LATE RUPTURE OF THE POSTERIOR CRUCIATE LIGAMENT AFTER TOTAL KNEE REPLACEMENT

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ABSTRACT

To our knowledge there have been no reports of late rupture of the posterior cruciate ligament (PCL) as a cause of instability in PCL-retaining total knee prostheses. In our experience of 150 total knee replacements using PCL-retaining prosthesis, three cases (2.0%) of late rupture of the posterior cruciate ligament have occurred, each leading to chronic instability, disabling pain, and revision arthroplasty. In each case rupture of the posterior cruciate ligament was confirmed at the time of revision arthroplasty. The use of a more constrained prosthesis led to a successful outcome in each case.

INTRODUCTION

The major goal of total knee arthroplasty (TKA) is to provide a stable, painless knee with a functional range of motion. The reported overall failure rate has ranged from 5% to 13.5% and is secondary to component loosening, infection, or instability. Failure due to instability usually arises early in the post-operative course, and stems from pre-existing instability, soft tissue imbalance, or patellar tracking problems. Much attention has been directed to more common problems such as loosening and infection. A relatively rare cause of instability is late rupture of one or more ligaments of the knee. To our knowledge there have been no reports of instability from rupture of the posterior cruciate ligament (PCL) in PCL-retaining total knee prostheses.

In our experience of 150 total knee replacements using a posterior cruciate retaining prosthesis, three cases (2.0%) of late rupture of the PCL have occurred, each leading to severe instability and revision arthroplasty using a more constrained prosthesis. In each case, rupture of the PCL was confirmed at the time of revision surgery.

CASE REPORTS

Case #1

A seventy-two year old male with psoriatic arthritis had staged, bilateral, cemented total knee replacements with the Whiteside total knee prosthesis (Dow Corning, Arlington TN.). At three years, both knees were stable and painless with a range of motion of 0 to 90 degrees (Figure 1-A).

Four years postoperatively, the patient developed the insidious onset of vague posterior right knee pain. There was no history of trauma or infection of the knee. Physical examination revealed a mild effusion. Posterior drawer and tibial sag signs could be elicited. This posterior subluxation was manually correctable. These findings had not been present on previous examinations. In addition, 25 degrees of valgus laxity with the knee in extension was now present. Radiographic examination did not reveal any evidence of loosening of the components, but the lateral projection demonstrated marked posterior subluxation of the knee (Figure 1-B).

A nine month trial of bracing and quadriceps strengthening failed due to increasing knee pain and instability. The patient eventually underwent a revision arthroplasty with a posterior stabilized prosthesis (Kinemax, Howmedica, Rutherford, N.J.). At surgery the PCL was found to be ruptured in its midportion. Two years after revision, the patient has a stable, painless knee with a range of motion of 0 to 110 degrees (Figure 1-C).

Case #2

A seventy-nine year old Peruvian female with severe tricompartmental osteoarthritis of both knees underwent staged bilateral total knee replacements using the Porous Coated Anatomic (PCA) total knee prosthesis (Howmedica, Rutherford, N. J.).

One year after replacement of the left knee, the patient developed an intermittent discomfort in the popliteal and posterolateral calf regions. The pain was exacerbated by ambulation and extension of the knee, and relieved by rest with the knee in flexion. There was no history of locking, giving way, or instability. Examination revealed no evidence of instability. The range of motion of the knee was 0 to 90 degrees with pain on full extension. Radiographs revealed well-placed components without signs of loosening or malalignment. The posterior knee discomfort continued intermittently for over a year.

Approximately two and one-half years postoperatively, the patient slipped and sustained a mild hyperextension injury of the left knee. She experienced an immediate exacerbation of her knee pain and was unable to flex her

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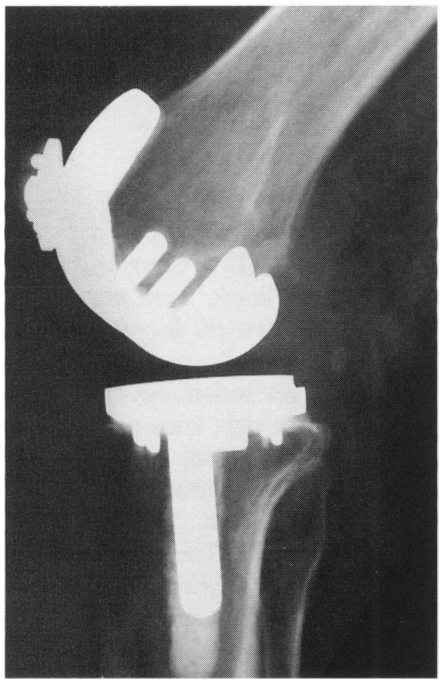

Figure 1-A: Three years postoperatively a lateral radiograph showed no evidence of posterior subluxation. Clinically the patient had a stable, painless knee.

Figure 1-B: At four years he developed pain and instability, and a lateral radiograph revealed significant posterior subluxation of the knee.

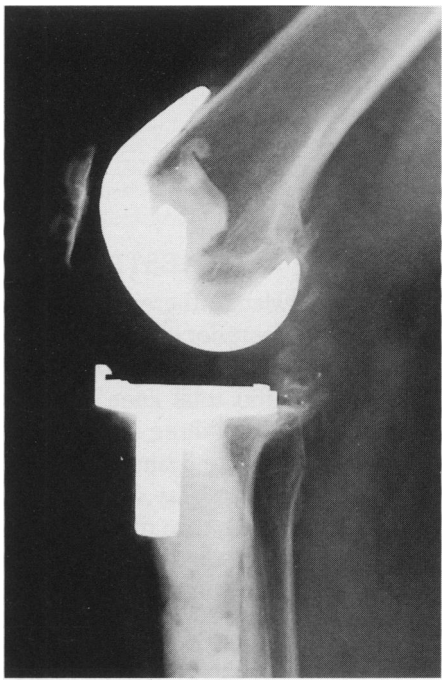

Figure 1-C: Lateral radiograph after revision arthroplasty with a posterior stabilized prosthesis.

knee from a position of full extension. Physical examination revealed a definite posterior sag sign and spontaneous posterior subluxation of the knee with attempted flexion. Radiographs confirmed new posterior subluxation but did not show any sign of component breakage or loosening.

The patient was treated with a cast-brace with motion restricted from 0 to 45 degrees. However, after two months, she developed a spontaneous complete foot drop and subjective sensory loss in the common peroneal nerve distribution. Electromyographic studies confirmed denervation of the tibialis anterior and peroneus longus muscles. Nerve conduction tests showed a partial block of the common peroneal nerve at the knee with evidence of mild axonal degeneration. The cast-brace was discontinued, as it was apparent that continued posterior subluxation was taking place despite the use of a brace.

During revision arthroplasty intraoperative examination confirmed the presence of a complete midsubstance PCL tear with posterior subluxation of the tibia. Although all of the components were well fixed, there was substantial wear of the anterior aspect of the polyethylene tibial insert. The components were replaced with a posterior stabilized prosthesis (Kinemax, Howmedica, Rutherford N.J.). Two years after revision, the patient had a range of motion from 0 to 90 degrees without instability or discomfort. The peroneal nerve palsy completely resolved after several months.

Case #3

A sixty-two year old white male suffered from gouty arthritis and severe degenerative joint disease of both knees. He had undergone a right arthroscopic debridement and chondroplasty five years earlier, and an arthroscopic synovectomy and intravenous antibiotic treatment for a septic knee (Beta haemolytic Streptococcus) three years earlier. The infection resolved, but the degenerative arthritis continued to progress until the pain in his right knee became unbearable and limited his activities of daily living.

After two sterile knee joint aspirations, the patient underwent a cemented right total knee replacement with a PCA prosthesis. Intraoperative cultures and tissue for pathology were taken at the time of arthroplasty. These proved to be negative for infection.

Although the early postoperative course was uneventful, a fascial dehiscence developed and was repaired six weeks postoperatively. Lateral subluxation of the patellofemoral joint was identified and corrected by lateral retinacular release and medial capsular plication four months postoperatively. At surgery, the posterior cruciate ligament was found to be normal. Just prior to the six month postoperative visit, the patient developed painful instability of the knee. Clinical examination disclosed significant posterior drawer and sag signs, but no other instability. Radiographic examination revealed no evidence of component loosening or malposition, however posterior

subluxation of the knee joint was noted. The patient subsequently underwent revision arthroplasty with insertion of a thicker, more constrained polyethylene tibial insert. Inspection of the PCL at surgery revealed a complete midsubtance rupture. Intraoperative cultures were negative at the time of revision. After placement of the new tibial implant, the knee was brought through a range of motion and found to be stable from full extension to a least 90 degrees of flexion. Postoperatively the knee was placed in a bulky dressing and knee immobilizer. Continuous passive motion was started on the fourth postoperative day. However, on the fifth day as he rolled over in bed, the patient experienced an uncomfortable locking of the operated knee. Clinical examination demonstrated that a posterior subluxation had occurred. The subluxation was reduced by gentle longitudinal and anterior traction of the tibia. The subluxation became a recurrent problem over the next several days and the limb was placed in a cylinder cast for six weeks. One year postoperatively, the knee was stable and demonstrated a range of motion of 20 to 80 degrees.

DISCUSSION

Subluxation and dislocation after TKA are relatively rare[1,2,3,5,7,10,12,13]. Bryan and Peterson (1973 and 1979) reported on the postoperative complications of 450 polycentric knee arthroplasties. Instability was second only to infection as a cause of failure in the three year follow-up period. A total of seven knees were unstable (1.6 percent), six of which presented within the first three months after operation. Six anterior subluxations occurred, and at least two required operative revision. Only one posterior subluxation of the knee was observed. The authors felt posterior subluxation resulted because all the ligaments had been cut to gain motion in a locked knee. The knee was eventually fused.

Skolnick et al (1975) reported on 119 Geometric total knee arthroplasties. Dislocation occurred in one case of advanced rheumatoid arthritis with complete absence of the cruciate ligaments. The patient was able to voluntarily displace the tibia posteriorly and medially by contracting the hamstring muscles with the knee partially flexed. However this patient denied instability. Skolnick et al (1976) later reported a dislocation rate of 1.4% after 500 total knee replacements using the polycentric prosthesis. Five of the dislocations were anterior, one was posterior and one was lateral. Three of the seven dislocating knees required more surgery.

Insall and coworkers (1979) identified six subluxations in their review of 461 total condylar knee arthroplasties. All cases were posterior subluxations and occurred during knee flexion. In two knees this represented only a minor inconvenience and both knees had a good rating. However, in four knees, the symptoms resulted in a poor rating; two of these four were eventually revised to a more stabilized prosthesis.

Cameron and Hunter (1982) reviewed the outcome of 700 total knee arthroplasties and found an overall failure rate of 13.4 percent. Late rupture of the medial collateral ligament occurred in seven (1.0 percent), and lateral subluxation of the tibia on the femur occurred in five knees (0.7 percent). Rotational subluxation occurred in three knees (0.4 percent) and was felt to be due to rotational malposition of the tibial component. Instability in the anteroposterior plane was found in two knees (0.3 percent), but no details concerning the specific type of prosthesis, the symptomatology or the etiology were given.

Interestingly, Galinat and coworkers (1988) reported the dislocation of two posterior stabilized total knee arthroplasties. Both patients had valgus deformities which required extensive release of the contracted lateral soft tissues. The dislocations occurred with slight flexion and external rotation. The prosthetic tibial spine had become locked posterior to the femoral cam. Sidney and colleagues (1989) have also reported two cases of posterior dislocation of the constrained Insall-Burstein Total Condylar III Prosthesis.

The three patients reported in our series all had stable knee arthroplasties with a functional range of motion prior to the occurrence of posterior subluxation. Immediately prior to the episodes of subluxation, two of the three patients complained of a vague ache in the popliteal area. Whether this was due to stretching of the PCL or posterior capsule, or early subluxation of the knee is unknown. In the second case, the subluxation probably stretched the peroneal nerve, leading to the neuropraxia. Fortunately, this resolved when mechanical stability of the knee was re-established with a posterior stabilized prosthesis. The third patient had a difficult postoperative course requiring further operative procedures on the knee. The PCL may have been injured during these subsequent procedures.

The etiology of PCL rupture after TKA is unknown. Interestingly, in all three cases the PCL had sustained a midsubstance tear. This may be related to compromised vascularity of the ligament after surgery or to inadvertent injury during the surgical procedure.

The posterior cruciate ligament is larger and roughly twice as strong as the anterior cruciate ligament. It is more vertically oriented and forms the axis around which rotation of the knee occurs. Its most important function occurs in flexion where it provides rotational stability and prevents posterior displacement[6,11]. Noyes et al (1974 and 1976) have reported that the PCL accounts for 89 percent of the resistance to posterior translation of the tibia on the femur. The PCL also acts to check hyperex-

tension only after the anterior cruciate ligament (ACL) has been ruptured or surgically removed. Therefore, in ACL-sacrificing total knee prostheses, the PCL must endure increased stress in flexion as well as in extension. This may lead to degenerative changes and eventual rupture of the ligament.

The vascularity of the PCL has not been studied as extensively as that of the ACL. The blood supply is classically attributed to vessels entering the intercondylar notch near the femoral attachment, and intraarticular capsular vessels near the tibial attachment[11]. There may be a significant contribution from vessels in the soft tissues and synovium which envelop the ligament's intraarticular portion. If the blood supply to the PCL is disrupted during a surgical procedure, rupture of the ligament may result.

Finally, the PCL may be damaged inadvertently by the oscillating saw, osteotomes or other sharp surgical instruments.

These cases illustrate late rupture of the PCL following total knee arthroplasty. In our experience, conservative treatment such as bracing and physical therapy has ended in failure. Surgical revision to a more stabilized prosthesis has been successful.

SUMMARY

To our knowledge there have been no reports of late rupture of the posterior cruciate ligament as a cause of instability in PCL-retaining total knee prostheses. In our experience this has occurred in 2.0% of cases and has led to severe instability. In each case, the PCL had sustained a midsubstance rupture. There was no associated loosening or malalignment of the prostheses. Revision to a more stabilized prosthesis has led to a successful outcome.

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