Biceps Brachii Tendon Proximal Rupture

Surgical Indications and Considerations

Anatomical Considerations: Biceps brachii, one of the dominant muscles of the arm, is involved in functional activities of the upper limb, both as a result of its size and its orientation about both the shoulder and elbow joints. At its proximal attachment, the biceps has two distinct tendinous insertions on the scapula from its long and short heads. The short head arises from the coracoid process with the coracobrachialis, while the long head originates from the supraglenoid tubercle and passes over the humeral head within the capsule of the glenohumeral joint. The biceps muscle then continues down the arm within the intertubercular groove covered by a synovial out pouching of the joint capsule. The two muscle bellies unite near the midshaft of the humerus and attach distally on the radial tuberosity. The distal tendon blends with the bicipital aponeurosis, which affords protection to structures of the cubital fossa, allowing distribution of forces across the elbow to lessen the pull on the radial tuberosity. The biceps receives innervation via the musculocutaneous nerve (C5, C6) from the lateral cord of the brachial plexus.

Pathogenesis: The long head of the biceps is at risk of injury and degenerative changes because of its mechanical function and proximity to the rotator cuff, bicipital groove, and acromion. Most ruptures occur at the tendinous insertion to the bony anchor, both proximally and distally. The conditions that are most frequently associated with, and probably contribute to, ruptures of the long head of the biceps are rotator cuff pathology, spurs of the bicipital groove, and shoulder instability. Histological studies associated with tendon rupture repeatedly have revealed similar results. Nontraumatic tendon ruptures, including those of the biceps brachii, show evidence of advanced degeneration. Changes include hypoxic tendinopathy, mucoid degeneration, lipomatosis, and calcifying tendinopathy. In both symptomatic and asymptomatic patients with rupture (not limited to biceps alone), a healthy tendon composition rarely, if ever, has been encountered. In contrast, nonruptured (control) tendon samples have demonstrated much lower incidence of degenerative change in large study populations. Although the etiology of degenerative changes remains unclear, this group of subjects may be heterogeneous with multiple factors at work. Younger individuals may rupture the biceps tendon following a traumatic fall, during heavy weightlifting, or during sporting activities (e.g. snowboarding, football).

Epidemiology: Biceps tendon ruptures are reported in the US with increasing frequency. A majority of biceps ruptures occur in males aged 40-60 years with a history of shoulder problems. The dominant arm is involved more commonly, probably related to its greater proportional use compared with the nondominant side. Ruptures of the long head account for 96% of all biceps brachii injuries, while distal tendon and short head ruptures account for 3% and 1% respectively.

Diagnosis

- At the time of long head tendon rupture, patients often feel a pop. This is may be accompanied by a sudden, sharp pain in the anterior shoulder. Pain may actually diminish when a complete rupture occurs following chronic impingement and irritation.
- Most patients present with unusual bulging of the biceps ("Popeye" arm) muscle on the affected extremity.
- The bicipital groove may show indentation or hollowing when the tendon is absent following a rupture.
- Positive Ludington's test: The patient supports the weight of the upper limbs by clasping both hands on top of the head and contracts and relaxes the biceps muscles of both arms. A ruptured long head tendon is demonstrated in two ways, 1) the biceps muscle of the injured extremity will show unusual bulging, and 2) the examiner will be unable to palpate the tendon on the injured side.
- Speed's test: Weakness can be a sign of tendonitis or of tendon rupture.
- Radiographs and MRI: Diagnosis can usually be made on the basis of the history and physical exam, but imaging may help rule out other conditions. The biceps groove may demonstrate spurring of the groove, indicating chromic inflammation of the bicipital tendon. A supraspinatus outlet view may show evidence of supraspinatus outlet impingement syndrome.
- Differential diagnosis: Other diagnoses to consider include brachialis tendon rupture, biceps tendonitis, biceps tendon subluxation, and rotator cuff pathology.

Nonoperative Versus Operative Management: Treatment of biceps tendon ruptures is a topic of debate. Several reviews of surgical repair versus conservative (nonoperative) management report conflicting results; neither complete agreement nor general clinical consensus has been reached. Although no concrete evidence provides unconditional support for one treatment protocol, the results of these reviews ultimately may lend credence to the longstanding practice of individualizing treatment to each patient's circumstances.

Conservative management is considered appropriate for middle-aged or older patients and for those who do not require a high degree of supination strength in daily activities. Most studies have shown no significant deficits in forearm supination or elbow flexor strength in long-term follow-up of nonoperative management. The number of patients managed conservatively outweighs the number repaired surgically in most practice settings, and this therapy provides an effective and highly tolerable means of treatment.

Generally accepted clinical guidelines advocate surgical repair consisting of tenodesis and subacromial decompression proximally for young or athletic patients or those who require maximum supination strength. Cosmetic concerns may prompt a surgical approach when appearance is unacceptable the patient following rupture.

Surgical Procedure: Biceps tenodesis is a surgery to anchor the ruptured end of the biceps tendon. The best surgical results are achieved when the repair is performed within 3 to 4 weeks of the injury. A common method, called the keyhole technique, involves anchoring the ruptured

end to the upper end of the humerus. The keyhole describes the shape of a small hole made by the surgeon in the humerus. The end of the tendon is slid into the top of the keyhole and pulled down to anchor it in place. The surgeon tests the stability of the attachment by bending and straightening the elbow. When the surgeon is satisfied with the repair, the skin incisions are closed, and the shoulder is placed in a protective sling.

NONOPERATIVE REHABILITATION

Phase I for Immobilization and Rehabilitation: Weeks 1-4

Goals: Control edema and pain
Minimize deconditioning

Intervention:

- Shoulder brace/immobilizer for 4 weeks.
- Pendulums
- Active-assisted ROM elbow 0-145 degrees with gentle ROM into extension.
- Shoulder isometrics for 10-14 days.
- Shoulder active-assisted ROM wand external and internal rotation in scapular plane.
- Shoulder passive ROM: flexion, external and internal rotation.
- Cryotherapy, other modalities as indicated to reduce edema or control pain

Phase II for Immobilization and Rehabilitation: Weeks 5-8

Goals: Control any residual symptoms of edema and pain
Minimize deconditioning

Intervention:

- In addition to Phase I treatment, add light shoulder PREs.

Phase III for Immobilization and Rehabilitation: Weeks 9-16

Goals: Limit scar tissue adhesions
Full range of motion (ROM)
Improve strength of all shoulder girdle and elbow musculature

Intervention:

- Progress to isotonic exercise program including bench press and shoulder press.

POSTOPERATIVE REHABILITATION

Phase I Immediate Postoperative phase-"Restrictive Motion": Day 1 to Week 6

Goals: Protect the anatomic repair.
Prevent negative effects of immobilization
Promote dynamic stability.
Diminish pain and inflammation.

Intervention:

Week 0-2

- Sling for 4 weeks
- Sleep in immobilizer for 4 weeks
- Elbow and hand ROM
- Hand-gripping exercises
- Passive and gentle active assisted ROM exercise
    - Flexion to 60 degrees (week 2: flexion to 75 degrees).
    - Elevation in scapular plane to 60 degrees.
    - External and internal rotation with arm in scapular plane.
    - External rotation to 10-15 degrees.
    - Internal rotation to 45 degrees.
    - Note: No active external rotation or extension or abduction.
- Sub maximal isometrics for shoulder musculature.
- NO isolated biceps contractions

Weeks 3-4

- Discontinue use of sling at 4 weeks.
- Sleep in immobilizer until week 4.
- Continue gentle ROM exercises (passive ROM and active assisted ROM)
    - Flexion to 90 degrees
    - Abduction to 75-85 degrees
    - External rotation in scapular plane to 25-30 degrees.
    - Internal rotation in scapular plane to 55-60 degrees.
    - Internal rotation in scapular plane to 55-60 degrees.
    - Note: Rate of progression based on evaluation of the patient.
- No active external rotation, extension, or elevation.
- Initiate rhythmic stabilization drills.
- Initiate proprioception training.
- Tubing external and internal rotation at 0 degrees abduction.
- Continue use of cryotherapy

Weeks 5-6

- Gradually improve ROM.
    - Flexion to 145 degrees.
    - External rotation at 45 degrees abduction: 45-50 degrees.
    - Internal rotation at 45 degrees abduction: 55-60 degrees.
- May initiate stretching exercises.
- May initiate light ROM at 90 degrees abduction
- Continue tubing external and internal rotation (arm at side).
- PNF manual resistance.
- Initiate active shoulder abduction (without resistance).
- Initiate full can exercise (weight of arm).
- Initiate prone rowing, prone horizontal abduction.
- NO biceps strengthening

Phase II Intermediate phase-Moderate Protection Phase: Weeks 7-9

Goals: Gradually restore full ROM (week 10)
Preserve the integrity of the surgical repair
Restore muscular strength and balance.

Intervention:

- Gradually progress ROM
    - Flexion to 180 degrees
    - External rotation at 90 degrees abduction: 90-95 degrees.
    - Internal rotation at 90 degrees abduction: 70-75 degrees.
- Continue to progress isotonic strengthening program.
- Continue PNF strengthening
- Initiate "Thrower's Ten" program.

Weeks 10-12

- May initiate slightly more aggressive strengthening.
- Progress external rotation to thrower's motion
    - External rotation at 90 degrees abduction: 110-115 in throwers (week 10-12)
- Progress isotonic strengthening exercises.
- Continue all stretching exercises. Progress ROM to functional demands (i.e., overhead athlete).
- Continue all strengthening exercises.

Phase III Minimal Protection Phase: Weeks 14-20

Criteria for Progression to Phase III:
Full nonpainful ROM.

Satisfactory stability.
Muscular strength (good grade or better).
No pain or tenderness.

Goals: Establish and maintain full ROM
Improve muscular strength, power, and endurance.
Gradually initiate functional activities.

Intervention:

Weeks 14-16

- Continue all stretching exercises (capsular stretches).
- Maintain thrower's motion (especially external rotation).
- Continue strengthening exercises.
    - "Thrower's Ten" program or fundamental exercises.
    - PNF manual resistance.
    - Endurance training.
    - Initiate light plyometric program.
    - Restricted sport activities (light swimming, half golf swings).

Weeks 16-20

- Continue all exercises listed above.
- Continue all stretching.
- Continue "Thrower's Ten" program.
- Continue plyometric program.
- Initiate interval sport program (e.g., throwing).

Phase IV Advanced Strengthening Phases: Weeks 20-26

Criteria for Progression to Phase IV:
Full nonpainful ROM.
Satisfactory static stability.
Muscular strength 75-80% of contralateral side.
No pain or tenderness.

Goals: Enhanced muscular strength, power, and endurance.
Progress functional activities.
Maintain shoulder mobility.

Weeks 20-26

- Continue flexibility exercises.
- Continue isotonic strengthening program.
- PNF manual resistance patterns.
- Plyometric strengthening.

- Progress interval sport programs.

Phase V Return to Activity Phase: Months 6-9

Criteria for Progression to Phase V:

Full functional ROM.
Muscular performance isokinetic (fulfills criteria).
Satisfactory shoulder stability.
No pain or tenderness.

Goals: Enhanced muscular strength, power, and endurance.
Progress functional activities.
Maintain shoulder mobility.
Gradual return to sport activities
Maintain strength, mobility, and stability

Exercises

- Gradually progress sport activities to unrestrictive participation.
- Continue stretching and strengthening program.

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