Original Article

Posteromedial Osteophyte Resection in Baseball Players Undergoing Ulnar Collateral Ligament Reconstruction Has no Effect on Return to Play but Decreases Patient-Reported Satisfaction and Throwing Control

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Purpose: The purpose of this study was to compare patient-reported outcomes and return to play (RTP) rates following ulnar collateral ligament reconstruction (UCLR) in patients with and without posteromedial elbow impingement (PI) treated with concomitant arthroscopic posteromedial osteophyte resection. **Methods:** Baseball players who underwent UCLR performed by the senior surgeon with minimum follow-up of 2 years were surveyed in this retrospective cohort study. Primary outcomes included Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow (KJOC) score, Andrews-Timmerman score, and RTP rate. Secondary outcomes included patient satisfaction scores. **Results:** 35 baseball players were included. Eighteen had no preoperative impingement (mean age: 19.06 ± 3.28 years), while 17 had PI treated with concomitant arthroscopic osteophyte resection (mean age: 20.06 ± 2.68 years). Following surgery, there was no difference in mean Andrews-Timmerman score (no impingement = 91.67 ± 8.04 vs PI = 92.06 ± 7.92, $P = .89$) nor KJOC score (no impingement = 83.36 ± 11.72 vs PI = 79.88 ± 12.35, $P = .40$), but there was a decreased mean KJOC throwing control sub-score in the PI group (7.65 ± 2.40 vs 9.11 ± 1.32, $P = .04$). There was no difference in RTP rate between the groups (no impingement = 72.22%, PI = 94.12%, $\chi^2 = 1.28$; $P = .26$). There was significantly higher mean satisfaction score in the no impingement group (96.67 ± 4.58 vs 90.12 ± 11.91; $P = .04$), and those patients were also more likely to pursue surgical treatment again (94.44% vs 52.94%, $\chi^2 = 7.88$; $P = .005$). **Conclusions:** There was no difference in RTP rate following ulnar collateral ligament reconstruction in baseball players with and without posteromedial impingement treated with arthroscopic resection. Outcomes on the KJOC and Andrews-Timmerman scores were good to excellent in both groups. Players in the posteromedial impingement group were less satisfied with their outcome, however, and less likely to elect for surgery if they were to sustain the injury again. Additionally, players in the posteromedial impingement group were found to have decreased throwing control on the KJOC questionnaire, which may suggest that the presence of posteromedial osteophytes represent adaptive changes to stabilize the elbow while throwing.

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Introduction

Valgus extension overload (VEO) in throwing athletes is associated with a spectrum of pathologies, including ulnar collateral ligament (UCL) tears. Along with concerns for tensile damage to other medial structures (i.e., flexor-pronator mass, ulnar nerve), VEO can also lead to radiocapitellar compression, potentially resulting in the development of loose bodies, as well as olecranon fossa shearing with resultant posterior compartment osteophytes and/or loose body generation.[1-4] Such osteoarthritic changes and loose bodies may cause pain, dysfunction, and mechanical symptoms that result in continued morbidity after UCL reconstruction (UCLR) and possible need for

reoperation. Athletes with posteromedial impingement (PI) are commonly treated with concomitant arthroscopic resection of posteromedial osteophytes at the time of index UCLR[5-10] to mitigate these risks.

A number of studies have described the outcomes of arthroscopic posteromedial osteophyte resection.[5-11] A possible consequence of treating PI is over-resection of the posteromedial olecranon, which increases the strain on the reconstructed UCL postoperatively.[12,13] The purpose of this study was to compare patient-reported outcomes (PROs) and return to play (RTP) rates following UCLR in patients with and without PI treated with concomitant arthroscopic posteromedial osteophyte resection. We hypothesized that there would be no significant difference in PROs and RTP rates between the 2 groups.

Methods

In this retrospective cohort study, we compared the outcomes of baseball players undergoing UCLR following primary UCL tears with and without PI. All baseball players who had undergone UCLR with the senior surgeon (C.S.A.) were identified using CPT code 24346, and those who met inclusion criteria were surveyed between June and July 2020. Inclusion criteria were minimum follow-up of 2 years and date of surgery within 10 years of survey completion. The PI group included players with symptomatic posterior compartment pathology (i.e., osteophytes, loose bodies) based on exam and imaging, who were treated with UCLR and concomitant arthroscopic resection of posteromedial osteophytes and removal of loose bodies, if present. The "no impingement" group included players without symptomatic posterior pathology preoperatively who were treated only with UCLR. Players undergoing revision surgery were excluded, as were players who received non-UCL procedures in the perioperative period. Players who did not have a phone number on file were also excluded.

Medical records were reviewed for patient demographics and operative details. For each athlete, basic demographic data (age, baseball position, dominant hand, level of competition), graft choice, and RTP data were collected. PROs utilized included the Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow (KJOC) score, the subjective component of the Andrews-Timmerman score, and a satisfaction questionnaire developed by this study's authors.[5,14] Item 1 of the satisfaction questionnaire was a continuous variable: "How satisfied are you with the outcome of your elbow injury on a scale of 0-100." Item 2 was a binary variable: "If you had the same injury again would you elect to undergo surgery again?"

Categorical variables were reported as counts, and continuous variables were reported as means with standard deviation. The Shapiro-Wilk test was employed to examine the distribution of individual variables for normality. *T*-tests were used to compare means of continuous data between each group. Chi square tests were used to evaluate differences in categorical variables. Statistical significance was set at $P < .05$. All analyses were performed with R Version 4.1.0 (R Foundation for Statistical Computation, Vienna, Austria). Our power analysis revealed that a sample of 32 subjects would be required to detect a 10-point difference ($\sigma = 10$) in mean questionnaire scores (scale 0 to 100) between the two groups ($\beta = 0.2$, $\alpha = 0.05$).

Surgical Technique

The senior author of this study (C.S.A.) uses the modified Jobe figure-of-eight technique for UCLR.[15] The technical details of elbow arthroscopy used in the PI group are described in depth in a previous study.[16] After placement of posterolateral (PL) and direct posterior (dP) portals, an arthroscopic shaver is inserted through the dP portal. Fibrous tissue overlying the olecranon fossa and tip is debrided. An arthroscopic electrocautery ablation device may be used for debridement, and an arthroscopic retractor may be used to protect the ulnar nerve located immediately superficial to the capsule.

Debridement should be carried out paying particular attention to the demarcation between olecranon native bone and osteophyte/loose body. A Freer elevator is inserted through the dP portal to probe for a plane between the loose body and normal olecranon and dislodge fractured osteophytes. A motorized shaver can then continue debridement until the bony fragment is small enough to be removed with an arthroscopic grasper preferably through the PL portal, and the olecranon is contoured with the shaver. All portal incisions are closed with 4-0 nylon sutures in a simple, interrupted manner. A soft compressive dressing is applied. In the postoperative recovery room, an upper extremity neurologic exam is done to assess for nerve injury.

Rehabilitation

Postoperatively, the elbow is put in an elbow brace held in flexion to promote healing. Gentle passive and active elbow range of motion (ROM) are started 5 to 7 days postoperatively, with the goal of achieving full passive ROM by week 4 and active ROM by weeks 5 to 6. Shoulder isometrics are begun during the second week, and initiation of shoulder strengthening programs, such as the Thrower's Ten, are initiated at week 6.[17] A two-handed plyometric program is initiated around week 10. It is anticipated that players who undergo UCLR initiate a flat ground throwing progression by roughly 4 months postoperatively. Over the next several months, players gradually progress their throwing volume, intensity, and distances prior to

Table 1. Demographic & Perioperative Data

	No Impingement ($n = 18$)	Posteromedial Impingement ($n = 17$)	P Value
Age, mean ± years	19.06 ± 3.28	20.06 ± 2.68	.33
Follow-up time, mean ± months	62.28 ± 28.54	39.12 ± 10.10	**.004**
Level of competition, *n* (%)			.59
High school	8 (44.44%)	5 (29.41%)	
Collegiate	9 (50.00%)	10 (58.82%)	
Professional	1 (5.56%)	2 (11.76%)	
Dominant arm, *n* (%)			.17
Right	16 (88.89%)	17 (100%)	
Left	2 (11.11%)	0 (0%)	
Position, *n* (%)			.32
Pitcher	15 (83.33%)	16 (94.12%)	
Position player	3 (16.67%)	1 (5.88%)	
Graft, *n* (%)			.83
Palmaris longus	11 (61.11%)	11 (64.71%)	
Gracilis	7 (38.89%)	6 (35.29%)	

UCLR, ulnar collateral ligament reconstruction.

returning to game play. Position players are anticipated to return to play between 8 and 9 months versus pitchers who return around 12 months. However, seasonal timing plays a role when players actually return to game competition. There are no differences in our postoperative protocols for patients with and without preoperative PI.

Results

271 players were identified using CPT code 24346, of which 227 players met inclusion criteria and were contacted to complete the survey. A total of 35 baseball players completed the survey and were included in the analysis, representing a 15.4% response rate. 18 patients were in the no impingement group, while 17 were in the posteromedial impingement group. Mean age at time of surgery was similar for both groups of patients (19.06 ± 3.28 years for no impingement group vs 20.06 ± 2.68 years for PI group; $P = .33$). Overall, mean PRO follow-up time from date of surgery was 51.03 ± 23.35 months and was greater in the no impingement group (62.28 ± 28.54 months for the no

Table 2. Return to Play and Patient-Reported Outcomes

	No Impingement ($n = 18$)	Posteromedial Impingement ($n = 17$)	P Value
Return to play, *n* (%)	13 (72.22%)	16 (94.12%)	.26
KJOC Score (Total score, 0 to 100)	83.36 ± 11.72	79.88 ± 12.35	.40
1. Do you have difficulty getting loose before competition or practice?	8.55 ± 1.51	7.59 ± 1.80	.10
2. How much pain do you experience in your elbow?	8.72 ± 1.60	8.71 ± 1.76	.98
3. Do you have weakness/fatigue in your elbow?	9.11 ± 1.13	8.71 ± 1.65	.41
4. How much instability do you experience in your elbow?	9.00 ± 1.91	8.88 ± 1.45	.84
5. How much has your elbow affected your relationships with coaches, management, and agents?	8.06 ± 2.62	6.35 ± 2.37	.052
6. How much have you had to change your throwing motion?	7.67 ± 1.97	7.47 ± 2.60	.80
7. How much has your velocity/power suffered?	7.50 ± 2.50	8.59 ± 1.58	.13
8. What limitation do you have in endurance in competition?	7.78 ± 1.99	7.71 ± 1.69	.91
9. How much has your throwing control suffered?	9.11 ± 1.32	7.65 ± 2.40	**.04**
10. Is your arm affecting your current level of competition?	7.86 ± 2.23	8.24 ± 1.71	.58
A-T Score, Subjective (Total score, 0 to 100)	91.67 ± 8.04	92.06 ± 7.92	.89
1. Pain?	20.83 ± 6.24	21.47 ± 4.93	.74
2. Swelling?	23.89 ± 2.14	22.94 ± 2.54	.24
3. Locking/Catching?	23.61 ± 3.76	23.53 ± 3.86	.95
4. Activity Limitation?	23.33 ± 3.83	24.12 ± 1.96	.45
Satisfaction Questionnaire			
Overall satisfaction (0 to 100)	96.67 ± 4.58	90.12 ± 11.91	**.04**
Would elect for surgery again, *n* (%)	17 (94.44%)	9 (52.94%)	**.005**

Each individual item in the KJOC scores is graded on a 0 to 10 scale, with 0 being maximally symptomatic and 10 being asymptomatic. Each individual item in the A-T scores is graded on a 0 to 25 scale, with 0 being maximally symptomatic and 25 being asymptomatic. Bolded values indicate significant difference. A-T, Andrews-Timmerman score; KJOC, Kerlan-Jobe Orthopaedic Clinic score; UCLR, ulnar collateral ligament reconstruction.

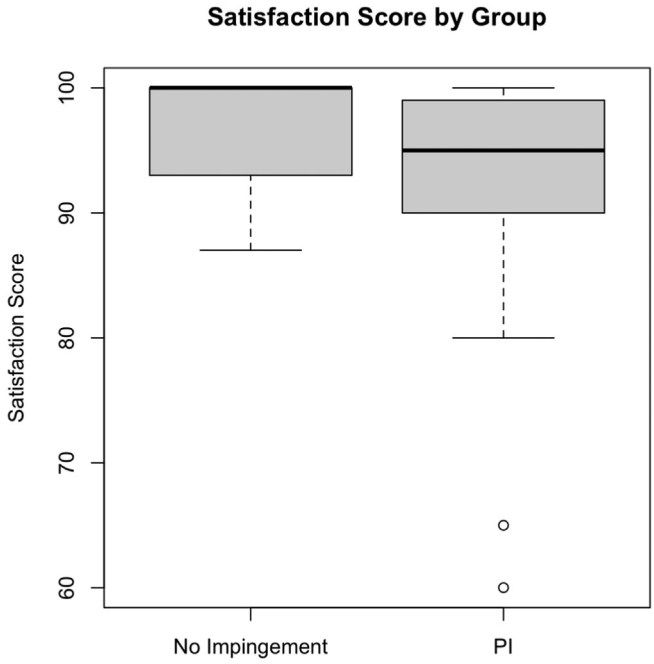

Fig 1. Satisfaction score by group. The center line of each box plot represents the median, with the upper and lower margins of the box defining the interquartile range. The whiskers were set at a distance above and below the box equal to 1.5 multiplied by the interquartile range. PI, posteromedial impingement.

impingement group vs 39.12 ± 10.10 months for the PI group; $P = .004$). There was no baseline difference in the proportion of players in each level of competition between the two groups (Table 1). There was also no difference in the distribution of graft type used (11 palmaris longus, 7 gracilis in no impingement group vs 11 palmaris longus, 6 gracilis in PI group; $P = .83$). Additional demographic data can be found in Table 1.

There was no difference in the mean KJOC scores (no impingement = 83.36 ± 11.72 vs PI = 79.88 ± 12.35; $P = .40$), although there was a higher mean score for item 9 of KJOC questionnaire (i.e., "How much has your control of pitches suffered due to your arm?" [KJOC-Control]) in the no impingement group (9.11 ± 1.32 vs 7.65 ± 2.40; $P = .04$), indicating increased loss of control in the PI group.[14] There was no difference in mean Andrews-Timmerman scores between the no impingement (91.67 ± 8.04) and PI groups (92.06 ± 7.92; $P = .89$). A total of 29 athletes returned to play (82.86%), with no statistically significant difference between the groups (no impingement = 72.22% vs PI = 94.12%, $\chi^2 = 1.28$; $P = .26$) (Table 2). There was significantly lower mean satisfaction score in the PI group (90.12 ± 11.91 vs 96.67 ± 4.58, respectively; $P = .04$), and those patients were also less likely to pursue surgery again if they were to have the same injury again (52.94% vs 94.44%, respectively, $\chi^2 = 7.88$; $P = .005$) (Fig 1, Table 2). Of note, two of the PI group athletes mentioned they would not re-elect to receive the procedure due to the extensiveness of the rehabilitation process; no other athletes in this analysis specified a reason for their response to this question. No major complications occurred in either group of patients at the latest follow-up.

Discussion

In this study, we found no significant differences in mean KJOC score, mean Andrews-Timmerman scores, or RTP rate between the two cohorts. However, patients with preoperative PI treated with elbow arthroscopy at the time of UCLR were found to have decreased throwing control postoperatively and were less satisfied postoperatively on average.

Arthroscopic resection of posteromedial osteophytes can be beneficial in reducing morbidity after UCLR for athletes with preoperative PI.[5-11] The good to excellent mean PRO scores in both groups in our cohort at mean follow-up of over 50 months suggest that UCLR with arthroscopic resection of posteromedial osteophytes in athletes with PI can produce excellent outcomes. Given the potential benefits of treating posterior compartment pathology, some authors have recommended routine diagnostic arthroscopy during UCLR to screen for posteromedial osteophytes or loose bodies and resect them, if present. A recent systematic review and meta-analysis of 25 studies ultimately did not find a difference in reoperation rate between UCLR with and without diagnostic arthroscopy (1.16% vs 0.40%, respectively; $P = .58$)[18].

Posteromedial osteophyte resection is not without potential consequences, however. Some authors argue that posterior compartment osteophytes, secondary to olecranon fossa shearing, may be adaptive changes to the thrower's elbow, and that arthroscopic resection may destabilize the elbow.[12,13,18-20] Kamineni et al., indeed, demonstrated that excessive resection of posteromedial osteophytes leads to increased translation of the olecranon during elbow motion and a resultant increase in strain on the anterior bundle of the UCL.[12,13] While there was no difference in mean KJOC or Andrews-Timmerman scores in our analysis, there was a higher mean KJOC-Control score in the no impingement group (9.11 ± 1.32 vs 7.65 ± 2.40; $P = .04$), which may be explained by this destabilization theory following resection of posteromedial osteophytes. Interestingly, baseball players in the no impingement group were also slightly more satisfied with their outcome and were far more likely to elect for surgery if they were to sustain the injury again (Fig 1). There are several possible explanations for these findings. First, this may suggest that patients with preoperative PI had more severe pathology at baseline, leading to relatively worse postoperative clinical

outcomes and resultantly less satisfaction with the decision to undergo surgery. It is also possible that the adaptive change theory may again be at play, with athletes feeling less satisfied because of removal of adaptive posterior compartment osteophytes.[12,13,18-20] Ultimately, postoperative PROs were largely the same between the two groups. Despite having identical protocols, two of the PI group athletes mentioned the rehabilitation process as the reason why they would not re-elect for the procedure; thus, patient dissatisfaction may have been secondary to difficulties with rehabilitation rather than the procedure itself.

Limitations

This study is not without limitations. First, it is possible that the findings in this study were influenced by baseline differences between the cohorts that were not included within our preoperative data collection. Second, there was a statistically significant difference in mean time of survey follow-up. The primary surgeon was not routinely performing concomitant arthroscopy at the beginning of the study period, which likely explains this difference. While the medical records of players in the "no impingement" group were reviewed to exclude players with symptomatic posterior compartment pathology, this change in the senior surgeon's practice over time still represents a possible source of bias. Third, there may have been selection bias in the form of differing nonresponse rates between the two groups, especially given the overall low response rate. Fourth, this article does evaluate the outcomes of athletes with PI who are treated with UCLR alone. Prospective, randomized research of UCL-injury athletes with PI treated with and without posteromedial osteophyte resection is required to further test the conclusions of this study. Finally, this study would have benefitted from a larger sample size to improve power and improve precision of reported outcome mean values.

Conclusions

There was no difference in RTP rate following ulnar collateral ligament reconstruction in baseball players with and without posteromedial impingement treated with arthroscopic resection. Outcomes on the KJOC and Andrews-Timmerman scores were good to excellent in both groups, suggesting that preoperative posteromedial joint pathology can be effectively treated. Players in the posteromedial impingement group were less satisfied with their outcome, however, and less likely to elect for surgery if they were to sustain the injury again. Additionally, players in the posteromedial impingement group were found to have decreased throwing control on the KJOC questionnaire, which may suggest that posteromedial osteophytes are adaptive changes to stabilize the elbow while throwing.

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