Prevention of possible complications after partial arthroplasty the knee joint, as a method of treatment for isolated osteoarthritis

Stanislav Karamitev

Department of Orthopedics and Traumatology

Faculty of Medicine, Medical University-Plovdiv

Introduction

In the last twenty years, the use of unicompartmental knee arthroplasty (UKA) has increased significantly. Between 1998 and 2005, the incidence of UKA increased almost threefold compared to total knee arthroplasty (TKA) (17). UKA can be performed using a minimally invasive approach and is associated with a relatively low incidence of complications. A number of reports in the literature have reported over 90% survival of the prosthesis in a ten-year follow-up of relevant patients (17,18). Despite these results, a number of prosthetic registries for knee replacement indicate a relatively high rate of revision and failure of UKA, especially when comparing this type of prosthesis with total knee replacement (2). The frequency and type of complications in UKA vary depending on the type and design of the implant, as well as the follow-up period by the surgeon who performed the surgery. When it is necessary to perform an audit of the relevant UKA, most of them are converted into a total one. There are a number of challenges that the surgeon faces before and during a post-UKA revision. The results obtained from the conversion of UCA to TKA still seem contradictory.

Purpose

To indicate the factors leading to poor results and the possibility of preventing possible complications after partial arthroplasty of the knee joint, as a method of treatment for isolated osteoarthritis of the knee. To consider the surgical approaches during the revision after a failed UKA in order to obtain the desired end result.

Factors influencing the results after UKA

The factors that largely determine the significantly reduced survival of the UKA prosthesis and the poor results after this type of surgical procedure are: poor surgical and / or cementation technique of the components; inappropriately selected design of the components (prosthesis model); excessive bone removal from the tibial plateau; incorrect positioning of components (malalignment); damage to a certain component; performing UKA in inappropriately selected patients, ie with contraindications for this type of surgery (4,8,9).

1. Surgical technique is crucial when performing UKA. With regard to surgical technique, the main recommendations include lateralization of the femoral component when performing medial UKA to account for external rotation in knee extension. When using an polyethylene component, it is important to implant a sufficiently wide tibial implant, starting as far as possible from the medial tibial cortex to the anterior cruciate ligament (ACL). Applying an appropriate technique for cementing the components is also crucial, which includes drilling, using jet lauvage, and drying the surfaces before placing the bone cement on them. The cement must be applied in dough form. This provides better fixation of the femoral and tibial components.

2. During the intervention itself, it is very important to avoid removing too much bone from the tibia

in order to prevent fracture and / or failure of the tibial component. There are a number of reports describing fractures of the tibia obtained during the placement of the pins or other fixing device for its treatment. Early onset of medial collapse is observed with significant medial removal of bone mass. It is important to know that in the posterior medial and posterolateral part of the resected proximal tibia there is up to 20% more bone substance than in the rest of the joint surface. Therefore, implantation of the tibial component on the more resected anterior-medial and anterior-lateral part of the tibial surface can be a problem and tighten until it sinks. The placement of a smaller tibial component without support and contact with the medial tibial cortex can also lead to this complication.

3. Alining and correct positioning of the components is crucial for the success of UKA. The sizing of the femoral and tibial condyle is very important. The tibial component should be placed on a healthy medial tibial cortex to prevent implant failure, which is a common failure. This complication is also seen with too much removal of the tibial bone or with the placement of a small tibial component. The lateral positioning of the femoral component on the medial femoral condyle is correct to avoid medial-lateral divergence.

4. Insufficiently accurate selection of patients is also a factor that leads to undesirable results after UKA prothesis. These are patients in whom osteoarthritis (OA) affects more than one part of the knee joint, as well as those in whom the pain covers the entire knee. Contradictions exist, however, regarding the degree of involvement of the patellofemoral joint by the OA process, which can be ignored during UKA. Some authors claim and believe that there are no contraindications to performing UKA in the presence of OA in patella-femoral joint, unless there is significant bone loss and involvement of the lateral facet of the trochlear groove. Performing UKA in active patients is also not recommended, as premature loosening and wear of the components is possible. It is indicated in patients leading a sedentary lifestyle, such as middle-aged and elderly.

Complications after UKA

The main complications in partial prosthetics of the knee joint are: dislocation of the mobile inlay (in mobile -bearing design UKA); aseptic mechanical loosening of prosthetic components; polyethylene wear; progression of OA in the non-prosthetic knee compartment; periprosthetic infection; impingement; periprosthetic fracture; retention of cement debris (debris) in the joint; arthrofibrosis and unexplained knee pain (5,6,15,17).

The dislocation of the movable inlay is indicated as the main complication in the mobile-bearing design UKA (10,19), while in the fixed-bearing type UKA the wear of polyethylene and aseptic loosening of the prosthetic components are the most common complications (17,19).

The progression of the degenerative process in the non-prosthetic department of the knee joint after UKA occurs equally in the prostheses with a movable and in the fixed platform. Regardless of the design of the implant, most cases of complications in medial UKA are compared to lateral unicompartment prosthetic replacement (3.19).

1. Luxation of the mobile platform

The dislocation of the movable inlay is certainly the main complication of mobile-bearing design UKA. Reasons for displacement of the insert may be incorrect and inaccurate positioning of the prosthetic components; unbalanced flexion-extension gap, "injection" of the insert with an adjacent bone or with the tibial / femoral component; knee instability due to damage to the medial collateral ligament (MCL) or secondary loosening of the femoral / tibial component (19,20). This complication is particularly common in prosthetics of the lateral knee, as the lateral collateral ligament (LCL) is loose in flexion, unlike the medial department, where the MCL is tight and taut. MCL is the most important structure, which has a decisive role in the flexion-extension gap and also affects the stability

(along with ACL) after partial knee arthroplasty. During the intervention, the surgeon must be especially careful about the MCL. For the same reasons, soft tissue release should never be performed during UKA. The purpose of this type of prosthesis is to restore the kinematics of the knee by restoring normal ligament tension. Proper ligament balance of the ligaments is restored by accurately positioning the prosthetic components and placing an inlay of appropriate thickness. Otherwise, the release of ligaments can lead to excessive sagging of the periprosthetic soft tissues, with a subsequent tendency for the insert (and implant) to move forward. This can also cause early wear of the polyethylene as well as aseptic loosening of the components (7).

When this complication occurs, the dislocated mobile inlay can be replaced with another thicker one. The conversion of mobile-bearing UKA to TKA, according to the reason for the dislocation, is also considered.

2. Aseptic loosening of prosthetic components

Aseptic mechanical loosening of prosthetic components has been reported as the most common reason for revision after TKA (20). The frequency of this complication, after the introduction in practice of new instruments and prostheses with a changed design, significantly decreases with the implementation of modern UKA. Younger age, obesity and varus deformity are indicated as possible risk factors causing mechanical damage to the UKA prosthetic components. In a fixed platform UKA, there is a higher contact stress (load) on the polyethylene insert, which can ultimately lead to damage associated with loosening of the tibial component (19). Loosening of the tibial component is more common in this UKA model, where the tibial part of the prosthesis is entirely polyethylene (in all-poly design), in contrast to the metal-backed tibial part of the UKA model (21). Mechanical loosening after UKA may be due to impaired alignment between prosthetic components; insufficient correction of the available deformation; PCL deficiency; excessive tibial slope and dislocation of the inlay in UKA with a movable platform. All of these factors can also cause wear-induced periprosthetic osteolysis (due to increased asymmetric loading), which further increases the degree of component loosening.

When such a complication occurs, the UKA prosthesis is revised or converted to TKA, and the bone integrity for available bone loss, the condition of the ligaments must be assessed very precisely, in order to select an appropriate primary or revision total endoprosthesis. (fig.1,2)

3. Progression of OA in the opposite compartment

The progression of OA in the opposite compartmnet of the knee joint and / or in the patella-femoral joint is one of the main reasons for complication after UKA, both in fixed and mobile version. Overcorrection of the mechanical axis of the lower limb can cause degenerative changes in the contralateral compartment of the knee. This complication can occur in patients with systemic inflammatory diseases, ie rheumatoid or psoriatic arthritis. PFJ degeneration can occur with an implanted femoral component of a larger size.This in turn leads to the impingement of the component with the patellar cartilage. The progression of OA in the contralateral and / or patello-femoral department is objectified radiographically (phase projection with load / axial projection) with data for narrowing of the joint space and formation of osteophytes in the initial stage, which ultimately leads to the development of pain, subchondral sclerosis and deletion of the joint space in the non-prosthetic compartment (17).

In case of progression of the degenerative process in the opposite compartment of the knee, it is necessary to proceed to prosthetics of the newly affected OA department by bi- or three-compartmental prosthesis or by conversion of the primary UKA to TKA. (fig.3,4,5)

4. Polyethylene wear

Polyethylene wear is a complication that is more common in fixed platform UKAs (7). It leads to an increased amount of debris at the bone / implant border, leading to osteolysis, which is the basis for subsequent loosening of the components and degeneration of the non-prosthetic part of the knee. In addition, wear causes impaired alignment and reduced joint stability, which leads to an increased load between the bone and the implant, which further accelerates the loosening of the prosthesis.

The following factors related to the increased wear of polyethylene after UKA are indicated: incorrect positioning of the prosthetic components; insufficient correction of the existing preoperative deformation of the knee; use of polyethylene with a thickness of less than 6 mm; inaccuracies in the production process and methods of sterilization of polyethylene (7).

The introduction of UKA prostheses in the practice of modern designs and the improvement of the tools help to avoid the incorrect positioning of the components and the load on the edges of the resected surfaces, even for whom the UKA is performed through minimally invasive access. This in turn reduces polyethylene wear. Polyethylene thicker than 6 mm is used in UKA with a fixed platform, as well as cross-linking polyethylene in some fixed and mobile designs.

If a complication related to polyethylene wear occurs, insert replacement may be the first treatment of choice in these cases. Most often, however, the primary UKA is converted to TKA.(fig.6,7)

5. Periprosthetic infection

The incidence of infections after UKA is significantly lower than that after TKA, ranging from 0.2 to 1% (22). The low incidence of UKA infection is due to the fact that this procedure can be performed through minimally invasive access, with less damage to adjacent soft tissues, minimal bone resections and sparing of ligament structures.

In patients with acute infection after UKA, debridement is performed with subsequent rinsing and replacement of the insert. In case of non-response to the performed debridement or in case of chronic infections, resection of all components and subsequent one-stage or two-stage revision operation with primary or revision TKA is required.

6. Periprosthetic fracture

Periprosthetic fractures are rare but a serious complication of UKA. They are observed mostly around the tibial condyles. This is due to the increased pressure and load that is concentrated on the proximal tibia. If a tibial condylar fracture occurs, after UKA, it can be approached conservatively only if it is not displaced and there is a stable prosthetic component. Rarely, a periprosthetic fracture of the femoral condyle may occur. This complication can occur if the force acts directly on the femoral condyle or when the load on the distal femur is reduced.If the fracture is displaced and with deformation present, percutaneous osteosynthesis with cannulated screws or open repositioning and fixation with plaque should be performed in the case of a stable prosthesis. In case of non-healing of the fracture, displacement or loose components, the UKA should be converted in TKA.

7. Arthrofibrosis

The incidence of arthrofibrosis after UKA is much lower than after TKA, as it is a minimally invasive procedure that results in minimal damage to the extensor apparatus of the knee and the suprapatellar bursa (4). Modern designs and models of UKA prostheses significantly reduce the frequency of prosthesis impingement and / or impingement between the femoral component with the patella. Postoperative arthrofibrosis in UKA can be treated by redressing the knee joint under anesthesia, but arthroscopic removal of intra-articular fibrous tissue and existing adhesions are also often required.

8. Unexplained pain

Revision of a prosthetic knee joint due to unexplained knee pain is more common after UKA, as opposed to TKA (11). Common reasons for this can be: loose joint bodies, rupture of the meniscus and extrusion of cement. In addition, unexplained pain can be caused by things that the surgeon is unable to document. The revision of the UKA prosthesis due to unexplained pain is largely related to the surgeon's experience. This complication is more common in the UKA model with a fully polyethylene tibial component, in which there is an increased load on the proximal tibia, thus leading to permanent bone remodeling (5,18).

Surgical approaches after complicated UKA

Depending on the type, severity and consequences of the complications that have occurred after UKA, a revision operation can be undertaken, which usually consists of replacing the polyethylene insert, revising the entire UKA prosthesis or converting the UKA to TKA.

Replacement of the polyethylene insert can be performed in case of displacement (luxation) of the insert or its wear, but with the available stability of the prosthetic components and without severe osteolysis.

Revision of the components in UKA is performed with preserved ligament integrity and sufficient bone substrate. An important condition is that there are no signs of degenerative changes in the opposite compartment of the knee joint. Nevertheless, most of the failed UKA prostheses are converted to TKA (1).

The reasons for the conversion of UKA to TKA are: multiple luxation of a mobile bearing in a UKA model with a mobile platform; mechanical loosening of the components and related bone defect; visibly torn ACL; overcorrection of preoperative varus deformity in valgus and progression of OA in the opposite and / or patellofemoral region (20).

Conversion to TKA can be difficult, especially in septic audits (22). Preoperative planning is extremely important in view of the need for revision components, augments and even the presence of constrained prosthetic implants (13). The challenges we may face during the audit after a failed UKA are related to access to the joint; with the subsequent removal of the components; with bone defects present and with possible knee instability.

Access to the knee joint is usually standard parapatellar. In certain cases, mit-vastus or sub-vastus access may be performed, as well as osteotomy of tuberositas tibia if necessary, according to the surgeon's preferences.

Although components of the UKA can be easily removed with an osteotome or a thin saw, the surgeon must be careful during their removal while maintaining the available bone integrity. In the presence of a cementless prosthesis, the removal of a stable implant can lead to significant bone loss, while the removal of a loose implant usually preserves much more bone substrate. In the presence of a cement prosthesis, removal of the implants is easier due to the separation of the boundary between cement and metal.

If there are bone defects formed after UKA in the area of the resected surfaces, conversion to TKA may require revision implants, metal augments, bone grafts, and revision stems.
The reasons for bone loss after a failed UKA can be: metal-backed design UKA (compared to allpoly

tibia); wear osteolysis; periprosthetic infection; loosening with failure of prosthetic components; removal of components and / or cement; periprosthetic fracture; presence and sequential removal of a spacer in a two-stage septic audit.

In most cases of failed UKA, the residual femoral defects are usually small, requiring only autologous morselated bone grafts or cement. More commonly in failed UKA, bone loss is observed in the tibial region, due to most bone loss during primary resection (especially in metal-backed design UKA implants). In these cases of preoperative X-rays, we can calculate the extent of the defect and whether we will need a revision of the tibial implant with a stem and additional augments that will be able to deal with the available bone loss.

Medial-lateral stability in the coronal plane is usually preserved in a failed UKA. In these cases, a primary total knee prosthesis may be used, with or without preservation of the posterior cruciate ligament. In the presence of collateral ligament deficiency, soft tissue instability and inability to balance the joint space in flexion and extension, a more constrained prosthesis is needed.

Conclusions

Although the incidence of complications is significantly reduced in the latest generation of UKA prostheses, mobile inlay dislocation, polyethylene wear, mechanical loosening, and OA progression in the opposite compatment continue to affect the survival time of the modern partial knee arthroplasty. Converting UKA to TKA is a more complex procedure than primary TKA. Clinical and functional outcomes following a TKA revision in the event of a failed UKA were worse than those after primary total knee replacement. A primary implant can be used in the conversion of a failed UKA to TKA, however, the orthopedist must have a set of stems and augments available during each revision to be used if necessary, especially by the tibia.