Revision Ulnar Collateral Ligament Reconstruction

22

Andrew J. Rosenbaum, Michael A. Flaherty, Christopher Chin, Neal S. Elattrache and Joshua S. Dines

Introduction

Repetitive overloading associated with the throwing motion can cause microscopic tears in the UCL with subsequent ligament attenuation and failure [1, 2]. Surgical reconstruction of the UCL has been found to be effective in correcting valgus elbow instability allowing most overhead athletes (83 %) to return to the previous or higher level of competition in less than 1 year [3]. Retears of the reconstructed ligament are uncommon, with a large series investigating complications by Andrews et al. reporting a 2 % retear rate [4]. The small retear rate may be due to the higher tensile strength of the grafts used in reconstruction (357 N for palmaris longus tendon [5], 837 N for gracilis tendon [6]) compared to the native UCL (260 N). The high strength of the graft used may expose poor cortical bone, poor quality of soft tissue and technique as the cause for poor outcome.

The actual rate of retear may be higher than the reported 2 %, as it is possible that some patients are unable or unwilling to undergo a second long rehab period required after reconstruction and thus do not seek revision surgery. Given the low retear rate in primary reconstruction as well as the limited indications for reconstruction, revision procedures are infrequently performed. However, with the trend toward an increasing number of high school overhead throwing athletes having primary reconstructions, and subsequently more professional athletes, the number of revision procedures will continue to increase [7]. This chapter explores failed UCL reconstruction, evaluation for revision, treatment options, techniques, and outcomes following revision surgery.

Suboptimal Outcomes and Complications After Primary Reconstruction

The original UCL reconstruction technique had a >30 % complication rate [8]. Complications are now estimated to occur at a reported rate ranging from 3 to 25 % [9]. Ulnar neuropathies, sensory nerve paresthesias, fixation loss and graft site complications including infection, tightness, and tenderness, have been described.

Although excellent results are seen in primary reconstruction, suboptimal outcomes do occur,

A. J. Rosenbaum (✉)
Orthopaedic Surgery, Albany Medical Center, 1367 Washington Avenue, Suite 202, Albany, NY 12206, USA
e-mail: Andrewjrosenbaum@gmail.com

M. A. Flaherty
Sports Medicine Orthopaedic Surgery, Capital Region Orthopaedics Group, Albany, NY, USA

C. Chin
Sports Medicine and Shoulder Service, Hospital for Special Surgery, New York, NY, USA
e-mail: jdinesmd@gmail.com

N. S. Elattrache
Kerlan Jobe Orthopedic Clinic, Los Angeles, CA, USA

J. S. Dines
Orthopedic Surgery, Sports & Shoulder Service, Hospital for Special Surgery, Weill Cornell, Medical College, Uniondale, NY, USA

J. S. Dines, D. W. Altchek (eds.), *Elbow Ulnar Collateral Ligament Injury,*
DOI 10.1007/978-1-4899-7540-9_22,

with prior elbow surgery a major risk factor [10]. Conway et al. reported that patients who underwent elbow surgery prior to UCL reconstruction had a significantly decreased chance of returning to their previous level of sports participation [11]. The previous surgeries included arthroscopic loose body removal, diagnostic arthroscopy, osteophyte debridement, ulnar nerve transposition, and prior UCL repair. Of the patients having undergone a prior elbow surgery, only 33 % had an excellent outcome. The specific outcomes of the two patients who underwent revision UCL reconstruction were not discussed.

In technique-related complications, considerations include the approach to the flexor pronator mass (e.g., detachment vs. muscle-splitting technique), type of humeral tunnels (e.g., posterior, anterior), graft fixation technique (e.g., figure-of-8, docking technique), type of graft used, indications and technique for ulnar nerve transposition, performance of diagnostic arthroscopy, and if any additional procedures are to be performed at the time of reconstruction. In a metaanalysis performed by Vitale and Ahmad, these factors were evaluated in eight studies describing 493 patients [12]. Better outcomes, were observed with the muscle-splitting approach, as compared to detachment of the flexor-pronator mass; with avoidance of obligatory ulnar nerve transposition; and when the docking or modified docking technique was used instead of a figure-of-8 technique.

In a large case series by Cain et al., 55 of 942 patients who underwent UCL reconstruction required 62 subsequent elbow surgeries, ranging from 6 months to 7 years after reconstruction [3]. Although arthroscopic debridement of an olecranon osteophyte was the most common reason for a second procedure (53 of the 55 patients), 1 % of the patients required revision surgery. Additionally, four patients required open reduction and internal fixation of avulsion fractures of the medial epicondyle at the tunnel site.

Indications for Revision Surgery for Failed UCL Reconstruction

The decision to revise a failed UCL reconstruction is dependent on several factors, including the history, physical examination findings and most importantly, patient expectations. Because revision surgery is generally associated with inferior outcomes and more complications, suboptimal results are not uncommon and patients must understand that they may not return to their preinjury level of play, the primary measure of success with regard to UCL reconstruction [13, 14].

Patients with a torn UCL graft may complain of medial elbow pain, stiffness or ulnar nerve symptoms, which are similar findings to those observed with a primary tear. They may describe an acute event that caused their recurrent UCL pain, or present with a more insidious onset of symptoms. Of the 15 patients studied by Dines et al. who underwent revision UCL surgery, seven identified an acute event, while the remainder had a more chronic history of medial elbow pain [15]. The average time from initial reconstruction to revision surgery was 36 months (range, 12–76 months).

Preoperative Evaluation and Considerations for UCL Reconstruction

Physical examination must include inspection, palpation, and determination of elbow range of motion. Palpation about the medial elbow and previous incision will show the position of the ulnar nerve and pinpoint area of tenderness (ulnar vs. humeral failure). Valgus stress testing and a moving valgus test should also be performed in all patients. Range of motion about the elbow should also be evaluated for osteophyte formation or loose bodies which may have recurred or been untreated previously. Preoperative radiographs and magnetic resonance imaging can aid in diagnosis and clinical decision-making, at times identifying additional pathology requiring treatment (bone loss, loose body, osteoarthritis, avulsion fracture) (Fig. 22.1). Prior to performing revision UCL surgery, the operative records from the primary reconstruction must be reviewed. Knowledge of the surgical technique used is important as it is difficult to perform a docking procedure on a patient who had a previous Jobe procedure. Type and size graft used is also important to plan for tunnel size and possible bone loss. The position of the ulnar nerve and previous transpo-

Fig. 22.1 Coronal magnetic resonance image showing retear of UCL status post figure-of-8 technique

to plan for tunnel size and possible bone loss. The position of the ulnar nerve and previous transposition must be reviewed as well as other intraoperative findings, complications, and additional procedures performed. Revision surgery must be individually tailored to each patient based on the previous operation, and clinical evaluation and imaging.

When possible, previous incisions should be used. A careful dissection is imperative, as the medial antebrachial cutaneous and ulnar nerves may be encased in scar tissue. Different techniques have been described for revision UCL surgery, including direct repair, the modified Jobe [10], DANE TJ [15], docking [16], and suspension button [17] and endobutton (Smith and Nephew Endoscopy, Mansfield, Mass) fixation techniques.

Principles of Revision Surgery for Failed UCL Reconstruction

The technique and type of graft the surgeon feels most comfortable with should be utilized. However, certain situations such as bone loss, previous technique and ulnar nerve position may dictate specific treatment options and make revision more challenging. The surgeon must have contingency plans for all potential sources of graft fixation failure. Ulnar bone tunnel quality and the presence of ulnar cortical bone loss is one such example and one of the most important factors that can influence which reconstruction technique to use.

Ulnar Bone Loss

The DANE TJ is useful when faced with ulnar bone loss (see Chap. 19 for details regarding the DANE procedure). It is a hybrid procedure combining a proximal docking technique with interference screw fixation on the ulna [18]. By fixing the UCL to a single tunnel distally, the ligament's native anatomy is more closely restored, as anatomical studies have shown the UCL to have a narrow insertion on the ulna's sublime tubercle. Because multiple drills holes in the ulna are unnecessary, the DANE TJ is effective in cases of insufficient bone stock on the sublime tubercle. This technique also decreases the risk of ulna bone bridge fracture. Excellent outcomes have been reported in 86% of patients undergoing reconstruction with the DANE TJ technique [19].

Lee et al. [8] assessed the applicability of suspension button fixation in the setting of ulnar cortical bone loss. In this cadaveric study, a guidewire was drilled through the center of the ulnar footprint of the ligament into the lateral ulnar cortex. The guidewire should be angled at about 30° in the coronal and sagittal planes to protect the posterior interosseous nerve. A cannulated reamer is used to drill the sockets after which the graft is shuttled into the ulna. Several suspensory buttons exist, which can be used for fixation (Fig. 22.2). While there are no reports of clinical outcomes using this technique, the investigators found elbow kinematics with the suspension button reconstruction to be comparable to those of the UCL in its intact state, and failure testing identified comparable fixation loads as compared to historical controls, even with the presence of ulnar cortical bone loss.

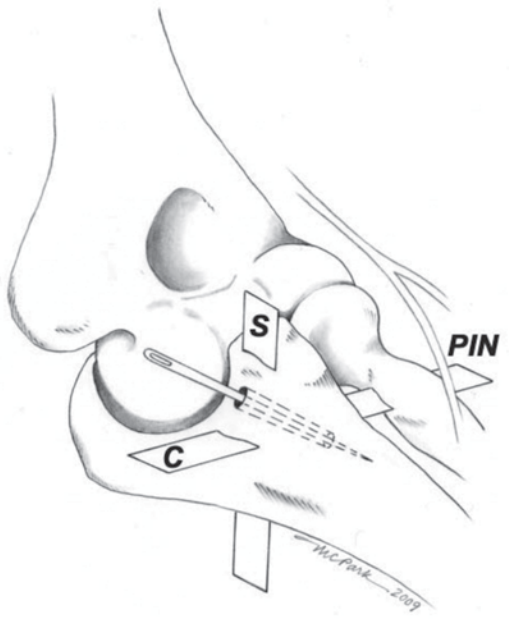

Fig. 22.2 Guidewire angled 30° in the coronal and sagittal plane to avoid posterior interosseous nerve. (From [17], reprinted with permission from Sage publications)

Humeral Bone Loss

Humeral bone loss presents a much more complicated clinical scenario for the treating surgeon. No good options exist to secure the graft into a fractured or insufficient medial epicondyle (Fig. 22.3). If, after counseling the patient about the prolonged recovery course and less-than-ideal clinical outcomes, patients wish to proceed, a staged procedure can be used. Bone grafting of the humeral tunnels should be done at the index procedure. After incorporation of the bone graft is confirmed by computed tomography (CT) scan, the revision UCL reconstruction can be carried out.

Additional procedures may be performed at the time of revision surgery. In the Dines et al. case series examining revision UCL surgery, four patients underwent concomitant revision ulnar nerve transposition, and one underwent ulnar nerve transposition for the first time. Open posteromedial osteophyte resection, flexor muscle repair, and transposition of the medial antebrachial cutaneous nerve may also be necessary.

Fig. 22.3 Fractured humeral socket after UCL reconstruction

Outcomes Following Revision Surgery for Failed UCL Reconstruction

The paucity of data on functional outcomes following revision UCL surgery makes it challenging to establish objective guidelines and recommendations for return to competition [4, 19, 20]. Of the 15 patients in the Dines et al. series, only five (33%) were able to return to their previous level of competition for at least 1 year. Andrews

presented similar data in a presentation titled "Complications of Failed Medial UCL Reconstructions and Evaluation of Revision Surgery" [4]. Of the seven patients who underwent revision surgery in this series, only two returned to their previous level of play or higher (<30%) [4]. Although these outcomes are worse than those seen after primary reconstruction (83%), given the complexity of revision surgery and the technical difficulties of revision UCL surgery, it is not surprising [21].

Dines et al. reported a 40% complication rate in their revision series, a higher rate than that seen after primary surgery (3–25%) [10, 21]. Although six players developed postoperative complications, most were effectively treated conservatively with physical therapy and anti-inflammatory medications. The patients conservatively managed for stiffness, transient ulnar neuritis, and medical epicondylitis were all able to return to their previous level of play, having excellent outcomes following revision surgery. There was one patient with stiffness requiring an arthroscopic lysis of adhesions and excision of an olecranon spur. This patient was ultimately classified as having a poor outcome. A rerupture of the revised UCL occurred at 15 months post revision in another patient. At the time of retear, the patient had returned to his previous level of play for 3 months. He retired from baseball after this, and was considered to have had a poor outcome.

Some studies suggest that one in nine Major League Baseball (MLB) pitchers require UCL reconstruction, making them a unique and excellent cohort to follow in regard to UCL injuries [12, 21]. Dines et al. found a 75% rate of return to preinjury competition for MLB pitchers who underwent revision UCL surgery. However, they did not discuss whether these players returned to their preinjury pitching workload [15]. Jones et al. sought to determine the functional outcomes of MLB players after revision UCL reconstruction by evaluating pitching workload (appearances for relief pitchers, games started/innings pitched for starters; earned run average, strike outs per nine innings, walks per nine innings) [20]. In their case series, 78% (14/18) of pitchers were able to return to MLB play within two full seasons. Relief pitchers were able to resume 50% of their preinjury workload, while starting pitchers reached only 35% of their preinjury workload. Based on these findings, the authors believe starting pitchers to be at higher risk for suboptimal outcomes in the revision setting, and that they may benefit from transition to a relief role [20].

Summary

Primary reconstruction of the UCL can be accomplished via many proven techniques, with an 83% rate of return to previous or higher level of competition in less than 1 year [4]. However, complications and poor outcomes are at times observed, albeit infrequently. Rerupture is a rare complication estimated to occur in 2% of patients but may be vastly underreported. Little is known about optimal treatment for rerupture and the outcomes following revision UCL surgery. In the setting of intact bone tunnels, many of the techniques used for primary reconstruction can be used for revision surgery. When ulnar cortical bone loss is present, options become more limited, with the DANE TJ and endobutton techniques showing good results. Cadaveric studies have also shown a suspension button construct to be an effective treatment when faced with bone loss. Like other revision procedures, outcomes following revision UCL surgery are inferior to those seen with primary reconstruction. Further research and investigation must be conducted on revision UCL surgery in order to develop evidence-based guidelines and treatment recommendations that will optimize outcomes.

References

1. Feltner ME. Three-dimensional interactions in a two-segment kinetic chain, part II: application to the throwing arm in baseball pitching. Int J Sport Biomech. 1989;5:420–50.
2. Fleisig GS, Andrews JR, Dillman CJ, Escamilla RF. Kinetics of baseball pitching with implications about injury mechanisms. Am J Sports Med. 1995;23:233–9.

3. Cain EL, Andrews JR, Dugas JR, Wilk KE, McMichael CS, Walter JC 2nd, Riley RS, Arthur ST. Outcome of ulnar collateral ligament reconstruction of the elbow in 1281 athletes: results in 743 athletes with minimum 2-year follow-up. Am J Sports Med. 2010;38:2426–34.
4. Mauro CS, Dines JS, ElAttrache NS. Ulnar collateral ligament tears: Special Considerations. In: Dines JS, Altchek DW, Andrews J, ElAttrach NS, Wilk KE, Yocum LA, editors. Sports medicine of baseball. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2012. p. 247–248.
5. Regan WD, et al. Biomechanical study of ligaments around the elbow joint. Clin Orthop Relat Res. 1991;271:170–9.
6. Hamner DL, et al. Hamstring tendon grafts for reconstruction of the anterior cruciate ligament: biomechanical evaluation of the use of multiple strands and tensioning techniques. J Bone Joint Surg Am. 1999;81(4):549–57.
7. Petty DH, Andrews JR, Fleisig GS, Cain EL. Ulnar collateral ligament reconstruction in high school baseball players: clinical results and injury risk factors. Am J Sports Med. 2004;32(5):1158–64.
8. Lee GH, Limpisvasti O, Park MC, McGarry MH, Yocum LA, Lee TQ. Revision ulnar collateral ligament reconstruction using a suspension button fixation technique. Am J Sports Med 2010;38:575–80.
9. Rohrborough JT, Altchek DW, Hyman J, Williams RJ III, Botts JD. Medial collateral ligament reconstruction of the elbow using the docking technique. Am J Sports Med. 2002;30:541–8.
10. Azar FM, Andrews JR, Wilk KE, Groh D. Operative treatment of ulnar collateral ligament injuries of the elbow in athletes. Am J Sports Med. 2000;28:16–23.
11. Conway JE, Jobe FE, Glousman RE, Pink M. Medial instability of the elbow in throwing athletes: treatment by repair or reconstruction of the ulnar collateral ligament. J Bone Joint Surg Am. 1992;74:67–83.
12. Vitale MA, Ahmad CS. The outcome of elbow ulnar collateral ligament reconstruction in overhead athletes. AJSM. 2008;36:1193–205.
13. Dines JS, Fealy S, Strauss EJ, et al. Outcomes analysis of revision total shoulder replacement. J Bone Joint Surg Am. 2006;88:1494–500.
14. Djurasovic M, Marra G, Arroyo JS, Pollock RG, Flatow EL, Bigliani LU. Revision rotator cuff repair: factors influencing results. J Bone Joint Surg Am. 2001;83:1849–55.
15. Dines JS, Yocum LA, Frank JB, ElAttrache NS, Gambardella RA, Jobe FW. Revision surgery for failed elbow medial collateral ligament reconstruction. Am J Sports Med 2008;36:1061–5.
16. Rohrborough JT, Altchek DW, Hyman J, Williams RJ III, Botts JD. Medial collateral ligament reconstruction of the elbow using the docking technique. Am J Sports Med. 2002;30:541–8.
17. Lee GH, Limpisvasti O, Park MC, McGarry MH, Yocum LA, Lee TQ. Revision ulnar collateral ligament reconstruction using a suspension button fixation technique. Am J Sports Med 2010;38:575–80.
18. Conway JE. The DANE TJ procedure for elbow medial ulnar collateral ligament insufficiency. Tech Shoulder Elbow Surg. 2006;7:36–43.
19. Dines JS, ElAttrache NS, Conway JE, Smith W, Ahmad CS. Clinical outcomes of the DANE TJ technique to treat ulnar collateral ligament insufficiency of the elbow. Am J Sports Med 2007;35:2039–44.
20. Jones KJ, Conte S, Patterson N, ElAttrache NS, Dines JS. Functional outcomes following revision ulnar collateral ligament reconstruction in Major League Baseball pitchers. J Shoulder Elbow Surg 2013;22:642–46.
21. Cain EL, Andrews JR, Dugas JR, Wilk KE, McMichael CS, Walter JC 2nd, Riley RS, Arthur ST. Outcome of ulnar collateral ligament reconstruction of the elbow in 1281 athletes: results in 743 athletes with minimum 2 year follow-up. Am J Sports Med. 2010;38:2426–34