Original Article

# Arthroscopic Posterior Capsular Release Improves Range of Motion and Outcomes for Flexion Contracture After Anterior Cruciate Ligament Reconstruction in Athletes

Joseph C. Brinkman, M.D., Jose M. Iturregui, M.D., M. Lane Moore, B.S., M.B.A., Jack Haglin, M.D., Adam Thompson, B.S., Justin Makovicka, M.D., and Kostas J. Economopoulos, M.D.

**Purpose:** To assess outcomes of arthroscopic posterior capsular release among athletes for loss of terminal extension following anterior cruciate ligament (ACL) reconstruction. **Methods:** A retrospective review of prospectively collected data was performed for patients undergoing arthroscopic posterior capsular release for knee extension loss following ACL reconstruction between January 2014 and December 2019. Procedure indications included extension loss greater than 10° at least 3 months after ACL reconstruction that was refractory to physical therapy. Patients were included if they were involved in either high school or college athletics, had complete outcomes of interest, and had at least 2 years of follow-up. Prospectively collected outcomes included preoperative and postoperative measurement of knee extension, International Knee Documentation Committee score, Lysholm score, return to sport data, and complications. **Results:** Eighteen athletes with minimum 2 years of follow-up who underwent posterior capsular release following ACL reconstruction performed by a single surgeon were included in the analysis. Patients underwent surgery at an average of 16 weeks after ACL reconstruction. Knee extension improved an average of 13.8° at 2 years' follow-up (prerelease mean extension deficit 15.1°, postrelease mean extension deficit 1.3°, $P < .005$). Improvements in the International Knee Documentation Committee score averaged 21.7 at 6 months and 35.0 at 24 months, both of which were statistically significant ($P < .001$). Similarly, differences in Lysholm included a significant improvement of 23.0 and 34.2 at 6 months and 2 years, respectively ($P < .001$). In total, 77.8% returned to sport at an average of 9.8 months from their primary ACL surgery and 6.5 months following posterior capsular release surgery. No infections or neurovascular complications were observed. One patient required secondary release to achieve adequate extension. **Conclusions:** For athletes with persistent knee extension loss after ACL reconstruction, knee extension was significantly improved at 2 years following arthroscopic posterior capsular release. Substantial improvements in patient-reported outcomes also were seen. In addition, subjects demonstrated a high rate of return to sport and return to preinjury performance levels. **Level of Evidence:** Level IV, therapeutic case series.

Flexion contracture or loss of terminal extension is a substantial postoperative challenge after arthroscopic knee surgery that can affect patient outcomes and function. Various etiologies have been reported, including excess scar tissue formation, capsular contraction, cyclops lesions, capsulitis, and nonanatomic anterior cruciate ligament (ACL) graft placement or excess graft tension.[1-4] Despite conservative treatment modalities including physical therapy, extension orthosis bracing, and medications, it is reported that 0.49% to 11% of patients fail to achieve satisfactory knee range of motion (ROM)

*From the Department of Orthopedic Surgery, Mayo Clinic Arizona, Phoenix, Arizona, U.S.A. (J.C.B., J.M.I., J.H., J.M., K.J.E.); Mayo Clinic Alix School of Medicine, Scottsdale, Arizona, U.S.A. (M.L.M.); and University of Vermont School of Medicine, Burlington, Vermont, U.S.A. (A.T.).*

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*Address correspondence to Kostas J. Economopoulos, M.D., 5777 E Mayo Blvd., Phoenix, Arizona 85054, U.S.A. E-mail: Economopoulos.kostas@mayo.edu*



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postoperatively.[2-6] In these cases, persistent extension deficits of even 5° have been shown to cause deteriorating knee function and greater risk of osteoarthritis development.[1,3,4,7-9] For athletes in particular, a small loss of extension is a particular detriment to knee function and return to sport.[2,10]

Treatment options such as manipulation under anesthesia (MUA), debridement, and lysis of adhesions (LOA) have been reported for cases refractory to conservative measures.[3,11-13] However, these measures do not address the posterior capsule, which is reported to be one of the main sources of knee extension loss after surgery.[6] Open and arthroscopic release of the posterior capsule have been reported with significant improvements in knee function and ROM.[1,3-7,9,13-16] Although both the open and arthroscopic procedures have been proven to be successful, the arthroscopic release provides improved visualization and protection of vital knee structures, better pain control, and faster recovery.[1,4] Commonly, a posteromedial capsular release is effective; however, the posterolateral approach can be added as necessary to obtain full knee extension if needed at the time of surgery.[6,17]

Previous reports have demonstrated the safety and efficacy of the posterior capsular release to regain knee ROM following the failure of conservative measures. However, this body of literature includes mixed patient populations and understanding of arthroscopic posterior capsular release outcomes in athletes following ACL reconstruction remains limited. This is a particularly important patient population to understand, given the high demands of athletes who suffer this injury in addition to the fact that loss of extension is the most prevalent complication following ACL reconstruction, with a reported incidence as high as 59%.[2,4,8,18] The purpose of this study is to assess outcomes of arthroscopic posterior capsular release among athletes for loss of terminal extension following ACL reconstruction. We hypothesized that, in athletes with knee extension deficits following ACL reconstruction, arthroscopic posterior capsular release would be a beneficial surgical procedure for restoring knee extension, improving in clinical outcomes, and allowing high school and college athletes to return to sport.

## Methods

A retrospective review of prospectively collected data was performed for all patients undergoing arthroscopic posterior capsular release for knee extension loss after ACL reconstruction between January 2014 and December 2019, performed by a single surgeon (K.J.E.) (institutional review board #20216101). Patients were included in the study if they were involved in either high school or college athletics, had complete outcomes of interest, and had at least 2 years of follow-up. Patients were indicated for the procedure if they had greater than 10° of extension loss at least 3 months after ACL reconstruction that was refractory to physical therapy. Collected outcomes included preoperative and 2-year postoperative knee ROM goniometric measurement, International Knee Documentation Committee (IKDC) score, Lysholm score, return to sport data, and complications.

### Technique

The technique used has been previously reported.[5] The patient was placed supine and underwent general anesthesia. An examination under anesthesia was first performed to record preoperative knee ROM. Manipulation was then performed. If full ROM was achieved with manipulation, arthroscopic release was not necessary. If there was still loss of extension after manipulation, arthroscopic posterior capsular release was performed. A tourniquet was used in all cases to allow clear visualization. Diagnostic arthroscopy was performed through standard anterior-lateral and anterior-medial portals, with evaluation of the medial joint performed with the knee on valgus stress. Following anterior release and debridement, knee ROM was once again tested. If contracture remained present, posterior knee access was established.

### Posteromedial Capsular Release

The knee was placed over the side of the bed, relaxed at approximately 90° of flexion to allow the neurovascular structures to fall away from the knee joint. Using a trocar, the intercondylar notch was palpated along the medial femoral condyle until access was gained to the posteromedial compartment inferior to the posterior cruciate ligament. An arthroscope was then inserted to show the posteromedial view before establishing the posteromedial portal under direct visualization with a spinal needle. This portal is ideally placed above the medial meniscus and just posterior to the medial femoral condyle. A small incision followed by sled placement and dilation was used to allow placement of an arthroscopic cannula. A shaver was used to debride tissues obstructing visualization. Following, electrocautery was used to section the capsule from lateral to medial midway between the femoral and meniscal attachment. Visualization of the medial head of the gastrocnemius confirms complete release of the posteromedial capsule.

### Posterolateral Capsular Release

The posterolateral compartment of the knee was visualized through the anteromedial portal between the interval of the anterior cruciate ligament and the lateral femoral condyle. Once the arthroscope was appropriately in place, the posterolateral portal was created under direct visualization using a spinal needle between the lateral head of the gastrocnemius and the lateral

collateral ligament. After blunt dilation, a cannula was placed, followed by insertion of a shaver to debride synovium or adhesions blocking visualization. Electrocautery was then used to section the capsule from medial to lateral at the midway point between femoral and meniscal attachments. Visualization of the lateral head of the gastrocnemius confirms complete release.

Once both the posteromedial and posterolateral capsular releases were performed, instrumentation was removed to allow for final evaluation of knee ROM. Postoperatively, patients were placed in a soft dressing without bracing. Crutches were used for 2 days and then encouraged to be discontinued.

### Rehabilitation

Patients undergoing capsular release were asked to make an appointment with their physical therapist the day after surgery and were to have physical therapy every day for 5 straight days. Therapy could be reduced to 3 times a week for the next 2 weeks and twice a week beginning week 4. Focus of therapy for the first month after capsular release was to regain/maintain full ROM of the knee and quadriceps strengthening. Once the athlete had full ROM, they were returned to the previous ACL protocol.

### Statistical Analysis

Excel, version 16.76 (Microsoft, Redmond, WA) was used for statistical analysis. Patient characteristics alongside surgical variables and complications were documented as mean ± standard deviation. The delineation of individual sport involvement was presented as a percentage. Postoperative ROM and outcome scores (IKDC and Lysholm assessments) underwent comparison with preoperative values using the Student *t* test. Statistical significance was set at $P < .05$.

## Results

Over the study period, a total of 38 arthroscopic posterior capsular releases were performed for flexion contracture after ACL reconstruction. Of these, 20 were high school or college athletes. Two of these patients did not have 2-year follow-up, leaving a total of 18 patients included in the final analysis.

Study participants were an average age of 17.7 years old, and 55.6% were female. The majority of patients were high school athletes (66.7%), and 7 total sports were represented, with the most common being soccer (44.4%) (Table 1). Patients underwent surgery at an average of 16 weeks after their primary ACL reconstruction. Four of these patients had a previous MUA or LOA with an average time from primary ACL reconstruction to MUA/LOA of 7.6 weeks. In regard to their primary ACL reconstruction, 8 patients had a previous bone–patellar tendon–bone graft (44.4%), 7 had a quadriceps tendon graft (38.9%), and 2 had a hamstrings tendon graft (11.1%). The mean prerelease extension deficit was 15.1 ± 6.6° (Table 2).

**Table 1.** Patient Characteristics

| Characteristics | Participants (n = 18) |
|---|---|
| Age, y | 17.7 ± 2.2 |
| BMI | 24.6 ± 3.9 |
| Sex, female % | 55.6 |
| Laterality, right % | 61.1 |
| High school, n (%) | 12 (66.7) |
| Sport, n (%) | — |
| Soccer | 8 (44.4) |
| Football | 5 (27.8) |
| Volleyball | 1 (5.6) |
| Baseball | 1 (5.6) |
| Gymnastics | 1 (5.6) |
| Lacrosse | 1 (5.6) |
| Hockey | 1 (5.6) |

NOTE. Data are reported as mean ± standard deviation unless otherwise indicated.
BMI, body mass index.

Following posterior capsule release, knee extension improved by a mean of 13.8° at 2 years' follow-up (pre-extension loss 15.1, postextension loss 1.3, $P < .005$). Patient improvements in the IKDC score averaged 21.7 at 6 months and 35.0 at 24 months, both of which were statistically significant ($P < .001$). Similarly, differences in Lysholm included an improvement of 23.0 and 34.2 at 6 months and 2 years, respectively ($P < .001$) (Table 3). In total, 77.8% returned to sport at an average of 9.8 ± 2.4 months from primary ACL surgery. A total of 11 patients (61.1%) were able to return to their sport at their same level of play. The mean time to return to sport following posterior capsular release was 6.5 ± 2.1 months (Table 4). Complications included 1 patient who required revision capsular release for persistent extension loss, 1 ACL tear of the ipsilateral knee, and 2 ACL tears of the contralateral knee. No infections or neurovascular injuries occurred.

## Discussion

Our results demonstrated that arthroscopic posterior capsular release is a reasonable surgical option offering similar return to sport rates compared with those without capsular release and an acceptable complication profile for athletes who develop an extension deficit following ACL reconstruction. Specifically, arthroscopic posterior capsular release resulted in significant improvements in knee extension and patient-reported outcome scores at 6 months and 2 years postoperatively.

Loss of knee extension has been reported as the most common complication following ACL reconstruction, with rates up to 59%, and even a small loss of extension may have detrimental effects for an athletically active

**Table 2.** Patient Surgical Factors

| Factor | Participants (n = 18) |
|---|---|
| Weeks to posterior capsule release following primary surgery | 16.1 ± 6.6 |
| Previous MUA/LOA, n (%) | 4 (22.2) |
| ACL graft type, n (%) | – |
| BPTB | 9 (44.4) |
| Quadriceps | 7 (38.9) |
| Hamstrings | 2 (11.1) |
| Prerelease extension deficit, ° | 15.1 ± 3.4 |

NOTE. Data are reported as mean ± standard deviation unless otherwise indicated.

ACL, anterior cruciate ligament; BPTB, bone–patellar tendon–bone; LOA, lysis of adhesions; MUA, manipulation under anesthesia.

individual.[2] ROM is usually regained with nonoperative measures, including physical therapy, quadriceps strengthening, extension orthosis bracing, nonsteroidal anti-inflammatory medications, and corticosteroids.[2,3,5] If ROM is not regained with these treatment options, then MUA may be indicated. Surgical options once nonoperative measures are exhausted include anterior compartment arthroscopic debridement, LOA, and arthroscopic posteromedial with or without posterolateral capsular release.[2,3,5,19] A large national insurance database study reported a MUA incidence of 0.11% to 8.00% and a LOA incidence of 0.06% to 6.00% by 6 months following different arthroscopic knee procedures.[19] When evaluating isolated ACL reconstruction procedures specifically, the authors reported a MUA incidence of 0.49% and LOA incidence of 0.34% by 6 months postoperatively.[19]

Knee arthrofibrosis following ACL reconstruction has been reported at rates up to 35%.[19-22] MUA and arthroscopic LOA are effective treatment options with low complication profiles for restoring ROM for postoperative arthrofibrosis or loss of extension.[11-13] However, if extension deficits persist, then posterior capsular release may be a reasonable surgical option.[1,3-6,9,13-16] LaPrade et al.[1] demonstrated that arthroscopic posteromedial capsular release was an effective procedure for regaining knee extension in 15 patients who developed a knee flexion contracture who exhausted nonoperative and operative treatments. The average knee extension significantly improved from 14.7° prerelease to 0.7° postrelease at final average follow-up of 24.1 months ($P < .05$).[1] Similarly, Mariani[15] performed posterior compartment releases in 18 patients with more severe flexion contractures and reported a regain of extension from an average of 34° prerelease to 3° postrelease at 1-year follow-up. However, none of the primary procedures in this series were an ACL reconstruction.[15] Wierer et al.[4] evaluated a 10-patient, ACL reconstruction-only cohort that developed a persistent, postoperative flexion contracture and underwent an arthroscopic posterior capsulotomy. The authors reported a significant improvement in extension deficit from a median of 15° prerelease to 1° postrelease at final median follow-up of 25 months ($P < .01$). Most recently, Reinholz et al.[3] evaluated 22 patients with a recalcitrant flexion contracture who underwent arthroscopic posterior capsular release. The authors reported significant improvements in extension deficit from 15° prerelease to 2° immediately postoperatively ($P < .001$) to 0° at final average follow-up of 3.7 years.[3] The results of these studies are similar to our 18-patient series, where knee extension significantly improved from an average of 15.1° prerelease to 1.3° postrelease at 2-years follow-up ($P < .005$).

Overall improvements in subjective outcome measures have been reported following arthroscopic posterior capsular release for the treatment of persistent extension deficits. Wierer et al.[4] reported significant improvements in the median Lysholm score from 52 prerelease to 92 postrelease ($P < .01$), the median Tegner activity level score from 3 prerelease to 6 postrelease ($P < .02$), and the median visual analog scale (VAS) pain score from 5 prerelease to 1 postrelease

**Table 3.** Postoperative Range of Motion and Outcome Scores

| Outcome | Score | *P* Value (Compared With Preoperative) |
|---|---|---|
| Knee extension, ° | – | – |
| Preoperative | 15.1 ± 3.4 | – |
| 2-y postoperative | 1.3 ± 3.2 | **<.001** |
| IKDC score | – | – |
| Preoperative | 52.3 ± 7.9 | – |
| 6-mo postoperative | 73.9 ± 12.0 | **<.001** |
| 1-y postoperative | 85.2 ± 13.1 | **<.001** |
| 2-y postoperative | 87.2 ± 13.0 | **<.001** |
| Lysholm score | – | – |
| Preoperative | 54.2 ± 8.1 | – |
| 6-mo postoperative | 77.3 ± 14.1 | **<.001** |
| 1-y postoperative | 87.1 ± 13.7 | **<.001** |
| 2-y postoperative | 88.4 ± 13.9 | **<.001** |

NOTE. Data are reported as mean ± standard deviation unless otherwise indicated.

Bold denotes statistical significance. Student's *t* test used for comparison between groups.

IKDC, International Knee Documentation Committee.

**Table 4.** Return to Sport Outcomes

| Factor | Participants (n = 18) |
|---|---|
| Return to sport, n (%) | 14 (77.8) |
| Return to sport same level, n (%) | 11 (61.1) |
| Time to return to sport from primary surgery, mo | 9.8 ± 2.4 |
| Time to return to sport from posterior capsular release, mo | 6.5 ± 2.1 |

NOTE. Data are reported as mean ± standard deviation unless otherwise indicated.

($P < .01$).[4] Furthermore, all the patients in the series reported they would elect to undergo posterior capsulotomy again.[4] Reinholz et al.[3] reported significant improvements in median VAS pain at rest scores from 2 prerelease to 0 postrelease ($P = .001$) and VAS pain with use scores from 5 prerelease to 1.8 postrelease ($P = .017$).[3] Interestingly, compared with other etiologies, patients in their study who developed an extension deficit after an ACL reconstruction reported significantly better median International Knee Documentation Committee (IKDC) (81.0 vs 51.3; $P = .008$), Tegner (5.8 vs 3.6; $P = .007$), VAS at rest (0.2 vs 1.8; $P = .008$), and VAS with use (1.3 vs 5.0; $P = .004$) scores at final follow-up. The present study demonstrates that improved patient-reported outcomes can be expected for athletes in this case as well, with significant average pre- to postoperative 35.0- and 34.2-point improvements observed for both the IKDC and Lysholm scores (both, $P < .001$) at final 2-year follow-up, respectively.

Furthermore, arthroscopic posterior capsular release appears to be a safe procedure, with few reported complications. However, there have been cases that required additional surgery for recalcitrant extension loss. LaPrade et al.[1] reported no complications during or after arthroscopic posteromedial capsule release in their 15-patient series. Mariani[15] reported only one complication, which was a synovial fistula that formed at the posteromedial portal. Wierer et al.[4] also reported no complications. Reinholz et al.[3] reported 3 (14%) patients who required further intervention due to recalcitrant extension deficits: one MUA, one revision arthroscopic debridement, and one revision posterior capsular release that progressed to a total knee arthroplasty.[3] The authors also reported 1 patient who decided to undergo a through-knee amputation because of persistent pain, functional deficits, and decreased ROM.[3] In our series, 1 (5.6%) patient required repeat arthroscopy for persistent knee extension loss. In addition, 1 patient suffered an ACL tear of the ipsilateral knee, and 2 patients suffered an ACL tear of the contralateral knee. However, no infections or neurovascular injuries occurred.

Arthroscopic posterior capsular release also appears to allow return to sport rates comparable with those with uneventful primary ACL reconstruction. In the current study, 77.8% of athletes returned to sport after posterior capsular release, and 61.1% returned to preinjury level. This is comparable with previous literature, as previous studies have estimated overall return to sport rates range between 69% and 83%, whereas rates of return to preinjury levels range from 43% to 65%.[23-28] Although return to sport timing is complex and uniquely dependent on the patient, the physician's standard protocol, and other factors such as level of play,[29] recommendations across the literature outline a 6 to 12 month return to sport window.[30,31] Return to sport time appears reasonably unaffected by posterior capsular release in our series, as the current study's return to sport time of 9.8 months (±2.4 months) from primary ACL reconstruction is consistent with previous literature.[32-36]

The effect of posterior capsular release on patient-reported outcomes remains notably limited. The average IKDC and Lysholm scores at final follow-up (87.2 and 88.4, respectively) in the current study reflect similarly to those in earlier literature, reinforcing the efficacy of the posterior capsular release as a viable treatment option. Nwachukwu et al.,[37] for example, reported comparable preoperative and postoperative scores. Their preoperative scores of 50.9 and 62.2 for IKDC and Lysholm, respectively, correspond closely to the current study's preoperative IKDC score of 52.3 and Lysholm score of 54.2. Following primary ACL reconstruction, Nwachukwu et al.[37] recorded postoperative IKDC and Lysholm scores of 87.9 and 90.5, respectively, at >5-year follow-up. Likewise, within a cohort of 2,042 patients, Randsborg et al.[38] identified an average IKDC score of 51.8 preoperatively and 84.2 postoperatively in primary ACL reconstruction patients during long-term follow-up. Overall, our data are consistent with the idea that posterior capsular release does not compromise patient reported outcomes at the 2-year follow-up time point.

### Limitations

Several limitations warrant consideration in our study. Foremost among these is the small and retrospective sample size. In addition, selection bias of included patients and patient-reporting bias of subjective outcomes are factors that may limit the study. Furthermore, this was a single-center study, and all cases were performed by a single surgeon, which may impact the generalizability of our results.

## Conclusions

For athletes with persistent knee extension loss after ACL reconstruction, knee extension was significantly improved at 2 years following arthroscopic posterior capsular release. Substantial improvements in patient-reported outcomes were also seen. In addition, subjects demonstrated a high rate of return to sport and return to preinjury performance levels.

## Disclosures

All authors (J.C.B., J.M.I., M.L.M., J.H., A.T., J.M., K.J.E.) report no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

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