

ANDREW L. MERRITT, MD — PROLIANCE ORTHOPEDIC ASSOCIATES

## CARTILAGE GRAFT AND OSTEOTOMY RECOVERY

### A GUIDE TO PHYSICAL THERAPY

#### THE ROLE OF PHYSICAL THERAPY IN YOUR RECOVERY

You had two procedures: an osteochondral allograft (OCA) that replaced damaged cartilage on your kneecap or the groove it runs in, and a tibial tubercle osteotomy (TTO) — a bone cut that shifts the kneecap's attachment point to reduce load on the graft. The bone cut drives the weight-bearing rules for the first six weeks: toes barely touch the ground. After that, weight-bearing progresses and strength is rebuilt. Running begins at 14–16 weeks; return to cutting and pivoting sport at 6–9 months.

**Important:** Toe-touch weight-bearing for six weeks is driven by the bone cut — not the cartilage graft. Both structures are healing simultaneously and require the same protection.

#### YOUR RECOVERY TIMELINE

| PHASE | TIMEFRAME                      | PT VISITS                       | WHAT YOU'RE WORKING ON                                                                                                                                                                                                                                                                                                |
|-------|--------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Weeks 1–6                      | 2–3× per week                   | <ul style="list-style-type: none"><li>• Toe-touch only — crutches carry your weight for bone protection</li><li>• Kneecap mobilization from Day 1 — gentle glides to prevent stiffness</li><li>• VMO and quad activation with electrical stimulation</li><li>• Free range of motion when non-weight-bearing</li></ul> |
| 2     | Weeks 6–14<br>(after X-ray OK) | 2× per week                     | <ul style="list-style-type: none"><li>• Weight-bearing progresses after osteotomy X-ray confirms healing</li><li>• Wean crutches before brace discontinuation</li><li>• Step-ups, stationary bike, progressive quad and VMO strengthening</li><li>• Hip abductor strengthening to protect patellar tracking</li></ul> |
| 3     | Months 3–6                     | 1–2× per week<br>+ home program | <ul style="list-style-type: none"><li>• Running begins at 14–16 weeks once 8-inch step-down test is passed</li><li>• Jogging → tempo → sport-specific conditioning</li><li>• Limb symmetry testing at Month 4–5</li><li>• No cutting or jumping before Month 6</li></ul>                                              |
| 4     | Months 6–9                     | As needed                       | <ul style="list-style-type: none"><li>• Cutting, pivoting, and agility drills</li><li>• Final strength and hop testing before clearance</li><li>• Return to sport at 6 months minimum; 9 months for high-demand sport</li><li>• Clearance by Dr. Merritt at each stage</li></ul>                                      |

Questions about your PT progress? Call our office or bring them to your next appointment. We are always glad to coordinate with your therapist.

## OSTEOCHONDRAL ALLOGRAFT — PATELLA OR TROCHLEA WITH TIBIAL TUBERCLE OSTEOTOMY PHYSICAL THERAPY PROTOCOL

Patient Name: \_\_\_\_\_  
Date of Surgery: \_\_\_\_\_

Surgeon: Andrew L. Merritt, MD  
PT Start Date: \_\_\_\_\_

### Overview & General Principles

This protocol addresses two concurrent healing processes: (1) OCA osseous integration — bone-to-bone union at the patella or trochlea graft-host interface, and (2) TTO osteotomy healing — bridging callus formation at the tibial tubercle osteotomy site. The TTO dictates the weight-bearing and early loading restrictions. TTWB  $\times$  6 weeks is required — this is more restrictive than the standard OCA patella/trochlea protocol (WBAT). Running begins at 14–16 weeks once the 8-inch step-down criteria are met. Return to cutting and pivoting sport requires a minimum of 6 months, with 9 months recommended for high-demand sport.

1. **TTWB  $\times$  6 WEEKS (TTO-DRIVEN):** The TTO is the governing procedure for weight-bearing restrictions. TTWB  $\times$  6 weeks is required for osteotomy bone healing — this replaces the WBAT restriction of the standalone OCA patella/trochlea protocol. The tibial tubercle remains in soft callus formation through Week 6; premature loading can disrupt fixation or cause delayed union.
2. **VMO EMPHASIS — ALL PHASES:** VMO is the primary dynamic patellar stabilizer. After TTO medialization, VMO strengthening supports optimal patellar tracking through the newly corrected position. VMO emphasis continues throughout all phases.
3. **PATELLAR MOBILIZATION FROM DAY 1:** Patellar mobilization (superior, inferior, gentle medial glides) begins from Day 1. Avoid direct compression of the graft articular surface. Gentle medial patellar mobilization is permitted per surgeon preference.
4. **ROM UNRESTRICTED — NO CPM:** Active and active-assisted ROM exercises throughout — no CPM. ROM without load is unrestricted from Day 1.
5. **OSSEOUS INTEGRATION ADVANTAGE:** OCA heals through bone-to-bone integration, which is more rapid and structurally robust than MACI scaffold ingrowth. OCA osseous integration supports a return-to-sport timeline of approximately 6 months — consistent with TTO recovery.
6. **AVOID VALGUS STRESS:** Dynamic knee valgus increases lateral patellar force and loads the TTO fixation asymmetrically. Hip abductor and external rotator strengthening is mandatory in every phase. Cue neutral knee alignment throughout.

### CONCOMITANT PROCEDURE MODIFICATIONS

#### Concomitant MPFL Reconstruction

7. MPFL reconstruction is commonly performed with TTO to restore patellar stability. MPFL reconstruction does not change this rehabilitation protocol. Proceed per the standard OCA patella/trochlea + TTO timeline.

#### Concomitant Lateral Retinacular Lengthening

8. Lateral retinacular lengthening is a standard part of TTO to rebalance proximal alignment. This does not change the rehabilitation protocol. Gentle medial patellar mobilization may be performed per surgeon preference — avoid excessive patellar compression against the graft surface.

## PHASE 1 — PROTECTION (Weeks 0–6)

### INFORMATION FOR THE PATIENT — What to Expect This Phase

For the first 6 weeks, you must use crutches and only touch your foot lightly to the ground — for balance only. This protects the bone that was moved at your tibial tubercle, and also protects the cartilage graft. Your brace locks straight when walking, but you can bend your knee freely during exercises and at rest.

Quad exercises and electrical stimulation begin immediately to prevent muscle loss. Patellar mobilization begins from Day 1.

### Goals:

9. Protect TTO osteotomy site and OCA graft osseous integration — TTWB × 6 weeks
10. Establish volitional quad activation — 20 consecutive SLR without extension lag by Week 4–6
11. Activate VMO with NMES and BFR as needed
12. Restore knee ROM 0–90° in non-WB position; progress to 130°+ by Week 4–6
13. Begin patellar mobilization from Day 1
14. Control post-operative pain and effusion
15. Begin supervised PT within 3 days post-op

**Weight-Bearing Status:** Toe-touch weight bearing (TTWB) with bilateral crutches throughout Weeks 0–6. Approximately 10% body weight contact for balance only. Do not progress to partial or full weight bearing during this phase. This restriction is dictated by TTO osteotomy bone healing biology and is non-negotiable without surgeon direction.

**Bracing:** Hinged knee brace worn during all ambulation, locked in full extension (0°). Brace provides stability and prevents valgus stress during TTWB crutch ambulation. ROM exercises and rest performed without brace restriction. Brace may be unlocked for seated or supine ROM exercises and for hygiene only.

**Range of Motion:** Unrestricted from Day 1 in non-WB positions. Active and active-assisted ROM exercises — no CPM. Target full ROM (0–130°+) by Week 4–6. Stationary bike permitted when ROM reaches 75–90° (typically Week 2–3).

### Exercises:

16. NMES to quadriceps — 20–30 min, 2× daily; begin Day 1–2 post-op; VMO biofeedback as needed
17. Quad sets (isometric, knee flat): 3×15 reps, 5-second hold, 3–4×/day starting Day 1
18. BFR quad activation — low-load quad sets with BFR cuff; begin Week 1–2; 30-15-15-15 scheme
19. Straight-leg raises (supine): 3×15 — begin once quad set is present; goal 20 consecutive reps without extension lag by Week 4–6
20. Heel slides (supine, pain-limited): 3×15 — primary early ROM exercise
21. Short-arc quads (towel roll under knee, full arc): 3×15 — begin Week 2
22. Patellar mobilization: superior, inferior, and gentle medial glides — 1–2 minutes per direction per session from Day 1; avoid direct graft surface compression
23. Hip abduction (supine, operative leg): 3×15 — begin Week 2; hip abductor/ER strengthening throughout for valgus prevention

24. Glute sets (isometric): 3×15
25. Ankle pumps: 2×20 reps for DVT prevention
26. Stationary bike (no resistance, seat height for pain-free ROM): begin Week 2–3 once 75–90° of flexion achieved
27. Pool deep-water walking (when incision healed, Week 3–4): full joint offloading
28. Well-leg cardiovascular conditioning and upper extremity exercises as tolerated
29. Cold compression: 15–20 minutes post-session throughout Phase 1

#### **Progression Milestones — Must Meet All Before Advancing:**

30. TTWB compliance maintained × 6 weeks
31. 20 consecutive SLR without extension lag
32. Active knee ROM 0–90° in supine; goal 130°+ by Week 4–6
33. Volitional VMO activation confirmed on palpation
34. Effusion trace or absent at rest
35. Stationary bike tolerated with full pain-free pedal stroke

#### **PHASE 1 PRECAUTIONS — TTO + OCA GRAFT PROTECTION**

36. TTWB STRICTLY ENFORCED × 6 weeks — no partial or full WB before Week 6; the tibial tubercle is fixed with screws and remains in soft callus phase; premature loading risks fixation failure or delayed union
37. No weight-bearing closed kinetic chain exercises (squats, step-ups, lunges) — ROM and quad activation performed in non-WB positions only
38. NMES should be used aggressively if quad activation is absent or extension lag is present — prolonged AMI after TTO is a known complication; do not wait for spontaneous recovery
39. Brace locked in extension for all ambulation — prevents loaded knee flexion during stance and protects both the TTO fixation and the OCA graft
40. Gentle patellar mobilization only — no direct compression of graft articular surface
41. Avoid dynamic knee valgus — hip abductor strengthening from Day 1
42. If extension lag persists beyond Week 4, increase NMES frequency and notify Dr. Merritt

Rationale: The TTO creates a controlled fracture at the tibial tubercle fixed with interfragmentary screws. Bone healing follows sequential biology with bridging callus forming at Weeks 6–12. TTWB maintains neuromuscular input without exceeding the load tolerance of early-stage callus. The brace locked in extension prevents loaded patellofemoral contact that would stress both the OCA graft surface and the TTO fixation.

## **PHASE 2 — RETURN TO LOADING (Weeks 7–12)**

#### **INFORMATION FOR THE PATIENT — What to Expect This Phase**

At 6 weeks you start putting more weight on your leg. You control the pace — push as much as feels safe and comfortable, but stop if you feel pain at the surgery site. The brace gradually unlocks from full extension over Weeks 7–8 and is discontinued once you walk confidently without crutches. Mini-squats and step exercises begin to rebuild your leg strength.

#### **Goals:**

43. Transition from TTWB to full weight bearing at a patient-guided pace
44. Wean from crutches, then wean from brace in sequence
45. Achieve full active ROM (0–120°+)

46. Initiate closed kinetic chain (CKC) strengthening — mini-squats, step-ups
47. Restore single-leg balance on firm surface
48. Advance quad and VMO strength toward LSI 70%
49. OKC knee extension with progressive resistance established (TKE now permitted)

**Weight-Bearing Status:** Progressive WBAT beginning Week 7, patient-guided. The pace is determined by osteotomy site comfort, patient confidence, and quad control — not by a fixed calendar. Do not push the pace if the patient reports pain at the osteotomy site with loading. Reduce activities for pain or effusion.

**Bracing:** Crutches are weaned before the brace. Gradually open brace over Weeks 7–8. Once the patient demonstrates confident ambulation with the brace unlocked, without crutches and without apprehension, the brace is discontinued. Crutch-independent unlocked walking first, then brace wean — this sequence is not negotiable.

**Range of Motion: Full, unrestricted. Progress loaded knee flexion gradually: limit to 60° initially (Weeks 7–10); advance to 90° by Week 14. Avoid loaded flexion past 60° until Weeks 10–12 — patellofemoral loading is highest in the 60–90° range.**

#### Exercises — Weeks 7–10:

50. Active OKC knee extension with progressive resistance — begin 5 lbs Week 7, increase 2–3 lbs/week, 3×15 (limited arc initially, avoiding deep flexion loading)
51. Terminal knee extension (TKE) with resistance band — 3×15
52. Ergometry / stationary bike — progress to 20–25 min; increase resistance progressively
53. Mini-squats (0–45°) — 3×15; cue knee over second toe, no valgus; use mirror feedback; progress to 45° by Week 8–10
54. Wall sits (0–45°): 3×20–30 second holds
55. Step-ups (4-inch step, operative leg leads): 3×10 reps with 5-second hold — begin Week 8–9 once mini-squats are pain-free
56. Sit-to-stand: 3×10 reps; progress from armrest-assisted to unsupported
57. Standing hip abduction/ER with progressive resistance — 3×12 (valgus prevention throughout)
58. Lateral band walks: 3×15 steps per direction
59. Clamshells with resistance band: 3×15–20
60. Leg press (0–60° arc) — 3×12; avoid loaded deep flexion
61. Hamstring curls with resistance — 3×12
62. Proprioceptive / neuromuscular exercises: single-leg balance on firm surface — 3×20–30 sec when crutch-free ambulation established
63. Patellar mobilization self-performed all directions: 1–2 minutes/day — continue throughout
64. Continue BFR and stationary bike; aquatherapy as tolerated
65. Cryotherapy after every exercise session

#### Exercises — Weeks 10–12 (add to above):

66. Elliptical trainer — low to moderate resistance; introduce when FWB without crutch
67. Mini-squats progress to 0–60° — monitor for PF pain and reactive effusion
68. Leg press: advance ROM to 0–60°, increase resistance; do not advance into deep flexion yet
69. Step-ups progress to 4–6 inch step — 3×10
70. Single-leg balance: progress to foam or unsteady surface when crutch-free
71. Stair climbing and descent — reciprocal pattern when off crutches

#### Progression Milestones — Must Meet All Before Advancing:

72. Full WB ambulation without crutches (brace initially locked, then unlocked)
73. Brace discontinued — crutch-independent unlocked walking first
74. Full ROM 0–120° or symmetric with contralateral
75. Mini-squats to 45° pain-free with neutral knee alignment and no valgus
76. Step-ups 10 reps on 4-inch step with hold and no compensation
77. Single-leg stance 20 seconds on firm surface
78. Quad strength  $\geq 55\%$  contralateral

#### PHASE 2 PRECAUTIONS

79. Do not allow valgus collapse during mini-squats or step-ups — dynamic knee valgus increases lateral patellar force and stresses TTO fixation asymmetrically
80. Do not advance to step-ups until mini-squats to 45° are pain-free and quad control is consistent
81. Brace comes off after crutches — not before; removing brace while still crutch-dependent creates an unsafe transition
82. No loaded knee flexion past 60° through Weeks 10–12 — highest PF compression zone
83. Patellofemoral pain with squatting or leg press — avoid the movement and return to isometric exercises
84. No running, jumping, or impact activities in Phase 2
85. Monitor for joint effusion after each session — cryotherapy required after every session

### PHASE 3 — RETURN TO FUNCTION (Weeks 13–20)

#### INFORMATION FOR THE PATIENT — What to Expect This Phase

This phase focuses on rebuilding strength and teaching your leg to move correctly under higher demands. You will progress to single-leg squats, begin jogging, and start low-level jumping exercises. Your quad and hip strength need to reach symmetry with your other leg before you advance. Running begins when you can perform an 8-inch step-down with good mechanics — typically at Weeks 14–16. Push hard — but anterior knee pain or pain at the osteotomy site is always a reason to slow down.

#### Goals:

86. Quad strength  $\geq 80\%$  contralateral
87. 8-inch step-down with symmetric mechanics, no pain, no valgus
88. Begin plyometric progression (bilateral) — Week 16–17
89. Initiate running program (walk-jog intervals) at Weeks 14–16
90. Dynamic patellar tracking — no valgus on single-leg squat or step-down
91. Enhance strength, flexibility, endurance, and neuromuscular control

**Weight-Bearing Status:** Full weight bearing. Progressive single-leg and impact loading.

**Range of Motion:** Full, unrestricted. Loaded deep flexion past 90° now permitted.

#### Exercises:

92. Continue all Phase 2 exercises with progressive resistance and duration
93. Mini-squats progress to full goblet squats (0–90°): 3×12–15 reps with light weight — begin Week 12–13

94. Progressive squatting program — advance from 90° to full depth; increase resistance; avoid if PF pain
95. Step-ups (6-inch step): 3×15 reps — begin Week 12–13
96. Step-downs (6–8 inch, eccentric controlled): 3×12–15 reps/leg — begin Week 14–15; excellent VMO eccentric load
97. Single-leg mini-squats (0–30°): 3×8–10 reps/leg with mirror feedback — begin Week 14–15; progress depth to 60° by Week 18
98. Bulgarian split squats (rear foot elevated): 3×10–12 reps/leg — begin Week 16
99. Lateral step-ups (8-inch): 3×12–15 reps/leg — begin Week 16
100. TKE with progressive resistance: 3×20 reps — maintain throughout
101. Nordic hamstring curls (assisted to unassisted): 3×6–10 reps — begin Week 16
102. Single-leg glute bridges: 3×12 reps/leg — begin Week 13
103. Copenhagen adduction: 3×15 reps — VMO and adductor synergy
104. Lateral band walks with increased resistance; single-leg stance on foam/wobble board
105. Perturbation training (single-leg, arm perturbations from therapist): 3×30 sec/leg
106. Leg press: progress ROM and resistance; avoid if PF pain
107. Jogging progression: begin Weeks 14–16 on flat surface — pain-free single-leg squat is the prerequisite; progress distance and pace weekly
108. Double-leg vertical jump, stick landing: 3×8 reps — begin Week 16–17; cue quiet landing, neutral knee alignment
109. Lateral bounds (bilateral, controlled deceleration): 3×6/direction — begin Week 17–18

#### **Progression Milestones — Must Meet All Before Advancing:**

110. Single-leg squat to 60° without valgus, 10 reps
111. Step-down test: smooth eccentric control, no dynamic valgus
112. Quad LSI 80% (progress to 90% before Phase 4 clearance)
113. Single-leg hop for distance LSI 80%
114. Jogging 20 minutes continuously on flat surface, pain-free
115. No pain at osteotomy site with any loading activity
116. Bilateral plyometrics initiated and tolerated pain-free

#### **PHASE 3 PRECAUTIONS**

117. Do not advance to single-leg plyometrics until single-leg squat mechanics are controlled — poor neuromuscular control under reactive loading increases both re-dislocation risk and osteotomy stress
118. Running not before Weeks 14–16 AND 8" step-down criteria met — both required
119. Anterior knee pain with deep loading (past 90°) may indicate PF irritation at the TTO site — reduce depth; contact Dr. Merritt if persistent
120. Running mechanics must be assessed before progressing jogging distance — look for dynamic valgus, trunk lean, and contralateral pelvic drop
121. Do not begin plyometrics if osteotomy site remains tender with loading
122. Cutting, jumping, and pivoting sports not before 6 months (Phase 4)
123. Reactive effusion after loading — reduce intensity and reassess

## PHASE 4 — RETURN TO SPORT (Months 5–12+)

### INFORMATION FOR THE PATIENT — What to Expect This Phase

This phase is sport preparation — cutting, reacting, and playing at full intensity. Clearance for return to sport requires objective testing (strength and hop tests) and physician sign-off. Minimum 6 months for moderate-demand sport; 9 months recommended for cutting and pivoting sport. If you feel apprehension or instability during drills, stop and report it to your PT and Dr. Merritt.

#### Goals:

- 124. Isokinetic quad strength  $\geq 90\%$  contralateral
- 125. Isokinetic hamstring strength  $\geq 90\%$  contralateral
- 126. Single-leg hop test  $\geq 90\%$  limb symmetry index
- 127. Sport-specific cutting, pivoting, and deceleration at full speed
- 128. No anterior knee pain, instability, or apprehension with sport-level activity
- 129. Formal clearance from Dr. Merritt

**Weight-Bearing Status:** Full, unrestricted.

**Range of Motion:** Full, unrestricted.

#### Exercises:

- 130. Single-leg jump-and-stick: 3×5–8 reps/leg — controlled landing hold
- 131. Single-leg lateral hops: 3×8 reps/direction — progressive amplitude
- 132. Depth jumps (12-inch box, bilateral then unilateral): 3×5–6 reps — Week 22+
- 133. Crossover lateral bounds: 3×8 strides per direction
- 134. Full-speed straight-line sprint progression
- 135. 45° cut drills at progressive speed: bilateral then reactive (partner cued)
- 136. 90° direction-change drills: T-drill, 5-10-5 shuttle at full speed
- 137. Sport-specific movement sequence: acceleration, cut, deceleration, pivot
- 138. Strength maintenance: single-leg squats 3×12, lateral band walks 3×20, Nordic curls 2×10/leg
- 139. Continue BFR and quad maintenance 3–4×/week throughout season

#### Progression Milestones — Clearance for Sport:

- 140. Quad LSI  $\geq 90\%$  on isokinetic or handheld dynamometer at 60°/sec
- 141. Single-leg hop for distance, triple hop, and crossover hop LSI  $\geq 90\%$
- 142. 6-meter timed hop LSI  $\geq 90\%$
- 143. Y-Balance composite score symmetry  $\geq 90\%$
- 144. Full-speed cutting and pivoting with no instability or apprehension
- 145. No anterior knee pain, patellar apprehension, or osteotomy site tenderness
- 146. Athlete confidence rating  $\geq 8/10$
- 147. Functional knee scores completed (IKDC, KOOS, Lysholm, Tegner)
- 148. Surgeon clearance — minimum 6 months for moderate sport; 9 months recommended for cutting/pivoting

**PHASE 4 PRECAUTIONS**

149. Minimum 6-month timeline for functional return to sport — bone remodeling at the osteotomy site continues through 9–12 months; full cutting/pivoting sport may require 9 months
150. Do not use time alone as clearance — strength LSI below 90% at RTS is associated with significantly higher re-dislocation and re-injury rates
151. Apprehension with lateral movement or cutting is a disqualifying symptom — return to Phase 3 neuromuscular training and reassess
152. Any episode of patellar subluxation or dislocation post-operatively requires immediate suspension of RTS activity and notification of Dr. Merritt
153. Anterior knee pain or effusion with sport activity warrants imaging evaluation before progression

**RETURN TO ACTIVITY CRITERIA**

All criteria below must be satisfied AND surgeon clearance obtained before return to cutting, jumping, or pivoting sports.

| Return-to-Activity Criterion          | Required Threshold                                                       |
|---------------------------------------|--------------------------------------------------------------------------|
| <b>Isokinetic Quadriceps (LSI)</b>    | ≥90% contralateral limb                                                  |
| <b>Isokinetic Hamstrings (LSI)</b>    | ≥90% contralateral limb                                                  |
| <b>Single-Leg Hop Testing (LSI)</b>   | ≥90% contralateral (single, triple, crossover, timed)                    |
| <b>Full Pain-Free ROM</b>             | Equal to contralateral; no anterior knee pain                            |
| <b>No Reactive Effusion</b>           | No joint effusion after functional activity                              |
| <b>No Patellar Apprehension</b>       | No instability or subluxation with sport activity                        |
| <b>Functional Knee Scores</b>         | IKDC, KOOS, Lysholm, Tegner completed                                    |
| <b>TTO Bone Union (Radiographic)</b>  | Confirmed by Dr. Merritt; no osteotomy site tenderness with activity     |
| <b>TTO Hardware Review</b>            | Per surgeon; discussed at appropriate post-operative interval            |
| <b>Minimum Time — Running</b>         | 14–16 weeks (after 8" step-down criteria met)                            |
| <b>Minimum Time — Cutting/Jumping</b> | 6 months moderate sport; 9 months recommended for cutting/pivoting sport |
| <b>Surgeon Clearance</b>              | Required; gradual return to sport — criteria-based, MD directed          |

**Clinical Timeline Summary**

**Toe-touch weight bearing:** Weeks 0–6 (driven by TTO; crutches carry body weight)

**Supervised PT begins:** Within 3 days post-op

**Weight bearing advances:** Week 7, patient-guided (osteotomy site comfort + quad control)

**Brace gradually opened:** Weeks 7–8

**Brace discontinued:** After crutch-independent unlocked walking established

**FWB without crutch:** Weeks 8–12 (patient-guided pace)

**OKC resistance begins:** Week 7 (5 lbs; +2–3 lbs/week)

**Low-impact cardio (cycling, elliptical):** Weeks 7–10

**Loaded flexion to 90°:** Weeks 10–14

**Plyometrics (bilateral):** Weeks 16–17

**Running (walk-jog):** Weeks 14–16 — after 8" step-down criteria met

**Cutting / jumping / pivoting sport:** 6 months (moderate sport); 9 months recommended (cutting/pivoting)

**TTO hardware review:** Per surgeon; discussed at appropriate post-operative interval

**Return to sport:** Minimum 6 months — criteria-based, MD directed

Note: The TTO dictates weight-bearing restrictions in this combined protocol. TTWB replaces the WBAT restriction of the standalone OCA patella/trochlea protocol. OCA osseous integration proceeds concurrently during the same 6-week TTWB window. Progression is criteria-based throughout — strength, hop testing, patellar stability, and surgeon clearance determine advancement. Anterior knee pain or patellar apprehension at any stage warrants regression before advancing.

**Surgeon Notes / Special Instructions:**