

Low Rates of Postoperative Complications and Revision Surgery After Primary Medial Elbow Ulnar Collateral Ligament Repair



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Purpose: To evaluate the incidence of early postoperative complications and revision surgery in patients who underwent primary medial ulnar collateral ligament (MUCL) repair with minimum of 2-year follow-up. **Methods:** A retrospective review of a national insurance database was conducted to identify patients with MUCL injuries who underwent primary MUCL repair between 2015 to 2020 with minimum 2-year follow-up. Patients >40 years of age and those who had concomitant elbow fractures or dislocations, lateral UCL injuries, medial epicondylitis, elbow arthritis, or a history of previous elbow injury/surgery were excluded. The number of patients who underwent a concomitant ulnar nerve procedure (transposition or decompression) during the primary MUCL repair was recorded. Complications within 90 days of surgery and the incidence and timing of subsequent ipsilateral ulnar nerve surgery or revision MUCL surgery were assessed. **Results:** A total of 313 patients (63.6% male) were included. The mean age was 20.3 ± 6.9 years, and mean follow-up was 3.7 ± 1.3 years. Concomitant ulnar nerve transposition or decompression was performed in 34.2% (N = 107). The early postoperative complication rate was 7.3% (N = 23). The most common complication was ulnar neuropathy (5.8%, N = 18). Wound complications, elbow stiffness, and medial epicondyle fractures were much less common (N = 5). Sixteen of 18 (88.9%) patients with postoperative ulnar neuropathy underwent transposition or decompression at the time of primary repair. Of these 18 patients, 5 (27.8%) underwent a subsequent ulnar nerve surgery (1 primary and 4 secondary), with the majority occurring within 6 months. The incidence of revision MUCL surgery was low (1.0%, N=3), with all 3 patients undergoing MUCL reconstruction. **Conclusion:** There was a low incidence of early postoperative complications (7.3%) and 2-year revision MUCL surgery (1.0%) in young patients who underwent primary MUCL repair with no additional ligamentous, fracture, and dislocation-related diagnoses. All 3 (1.0%) MUCL revisions underwent reconstruction. **Level of Evidence:** Level IV, therapeutic case series.

The medial ulnar collateral ligament (MUCL) primarily acts to resist valgus forces on the elbow. MUCL injuries can occur from elbow fractures or dislocations or via athletics, which are more commonly seen in overhead-throwing athletes.¹ Traditionally, patient demographics and the respective mechanism of injury have had important implications with respect to the treatment approach for MUCL injuries.² In overhead-throwing athletes, isolated MUCL injuries

that fail conservative treatment often require operative management to continue playing.³⁻⁵ With the increased specialization of overhead athletics and year-round play, there has been a well-documented increase in the incidence of MUCL injuries and subsequent surgical interventions over the last 10 years.^{6,7} Therefore identifying the optimal surgical management for these patients has become increasingly important.

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Historically, overhead-throwing athletes who required MUCL surgery were treated with a reconstruction regardless of the age, level of play, tear pattern, ligamentous tissue quality, and location of injury along the MUCL,⁸ because early attempts at MUCL repair were associated with inferior outcomes compared to reconstruction.^{2,9} However, advancements in suture augmentation and suture-anchoring technology, in conjunction with advancements in the understanding of MUCL biomechanics, have resulted in a revived interest in performing MUCL repairs.^{10,11} A recent epidemiological study highlighted this pattern, reporting an increased incidence of MUCL repairs in NCAA Division I baseball athletes between 2017 (9.5%) to 2019 (25.1%).^{12,13} In addition, MUCL repairs are now being performed in appropriately selected patients, including young, nonprofessional athletes with proximal or distal tears and adequate tissue quality.¹⁴ This renewed interest is a function of several purported benefits of MUCL repair when compared with reconstruction, including a shorter rehabilitation time and quicker return to play.^{11,14-16} Although recent clinical outcome data representing contemporary MUCL repair are promising for carefully selected patients, these investigations have been limited to a few small case series with inadequate follow-up. Therefore longer-term outcome data are needed to provide enhanced prognostic information when considering MUCL repair.

As the indications and use of MUCL repair continue to expand, knowledge surrounding the incidence of adverse events, including early postoperative complications and revision surgery, may provide important clinical insight into the safety and durability of these repair techniques. The purpose of this study was to evaluate the incidence of early postoperative complications and revision surgery in patients who underwent primary MUCL repair with minimum of 2 years' follow-up. We hypothesized that there would be a low incidence of 90-day postoperative complications and revision surgery after primary MUCL repair.

Methods

Database and Patient Selection

Patient data between January 2015 and December 2020 was retrospectively reviewed from the PearlDiver (M151Ortho) database (PearlDiver Technologies, Colorado Springs, CO), a commercially available administrative United States database containing 150 million patients. This is a deidentified and Health Insurance Portability and Accountability Act-compliant database. Given the deidentified nature of the data, our Institutional Review Board granted exemption for conducting this research.

Patients with an International Classification of Diseases (ICD)-10 diagnosis codes for "medial ulnar

collateral ligament sprain" or "traumatic rupture of medial ulnar collateral ligament" were queried based on the following codes: ICD-10-D-S53.441 (MUCL sprain, right elbow), ICD-10-D-S53.442 (MUCL sprain, left elbow), ICD-10-D-S5331 (MUCL traumatic rupture, right elbow), and ICD-10-D-S5332 (MUCL traumatic rupture, left elbow).¹⁷ In an attempt to confine our cohort to only isolated MUCL injuries, any patients with concomitant elbow fractures, elbow dislocations, lateral ulnar collateral ligament injuries, lateral epicondylitis, medial epicondylitis, elbow arthritis, or a history of ipsilateral elbow injury or surgery were excluded using PearlDiver software function and additional ICD-10 codes. To isolate for a younger and more athletic patient population, patients aged >40 years were also excluded from this study.¹⁷

The remaining patients with ICD-10 diagnosis for MUCL injuries were paired with the respective same-day Current Procedural Terminology (CPT) code for "repair, medial collateral ligament, elbow, with local tissue (CPT 24345). To further isolate MUCL injuries that were surgically treated without any concomitant procedures, any patients who underwent same-day MUCL reconstruction (CPT 24346), lateral ulnar collateral ligament reconstruction or repair (24344), open elbow fractures/dislocation surgery (CPT 24586, 24587, 24635), elbow arthroplasty (24360, 24361, 24362, 24363, 24365, 24366, 24370, 24371), arthrotomy with synovectomy (CPT-29835), arthroscopic synovectomy (CPT-29836), and arthroscopic removal of loose bodies (CPT 29834) were excluded.^{18,19}

Records were filtered based on the first occurrence of a primary MUCL repair for patients with active records in the database with a minimum of 2-years following the primary repair. Therefore only patients <40 of age with ICD-10 codes for MUCL injuries, a same-day CPT code for MUCL repair, a lack of concomitant exclusion ICD/CPT codes, and minimum 2-year follow-up data comprised the study cohort.

The number of patients who underwent a same-day concomitant ulnar nerve procedure (CPT 64718, transposition or neuroplasty of the ulnar nerve at the elbow) was recorded. The number of patients receiving physical therapy or elbow-bracing treatment up to a year before the MUCL repair were also recorded based on CPT codes.

Rates of Early Postoperative Complications

Although all patients had a minimum 2-year follow-up, the incidence of early postoperative complications was also assessed and defined as those that occurred within 90 days of the primary MUCL repair. These complications included surgical site infections, wound dehiscence, hematomas, medial epicondyle fractures, ulnar neuropathies, and elbow stiffness.

Complications that constituted greater than 0 patients but fewer than 11 were reported as “<11” in the database. Complications that consisted of >11 patients were reported as the exact number of patients. For patients with postoperative ulnar neuropathy, an ICD-10 preoperative diagnosis for ulnar neuropathy was assessed, as well as any ulnar nerve procedures (decompression or transposition) at the time of the primary MUCL repair. For patients with postoperative ulnar neuropathy, a primary ulnar nerve revision surgery was defined as a subsequent surgery that occurred in those who did not undergo concomitant ulnar nerve surgery at the time of primary MUCL repair. Similarly, a secondary ulnar nerve revision surgery was defined as a subsequent surgery that occurred in patients who underwent concomitant ulnar nerve surgery at the time of primary MUCL repair.

Rates of Surgery Rates

All patients were assessed for the occurrence of a subsequent ipsilateral ulnar nerve surgery, MUCL revision reconstruction, or MUCL revision repair procedure. Because all MUCL repair patients were diagnosed using ICD-10 codes, every patient had documentation of laterality (right elbow or left elbow) at the time of the primary MUCL repair. Therefore the designated laterality of the operative elbow was assessed for a subsequent ipsilateral ulnar nerve transposition or decompression (CPT 64718, transposition or neuroplasty of the ulnar nerve at the elbow), MUCL revision repair (CPT 24345, repair, medial collateral ligament, elbow, with local tissue), or MUCL revision reconstruction (CPT 24346, reconstruction medial collateral ligament, elbow, with tendon graft [includes harvesting of graft]) to identify revision procedures. Subsequent surgeries on the contralateral elbow (even for MUCL injuries) were excluded from the reoperation analysis. Using PearlDiver software, Kaplan-Meier survival analysis was used to assess the timing and incidence of revision surgery in the study population.

Statistical Analyses

Patient demographic data, including age, sex, and body mass index were analyzed using descriptive statistics. To assess for attrition bias in our selection of only patients with minimum 2-year follow-up, a secondary χ^2 analysis was performed to determine whether early complication rates were similar between excluded MUCL repair patients with at least 90-day follow-up and the study population with minimum 2-year follow-up. Kaplan-Meier analysis of the PearlDiver software was used to assess reoperation free survival and time to reoperation. All statistical analyses were performed using the PearlDiver software or Microsoft Excel.

Results

Study Population

A total of 313 patients who underwent primary MUCL repair with minimum 2-year follow-up were included. The average age (\pm standard deviation) of the cohort was 20.3 ± 6.9 years, with 63.6% being male. The mean follow-up for the cohort was 3.7 ± 1.3 years (range 2-6.2). The most common form of nonoperative management in the previous year leading up to MUCL repair was physical therapy (N = 55, 17.6%), followed by elbow bracing (N = 26, 8.3%). Additional patient characteristics are outlined in Table 1.

Rates of Early Postoperative Complications

The overall incidence of early postoperative complications was 7.3% (N = 23). The most common postoperative complication was ulnar neuropathy (5.8%, N = 18). Surgical site infections (<3.8%, N < 11), wound dehiscence (<3.8%, N < 11), hematoma formation (<3.8%, N < 11), elbow stiffness (<3.8%, N < 11), and medial epicondyle fractures (<3.8%, N < 11) constituted the remaining 1.5%. There was no significant difference in the incidences of early postoperative complications between MUCL repair patients that were excluded with at least 90 days’ follow-up and the present MUCL repair study cohort with minimum 2-year follow-up (P = .512).

Postoperative Ulnar Neuropathy and Ulnar Nerve Revision Surgery

At the time of primary MUCL repair, 107/313 (34.2%) patients underwent a concomitant ulnar nerve procedure. Of the 18 patients with postoperative ulnar neuropathy, 16 (88.9%) had a preoperative ulnar neuritis diagnosis and underwent ulnar nerve surgery at the time of primary repair. Two of 18 (12.1%) had no ICD-10 diagnosis of preoperative ulnar neuropathy and did not undergo ulnar nerve surgery at the time of

Table 1. Demographics of the Entire Cohort That Underwent Primary MUCL Repair

Demographics of MUCL Repair Patients	
Follow-up (yr), mean \pm SD	3.7 \pm 1.3
Age	20.3 \pm 6.9
5-9 years	3 (1.0%)
10-14 years	30 (9.6%)
15-19 years	151 (48.2%)
20-24 years	68 (21.6%)
25-29 years	18 (5.8%)
30-39 years	43 (13.7%)
Sex	
Female	114 (36.4%)
Male	199 (63.6%)
Obesity (BMI > 30)	20 (6.4%)

BMI, body mass index; SD, standard deviation.

primary repair. Of the 18 patients with postoperative ulnar neuropathy, 5 (27.7%) required a subsequent ulnar nerve surgery: 1 primary surgery that occurred 3.0 years after the MUCL repair and 4 secondary surgeries that occurred 47, 84, 147, and 160 days after the primary MUCL repair (secondary surgery average = 3.7 months).

MUCL Revision Surgery

All 313 patients had laterality-based ICD-10 codes and minimum 2-year follow-up data to assess ipsilateral MUCL revision surgery rates. The revision MUCL surgery rate was 1.0% (N = 3/313). All 3 patients underwent ipsilateral revision to MUCL reconstruction 279, 293, and 299 days after the primary MUCL repair. In addition, no patients underwent an ipsilateral MUCL revision repair at any point during the study period.

Discussion

The most important findings of the current study were a low incidence of early postoperative complications (7.3%) and 2-year revision MUCL surgery (1.0%) in young patients who underwent primary MUCL repair with no additional ligamentous, fracture, and dislocation-related diagnoses. Ulnar neuropathy was the most frequently reported postoperative complication, with an incidence of 5.8%, and 88.9% of these patients having undergone a concomitant ulnar nerve decompression or transposition at the time of the primary MUCL repair. Interestingly, 22.2% of patients who had a postoperative ulnar neuropathy after concomitant MUCL repair and ulnar nerve surgery underwent a subsequent ulnar nerve procedure within 6 months. Finally, all 3 patients (1.0%) necessitating revision MUCL surgery underwent MUCL reconstruction as opposed to revision MUCL repair.

Recent epidemiological studies have reported that the rate of revision surgery after MUCL reconstruction vary between 1% to 15% depending on patient selection and injury mechanism.²⁰ However, the rates of revision surgery after MUCL repair are not well understood. Savoie et al.¹⁶ published results on 60 nonprofessional athletes (mean age, 17.1 years) who underwent MUCL repair with suture anchors and reported that only 6% of patients met criteria for repair failure (defined by poor function or conversion to MUCL reconstruction). Similarly, Dugas et al.²¹ reported 1 repair failure (retear) in 111 overhead athletes who underwent MUCL-augmented repairs with minimum 1-year follow-up. Although these results demonstrated the short-term success after MUCL repair in young athletes, many have suggested that further long-term data are needed to better understand the durability of these enhanced repairs.^{16,21}

In the current study comprising 313 patients who underwent primary MUCL repair with an average

follow-up of 3.7 ± 1.3 years, only 3 (1%) patients underwent subsequent MUCL reconstruction whereas no patients underwent revision MUCL repair. In addition, the 3 repair failures underwent conversion to MUCL reconstruction 9 months after the primary repair. The low rates of revision surgery with contemporary MUCL repair oppose the results of historical reports that documented higher failure rates, ranging between 50% to 70%.^{5,22} The improved survivorship for newer MUCL repairs may be attributed to the development and application of internal brace augmentation and a more profound understanding of appropriate patient selection criteria.^{11,16} However, we are unable to determine what, if any, effect internal brace supplementation has on MUCL repair postoperative complications. Although the current study design is limited by the inability to determine the specific MUCL repair technique(s) used, it is important to consider that we only analyzed MUCL repairs performed from 2015 to 2020, which coincides with emergence of MUCL repair augmentation.^{11,16} Therefore these techniques likely differed from historical repair techniques that resulted in high rates of failure. The low rates of MUCL reconstruction or revision repair observed in the current study offer important prognostic data pertaining to the durability of contemporary MUCL repair techniques, although additional clinical data are needed to comprehensively assess long-term survivorship.

Ulnar neuropathy was the most common postoperative complication in this population, which is in agreement with recent case series on MUCL repair with internal brace augmentation that reported this incidence to be similar at 8.2%.¹¹ In our study population, 88.9% of patients with postoperative ulnar neuropathy were diagnosed with preoperative ulnar neuropathy and underwent a concomitant ulnar nerve procedure at time of the primary MUCL repair. These findings are also in agreement with the 87.7% rate reported by Rothermich et al.¹¹ In terms of ulnar nerve revision surgery, 4/18 (22.7%) underwent a revision ulnar nerve procedure within 6 months after the primary MUCL repair. Although the severity of neuropathy or reason for secondary surgery was not obtained, clinicians should be aware of this potential complication and revision surgery rate in those who experience postoperative ulnar neuropathy after concomitant MUCL repair and ulnar nerve surgery.

The remaining 2 patients (12.1%) who experienced postoperative ulnar neuropathy were not diagnosed with preoperative ulnar neuritis (based on ICD-10 codes) and did not undergo concomitant ulnar nerve surgery at the time of primary MUCL repair. These findings are also in agreement with the similar rate (13.3%) reported by Rothermich et al.¹¹ The possibility exists that this type of postoperative ulnar neuropathy

could potentially be related to ulnar nerve compression in its native location because of postoperative inflammation or from iatrogenic nerve injury because of its close proximity to the MUCL repair working space. In addition, only 1 of these patients required a subsequent ulnar nerve procedure, which occurred nearly 3 years after the primary MUCL repair. Although further clinical data and larger numbers are needed, these findings may offer important considerations for postoperative neuropathy reported after isolated MUCL repair in patients without evidence of preoperative ulnar neuritis.

Limitations

This study is not without limitations. There are several, well-documented limitations inherent to large national databases such as PearlDiver and the retrospective nature of this study. The use of ICD and CPT codes introduces potential bias into the accuracy of the data, as it is a reflection of the accuracy of coding performed by the physicians and billers. However, unlike other procedure codes, there are distinctly separate codes for MUCL reconstruction and MUCL repair that enabled isolation of patients who underwent MUCL repair. Although a comparison between MUCL repair and reconstruction could have been conducted, a direct comparison without the proper indications for each procedure may have limited clinical utility. Because data available from this national administrative database are based on claims data, variables outside those already present in the database are not available. Therefore we were unable to assess factors such as physical exam findings and type of augmented or isolated repairs performed, the number of athletes, type of sport, return to play, or patient reported outcomes in our cohort. In addition, given the general nature of the CPT code for ulnar nerve surgery, we could not determine the exact procedure performed (transposition or decompression), as well as more granular clinical information regarding postoperative ulnar neuropathy symptoms and reasons for revision surgery. We could also only determine whether a patient had preoperative ulnar neuropathy if they reported postoperative ulnar neuropathy. Last, we selected for a group of patients with minimum 2 years' follow-up, which could introduce some attrition bias when calculating revision surgery rates.

Conclusion

There was a low incidence of early postoperative complications (7.3%) and 2-year revision MUCL surgery (1.0%) in young patients who underwent primary MUCL repair with no additional ligamentous, fracture, and dislocation-related diagnoses. All 3 (1.0%) MUCL revisions underwent reconstruction.

Disclosure

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: A.J. reports other from Medwest, outside the submitted work. L.V.G. reports personal fees from DePuy/Medical Device Business Services; Exactech, Zimmer Bioment, and Smith & Nephew; and other from Gotham Surgical and Exactech, outside the submitted work. J.D. reports personal fees from Arthrex, Merch Sharp and Dohme, and Trice Medical; and other from Arthrex and Linvatec, outside the submitted work. D.W.A. reports personal fees from Stryker; and other from Stryker and Arthrex, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

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