TOTAL KNEE REPLACEMENT & KNEE ARTHRODESIS

PATIENT INFORMATION

PETER BREHM
Die Präzision in Titan
für den Menschen

Patient information

Dear patient,

This patient information brochure gives you general information about knee disorders and their treatment, including implantation of an artificial knee joint or a knee arthrodesis.

The patient information brochure is intended to supplement your personal consultation with your doctor and to help you get answers to your questions.

Contents

1. Knee disorders

- How is the knee structured?
- What happens in osteoarthritis of the knee?
- What conservative treatment options are there for osteoarthritis of the knee?

How is the knee structured?

The knee joint works similarly to a hinge and consists of the thigh bone (femur), the shin bone (tibia), and the kneecap (patella), all of which are covered with cartilage on their articular surfaces. The smaller calf bone (fibula) is not directly involved in the articular surfaces although it is the point of insertion of the lateral collateral ligament (Fig. 1).

We differentiate three parts of the joint where osteoarthritis can develop. The most important ones here are the articulation between the tibia and the femur (tibiofemoral articulation) and the articulation between the femur and the inner surface of the kneecap (patellofemoral joint).

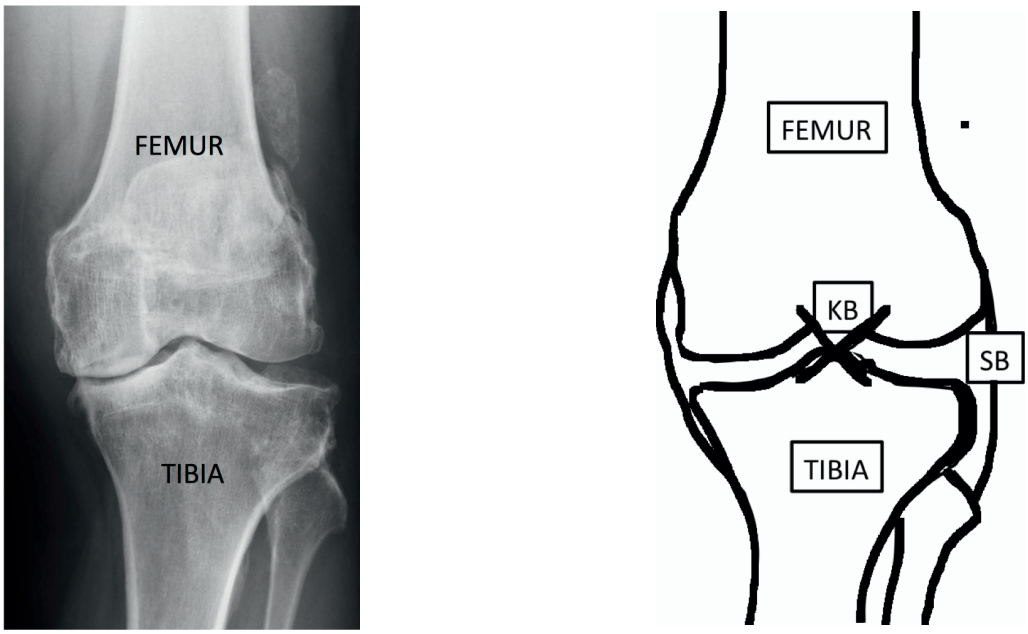

Fig. 1: Anatomy of the knee as shown on a radiograph (left) and in a schematic diagram (right). Abbreviations: CRL = cruciate ligament, CLL = collateral ligament (Courtesy of Kathi Thiele, MD, Charité, Berlin, Germany)

In addition to the main motions of flexion and extension, there are also rotational and gliding motions between the thigh and the lower leg. To compensate for the incongruent articular surfaces of the femur and tibia, two crescent-shaped disks of fibrocartilage (menisci) are located on the lateral and medial sides of the knee to provide a buffer between the cartilage-covered ends of the bones. The patella acts as a large fulcrum that allows adequate flexion and extension motion. The knee joint is stabilized by a complex system of ligaments consisting of the lateral and medial collateral ligaments as well as the anterior and posterior cruciate ligaments. The knee joint itself is enclosed in a dual-layer joint capsule; the inner capsule produces synovial fluid, while the outer capsule stabilizes the joint. The synovial fluid provides nutrients to the articular cartilage and reduces friction. Any damage to one or more of the structures of the knee joint can lead to joint degeneration, osteoarthritis.

What happens in osteoarthritis of the knee?

Injury to the joint as well as chronic overuse and abnormal stress can result in damage to the surface of the cartilage with progressive joint degeneration (osteoarthritis). Physicians refer to this joint degeneration as osteoarthritis of the knee. The human body is unable to replace the loss of cartilage. Angular deformities (Fig. 2) lead to rapid progression of the disorder. The membrane lining the joint, the synovium, becomes inflamed and produces excessive amounts of synovial fluid, leading to knee effusion.

The tension in the joint capsule leads to further symptoms and increasing pain, a condition occasionally referred to as "active osteoarthritis." The final stage of osteoarthritis can involve total loss of the cartilage with an angular deformity, impaired motion, and eventually stiffening of the joint. The initial pain on weight bearing is increasingly accompanied by pain at rest.

Osteoarthritis is typically characterized by "start-up pain": The first few steps after getting out of bed in the morning or sitting for a long time are difficult as the joint seems to be "rusted in place."

Fig. 2: Schematic diagram and radiographic image of a bow-leg deformity
(Courtesy of Kathi Thiele, MD, Charité, Berlin, Germany)

What conservative treatment options are there for osteoarthritis of the knee?

It is not possible to heal osteoarthritis with conservative treatment methods such as medication, physical therapy, or surgical interventions that spare the joint although an operation can often be avoided or the time of surgical intervention delayed. Treatment is tailored to the cause and severity (stage) of the osteoarthritis. In early stages of the disorder, strengthening the muscles possibly within the scope of physical therapy helps to relieve the diseased knee. Pain medications, orthopaedic shoe inserts, and reducing stress in daily life and in occupational settings are also recommended.

The cause of the degenerative process should be determined early to allow consideration of surgical corrections that spare the joint such as correction of the axis of the leg or cartilage replacement procedures.

The irritation to the membrane lining the joint, the synovium, and thus the pain it causes can be temporarily relieved with anti-inflammatory drugs and pain killers or by injections of cortisone into the joint. Another recently developed treatment option involves injections of hyaluronic acid preparations into joints damaged by osteoarthritis. Hyaluronic acid is a component of the synovial fluid and it lubricates the joint, acting as a shock absorber and inhibiting inflammation. The effectiveness of this method has been evaluated differently in different studies so that health insurers do not usually assume the costs of treatment.

The situation is similar with the so-called chondroprotective agents (glucosamine and chondroitin sulfate). They are thought to have a protective effect on articular cartilage although their long-term efficacy has not been definitively proven. Increasing pain and failure of conservative treatment and joint-sparing surgery to sufficiently reduce pain can be an indication for implanting an artificial knee.

2. Facts about knee implants

- What components constitute a knee implant?
- How long does an artificial knee joint or a knee arthrodesis currently last?
- What is meant by "cemented" and "cementless" in knee prothetics?
- How is the surgery for a knee implantation performed?

Surgical intervention should be considered where conservative therapies have failed. The following section includes a few observations about this situation.

What components constitute a knee implant?

The physician must select the best possible solution and therapy for the patient from the various available types of implants according to the type and severity of the disorder. A knee implant usually consists of the following components:

- Metal or ceramic tibial component (resurfaces the tibia)
- Metal or ceramic femoral component (resurfaces the femur)
- Metal stem extensions and coupling elements
- Plastic liner that reconstructs the joint space
- Less often, the articular surface of the kneecap (patella) is replaced with an additional plastic disk.
- Metal femur- and tibial components for stiffening of the knee joint

The most commonly used material for the femoral and tibial components is a cast cobalt-chrome alloy. The liners are usually made of UHMWPE (ultra high molecular weight polyethylene) or increasingly of highly cross-linked polyethylene (HXLPE). The polyethylene (PE) used in arthroplasty is a specially hardened plastic that shows very little wear or plastic deformation when interacting with the other articular surfaces.

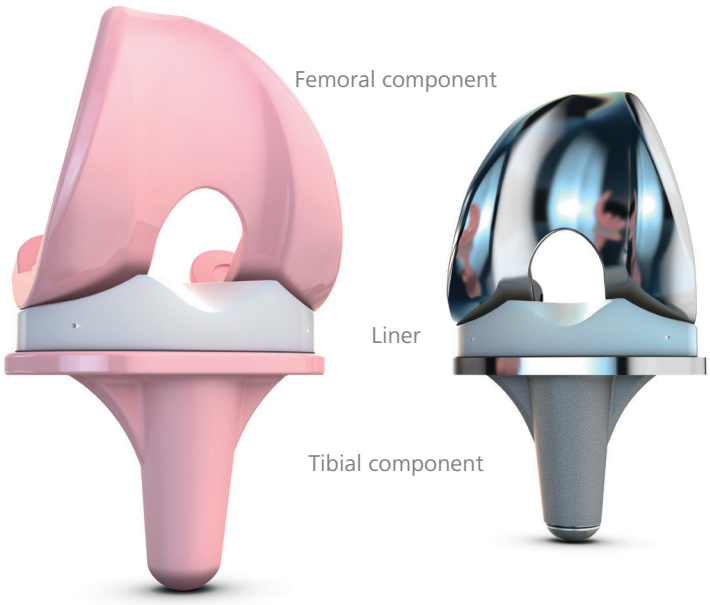

Fig. 3: Design of a primary total knee system
(examples: BPK-S Integration Ceramic and BPK-S Integration, PETER BREHM GmbH)

Patient information

The surgeon can choose between implant designs with varying degrees of constraint according to the severity of bone destruction and ligament damage. The higher the degree of constraint between the tibial and femoral components, the more the natural anatomic control of the knee is replaced by a mechanical coupling. Unconstrained (unlinked) implants (Fig. 3) are distinguished from semiconstrained (linked) implants (Fig. 4). Where only half of the articular surface is replaced, one refers to a unicondylar implant. The fundamental requirement for this treatment is that all the ligaments are intact. The bicondylar implant replaces the medial and lateral femoral condyles (the rounded articular surfaces) and the entire articular surface of the tibial head. This is the most commonly used implant type, as usually all articular surfaces are affected by osteoarthritis. In the presence of severe ligament damage (especially the posterior cruciate ligament), a special insert (posterior stabilized) or semiconstrained system may be required.

Semiconstrained implants are used where there is extremely severe joint destruction with damage to the ligaments and instability in the joint. The partial coupling of the femoral and tibial components ensures stable joint motion even in such cases.

Constrained implants (hinge joints) are used where the ligaments cannot provide sufficient stability in the joint. They are also often used in revision procedures to replace implants. In cases of very pronounced joint instability, usually with loss of extensibility of the knee joint, the stiffening of the knee is indicated. Special implants are used for this purpose with the help of which the thigh is fixed to the lower leg. The postoperative mobility of the knee joint is thus irreversibly excluded. The only alternative to arthrodesis is amputation of the lower leg.

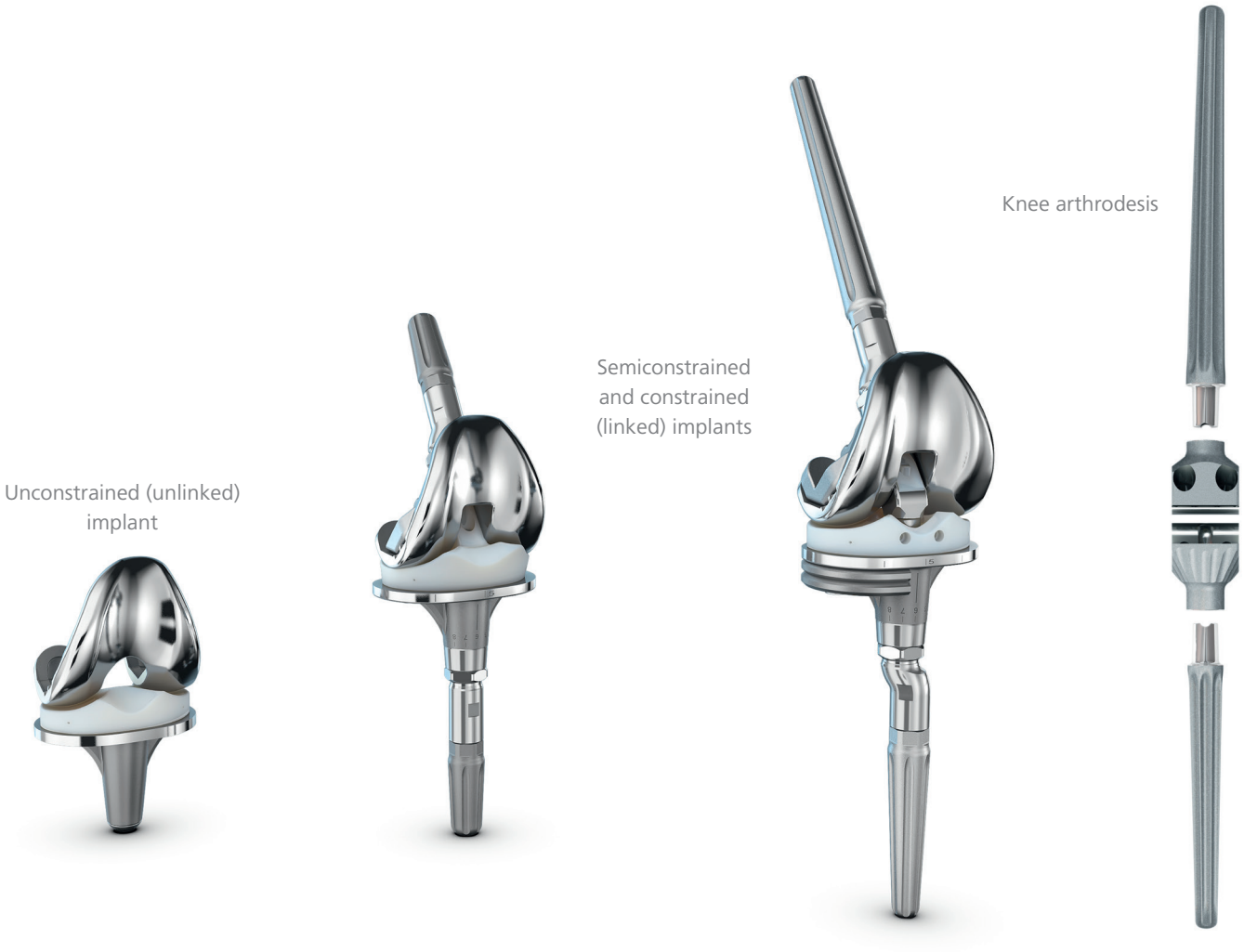

Fig. 4: Illustration of the respective implant design (example: BPK-S Integration knee system and KAM-TITAN, PETER BREHM GmbH)

How long does an artificial knee or a knee arthrodesis currently last?

The longevity of a knee implant depends on the following factors:

- Patient's age at the time of the first operation
- Duration and intensity of weight bearing
- Anatomy of the joint (deformity)
- Cause of joint degeneration
- Metabolic diseases of bone
- Quality of implantation
- Particulate wear with the release of particles from the implant

For these reasons it is not possible to predict exactly how long knee implants will last. Data from international patient registers confirm very good long-term function of knee implants. Eight out of ten knee joint replacements now last at least 25 years[1,2]. The durability of knee arthrodesis, on the other hand, is lower due to the severity of the treatment and handicaped mobility.

What is meant by "cemented" and "cementless" in knee prothetics?

In a cemented knee implant, a biologically compatible epoxy cement creates a resilient interface between the implant and the bone. This permits early weight bearing after surgery.

In a cementless knee implant, the interface between the implant and the bone is created solely by the shape of the implant (design, surface). The surgeon dissects the bone to optimize the implant bed for a perfect fit to the shape of the implant, ensuring implant longevity. However, the bone must grow into the surface of the implant after the operation. To facilitate this, the attending physician will often recommend several weeks of partial weight bearing in the operated leg.

The decision as to which type of implant is most suitable for you as the patient depends on many factors such as age, fitness, bone quality, anatomy, etc. and is determined on an individual basis in consultation between you and the attending physician.

How is the surgery for a knee implant performed?

The natural knee joint is usually opened with a medial skin incision. Once the joint has been opened, the worn out cartilage is removed and the bony structures are contoured for a perfect fit with the standardized metal implants. Navigation systems that allow precise positioning of the implants in difficult anatomic situations are also available. Depending on the specific implant design used, the implant is cemented in place or impacted without cement. After implantation the surgical wound is closed in layers, taking care to protect the knee extensors. When the operation has been completed, the proper position of the implant is verified by fluoroscopy.

1 Erfolgsstory: Hüft- und Knieprothesen halten länger als gedacht. Deutsche Gesellschaft für Endoprothetik e.V., März 2019, https://www.ae-germany.com/die-ae/presse/ae-pressemeldungen (German)

2 Evans JT, Walker RW, Evans JP et al.: How long does a knee replacement last? A systematic review and meta-analysis of case series and national registry reports with more than 15 years of follow-up. Lancet 2019; 393: 655-663

3. Before surgery

The decision in favor of an implant is not always an easy one to make; in spite of all advancements, it still brings with it certain changes in life. The following questions and answers may help to make the decision making process easier.

- Am I ready for a knee implant?
- I am overweight. Should I lose weight before undergoing knee surgery?
- Does smoking influence the course of the implant surgery?
- I have an allergy. What do I need to know about implant surgery?
- What kind of anesthesia is suitable for me?
- When is a blood transfusion required?
- How great is the risk of getting hepatitis or even HIV from implant surgery?
- What does a person with diabetes need to know about knee surgery?
- How does osteoporosis affect the longevity of the implant?

Am I ready for a knee implant?

Answer the following questions for yourself: If you end up with more positive answers, then you will benefit from implantation of an artificial knee joint.

- Does your knee pain significantly restrict you in your daily activities?
- Does your knee pain fail to improve significantly even when you take pain medication?
- Do you have knee pain not only during the day but also at night?
- Do you suffer from the side effects of pain medication taken regularly, such as nausea, stomach pain, and loss of appetite?
- Are alternate conservative treatments no longer successful to any relevant extent?

Positive answers and the presence of the following disorders should make you consider surgery:

- Osteoarthritis of the knee
- Rheumatic inflammation of the knee
- Osteonecrosis of the knee

The decision as to whether an implant is indicated and which type is most suitable for you as the patient depends on many factors and is determined on an individual basis in consultation between you and the attending physician.

I am overweight. Should I lose weight before undergoing knee surgery?

Weight loss is not absolutely required although it is very beneficial for your general physical well-being and the longevity of the implant. Excessive weight increases the risk of impaired wound healing or thrombosis. High body weight also increases the mechanical load on the implant. This can have a negative effect on the longevity of the implant.

The degree to which you are overweight can be calculated using the body mass index (BMI) according to the following formula: body weight in kilograms (kg) divided by the square of your height in meters (m). Values between about 18.5 and 25 kg/m² represent normal weight. Values between about 25 and 30 kg/m² are overweight. If the values are higher, then we refer to obesity. In such cases, dietary consulting and weight loss are recommended.

$$\text{BMI} = \frac{\text{weight (Kg)}}{\text{height x height (m)}}$$

Does smoking influence the course of the implant surgery?

Smoking negatively influences vascular perfusion and significantly slows wound healing. This can lead to dangerous wound infections. In the interest of an optimal surgical result, it would be advisable to quit smoking.

I have an allergy. What do I need to know about implant surgery?

In the initial consultation with the surgeon, you should mention all allergies you know of. Allergies to chrome or nickel lead to reddening or itching when the metal comes into contact with the skin. This can be caused by such things as costume jewelry or metal buttons. Special implants are available to the surgeon to minimize the risk of allergy. This means a suitable type of implant can be selected for you provided that your allergy and allergic predisposition are known. Finally, it should be mentioned that the influence of a metal allergy on the longevity of an implant is not yet fully understood.

What kind of anesthesia is suitable for me?

As a matter of course, the operation is performed under general anesthesia (injection of an intravenous anesthetic followed by an inhalation anesthetic administered with a mask) or under regional anesthesia (injection of anesthetic at the spinal cord; patient remains conscious). Which form of anesthesia is best for you is determined in a consultation with the anesthesiologist. Both types of anesthesia have proven effective in arthroplasty.

Additional available options you can discuss with your anesthesiologist include a catheter procedure or intraoperative local infiltration analgesia (LIA) in the knee for intraoperative and postoperative pain reduction.

When is a blood transfusion required?

A blood transfusion is performed when there is a deficiency of red blood cells (erythrocytes). These cells transport vital oxygen (O_2). If the quantity of red blood cells decreases (anemia), the risk of cell death from lack of oxygen increases. This can lead to deficient organ function. The heart, brain, kidneys, and liver are particularly vulnerable. The body's tolerance of an oxygen deficit depends among other things on preexisting underlying disorders and the patient's age. In general, the chance that a transfusion will be needed during initial implantation is very slight. However, a blood transfusion may be required in exceptional cases.

How great is the risk of getting hepatitis or even HIV from implant surgery?

Implant surgery itself cannot cause hepatitis (liver inflammation due to hepatitis viruses) or HIV infection. One possible transmission path is contact with donor blood such as from a transfusion of donor blood or injection of clotting factors. The processing of blood products is subject to a very strict procedure that includes careful testing of donors and blood products for viruses. A minimal risk remains nonetheless.

What does a person with diabetes need to know about knee surgery?

An operation represents a change in the rhythm of life and stress for the body which are associated with altered metabolism. These two factors usually lead to a slight temporary imbalance in the blood glucose level. Therefore you should adapt your insulin dose to your altered situation in consultation with your attending physician. If you are taking tablets to reduce blood glucose, ask your physician prior to surgery whether and to what extent your body will tolerate a transient increase in your blood glucose level. Diabetes medication must also be proportionately reduced or suspended prior to surgery.

Consult your attending physician before making any changes in your medication.

How does osteoporosis affect the longevity of the implant?

Osteoporosis means the amount of calcium salts in bone tissue is reduced, resulting in decreased stability. This increases the risk of fracture regardless of whether the patient has undergone surgery. Using a suitable surgical technique makes it possible to achieve secure fixation of the implant even in osteoporotic bone. There has not been any evidence of earlier implant loosening. However, take care to avoid falls and sports that put stress on the interfaces as fractures in the surrounding bone can occur.

4. Possible risks and complications in knee operations

- What is a knee implant infection?
- What is "aseptic" knee implant loosening?
- Is there a risk of a leg-length difference after implantation?
- What does the term "temporary arthrodesis" mean?
- When does a knee implant have to be replaced?
- What does the term "arthrofibrosis" mean?

What is a knee implant infection?

Another complication is an implant infection (bacterial infection). A distinction is made between early infections (within three weeks postoperatively) and late infections. These can even occur years later and often have an insidious onset. Pain, swelling, reddening of the skin, and prolonged secretions from acute wounds suggest an infection. Treatment requires lavage of the surgical wound, antibiotic therapy, or in the case of a persistent clinical course removal or replacement of the knee implant.

Therefore, you should inform the physician prior to surgery about any inflammation in the mouth, throat, nose, or ears and about any infection in the gastrointestinal tract. Fingernail and toenail injuries can also provide small entry portals for pathogens and require appropriate treatment prior to surgery and after the implant has been placed. Any loosening within the first three years invariably suggests the presence of an infection.

What is "aseptic" knee implant loosening?

The term "aseptic" means that no bacteria are involved in the loosening process of the implant that has been placed. In the case of a cemented implant, the cement mantle around the implant is usually broken and the metal no longer adheres securely to the bone. In cementless implants, there is no longer sufficient contact between the bony trabeculae (tiny bridge-like structures within the bone) and the metal. The implant shifts with every motion instead of being securely seated in the bone. A common reason for aseptic implant loosening is the increased particulate wear mentioned previously, which can occur with increased loading. The tiny particles set in motion an inflammatory cascade that in turn leads to loosening of the implant.

Is there a risk of a leg-length difference after implantation?

Modern digital planning modalities together with the preoperative radiographs (x-ray images) make it possible to select the implant that will fit perfectly. However, the preoperative leg length may have to change slightly in the interest of achieving optimal muscle tension and a perfect fit between the individual anatomy and the prefabricated implant. Larger leg-length differences can occur as a result of unilateral correction of bilateral angular deformities and are corrected by operating on the opposite leg. When an arthrodesis is implanted, a small amount of shortening is desired so that the leg with the joint fusion can swing freely.

What does the term "temporary arthrodesis" mean?

In a late infection, removal of the implant is often indicated. If the soft tissue permits it, removal of the infected implant can be followed by implantation of an implant consisting of antibiotic-impregnated bone cement or the joint can be temporarily immobilized (temporary arthrodesis). The underlying concept is that the infected joint is immobilized to allow the inflamed soft tissue to recover after surgical cleaning. In technical terms, the entire implant is removed and replaced with a cement spacer. This is necessary to counteract shrinkage of the joint capsule, which would severely limit the range of motion. The standard interval for this interim solution is usually six weeks. After the inflammation has resolved, a new implant can be placed. Usually an implant design with a higher degree of constraint is placed in order to compensate for the insufficiency of the capsular ligaments. In exceptional cases, the use of an arthrodesis for permanent joint stiffening may be necessary.

When does a knee implant have to be replaced?

Aseptic loosening as well as symptoms from other causes (such as instability or angular deformities) can make it necessary to replace the implant. This is usually possible in a single surgical intervention (single-stage implant replacement). In the case of implant infections, the physician determines whether the implant can be replaced in a single intervention or in two interventions with a temporary arthrodesis. This depends on the bacteria, sensitivity to antibiotics, and the condition of the soft tissue surrounding the knee joint. If it is no longer possible to change an arthrodesis, amputation of the lower leg is usually unavoidable.

What does the term "arthrofibrosis" mean?

This refers to postoperative scar formation in the joint with painfully restricted motion. In many cases the cause of this disorder is unknown. The physician must nonetheless exclude the presence of infection or a mechanical cause.

5. After surgery

- How will I manage in daily life after implant surgery?
- How do I protect myself against deep venous thrombosis after implant surgery?
- How long will I be hospitalized?
- What is an implant identification card?

How will I manage in daily life after implant surgery?

Soft-tissue-sparing surgical techniques and new implant designs allow early postoperative mobilization. In accordance with the specific pain control regime, the patient should be alert to possible postoperative weakness in the leg to minimize the risk of falling. On the first day postoperatively, you will begin under the supervision of a physical therapist to learn how to walk with two forearm crutches, how to get out of bed by yourself, and how to climb stairs. After your stay in the hospital, you can choose between outpatient physical therapy in the vicinity of your place of residence or a stay in a rehabilitation facility. An inpatient regime of range of motion training and muscle building at a special facility is often approved after a case review. The competent authority is the pension fund for gainfully employed persons, the workers' compensation association for victims of occupational accidents, and the health insurance fund for retirees.

The suitable treatment is decided on an individual basis and set in motion by the respective social worker during your stay at the facility. It is best to consult your physician (who will submit the rehabilitation application) and your health insurance fund (which will process the application) about this prior to or immediately after surgery. Inform yourself beforehand about the option of choosing a specific facility.

How do I protect myself against deep venous thrombosis after implant surgery?

Thrombosis is a vascular disorder in which blood clots develop within a blood vessel. To begin with, you should consult your family physician or the surgeon about your personal risk of developing thrombosis: Have you ever been diagnosed with thrombosis before? Are any risk factors present that may favor the development of thrombosis? Are you taking any medications that influence blood coagulation? Things such as compression stockings, leg muscle exercises, and special venous cuffs help to minimize the risk after surgery. Without full weight bearing, anticoagulant therapy in the form of injections or tablets must be continued postoperatively according to the attending physician's instructions.

Drink plenty of liquids unless the physician tells you something to the contrary due to a heart or kidney disorder. Some hospitals have a special department to determine the proper procedure for coagulation disorders.

How long will I be hospitalized?

The duration of hospitalization depends on the type of surgery, possible comorbidities (associated diseases), and the course of recuperation. Currently the average stay is seven to ten days, although it may well be shorter or longer. A longer hospital stay is required especially in the case of revision procedures to replace an implant.

What is an implant identification card?

An identification card is issued with every operation in which the patient receives an artificial implant. This implant identification card (Fig. 5) includes personal data as well as the date of surgery, the operated extremity, and the implant used. You can show this card at airport security checks with metal detectors. You should bring the identification card to every visit to a physician as it contains important information for the doctor.

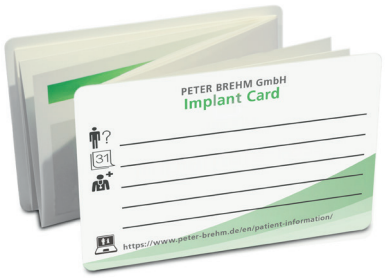

Fig. 5: Example of an implant identification card (PETER BREHM GmbH)

6. Living with an artificial knee or a knee arthrodesis

- Can I go back to work after knee implant surgery?
- Can I still participate in sports after knee implant surgery?
- Is sexual activity restricted after knee implant surgery?
- Will I be completely free of pain after knee implant surgery?
- Can I influence the longevity of the artificial knee or the knee arthordesis positively?

Can I go back to work after knee implant surgery?

The rule is that implanting a knee implant should improve the quality of life and therefore allow the patient to return to daily activity after surgery.

In the first twelve weeks after surgery you should avoid shock stresses, squatting or kneeling, compressive stresses, lifting or carrying heavy loads, and great exertion or rigorous physical work. Instead you should continue the familiar physical therapy exercise program after leaving the hospital. Then you can regain the ability to perform sedentary work and light physical tasks. The degree of weight bearing that is possible after implantation cannot usually be assessed before six weeks postoperatively.

You should no longer do any work on uneven terrain; physically demanding activities such as road work; or work that involves regularly standing on and climbing ladders, scaffolding, or roofs. Also avoid regularly working in a stooped or kneeling position or working in confined spaces with low ceilings. Driving a car or truck is possible in principle, although whether your joints and muscles will tolerate putting in a full eight hours of work is a question that must be decided on a case by case basis.
The limitations caused by arthrodesis are naturally greater than with an artificial joint.

Can I still participate in sports after knee implant surgery?

The scientific evidence regarding sports participation after knee implant surgery remains inconclusive. The crucial factor is your ability to participate in sports and your experience in the sport in question prior to surgery. The sports themselves are divided into low-impact and high-impact sports. The higher the load (high impact) on the implant, the greater the risk or implant loosening. Moderate, low-impact sports have a particularly beneficial effect. These include walking, bicycling, and swimming. Socalled power and contact sports (squash, tennis, and ball games) can lead to significantly higher mechanical stresses acting on the implant due to the abrupt acceleration and braking maneuvers they involve. This in turn can accelerate wear and tear, which is why these sports are generally not recommended. Jogging, skiing, martial arts, and most competitive sports can also shorten the life of the implant if practiced more intensively than at an amateur level.

As a result these sports, too, are viewed very critically. However, your attending physician will instruct you about specific options on an individual basis. Please avoid any sports that involve an increased risk of falling. The development of new implant designs and material matches in the articular surfaces has generally increased patients' ability to participate even in sports that involve greater peak stresses. An arthrodesis significantly limits their ability to play sports.

Is sexual activity restricted after knee implant surgery?

Intimate contact is also possible once the surgical wound has healed. In case of an artificial knee joint is implanted, avoid any knee motions that increase the risk of dislocation or cause pain, such as extreme flexion or rotation.

Will I be completely free of pain after knee implant surgery?

The artificial implant replaces the worn out parts of the knee joint, thus significantly reducing symptoms. The extent of the areas to be replaced depends on the degree of damage present. However, the implants also alter the natural anatomy and mechanics of the joint. For this reason it is not possible to guarantee that all symptoms will completely disappear in every case.

Can I influence the longevity of the implant positively?

The implant is subject to natural wear and tear which can make it necessary to replace the implant as the years go by. Your personal behavior can decisively influence the longevity of the implant. Avoid falls! Lifestyle and dietary habits influence bone metabolism and the mechanical load on the implant. Avoid sports with an increased risk of falling and sports that place excessive stresses on the joint. Talk to your physician about your personal risk.

Text: With the kind support of Kathi Thiele, MD (Charité Berlin, Germany)

Notes

! NOTE

The information about the products and/or procedures described in this brochure is of a general nature and does not represent the advice or recommendation of a physician. The information provided here does not in any way represent an opinion on the diagnosis or treatment of any specific medical case. The respective patient must be examined individually and advised accordingly. This brochure can neither completely nor partially substitute these measures.

The information contained in this brochure has been produced and compiled by medical experts and qualified PETER BREHM employees to the best of their knowledge. The greatest possible care has been taken to ensure that the information provided is correct and comprehensive.

PETER BREHM
Die Präzision in Titan
für den Menschen

PETER BREHM GmbH
Am Mühlberg 30
91085 Weisendorf
Germany

Telephone +49 9135 7103-0
Facsimile +49 9135 7103-16
info@peter-brehm.de

www.peter-brehm.de

Join us on

CE 0482

LBL101-30-20220105-EN