Complications of Total Knee Arthroplasty

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Abstract: Total knee arthroplasty (TKA) is an excellent surgical procedure that can make severely damaged knees painless and stable, but it can be associated with many complications. Once complications develop, their management is not necessarily easy. The major complications include loosening, wear and breakage of the prosthetic components, patellar problems, fracture in the vicinity of the prosthesis, disruption of the extensor mechanism of the knee, and infection. Complications can often be prevented if TKA is performed after adequate preparation, such as thorough evaluation of the appropriateness of surgery, and if the technique used for TKA is meticulous. Great care must be taken both before and during the operation. When complications occur despite such precautions, early detection, accurate evaluation, and appropriate treatment are important.

Key words: Total knee arthroplasty; Complications; Infection; Revision surgery

Introduction

Total knee arthroplasty (TKA) is a surgical procedure used to relieve the pain and functional limitations associated with severe knee joint damage caused by osteoarthritis, rheumatoid arthritis, and other diseases. TKA has already been performed for more than 30 years. Recent progress in prosthetic materials, the design of prosthetic components, and surgical techniques has made it possible to routinely achieve excellent results.1) When joint destruction is severe, however, successful TKA still owes a great deal to the surgeon’s skill and experience.

Uncemented fixation was originally developed to overcome the various complications arising from the use of bone cement in total hip arthroplasty (THA). To employ this technique for TKA, implants for uncemented fixation were designed and have been used, but are not reliable enough yet. Consequently, cemented knee prostheses are more widely used. This also reflects the fact that the incidence of complications of cemented TKA is lower than that of cemented THA, a difference that can be explained by the difference in the weight-bearing mechanisms of the hip and knee joints. In other words, the load distribution is more even in the knee joint than in the hip joint.
and the force exerted on the knee is mainly compressive.

It is no exaggeration to say that the most important factors determining the outcome of TKA arise in the course of the operation. In other words, if the indications and surgical technique are appropriate, most complications can be prevented, but some complications of TKA will still occur. In this article, the main complications are explained along with their management and preventive measures.

Problems with the Prosthetic Components

Among the various complications, loosening of the prosthetic components is one of the most common causes of failure. Use of the correct surgical technique is very important to prevent loosening of prosthetic components, as well as for preventing other complications after TKA. Loosening can be prevented in most of the cases if the anatomical alignment of the lower extremity can be properly restored with perfect ligamentous balance at the time of surgery.

In general, the femoral component loosening and damage are rare and most problems involve the tibial component. If the alignment of the lower extremity cannot be completely restored, the stability of the tibial component can be considerably affected depending on the strength of the tibia and the severity of osteoporosis. In addition, to fix the tibial component firmly, implants that are large enough to cover the cortical margin of the tibia should be chosen. A tibial component with a stem in the centre has been used to increase stability.

Bone cement should be spread evenly over the cut surface of the tibia to create a thin layer of about 3–5 mm. To form such a thin layer, the bone cement must be compressed between the bone and the component with adequate force. Once the component has become loose, bone deformity and defects will progress. When deformity and bone loss are marked, the prosthesis designed for revision arthroplasty is required. At the time of revision arthroplasty, care must be taken to restore the bony support and to preserve the extensor mechanism of the knee joint. As a rule, it is important to obtain the same alignment of the lower extremity as that achieved after the initial arthroplasty together with adequate ligamentous balance.

Damage to prosthetic components is another problem. If the alignment of the lower extremity is unsatisfactory after TKA, stress will be concentrated on particular parts of the ultra-high-molecular weight polyethylene (UHMWPE) tibial component, resulting in wear and deformation. If this damage progresses too far, the metal parts of the femoral and tibial components may come into contact with each other, resulting in wear and breakage of the metallic components. It was previously considered desirable for as little of the tibia to be removed as possible. If the UHMWPE layer is not thick enough, however, the stress is increased in magnitude, predisposing to wear and damage. Consequently, the tibia should be so cut that a tibial component of at least 8 mm in thickness can be inserted into the space created by bony resection.

Dislocation and Subluxation of the Patella

Frequent complications after TKA include dislocation and subluxation of the patella, as well as component loosening. These two complications occur usually from early to about 6 months after TKA. According to previous reports, the occurrence of such complications was recognized in 2% to 20% of patients. The risk of patellar dislocation depends on the balance of the supporting structures (retinaculum and collateral ligament), valgus deformity of the knee, the placement of the components, and the shape of the components used. The risk is particularly high with implants of a certain design in which the patellar groove of the femoral components is shallow such as the MG I model. When patellar replacement is per-
ponents. Such fractures have been reported in about 1–2% of patients undergoing TKA. The fracture commonly occurs in the supracondylar area, and is incomplete in many cases. Some of the fractures can be reduced and fixed in a cast under fluoroscopic observation. Usually the joint should be immobilized until bony healing is achieved, but load bearing can be resumed at a relatively early stage. Almost the same range of motion as before the operation can be restored in many cases.

Open reduction should be considered for fractures with substantial displacement, but surgical treatment is associated with a high risk of infection. In patients sustaining a fracture after TKA, the bone is also severely atrophic in the vicinity of the prosthesis, so fixation with ordinary instruments and materials is not necessarily easy. The incidence of postoperative nonunion is also high in such cases. Consequently, extreme care must be exercised when a fracture is treated surgically after TKA.

Furthermore, fracture is associated with loosening of the prosthetic components in some cases, and revision arthroplasty should be considered when this occurs. The femoral component with a long stem has been designed for such revision arthroplasties.

Complications Involving the Extensor Mechanism of the Knee Joint

Disruption of the extensor mechanism of the knee after TKA diminishes muscle strength, resulting in instability and weakening of the knee joint, with inability to stand up or sit down and “giving way” of the knee. Contributory events include intraoperative injury to the extensor mechanism, patellar fracture, detachment of the patellar tendon insertion, and rupture of the quadriceps and patellar tendon. Patellar fractures that occur after TKA are usually stress fractures, and several causative factors may be involved. Excessive osteotomy of the patella, ischemia secondary to lateral release, and bone resorption due to loosening...
of the patellar component can predispose to a patellar fracture.

Patellar fracture can be treated relatively well by immobilization in a cast for 6 weeks if the fragments show minimal displacement. Surgery is required if the patellar component has been loosened. Open reduction is followed by internal fixation of the bone fragments, and then the loosened patellar component is replaced. However, the use of bone cement in the preceding arthroplasty may make the revision arthroplasty impossible because of large bone loss. If so, the fracture is often difficult to treat, but the patient can recover extension of the knee joint partially even in the presence of small gaps between the fragments unless there is a transverse fracture associated with remarkable displacement.

Detachment of the patellar tendon and rupture of the quadriceps femoris muscle occur infrequently but are extremely difficult to treat, and thus are considered to be serious complications. In many of the patients who have undergone previous surgical treatments on the knee such as high tibial osteotomy or knee arthroplasty, the patella is difficult to evert because of scarring or shortening of the patellar tendon. Consequently, the patellar tendon may become detached when the knee is flexed during surgery after eversion of the patella. Care must be taken to avoid such detachment.

During postoperative passive range of motion exercises, the quadriceps femoris muscle and patellar tendon may be torn completely if the manipulation is performed violently beyond the range of motion achieved during the operation. Manipulation is effective for releasing adhesions of the extensor mechanism. It should be understood, however, that manipulation cannot stretch contractures of the quadriceps femoris muscle. There have been reports on several methods of surgical therapy, including primary repair of the soft tissues and repair of the patellar tendon augmented with the hamstring tendon graft. The outcome is often unsatisfactory because of limited motion, decreased quadriceps strength, and recurrence of rupture.

**Infection**

The most severe complication that can occur after TKA is infection, so its prevention is very important. The extremity must be fully cleansed before the operation. The operating room used for TKA should be clean, being furnished with facilities such as laminar air flow. Before operation, prophylactic antibiotics should be administered intravenously, and the operative site should be thoroughly irrigated with more than 6 L of physiological saline after bone cut and insertion of the prosthetic components. An intraarticular drain should be placed to remove blood postoperatively. These prophylactic measures make early infection after TKA an uncommon complication. The incidence of late infection has been reported as 1–10%, depending on the series. Local heat and pain, an increased erythrocyte sedimentation rate, leukocytosis, and elevation of the C reactive protein (CRP) level suggest infection. If any of these signs is noticed, synovial fluid should be aspirated and examined microbiologically to identify the causative organism. In case no causative organism is identified in the patients with clinical signs of infection, the diagnosis should be established by open biopsy.

When a wide radiolucent zone is demonstrated around the components during postoperative follow-up, infection should be considered. Even when infection is suggested by radiographic findings, no organism is identified in some instances. In such cases, the presence of infection should be identified from both clinical findings and the results of radiological and laboratory studies.

For mild infection after TKA, systemic administration of antibiotics and local irrigation have been reported to be effective with the prosthesis retained. In the case of late infection, however, cure is rarely achieved without removal of the prosthesis. In general, the whole prosthesis should be removed together with...
any cement and granulation tissue, followed by complete debridement of the infected area and systemic administration of antibiotics. Bone defects should be filled with cement beads containing antibiotics. In general, after complete resolution of the infection, revision arthroplasty or arthrodesis is done. In the United States and Europe, revision arthroplasty has been performed primarily after complete debridement, but this method requires further evaluation.

**Restricted Motion**

The range of motion that is achieved after TKA depends on several factors, such as the patient’s motivation, the success of rehabilitation, and the design of the prosthesis. The preoperative range of motion is considered to be the greatest determinant. One of the indications for TKA is extension contracture of the knee, which causes substantial limitation of flexion. In general, contracture of the quadriceps femoris or the joint capsule is the cause of extension contracture of the knee. Even if an adequate range of motion can be recovered at surgery, contracture frequently recurs and flexion is eventually limited to 45–60 degrees in such cases. Consequently, if the affected knee joint has a contracture, extreme care should be exercised intraoperatively in selecting a method to release the soft tissues and rebalance the ligaments. Usually, approach to the joint can be performed through medial parapatellar arthrotomy. If the patella cannot be everted after this is done, proximal release of the rectus femoris muscle is recommended, although osteotomy of the tibial tubercle has also been reported. If osteotomy of the tibial tubercle is performed, its fixation will pose another problem. In contrast, it is an advantage of proximal release of the rectus femoris that the tension of quadriceps can be adjusted at the end of the operation. In addition, the range of motion can be increased by manipulation under lumbar anesthesia with careful assessment of the tone of quadriceps.

In patients with severe flexion contracture of the knee, inappropriate bony resection and inadequate posterior release may result in limitation of the range of motion after TKA. When the distal femoral bone cut is added to provide extension gap, and a polyethylene component that is thick enough to achieve stability in extension is inserted without releasing the contracted posterior capsule, the collateral ligaments become excessively tight during flexion causing loss of flexion. Consequently, the distal femoral bone cut should not be done merely to gain space for extension. As a rule, femoral bony resection should only create a space that is as wide as the implant to be inserted. In addition to this bone cut, the posterior tissues, which are the main cause of flexion contracture of the knee, should be thoroughly released, including the posterior capsule, posterior cruciate ligament (PCL), and the popliteal tendon. Ater all of these are released, arthroplasty should be carried out routinely, including determination of the level of the tibial bone cut, which determines the range of both extension and flexion after TKA. A posterior stabilised prosthesis that requires resection of the PCL can improve flexion more easily than a cruciate-retaining prosthesis which allows the preservation of the PCL.

**Conclusion**

TKA is an operation about which there are high expectations. Once complications develop, however, the outcome of TKA becomes extremely poor and is often devastating. It must be recognised anew that thorough preoperative evaluation of the indications and meticulous surgical technique can prevent complications. When complications occur anyway, it is very important to diagnose them early and treat them appropriately.
REFERENCES


