

Total condylar knee replacement – our results

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SUMMARY

Pain and impaired motor function significantly reduce the quality of life in patients suffering from a knee osteoarthritis. The TKA is the one and only effective treatment in advanced stages of gonarthrosis.

The aim of this study was to evaluate the results obtained in patients after bicondylar TKA with/without patellar resurfacing. In the period from September 2008 to October 2011 were operated on 320 knee joints. Every patient was evaluated on the basis of clinical and radiological examination. We found that after surgical procedure in: 98,7% of the cases there was no pain and gait efficiency has improved, 94,7% of the cases was achieved correction of the axis of the lower limb operated on, 91% of the patients were satisfied with the outcome.

Keywords: arthroplasty, gonarthrosis, knee

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INTRODUCTION

Knee, due to its complicated anatomical structure and biomechanics, is difficult to replace by a prosthesis. Until this time, more than 400 varieties of artificial knee joints were invented: from McIntosh plates to modern constructions currently used in the clinic. Unfortunately they still do not fully reproduce the physiological range and biomechanics of motion of the knee joint, which leads to congestion and complications such as loosening or premature wear of the implant [1,2,3]. The aim of the study was to evaluate the results of clinical trials in patients after bicondylar total knee replacement procedure.

MATERIALS AND METHODS

In period from September 2008 to October 2011 were implanted 329 bicondylar knee prostheses in 320 patients operated on in the Department and Clinic of Orthopaedic Surgery Medical University of Silesia in Katowice. Unilateral treatment was performed in 311 patients (275 women, 36 men), and bilateral in 9 (8 women, 1 man). Age of the patients ranged from 37 to 79 years (mean 61 years). The prosthesis implanted in patients were: 14 Stryker Kinemax, 64 DePuy PFC, 73 Biomet AGC and AGC V2.

The indication for surgery was osteoarthritis in 240 cases and rheumatoid arthritis in the remaining 80). Medical history included typically several years and in that period of time patients were treated conservatively with pharmacotherapy and physical therapy. Some TKA was preceded by synovectomy in 11 cases, THA in 13 cases, Coventry-type osteotomy in 1 case.

The preoperative mobility of the knee was measured. There was observed:

1. In 26 cases the presence of persistent flexion contracture in the range from 10 to 20 degrees.
2. In 23 cases range to 60 degrees.

3. In 72 cases range to 90 degrees.
4. In 30 cases range up to 120 degrees.

Preoperative radiological assessment of the axis of the knee did not show the presence of the varus or valgus deformity in 32 cases. Varus deformity occurred in:

- 44 cases in the range of 5 to 10 degrees,
- 17 cases in the range of 11 to 15 degrees,
- 15 cases in the range of 16 to 20 degrees,
- 14 cases in the range of 21-25 degrees,
- 3 cases in the range of 26-35 degrees.

Valgus deformity was less frequent, mainly in rheumatoid arthritis. In the latter case the damage to the articular surface ranged from III, to IV or V grade according to the LDE scale was observed [4].

Preoperative and postoperative efficiency of the knee was evaluated using HSS (Hospital for Special Surgery) scale proposed by Insall et al. in 1976. After 6 weeks and in the 3rd, the 6th and the 12th month after surgery X-rays were performed in the AP and lateral views. On their basis possible signs of loosening of the implants were evaluated in a four grade scale, in 7 zones. The brightening was assessed in a following scale:

- I. Without brightening,
- II. Brightening less than 1mm,
- III. Brightening from 2mm to 4mm,
- IV. Generalized brightening, with or without the presence of a movable component [5, 6, 7].

Patients were operated on under general anesthesia. In a few cases due to the inability to inject the anesthetic needle for spinal anesthesia, patients were put under general anesthesia. In more than half of the patients tourniquet had been used for ischemia during the surgery. The cuff was used due to personal preferences of the operator. It wasn't used in case of varices and in the presence of thrombotic syndrome. Surgical approach was performed with a simple incision over the anterior surface of the joint and with a peripatellar cut passing on the medial side.

After providing hemostasis a double suction drainage was planted (to 2001 triple was performed). Peri- and postoperative antibiotic and antithrombotic prophylaxis was implemented.

Rehabilitation started in the first day with isometric exercises. Standing/walking and passive exercises with a CPM unit were introduced in 2-3 day, gradually increasing range of motion. Hospitalization lasted from 12 to 33 days (mean 17,4 days). Patients leaving hospital generally achieved approximately 90 degrees

of flexion range, with full extension of the knee. Continuation of antithrombotic prophylaxis was recommended usually for 30 days (currently 6 weeks). Further improving treatment was carried out in sanatorium. Patients in the postoperative period went with elbow crutches with partial weight bearing of the limb. Initially full bearing started depending on the condition of a patient at 12 to 16 week after surgery; currently patients fully bear weight after 7 to 14 days after surgery.

RESULTS

The follow up of patients after surgery (TKA) varies from 6 months to 6 years (mean 37 months). There was only one case of the death of the patient suffering from rheumatoid arthritis caused by acute heart failure 2 months after surgery. The case was excluded from the results analysis. In 1 patient was diagnosed the pulmonary embolism on the 3rd day after surgery. The patient was admitted to the Intensive Care Unit. One week after this patient had been referred to our clinic and on the 27th day left the hospital in the general and local good condition. In most cases patients showed reduction or elimination of pain and improvement of mood. Postoperative knee efficiency, measured in the scale of HSS, was better in comparison with the period prior to surgery. Average number of points before surgery was 42.0 points, and 80.4 points after surgery, so the average increase in the scale of HSS was 38.4 points.

Mobility of the operated knee was in 14 days after surgery: in 2 cases to 60 degrees, in 8 cases to 70 degrees, in 71 cases to 90 degrees, in 60 cases to 100 degrees, in 10 cases to 120 degrees. All patients operated on had full extension of the knee joint after surgery.

Radiological assessment of the knee axis due after total knee arthroplasty revealed: in 6 cases (3,97% of patients) presence of mild varus deformity, in 2 cases (1,32% of patients) had valgus deformity.

Only 1,98% of the patients had abnormal patellar traction, most likely due to an imbalance in tension between lateral and medial retinaculum. In those patients we made cross-cutting of the lateral patellar retinaculum under the control of the arthroscope.

In 5 cases (1,31% of patients) was observed the aseptic loosening of the tibial component of the prosthesis on the x-rays; 3 of them had minor postoperative varus deformity. However there were no clinical symptoms, therefore

attempts for reoperation were made. 1,32% of the patients (2 cases) had septic loosening of the prosthesis due to bacterial infection.

8 joints (5,3% of cases) had excessive degree of postoperative lateral instability, and in 2 patients persistent flexion contraction had occurred reaching 10°, despite obtaining the full range of joint motion.

In 6 cases (3,97%) there developed signs of marginal necrosis of the surgical wound in patients after pre-made extensive joint synovectomy. After necrectomy and surgical cleansing of the wound occurred healing. 3 of them needed delayed plastic reconstruction of soft tissues.

The peroneal nerve palsy occurred only in 2 patients (1,32% of cases) with preoperative significant valgus deformity of the knee operated on. In 1 case of them the complication was transient, whereas in the other persistent.

Despite using thromboprophylaxis in all patients, in 18 patients developed symptoms of venous thrombosis, which accounted 11,92% of cases. Symptoms disappeared after the administration of increased doses of NSAID's and higher doses of low molecular weight heparin. In 3 patients patellofemoral syndrome was observed. It began during flexion of the knee at an angle of 30°-35°. Due to absence of a pain, one patient did not agree to surgery. In 2 other we provided reoperation with resurfacing of the patella. 14 patients (9,27% of cases) underwent surgical puncture of the knee joint and suction of the synovial fluid due to the local edema. In 4 of these there was the macroscopically turbid synovial fluid and microscopically culture were positive. It revealed the presence of colonies of the following bacteria: *Staphylococcus aureus* in 2 cases, *Staphylococcus epidermidis* and *Enterococcus cloacae* in 1 case. Three patients had positive blood cultures confirming the smear from synovial fluid. 2 cases revealed isolated bacteremia, without the presence of bacterial colony in the synovial fluid, with the presence of following bacterial colonies in the blood: *Pseudomonas aeruginosa* and *Staphylococcus aureus*. In total, we observed deep infection in six patients, which represents 3,97% of all cases. There was 6 deep surgical wound infections in 6 patients: four patients were treated successfully with conservative treatment (asymptomatic period from 6 to 30 months). 2 patients (1,32% of patients) had septic loosening due to *Staphylococcus aureus* infection. In the first case, after the evacuation of the prosthesis and removal of the necrotic tissue,

joint stiffening with external fixation technique was performed. After 6 months due to lack of apparent radiographic union on x-rays that fixation was removed and the limb was immobilized in the plaster cast. After another three months, knee arthrodesis was performed using the locked intramedullary nailing. After three subsequent distal fixation screw was removed. After 6 months, full bone union was achieved. In the second patient, knee arthrodesis was performed with use of external fixator.

DISCUSSION

Knee arthroplasty using the bicondylar prosthesis is an effective treatment of the changes caused by degeneration and rheumatoid arthritis. Research done in Sweden on a large scale (over 41 000 cases) confirm the high percentage of good results, reaching 97,5%. Our relatively modest material confirms results from that report [7, 8].

In our material, except 2 cases of reoperation due to septic loosening, there were no complications which consequences led to undertake the removal of the endoprosthesis [5, 8, 9, 10, 11, 12]. In national and foreign literature estimated survival rate of the prosthesis in the 10-15 year follow-up is 90 to 99,9%.

In our patients group the impact of the type of destructive changes (osteoarthritis or rheumatoid background) on the success of the surgical procedure and the occurrence of complications was not observed, as in Cloutier's. Perhaps this is due to too few analysed cases.

During the research there were no statistically significant differences in the mobility of the knee in the preoperative period in both groups. There was, however, despite lower average age of the patients with RA (44 years), much slower progress in rehabilitation. In the Swedish registry (39 658 cases) differences between the condition of the knee, and the occurrence of complications were noted. In the group of patients with rheumatoid arthritis 8,81% have undergone primary revision, in comparison patients with degenerative disease - 2,83% of cases. It has been shown significant differences between groups in the indications for reoperation. Among patients with RA an infection and loosening of the implant occurred more often [5, 8, 10, 13].

Thromboembolism is the most common complication of knee arthroplasty. Without the use of thromboprophylaxis embolism was developed in about 84% of cases. In 7% there was

the creation of pulmonary embolism. Despite the use of thromboprophylaxis this complication could not be eliminated but only lowered to 2-12%. In our patients group 11.92% of the cases had symptoms of thromboembolism. There are many factors that increase the risk of thromboembolism among others previous incidents of venous thrombosis, older age, obesity, chronic heart disease. Finding thrombosis with use of clinical examination is very difficult, clinical symptoms are often discrete. In more than one third of the cases there is swelling, discomfort in the calf and pain that increases during bending foot dorsally (Homan's symptom). The disease can also be asymptomatic. Pulmonary embolism manifests by pain in the lungs and respiratory disorders. Manganeli et al have reported occurrence of one of the above symptoms in 60-80% of cases, in 40% symptoms occurred simultaneously. The author also notes the incidence of tachypnoea in 85% of the cases, in 50% he observed rales over the lung fields, and fever [14, 15].

Like Wakankar and colleagues we did not observe significant differences between the group of patients who used tourniquet during surgery, and those without ischemia. Operation time, postoperative pain, blood volume drainage, swelling, and the risk of infectious complications and embolic events were similar. An important advantage of the ischaemia is a bloodless operative field [16, 17].

Complications after total knee arthroplasty can be divided into aseptic and on the ground of infection. Those first are rather frequent. In 70s incidence rate of so-called anterior knee pain was 20 to 40%.

It was caused by the friction of the patella on implant due to the absence of anatomical femoral block in the design of knee prostheses. Complications of the extensor mechanism in the last decade has declined to 1,5-12% due to modification of the shape of implants and surgical technique. However, complaints from the femoropatellar joint are the most common reason for carrying out reoperation. These includes patello-femoral instability, abnormal position or fall off of parts of the implant, fracture of the patella, the use up of components of the implant, osteonecrosis, patellar "clunk" – a jump of the patella during flexion and extension of the knee and patellar tendon rupture [9, 18, 19, 20, 21].

Abnormal patellar traction is estimated at 0.5 to 29%. It can be caused by the asymmetrical resection, malrotation of the femoral or

tibial component, and the lack of balance in the tension of soft tissues (lateral retinaculum is too tight or medial too loose). In our material the incidence of this complication is found in 1.98% cases. In three cases we made the intersection of the lateral patellar retinaculum under the control of the arthroscope. The reason of this failure was most likely due to impaired balance in tension between the lateral and medial retinaculum. On the basis of radiographs the correct position of the patella can be assessed. Gomes et al, and Delgado-Martinez and colleagues determined the radiographic parameters for patellar subluxation. The occurrence of one of them is defined as patellar dysfunction [19, 22, 23].

Fracture of the patella occurs when bone structure is weak and when it is subjected to too heavy loads. Direct trauma rarely leads to fracture. Too large patellar resection predisposes to the occurrence of its damage. Research conducted by Reuben proved that the thickness of the patella below 15mm clearly increases the emphasis on the front section. Note that osteonecrosis of the patella caused by damage to blood vessels, done not only during arthroplasty eg over the lateral retinaculum release, but also after previous treatments such as meniscectomy, leads to a fracture in the late postoperative period. Goldberg's classification of fractures of the patella is helpful in planning surgical intervention. He divided them into four types. Type I avulsion fracture of the patella caused not by the implant, bone cement or quadriceps. Type II is a fracture with disruption caused by the implant or the quadriceps. Type IIIA – fracture of lower pole of the patella with ligament rupture, and type IIIB – fracture of lower pole of the patella with maintaining of ligament. Type IV – patella fracture with displacement. In our clinic in the group of 151 patients patellar fractures have not been observed [8, 19, 24].

The rupture of the aponeurosis of the patella after total knee arthroplasty is rare and occurs in 0.17 to 1.45% of cases. Mostly it comes to it during surgery with excessive knee flexion [19].

Sign of patellar clunk syndrome occurs when the fibrous nodule or hypertrophic synovium enters between the quadriceps aponeurosis and patella during flexion. In addition to jumping, pain occurs in the knee, also crackles, and sometimes the secondary instability. Symptom of patellar clunk syndrome appears almost exclusively in patients with implanted prosthesis with a posterior stabilization. Conservative

treatment involves the use of anti-inflammatory drugs and intraarticular injection of corticosteroids. If symptoms of “patella jumping” persists attempt to remove the overgrown tissue by performing arthroscopy or arthrotomy should take place. During arthroscopic cleaning of the joint, be careful not to damage the surface of the implant and thus avoid a secondary metallosis. This complication affected three of our patients. In two we made reoperation. One patient did not agree to surgery because of the absence of pain [8, 19, 21, 25].

The space between the tibial and femoral component should be constant, both in flexion and full extension of the knee in order to ensure stability and prevent postoperative subluxation of knee. However, in the early postoperative period, tibiofemoral instability due to the posterior cruciate ligament insufficiency may occur in patients with prosthesis that saves the ligament. In 5 cases that had an AGC prosthesis implanted, degree of lateral instability was mediocre. Knees did not have tendency for subluxation, therefore were not treated surgically. Tibiofemoral instability could be caused by surgeon error in the evaluation of the posterior cruciate ligament or by delayed insufficiency appearing after surgery. Especially the latter often appears in patients with rheumatoid arthritis. In two cases, the tibiofemoral instability was due to improper cutting of the articular surface in the mediolateral axis and the formation of asymmetrical intraarticular space. Authors report that it may be caused by excessive resection of the femoral condyle, especially in the rear part. Medial collateral ligament insufficiency can also cause tibiofemoral instability. Treatment of instability is difficult, therefore, it is very important to evaluate efficiency of the posterior cruciate ligament correctly, also appropriate qualification of patient and proper conduct of operation is crucial. [19, 26, 27].

Depending on patient's qualifications we perform knee arthroplasty with use of implant, which allows us to keep or delete the PCL. Staw and colleagues for the first time compared the stability of the knee after arthroplasty depending on how you deal with PCL. In both groups with preserved and removed posterior cruciate ligament, anterior-posterior and medial-lateral stability was preserved with a similar results (approximately 54 and 78.5%). It was shown that in patients with use of posterior fixation, which replaces the PCL, anterior-posterior stability occurred in 71%, and medial-lateral in

88% of cases. Efficiency of the joint was investigated with Knee Society Score [10]. They found that in those who had kept PCL, incidence of pain was less frequent (average 47.8 pts.), The ability to handle longer distances was better (average 38.6 pts.), walking up the stairs was more efficient (average 34.6 pts.), and joint function was improved (an average of 69.0 points.) in comparison to patients with the use of posterior stabilization, respectively, 48.2, 41.7, 34.6, 74.2, and with removal of posterior cruciate ligament, respectively: 38.2, 31.7, 31.3, 62.6 points. Presented information shows a very significant role of PCL in the joint mechanics, comfort of patient, and the use of posterior stabilization in order to substitute damaged ligament. Surgery is the only treatment for tibiofemoral instability. In significant instability revisional arthroplasty is made with use of prosthesis with posterior fixation. In some centers if instability occurs after total knee arthroplasty due to insufficiency of the medial collateral ligament reconstruction is performed, for example from semitendinosus tendon. Three of our patients are candidates for such treatment. Before surgery, they had significant varus deformity and instability of the knee. Despite the use of posterior stabilized prosthesis their instability remains [7, 19, 27].

Surgical incision of the skin and deeper tissues result in the intersection of blood vessels and stopping their supply of nutrients, oxygen and removal of waste products. Johnson and colleagues showed a decrease in oxygenation of the skin on the first day by 67%. The role of blood supply to damaged tissues takes over collateral circulation and at eighth day the skin is less oxygenated only by 16% compared to healthy skin. It was found that the most preferred course of cutting skin and subcutaneous tissue in primary knee replacement is cut in the midline of the knee. If the patient has had previous operation of the knee and the scar does not run centrally, cutting should be carried out parallel to the existing, creating a bridge, where the ratio of width to length of cut should be greater than 1:4 [17, 19, 28].

In patients with advanced osteoporosis, rheumatoid arthritis, and also after too much loss of the bone during surgery, fracture of distal femur after knee replacement surgery may occur. Frequency of their occurrence is estimated at 0.3 to 2%, and they appear most frequently in the early postoperative period and after 2-4 years. These fractures occurs most frequently in women over 70 years of age. The risk of

fractures of the tibia is very small. The only review discussing them is a description of 15 cases by Rand and Coventry. The risk of fracture increases with incorrect axis (varus knee) or bad implantation of prosthetic tibial component. If the displacement of the fracture fragments is small it can be treated conservatively. The limbs are immobilized in plaster for 6 weeks. During that period rehabilitation consists of isometric muscles tensing, conducting synergistic exercises and partial weight bearing of the broken limb. Then, after removing the plaster gently increasing range of motion of the knee begins using an external fixator until the proper strength of the quadriceps muscle will be achieved. Unfortunately, a large proportion of fractures which are treated conservatively can lead to non-union or significant shortening of the limb and reduction of the range of motion in the knee. In most cases, surgical treatment is necessary involving the use of AO plate or intramedullary nailing. Fracture, which runs into the implant gap often leads to loosening of the prosthesis. Total knee arthroplasty should be than reconsidered [19, 29, 30, 39].

In 0.3% to 2% of cases while performing total knee arthroplasty damage to the peroneal nerve take place. Several factors increases the risk of this complication including preoperative flexion contracture, valgus deformity of the limb, previous surgical procedures – especially tibial osteotomy. In our group 2 patients experienced nerve palsy, which represents 1.32% of cases. These knees were characterized by a significant valgus deformity. In one case the complication was transient, within 3 weeks full function of the nerve returned. In the second, patient had only partial recovery of innervation, and we were forced to supply him with orthopedic shoe. Most complications are diagnosed on the second day after surgery. Depending on the degree of peroneal nerve palsy prognosis may be different. Most patients with partial nerve palsy are back to full health. The prognosis for patients with total sensory palsy or a combination with motor paresis is uncertain. It is therefore so important to prevent the occurrence of this complication by proper resection of bone and by avoiding too much tension of tissue at the time of implantation of the prosthesis. Treatment of peroneal nerve paralysis involves the removal of all oppressing dressings and stabilizers, and conducting appropriate rehabilitation without bending the knee more than 20-30 degree. If the range of innervation

does not return up to 3 months after the procedure can be assumed that there has been irreversible damage to the peroneal nerve [8, 19, 31].

Besides the above discussed aseptic complications after total knee arthroplasty, infections also appears. Their frequency vary depending on the hospital, but also on the eligibility of patients for surgery and reaches between 1.1% and 12.4%. In patients with rheumatoid arthritis, immune disorders, obesity, diabetes, urinary tract infections, changes of the skin, the risk of infection is greater. Very important, which is constantly overlooked, potential outbreaks of infection are gangrenous teeth. Therefore, patients referred for implantation surgery should undergo oral sanitation. You should also note presence of bacteremia at each extraction, which may be the cause of infection through blood vessels. To prevent this infection, antibiotic prophylaxis should be implemented. Also, surgical technique has a major impact on the occurrence of infections from first incision to last suture. It has been proved that the drainage increases the risk of infection. The presence of bacteria in drain was detected in 25% of cases. The aims of the infection prevention are: maintaining the rules of asepsis in the operating room, appropriate preparation of the patient for surgery, operative time as short as possible, perioperative antibiotic prophylaxis, rapid removal of drains, sutures, catheters [12, 32, 33, 34, 35, 36].

In most cases, the cause of infection in the artificial knee joint is *Staphylococcus aureus*. Authors indicates infection rate from about 50 to over 70%. Other bacteria are *Staphylococcus epidermidis*, *Escherichia coli* and *Pseudomonas aeruginosa*. Pathomechanism of infection of implants is a complex process. Prosthesis as a foreign body produces an immune response, resulting in the accumulation of inflammatory factors. This leads to coating the implant by serum proteins - fibronectins. In the next stage *Staphylococcus* binds with fibronectin, which activates the immune system. The symptoms of infection of the knee is in 96% of knee pain, swelling in 77%, in 27% increased body temperature and in 27% purulent discharge from the wound. In 3 cases, operated in our department, with infected joint after total condylar arthroplasty and with use of GUEPAR, after unsuccessful conservative treatment, arthrodesis was performed. Shea and colleagues used external fixation after the removal of infected prostheses in order to achieve knee

stiffness and therefore bone union was achieved in 17% of cases. Whereas Woods et al using the same technique obtained union in 100% of cases. After intramedullary nail fixation Griend obtained union in 91% of cases. It seems that intramedullary nails have more advantages than biplanar external fixators. They are in fact lighter, give a lower proportion of secondary infections, better stabilize the femur and tibia, and allow earlier weight bearing of the limb by the patient. Our experience in this regard is limited and is based on two cases after primary condylar knee arthroplasty. In one of them after the application of external fixation bone union occurred in the second external fixation was removed because of non-union and intramedullary nail was successfully applied [12, 34, 37].

In the early postoperative period, knee pain can significantly hinder the rehabilitation. Therefore, in some resorts, analgesia is continued for 48 hours from operation in the form of epidural anesthesia. The use of CPM after total knee arthroplasty is still debated. It is very difficult to determine the length of exercises, and their pace in order to improve range of motion in the operated joint. Coutts, Toth and Kaita reported that the use of passive rehabilitation increases, the proportion of subjects who obtained the full range of motion, shortening of hospitalization, reduction of pain and the number of thromboembolic complications and improvement of wound healing. Contrast, Ritter et al found that the CPM has a negative impact on the operated joint by increasing flexor muscles tension, prolongation of lying time in a bed and a delay in active movement. They presented the idea that CPM affects only the range of movement and the formation of edema, without affecting muscles and their strength. Pope, et al assessed the rehabilitation with or without the use of passive exercises. He found only a significant advantage of passive rehabilitation in the first week after surgery in the range of movement of the operated knee and confirmed the results of Ritter et al. Lynch AF et al demonstrated in their work that the use of passive exercises after surgery by means of CPM does not reduce the risk of thromboembolism. Our experience with the use of CPM as a beginning for the long process of rehabilitation are positive. 95% of patients were satisfied with passive exercises. In addition, psychiatric patients feel the need for early implementation of rehabilitation and a quick return to full health [19, 38, 39, 40, 41, 42].

CONCLUSIONS

More than 3 years of postoperative follow-up of the patients after bicondylar TKA allows us to formulate preliminary conclusions:

- Knee arthroplasty can release patient from pain and improve range of motion of the knee.
- Result of arthroplasty depends on the correct patient eligibility, performance of the operation and proper rehabilitation.
- The most common cause of failure in knee arthroplasty is venous thrombosis, abnormal traction of the patella and lateral instability.
- Infections are the most serious complication of knee arthroplasty.

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