

[CLINICAL COMMENTARY]

APPENDIX A

POSTOPERATIVE REHABILITATION FOR ULNAR COLLATERAL LIGAMENT REPAIR WITH INTERNAL BRACE

Phase 1: Immediate Postoperative Phase (Week 1)

Goals: protect healing tissue, reduce pain and inflammation, retard muscle atrophy, achieve full wrist ROM

Day of Surgery

1. Elbow brace locked at 90° for 7 days
2. PROM of wrist and hand in locked brace

Postoperative Days 1 and 2: Add (all performed in locked elbow brace)

1. Shoulder PROM: flexion, ER, and IR to tolerance
2. Shoulder pendulum exercises
3. Wrist flexor/extensor stretching
4. Putty/gripping exercises

Postoperative Days 3 Through 7 (all exercises performed in locked elbow brace)

1. Continue previous exercises, advancing PROM as tolerated
2. Add the following exercises:
 - a. Shoulder isometrics: ER, IR, abduction, flexion, and extension performed pain free, submaximal
 - b. Scapular strengthening: seated neuromuscular control drills with manual resistance

Progression to next phase is purely time based

Phase 2: Controlled Mobility Phase (Weeks 2-5)

Goals: gradually restore elbow ROM, improve muscular strength and endurance, normalize joint arthrokinematics

Beginning Week 2 (Day 8)

1. Set elbow ROM brace to 30° to 110°
2. Begin elbow PROM and active-assisted ROM from 30° to 110°
3. Initiate elbow AROM for flexion
4. Initiate shoulder AROM in elbow brace
5. Progress scapular-strengthening exercises
 - a. Seated manual resistance: protraction/retraction, elevation/depression, diagonal patterns
6. Progress to light isotonic strengthening exercises for wrist, elbow, and shoulder at day 10

Beginning Week 3

1. Progress elbow ROM to 10° to 125°
2. Initiate Throwers Ten exercise program

Beginning Week 4

1. Progress elbow ROM to 0° to 145°
2. Progress elbow- and wrist-strengthening exercises
3. Initiate wrist flexion and elbow flexion movements against manual resistance

Criteria for progression to next phase: elbow PROM of 10° to 125°, minimal pain and tenderness, good manual muscle testing of key muscles/movements (elbow flexion/extension; wrist flexion; shoulder IR, ER, and scapular abduction)

Phase 3: Intermediate Phase (Weeks 6-8)

Goals: restore full elbow ROM, progress upper extremity strength, continue with functional progression

Beginning Week 6

1. Discontinue elbow brace at week 6
2. Initiate Advanced Throwers Ten program
3. Initiate 2-hand plyometrics: chest pass, side-to-side throw, and overhead pass
4. Initiate prone plank exercise (**ONLINE VIDEO**)

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Beginning Week 8

1. Progress to 1-hand plyometrics: 90°/90° ball throw, 0° ball throw
2. Continue with Advanced Throwers Ten program
3. Initiate side plank with shoulder ER strengthening exercise

Criteria for progression to next phase: full, nonpainful elbow AROM and PROM; no pain or tenderness; appropriate strength of shoulder and elbow (minimum of 70% compared to opposite side); satisfactory clinical examination; completion of current rehabilitation phase without difficulty

Phase 4: Advanced Phase (Weeks 9-14)

Goals: advanced strengthening exercises, initiate ITP, gradual return to throwing

Beginning Week 9

1. Continue all strengthening exercises, including Advanced Throwers Ten program and 1- and 2-hand plyometrics program

Beginning Week 10: Initiate

1. Seated chest-press machine
2. Seated row machine
3. Biceps/triceps machine or cable strengthening
4. Interval hitting program

Week 12: Initiate ITP Phase 1

1. Long toss

Criteria to enter next phase: full elbow, wrist, and shoulder ROM; no pain or tenderness; functional or isokinetic test that fulfills criteria for desired activity; satisfactory clinical examination

Phase 5: Return-to-Activity/Play Phase (Weeks 14+)

Goals: gradual return to competitive throwing, continue all exercises and stretches

Weeks 14 to 16

1. Continue all exercises as in weeks 9 to 14
2. Continue/progress ITP phase 1 (long toss)
 - a. Each athlete may progress through ITP at different rates/paces
 - b. Expected to complete throws of 0 to 27 m (0-90 ft) within 3 weeks of starting ITP and throws of 0 to 37 m (120 ft) within 8 weeks

Weeks 16 to 20

1. Continue ROM and stretching programs
2. Continue Advanced Throwers Ten program
3. Continue plyometrics
4. Initiate ITP phase 2 (off the mound) when phase 1 is complete and athlete is ready

Weeks 20+

1. Initiate gradual return to competitive throwing
2. Perform dynamic warm-ups and stretches
3. Continue Advanced Throwers Ten program
4. Return to competition when athlete is ready (physician decision and rehabilitation team)

Abbreviations: AROM, active range of motion; ER, external rotation; IR, internal rotation; ITP, interval throwing program; PROM, passive range of motion; ROM, range of motion.

APPENDIX B

EXERCISES INCLUDED IN THE THROWERS TEN EXERCISE PROGRAM

- Diagonal-pattern D2 extension
- Diagonal-pattern D2 flexion
- Shoulder external rotation at 0° of abduction
- Shoulder internal rotation at 0° of abduction
- Shoulder abduction to 90°
- Shoulder scapular abduction, external rotation ("full cans")
- Sidelying shoulder external rotation
- Prone shoulder horizontal abduction
- Prone shoulder horizontal abduction (full external rotation, 100° of abduction)
- Prone rowing
- Prone rowing into external rotation
- Press-ups
- Push-ups
- Elbow flexion
- Elbow extension
- Wrist extension
- Wrist flexion
- Wrist supination
- Wrist pronation

All exercises are performed against resistance, with the goal to improve strength. Full description of the program is available.^{45,46}

APPENDIX C

EXERCISES INCLUDED IN THE ADVANCED THROWERS TEN EXERCISE PROGRAM

Elastic Tubing/Band Resistive Exercises

- Shoulder external rotation at 0° of abduction while seated on a stability ball*
- Shoulder internal rotation at 0° of abduction while seated on a stability ball*
- Shoulder extensions while seated on a stability ball†
- Lower trapezius isolation while seated on a stability ball†
- High row into shoulder external rotation while seated on a stability ball†
- Biceps curls/triceps extensions while seated on a stability ball†

Isotonic Dumbbell Resistive Exercises

- Full can while seated on a stability ball†
- Lateral raise to 90° while seated on a stability ball†
- Prone T's on stability ball†
- Prone Y's on stability ball†
- Prone row into external rotation on stability ball†
- Sidelying shoulder external rotation
- Wrist flexion/extension and supination/pronation

**Contralateral sustained hold performed during exercise.*

†*Exercises are performed in 3 distinct continuous movements per exercise: bilateral active exercise, alternating reciprocal movement, and a sustained contralateral hold.*

Ten to 15 repetitions are performed for each movement successively, without rest, to complete 1 set. The goal is the ability to perform 2 full cycles of the entire program without pain, using sound technique and no substitution. Full description of the program is available.⁵²

APPENDIX D

RETURN TO THROWING

Criteria to Initiate Phase 1 Interval Throwing (Long Toss)

- Full, nonpainful ROM
 - Shoulder total ER/IR ROM in 90° of shoulder abduction within 5° of nonthrowing shoulder
 - Shoulder horizontal adduction of 40° or greater on throwing shoulder
 - Glenohumeral IR deficit of less than 15°
 - Elbow and wrist passive ROM within normal limits
- Shoulder, elbow, and wrist strength based on manual muscle test, handheld dynamometer, or isokinetic testing
 - ER/IR ratio of 72% to 76%
 - ER/abduction ratio of 68% to 73%
 - Throwing-shoulder IR greater than 115% compared to nonthrowing shoulder
 - Throwing-shoulder ER greater than 95% compared to nonthrowing shoulder
 - Throwing-arm elbow flexion/extension 100% to 115% compared to nonthrowing arm
 - Throwing-arm wrist flexion/extension and forearm pronation/supination 100% to 115% compared to nonthrowing arm
- Satisfactory clinical examination
 - No pain, tenderness, or effusion
 - Negative laxity testing: prone valgus stress and milking maneuver (**ONLINE VIDEO**)
 - Negative special test for other elbow or shoulder pathology
 - Physician and rehabilitation team clearance
- Successful completion of all steps in the rehabilitation process
- Satisfactory functional test scores
 - Prone ball-drop test (throwing side 110% or greater compared to the nonthrowing side) (**ONLINE VIDEO**)
 - One-arm ball throws against the wall using a 0.9 kg (2 lb) plyoball for 30 seconds without pain and exhibiting the ability to maintain 90°/90° arm position without compensation (throwing side greater than 90% of nonthrowing side) (**ONLINE VIDEO**)
 - Throwing into plyoback rebounder with 0.45-kg (1-lb) plyoball for 30 seconds with no pain, normal mechanics (without substitution), and good control
 - Single-leg step-down for 30 seconds, controlling pelvis and lower extremity alignment for both sides (limb symmetry: 95% or greater) (**ONLINE VIDEO**)
 - Prone plank test for time (**ONLINE VIDEO**)
- Minimum Kerlan-Jobe Orthopaedic Clinic throwers' assessment score of 85

Abbreviations: ER, external rotation; IR, internal rotation; ROM, range of motion.

Criteria are based on several sources.²