*Arthroscopy: The Journal of Arthroscopic and Related Surgery* 9(3):291–294
Published by Raven Press, Ltd. 

# Posterior Cruciate Ligament Injuries in Trauma Patients

Gregory C. Fanelli, M.D.

**Summary:** The purpose of this article is to evaluate the incidence of posterior cruciate ligament (PCL) injuries in trauma patients with acute hemarthrosis of the knee. Sixty-one acute knee injuries underwent examination under anesthesia and diagnostic arthroscopy at a tertiary care trauma center over an 11-month period. PCL injuries occurred in 44% (27 of 61) acute knee injuries; 81.5% (22 of 27) were trauma patients and 18.5% (five of 27) were sports related. Higher energy mechanisms of injury may account for the difference. Isolated PCL injuries were rare [7.5% (two of 27)], whereas 92.5% (25 of 27) of PCL injuries occurred in combination with other ligament injuries. Trauma patients have a higher incidence of PCL injuries than does the athletic population. Acute knee hemarthrosis in trauma patients should elevate suspicion for PCL injuries. Arthroscopy is a valuable tool for PCL evaluation and surgical planning. **Key Words:** Posterior cruciate ligament—Acute hemarthrosis—Trauma patients.

Several articles have been written indicating that acute knee injuries with hemarthrosis are often associated with serious injuries to the ligaments and other structures about the knee (1–13). Most of these articles emphasize injuries to the anterior cruciate ligament (ACL) and capsular ligaments with less attention to the incidence of posterior cruciate ligament (PCL) injuries in the acutely injured knee with hemarthrosis (1,7,9,11,12). The reported incidence of PCL injuries is 1–23% of knee ligament injuries (2,4–6,13–18). Few studies describe the incidence of PCL injuries in trauma patients with acute hemarthrosis of the knee (2,3,13).

Although arthroscopy is widely used for evaluation of acute knee injuries with particular attention to the ACL menisci and articular surfaces, there is little written about arthroscopic evaluation of the PCL (4,19).

The purpose of this study is to evaluate the incidence of PCL injuries in patients presenting with acute hemarthrosis of the knee to a regional trauma center. This study differs from previously performed studies of acute knee hemarthroses, which predominantly involved an athletic population (4,7,10–12). In our series, 26 of 61 knees (42.6%) had nonathletic-related trauma as the cause of their acute knee injury with hemarthrosis. Examination under anesthesia and diagnostic arthroscopy using the three-zone concept of PCL examination were used to evaluate 59 of 61 knees, and in each case, the PCL lesion was visualized arthroscopically.

## MATERIALS AND METHODS

Sixty-one acute knee injuries with hemarthrosis presented to the author's (G.C.F.) tertiary care referral center over an 11-month period with a variety of traumatic causes. Fifty-nine of the knees were evaluated by examination under anesthesia and diagnostic arthroscopy as a separate procedure. Two knees underwent examination under anesthesia and diagnostic arthroscopy at the time of PCL reconstruction. All 61 knees were evaluated by examination under anesthesia and arthroscopic evaluation. The three-zone concept of arthroscopic PCL evaluation was used in each case. There were 51 males and 10 female patients. There were 25 right knees and 36 left knees (Table 1).

From the Department of Orthopaedic Surgery, Geisinger Medical Center, Danville, Pennsylvania.
Address correspondence and reprint requests to Gregory C. Fanelli, M.D., Department of Orthopedic Surgery, Geisinger Medical Center, Danville, PA 17822-2130, U.S.A.

TABLE 1. *Patient population*

| | |
|---|---|
| 61 | Acute knee injuries |
| 51 | Men |
| 10 | Women |
| 25 | Right knees |
| 36 | Left knees |

The three-zone concept of arthroscopic PCL evaluation consists of dividing the PCL into three distinct zones. Zone 1 extends from the femoral insertion of the PCL to where that ligament disappears behind the ACL with the arthroscope in the inferior lateral patellar portal. Zones 2 and 3 are visualized with the arthroscope in the posterior medial portal. Zone 2 of the PCL is that portion that lies behind the ACL, and zone 3 of the PCL is the tibial insertion. The use of the inferior lateral patellar portal and the posterior medial portal allows complete arthroscopic visualization of the entire PCL. Although the zones 2 and 3 of the PCL can be visualized through the intercondylar notch, I feel that the posterior medial portal provides a better arthroscopic view of zones 2 and 3. When viewing the PCL from the posterior medial portal, a 25° or 30° arthroscope provides good visualization. Viewing the PCL from the intercondylar notch requires a 70° or 90° arthroscope to fully evaluate the ligament, which increases equipment inventory and expense. All patient evaluations consisting of examination under anesthesia and diagnostic arthroscopy and all subsequent reconstructions were performed by a single surgeon (G.C.F.).

## RESULTS

The overall incidence of structural injuries are presented in Table 2. ACL tears were present in 43 of 61 knees (70.4%), PCL tears were present in 27 of 61 knees (44.2%), medial collateral ligament tears were present in 18 of 61 knees (29.5%), posterior lateral complex tears were present in 19 of 61 knees (31.1%), medial meniscus tears were present in 22 of 61 knees (36.1%), lateral meniscus tears were present in 17 of 61 knees (27.8%), chondral injuries were present in 16 of 61 knees (26.2%), medial retinacular tears were present in six of 61 knees (9.83%), and patellar tendon ruptures were present in one of 61 knees (1.63%).

Patients with a PCL injury had a high incidence of multiple ligament injuries with the isolated PCL tear being rare. In the 27 knees with a PCL injury, associated ligamentous injuries included the following: one ACL/PCL tear, 11 PCL/posterior lateral complex tears, eight ACL/PCL/medial collateral ligament tears, four ACL/PCL/posterior lateral complex tears, one PCL/medial collateral ligament tear, and two isolated PCL tears (Table 3). It is interesting to note that 25 of the 27 PCL tears occurred in zone 2. There was one zone 1 tear in a knee with ACL/PCL/medial collateral ligament tears; and one zone 3 tear in a knee with PCL/posterior lateral corner tears.

TABLE 2. *Structural injuries in 61 acute knee hemarthroses*

| | N | % |
|---|---|---|
| ACL | 43 | 70.4 |
| PCL | 27 | 44.2 |
| MCL | 18 | 29.5 |
| PLC | 19 | 31.1 |
| MMT | 22 | 36.1 |
| LMT | 17 | 27.8 |
| Chondral injuries | 16 | 26.2 |
| MRT | 6 | 9.83 |
| PTR | 1 | 1.63 |

ACL, anterior cruciate ligament; PCL, posterior cruciate ligament; MCL, medial collateral ligament; PLC, posterior lateral complex; MMT, medial meniscus tear; LMT, lateral meniscus tear; MRT, medial retinacular tear; PTR, patellar tendon rupture.

Injuries also associated with PCL injuries included eight medial meniscus tears, three lateral meniscus tears, seven articular cartilage injuries, and three medial retinacular tears (Table 4). Mechanisms of injury associated with PCL injuries were 10 motor vehicle accidents, five motorcycle accidents, five athletic injuries, three patients hit by a car, three patients with a fall greater than 5 feet, and one farm equipment injury (Table 5).

## DISCUSSION

Acute traumatic hemarthrosis of the knee is associated with serious structural damage about the knee. In the sports injury population, the ACL is

TABLE 3. *Other ligament injuries associated with posterior cruciate ligament injuries*

| | |
|---|---|
| ACL/PCL | 1 |
| ACL/PCL/MCL | 8 |
| ACL/PCL/PLC | 4 |
| PCL/PLC | 11 |
| PCL/MCL | 1 |
| ISOLATED PCL | 2 |

ACL, anterior cruciate ligament; PCL, posterior cruciate ligament; MCL, medial collateral ligament; PLC, posterior lateral complex.

TABLE 4. *Other structural injuries associated with posterior cruciate ligament injuries*

| | |
|---|---|
| Meniscus tears | 11 |
| Medial | 8 |
| Lateral | 3 |
| Articular cartilage injuries | 7 |
| Medial retinacular tears | 3 |

most commonly injured (1,2,4,7,10–12). PCL injuries occurred in 44% (27 of 61) of the acute knee injuries in our series. This is considerably higher than the reported incidence of 1–23% in the literature (2,4–6,13–18). Twenty-two of 27 of these PCL injuries (81.5%) occurred in trauma patients, whereas only 18.5% (five of 27) were sports related. More violent collisions and higher speeds occurring with motor vehicle accidents, motorcycle accidents, falls from heights, and pedestrians being hit by motor vehicles account for this difference. A probable cause for the higher incidence of PCL injuries in trauma patients over athletic injuries is the mechanism of injury. Motor vehicle accidents, motorcycle accidents, pedestrians being hit by cars, and falls from heights are more violent scenarios for injury than most sports accidents. These higher energy collisions may account for the multiple ligament injuries about the knee, including the PCL injuries in our series. This trend agrees with previously reported studies (2).

Isolated PCL injuries were rare and occurred in only 7.5% (two of 27) of PCL-injured knees, whereas 92.5% (25 of 27) of PCL injuries occurred in combination with other ligament injuries. Meniscal injuries, articular surface injuries, and retinacular injuries also occurred in combination with PCL injuries.

The high percentage of PCL injuries seen at my institution is reflective of a tertiary care trauma practice where large numbers of severely injured patients are cared for each year. This trend may be seen in other trauma centers, but is not likely to occur in a private practice setting.

We have found examination under anesthesia and diagnostic arthroscopy very useful in the evaluation of PCL injuries. This is consistent with the findings of other investigators (4,5,19). The three-zone concept of arthroscopic PCL evaluation provides a systematic method of evaluating this ligament. The three-zone concept emphasizes PCL evaluation from two arthroscopic portals. The arthroscope is in the inferior lateral patellar portal to evaluate the PCL from its femoral insertion to where it disappears behind the ACL (zone 1). The posterior medial portal is used to visualize that portion of the PCL behind the ACL (zone 2), and the tibial insertion of the PCL (zone 3). Using this systematic approach, the entire PCL is arthroscopically visualized, and all PCL lesions in this series that were detected by physical examination could be visualized arthroscopically by the operating surgeon. The arthroscopic evaluation of the PCL assisted in diagnosis and facilitated surgical planning.

There was no problem with fluid extravasation in evaluating these acute knee injuries. Gravity inflow was used in all cases. No arthroscopic pump systems for in-flow were used in any case. Only one bag of fluid was "spiked" at a time, and a calibrated suction cannister was used and positioned so that the surgeon could monitor fluid flow and quantity into and out of the knee joint at all times. Careful attention to irrigation fluid flow is essential.

It is important to mention that magnetic resonance imaging is a useful and noninvasive tool in evaluating ligament injuries and bone contusions around the knee. I believe that examination under anesthesia and diagnostic arthroscopy provides better information to the surgeon with respect to preoperative planning and assessment of partial ligament injuries. It also allows meniscal repair at diagnostic arthroscopy, thus shortening the time required for the ligament reconstructive procedure.

## CONCLUSION

Acute hemarthrosis of the knee in a multiple-trauma patient should alert the surgeon to be suspicious of a PCL injury. In our series, 27 of 61 acute knee injuries had PCL tears, a 44.2% incidence. Of the knees with a PCL injury, 81.5% (22 of 27) were related to multiple trauma, whereas 18.5% (five of 27) were related to athletic injuries. Isolated PCL injuries are rare, accounting for only 7.5% (two of 27) of the PCL injuries in our series. Arthroscopy is a valuable tool for evaluation of PCL injuries.

TABLE 5. *Mechanisms associated with posterior cruciate ligament injuries*

| | |
|---|---|
| Motor vehicle accident | 10 |
| Motorcycle accident | 5 |
| Sports | 5 |
| Pedestrian hit by automobile | 3 |
| Falls | 3 |
| Farm equipment injury | 1 |

## REFERENCES


1. Bomberg BC, McGinty JB. Acute hemarthrosis of the knee: indications for diagnostic arthroscopy. *Arthroscopy* 1990;6: 221–5.
2. Casteleyn PP, Handelberg F, Opdecam P. Traumatic hemarthrosis of the knee. *J Bone Joint Surg* 1988;70B:404–6.
3. Davie B. The significance and treatment of hemarthrosis of the knee following trauma. *Med J Aust* 1969;1:1355–9.
4. DeHaven KE. Diagnosis of acute knee injuries with hemarthrosis. *Am J Sports Med* 1980;8:9–14.
5. Gillquist J, Hagberg G, Oretorp N. Arthroscopy in acute injuries of the knee joint. *Acta Orthop Scand* 1977;48:190–6.
6. Glinz W, Wegantini P, Kagi P. Arthroscopy in acute trauma of the knee joint. *Endoscopy* 1980;12:269–74.
7. Hardaker WT, Garrett WE, Bassett FH. Evaluation of acute traumatic hemarthrosis of the knee joint. *South Med J* 1990; 83:640–4.
8. Seitsalo S. The significance of arthroscopy and examination under anesthesia in the diagnosis of fresh injury hemarthrosis of the knee joint. *Injury* 1988;19:21–4.
9. Jain AS, Swanson AJG, Murdoch G. Hemarthrosis of the knee joint. *Injury* 1983;15:178–81.
10. Jones JR, Allum RL. Acute traumatic hemarthrosis of the knee: expectant treatment or arthroscopy? *Ann R Coll Surg Engl* 1989;7:40–3.
11. Noyes FR, Paulos L, Mooar LA, Signer BA. Knee sprains and acute knee hemarthrosis. *Phys Ther* 1980;60:1596–601.
12. Noyes FR, Bassett RW, Grood ES, Butler DL. Arthroscopy in acute traumatic hemarthrosis of the knee. *J Bone Joint Surg* 1980;62A:687–95.
13. Simonsen O, Jenson J, Lauritzen J. Arthroscopy in acute knee injuries. *Acta Orthop Scand* 1986;57:126–9.
14. Johnson JC, Bach BR. Current concepts review, posterior cruciate ligament. *Am J Knee Surg* 1990;3:143–53.
15. Bosworth DN, Bosworth BN. Use of fascia lata to stabilize the knee in cases of ruptured crucial ligaments. *J Bone Joint Surg* 1936;18:178–9.
16. Clancy WG, Shelbourne KD, Zoellner GB, King JF, Reider B, Rosenberg TD. Treatment of knee joint instability secondary to rupture of the posterior cruciate ligament: report of a new procedure. *J Bone Joint Surg* 1983;65A:310–22.
17. Hughston JC, Degenhardt TC. Reconstruction of the posterior cruciate ligament. *Clin Orthop* 1982;164:59–77.
18. O'Donoghue D. An analysis of the end results of surgical treatment of major injuries to the ligaments of the knee. *J Bone Joint Surg* 1955;37A:1–13.
19. Lysholm J, Gillquist J. Arthroscopic examination of the posterior cruciate ligament. *J Bone Joint Surg* 1981;63A:363–6.