak torsional loads. Controlled loading promotes osteoblast activity through mechanotransduction, but excessive loading risks stress fracture at screw hole sites.
Peroneal Priority	60% fibula involvement = reduced lateral column stiffness. Peroneal muscles are the primary dynamic stabilizers of the lateral ankle. Every gym and field session MUST include peroneal-specific work. Frontal plane control exercises are not optional — they are clinical necessities for this pathology.
Foot Core Integration	McKeon2015: Intrinsic foot muscles are the local stabilizers of the arch (analogous to transversus abdominis for the spine). Short foot exercise and toe yoga activate abductor hallucis, FDB, and quadratus plantae. These are critical post-fracture/post-immobilization because intrinsic foot muscle atrophy is significant and contributes to re-injury risk.
Tempo Prescription	Tempo notation: Eccentric-Pause-Concentric-Pause (e.g., 3-1-2-0 = 3s eccentric, 1s pause at bottom, 2s concentric, 0s pause at top). Slow eccentric loading is prescribed because: (1) it allows greater force production at lower velocities = safer for healing tissue; (2) it promotes tendon and bone adaptation through sustained mechanical load; (3) it builds motor control before speed is introduced.
Infection Monitoring	Given history of infection (SAM protocol context): Monitor for night pain, subtle warmth at surgical site, fatigue-associated pain, and low-grade swelling that doesn't correlate with loading. Any positive finding = immediate MD referral. This is a non-negotiable safety screen throughout Phases II-IV.
Plyometric Preparation	Weeks 3-4 introduce LOW-LEVEL plyometric preparation only (bilateral pogos, drop landings from 10cm). This is not true plyometrics — it is

	neuromuscular priming for elastic loading in Phase III. No unilateral impact. No lateral plyometrics. No reactive/chaotic components. These are strictly controlled, bilateral, sagittal-plane tasks.
Complementary Exercises	Nordic hamstring curls (assisted, W4 only), dead bugs, and hip flexor marches are ADDED exercises not in the original SAM protocol. Rationale: (1) Nordic curls for hamstring injury prevention during upcoming running phase (evidence: Al Attar 2017); (2) Dead bugs for anti-extension core stability needed for SL loading and running; (3) Hip flexor march to prepare hip flexion mechanics for running gait. These are low-risk, high-value additions.
⚠️ RESTRICTIONS	<p>STRICTLY PROHIBITED in Weeks 3-4:</p> <ul style="list-style-type: none"> • High-speed cutting or change of direction • Unilateral plyometrics (hops, bounds on single leg) • Lateral plyometrics (lateral bounds, lateral hops) • Running >30s continuous or >7 km/h • Ball work with direction changes • Any exercise causing pain >4/10 • Contact or competitive drills

SCIENTIFIC REFERENCES & VAULT EVIDENCE

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Document generated: 2026-04-20 *All recommendations require clinical validation before application.*