■ REVISION KNEE ARTHROPLASTY

The evolving incidence and reasons for re-operation after fixed-bearing PCL retaining total knee arthroplasty

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PCL retaining fixed-bearing TKA is a highly successful operation with the need for more surgery occurring at the rate of approximately 0.4% per year over the first 27 years. The most common cause for revision surgery is related to polyethylene insert failure and accounts for approximately 50% of re-operations. Late metastatic infection is the next most frequent cause followed by patellar problems, late instability and component loosening in decreasing frequency. A myriad of rare miscellaneous problems can also occur.

The specific incidence and causes for re-operation after total knee arthroplasty (TKA) continue to change with time.¹⁻³ In the early experience with hinge and condylar knees, re-operations were most frequently required for prosthetic loosening, knee instability, and sepsis. Twenty-five years ago, patellofemoral complications accounted for up to 50% of re-operations.⁴ With improved prosthetic designs and better surgical technique, re-operations are becoming less frequent. Polyethylene wear is now the leading cause for re-operation while prosthetic loosening, instability, and patellofemoral problems are relatively rare. Early peri-operative infection is also rare, but late metastatic infection remains possible throughout the patient's lifespan.

This report will review the various reasons for re-operation after fixed-bearing posterior cruciate ligament (PCL) retaining TKA in the order of their relative frequency (Table I). The percentages cited are approximate but reflect the relative incidence in a single surgeon's series of over 4000 consecutive knees followed for a mean of 13 years (1 to 27). The overall incidence of re-operation was 0.4% per year over these 27 years.

Polyethylene insert wear

Polyethylene wear has become the most frequent cause of re-operation after TKA. Wear can present as an isolated radiological finding or can produce symptomatic wear-debris synovitis and eventual osteolysis that can compromise prosthetic fixation. Polyethylene wear complications account for a little over 50% of re-operations. Of these, approximately two-thirds are associated with lysis, one-third with synovitis only and between

5% and 10% will present with asymptomatic radiological wear at a routine follow-up that is severe enough to warrant an elective insert exchange. The chance of requiring an operation for a wear related problem runs approximately 0.20% per year of follow-up for the first 27 years. Almost all wear related problems will be seen in modular tibial components. All-poly non-modular tibial components when used in elderly patients have few wear related issues and tend to outlive the patient.

Osteolysis was extremely rare in knees implanted in the 1980s. Its incidence began to slowly climb in the early 1990s and may have peaked in knees implanted in the mid to late 1990s. The reasons for this are multi-factorial. Inserts implanted in that era were still gamma radiated in air (the state of the art at that time). In addition, more conforming articulations started to be used to decrease topside wear. These conforming articulations will transfer stresses away from the topside to the insert-tray interface possibly leading to increased backside wear and the fine debris particles that incite the lytic process. The confounding issue of dealing with topside wear via increased conformity but precipitating backside wear because of force imparted to the insert tray interface can be addressed by rotating bearing components or by the use of non-modular metal-backed or all polyethylene components. Modern systems also tend to have better locking mechanisms and may have polished trays to minimise backside wear caused by micro-motion.⁵ Polyethylene, itself, also continues to undergo fabrication modifications to eliminate oxidation and improve wear characteristics.

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Table I. 27-year relative incidence of re-operation

Reason for re-operation	Total % of re-operations	Re-operation incidence/year (%)
Wear related problems	51	0.20
Late metastatic infection	12	0.05
Patella related problems	9	0.04
Late onset laxity	5	0.02
Femoral Component loosening	3	0.01
Tibial Component loosening	3	0.01
Miscellaneous causes	17	0.07

Prosthetic infection

Early peri-operative infection should be a rare occurrence today with the use of improved sterile technique, more efficient surgery with shorter operating times and peri-operative antibiotics. Most surgeons should experience an early operative infection rate between 0% and 0.3%. Infection is most likely to occur in the multiply-operated, diabetic, or morbidly obese patient or when there has been a wound healing issue.

Late metastatic infection from a remote focus can occur throughout the life of the patient and is the second leading cause of re-operation after TKA. Common sites that can cause a bacteremia that seeds the joint are the oral cavity, gastrointestinal and urinary tract or skin site (usually cellulitis). Some of these cases are inevitable despite education of patients and treating physicians about their possibility. They are currently responsible for about 12% of re-operations and may eventually become the leading cause as polyethylene issues are minimised. Patients must be educated as to their prevention and dental procedures must have antibiotic coverage. Some surgeons recommend dental prophylaxis for 2 years following the arthroplasty while others recommend lifetime coverage.

The rate of late metastatic infection arising in a TKA is approximately 0.05% per year of follow-up for the first 27 years.

Patellar problems

As mentioned earlier, patellar problems were the leading cause of re-operation 25 years ago. These complications included worn metal-backed patellar components (discontinued usage 26 years ago), patellar fracture when large central fixation lugs were in vogue and patellar loosening when fixation was via a small central fixation lug. Since the mid-1980s a three-pegged all polyethylene patellar component has become the state of the art. With this fixation method, both loosening and fractures have become relatively rare. Shearing-off of the 3 lugs could rarely occur in early designs. Its aetiology would require the presence of an abnormal shearing force caused by imbalance in the quadriceps mechanism. The conformity of the prosthetic

articulation would tend to keep the patella located in the trochlear groove while the soft-tissue imbalance would attempt to pull the patella toward the lateral side, resulting in the shear forces. Once the junction between the lug and the patellar component was reinforced by manufacturers, this complication was eliminated.

Traumatic fractures of the body of the patella can occur, but most can be treated conservatively and do not require surgery. Small avulsion fractures that usually involve a few millimeters of the superior pole of the patella can also be seen. These are rare incidental findings noted at routine follow-up. Occasionally, they are symptomatic for approximately six weeks during which time the patients should be advised to avoid high forces across the patellofemoral articulation such as ascending stairs and arising from a sitting position without arm support.

Patellar component loosening is seldom seen today. When it occurs, it is often associated with a history of a patellar fracture or osteonecrosis of the patellar bone such as after an extensive lateral release.

Un-resurfaced patellas may serve patients well for their lifetime, but may lead to a re-operation because of secondary pain. This need may not occur until the second decade. Whether or not to routinely resurface the patella remains controversial. Those who advocate resurfacing all patients point to the low incidence of resurfacing complications with current designs. Resurfacing can also be selective based on certain criteria such as the absence of a non-inflammatory arthritis, the absence of eburnated bone in the patello-femoral compartment and the presence of congruent tracking of the patella with the prosthetic trochlear flange. Even with this selection process, secondary resurfacing is still required at a rate of approximately 2% at ten years post-op.

Overall, patellar problems (apart from obsolete metal-backed components) account for 9% of re-operations and occur at a rate of 0.04% per year. About half of these are for secondary patellar resurfacings and half for patellar loosening. The 'patellar clunk' syndrome is usually associated with posterior stabilised prosthetic designs, but can also rarely be seen in a PCL retaining arthroplasty.

Traumatic and atraumatic laxity

Late onset knee instability can occur after TKA. It can be associated with trauma or develop insidiously over a period of many months. Trauma cases usually involve falls which can be purely accidental or be associated with a knee that has persistent quadriceps weakness and episodes of giving-way. They are treated with thicker inserts and quadriceps rehabilitation.

Atraumatic cases usually involve pre-operatively varus knees that have slowly drifted back into varus, associated with lateral laxity. These knees are usually slightly under-corrected regarding their mechanical axis and had some residual lateral laxity that then progressed as the varus recurred. They are treated with thicker inserts and a medial release to balance the lax lateral side.

Re-operations for laxity account for about 5% of all re-operations and occur at a rate of 0.02% per year of follow-up.

Femoral component loosening

Isolated femoral component loosening is very rare whether the component is cemented or cementless. Failure of either femoral fixation method accounts for approximately 3% of re-operations. The incidence of femoral loosening over time is 0.01% per year over the first 27 years. The success of a cementless femur is dependent on the quality of primary fixation at the time of the arthroplasty. A reliable standard is to test the difficulty of extracting the femoral trial as a way to quantify the fit. Both cemented and cementless femurs are vulnerable to late loosening in the presence of severe osteolysis.

Tibial component loosening

Isolated cemented tibial component loosening is also infrequent and accounts for approximately 3% of re-operations. It, too, has an extremely low incidence of 0.01% per year failure over the first 27 years. In the presence of severe osteolysis, however, tibial loosening is more prevalent.

Cementless tibial components are more likely to loosen than cemented components with the incidence dependent on their design and the accuracy of implantation. Components fixed with screws or those using metals with high ingrowth potential are more likely to enjoy long term success.

Miscellaneous causes of re-operation

There are a number of miscellaneous causes of re-operation after TKA that together account for approximately 17% of re-operations.⁶ These include ankylosis that doesn't respond to closed or arthroscopic manipulation, recurrent hemarthrosis, recurrent rheumatoid synovitis and symptomatic ganglion cysts that tend to arise from the proximal tibio-fibular joint. Together, these occur at the rate of approximately 0.07% per year for the first 27 years.

Summary

In summary, PCL retaining fixed-bearing TKA is a highly successful operation with the need for more surgery occurring at the rate of approximately 0.4% per year over the first 27 years. The most common cause for revision surgery is related to polyethylene insert failure and accounts for approximately 50% of re-operations. Late metastatic infection is the next most frequent cause followed by patellar problems, late instability and component loosening in decreasing frequency. A myriad of relatively rare miscellaneous problems can also occur.

Although today there are more younger and more very elderly patients undergoing TKA, the average age of patients having this surgery remains at about 68 years. Actuaries tell us that people this age die at the rate of 3% per year while we have noted that their arthroplasty will fail at the rate of 0.4% per year. It is a sobering thought that the average TKA patient has a seven times greater chance of dying than of ever undergoing another operation for their knee.

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