Knee osteoarthritis – from knee endoprosthesis to rehabilitation

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Abstract
The knee joint is a uniaxial joint that enables extension and flexion of the knee, playing a crucial role in walking, standing, and stabilization. It is susceptible to various injuries and degenerative changes, such as cartilage wear, leading to osteoarthritis. Older patients and those with metabolic disorders, obesity, and cardiovascular diseases are more prone to these issues. A damaged joint causes pain and restricted mobility, significantly diminishing the patient's quality of life. If conservative treatment is unsuccessful, surgical intervention, including the insertion of an endoprosthesis, is the optimal solution. Objectively assessing outcomes after total knee arthroplasty is essential for evaluating the effectiveness and success of treatment, including rehabilitation. Key words: Knee Arthrosis, Knee arthroplasty, Endoprosthesis, Rehabilitation

Osteoartritis kolena – od endoproteze kolena do rehabilitacije

Povzetek
Kolenski sklep je enoosni sklep, ki omogoča iztegovanje in upogibanje kolena ter igra pomembno vlogo pri hoji, stoji in stabilizaciji. Izpostavljen je številnim poškodbam in degenerativnim spremembam, kot so obraba hrustanca, kar vodi do artroze. Bolj so temu izpostavljeni starejši pacienti ter tisti s presnovnimi motnjami, debelostjo in srčno-žilnimi boleznimi. Poškodovan sklep povzroča bolečine in omejeno gibljivost, pri čemer kakovost življenja pacienta drastično upada. V primeru, da konzervativno zdravljenje ni uspešno, je kirurški poseg, vključno z vstavitvijo endoproteze, najboljša rešitev problema. Objektivno ocenjevanje izidov po totalni endoprotezi kolena je ključnega pomena za oceno učinkovitosti in uspešnosti zdravljenja, vključno z rehabilitacijo. Ključne besede: artroza kolena, artroplastika kolena, endoproteza, rehabilitacija

INTRODUCTION

The middle joint (knee joint) in our lower limb allows us to perform flexion and extension between tibia, femur and patella. It plays a key role in walking, standing, running – in our everyday acivities (Vaienti et al., 2017). However, the joint can be easely damaged, escpecially in older patients and those with genetical problems (Freemont and Hoyland, 2007) (Meng et al., 2019). When the joint is damaged, it causes a lot of pain and it limits patients movement. Quality of life drastically decreases, which is why knee arthroplasty is so commonly used-it reduces the pain and improves movement capabilities (Toguchi et al., 2020).

CONDITIONS LEADING TO KNEE ARTHROSIS

Many external and internal (genetic) factors influence the functioning of our body. For normal functioning, everything must be coordinated, otherwise there may be irregularities and, as a result, injuries or diseases occur. There are various diseases that can affect the knee joint.

Osteoarthritis is the most common joint disease of adults worlwide (Felson, 1988). It is a degenerative joint disease that affects millions of people. It primarily occurs due to the breakdown of cartilage, resulting in pain, stiffness, and reduced range of motion (Michael et al., 2010). The condition is firstly treated with physiotheraphy, paracetamol, reducing weight, non-steroidal anti-inflammatory drugs and intraarticular injections which can reduce the pain. When all treatments fail to provide relief, surgical procedures including arthroplasty, which involves the replacement of the damaged joint surface with an artificial implant, are performed (Kan et al., 2019).

Rheumatoid arthritis (RA) is the most common autoimmune disorder that can lead to chronic inflammation, joint and extra-articular organs damage, often affecting the knees (Conforti et al., 2021) (Jasvinder, 2022) Surgical treatment, which is used just in severe stages of RA, may involve the removal of inflamed tissue (synovectomy) or the use of knee arthroplasty to replace the damaged joint components (Bullock et al., 2018).

Injuries to the anterior cruciate ligament (ACL) and other knee ligaments are common among athletes and active individuals. Surgical reconstruction is often required to restore stability and function. Torn ligaments may be replaced with grafts (from the beginning of 20th century) (Satora et al.,2017), promoting healing and preventing future knee problems. In the 1980s the arthropscopy has been represented and it started a new revolutionary approach in healling of the ACL tear (D'Ambrosi et al., 2023).

Besides ligaments, meniscus can be injured too. The meniscus acts as a cushion in the knee joint, and tears in this structure are frequent. Depending on the location and severity of the tear, surgical intervention may involve meniscectomy (removal of the damaged portion) or meniscus repair to preserve the knee's stability. The healling is highly dependable on the type of tear (Beaufils and Pujol, 2017).

Patellofemoral syndrome is characterized by pain around the kneecap, which intensifies in flexion during weight bearing activities. Healing may require surgical realignment of the patella, but before that, patellar kinesiotaping, exercise therapies, nonsteroidal anti-inflammatory drugs and other methods are used to prevent the pain. Surgery is advised if other options fail (Heijden et al., 2015). Patellofemoral syndrome can also ocurre as a result of total knee arthroplasty (Laskin, 2008).

KNEE ENDOPROSTHESIS

Endoprosthesis, commonly known as joint replacement, is a surgical procedure designed to address joint problems by replacing damaged or diseased joint components with artificial implants. It can be used in the hip, knee, shoulder, elbow or other parts of the body. Knee endoprosthesis (knee arthroplasty) has become increasingly sophisticated over the years, offering improved longevity and better function for patients. Endoprostheses are made of various materials, including metal, plastic and ceramics (Jiao et al., 2021). Cobalt-Chromium Alloys are used in the femoral and tibial components due to their durability (Black, 1992). Titanium Alloys are biocompatible and lightweighted. Polyethylene is a type of plastic used for articulating surface of the tibia and patellar components. It is designed to reduce

wear on the oposing metal components. Bone cement (methyl methacrylate) is used to bond the prosthesis to the bone, providing stability and fixation (Chakravarty et al., 2015) (Meier et al., 2016).
Today, two types of procedure are most commonly performed; total knee arthroplasty (TKA) and partial knee arthroplasty (PKA). TKA is further divided into three categories, based on invasiveness of the procedure: the constrained type (extensive resection of bone is required, or if collateral ligaments are insufficient), the semi-constrained, partially stabilizing type (the amount of bone resection is lesser, collateral ligaments are partially sufficient) and the resurfacing type (if knee stability is preserved prior to the surgery, minimal bone resection is needed for implanting this type of prosthesis, collateral ligaments are sufficient) (Laskin, 2008). Resurfacing type is most commonly used in primary implantation of knee endoprothesis, whereas semi-constrained and constrained options are used in heavily damaged knees and in revision surgery.
Total Knee Arthroplasty (TKA) is commonly used to alleviate pain and improve the function of the knee joint in individuals who are experiencing severe knee problems. TKA is typically considered when conservative treatments, such as physical therapy, medication, and lifestyle modifications, have failed to provide sufficient relief from knee pain and functional limitations. Common indications for TKA include osteoarthritis, rheumatoid arthritis, post-traumatic arthritis, and other conditions that cause significant joint degeneration. During a TKA procedure, the surgeon makes an incision over the knee joint and removes the damaged or arthritic bone and cartilage. The femoral and tibial components of the artificial knee joint are then attached to the respective bones. These components are usually made of metal alloys. The undersurface of the kneecap (patella) may also be resurfaced with a polyethylene prosthetic components (Martin and Harris, 2023). The components are designed to mimic the natural knee joint's structure and function. The prosthetic components can be fixed to the bone using bone cement (methyl methacrylate) (Pitkin et al., 2013). The lifespan of a knee prosthesis varies but nowdays should last for several decades. Factors like the patient's age and implant material can influence the longevity of the prosthesis (Rand et al., 2003).
Partial Knee Arthroplasty (PKA), also known as unicompartmental knee arthroplasty (UKA) or partial knee replacement, is a surgical procedure used to replace only one part of the knee joint with an artificial implant, as opposed to replacing the entire knee joint in TKA. PKA is typically considered when the damage to the knee joint is confined to a single compartment of the knee, meaning that only one part of the knee joint is affected, while the other parts are relatively undamaged. The knee joint has three main compartments: the medial (inner), lateral (outer), and patellofemoral (between the kneecap and the thigh bone) compartments. During a partial knee arthroplasty, the surgeon makes a smaller incision compared to a TKA (Eustice, 2022). The damaged or arthritic portion of the knee joint, typically involving the femur and tibia or the patella, is replaced with a prosthesis – metal or plastic (Foran, 2021). The prosthesis can be either fixed with bone cement or implanted using press-fit techniques that encourage bone ingrowth (Martin and Harris, 2023).
PKA in comparison to TKA disturbes a smaller amount of bone and tissue. PKA is a more conservative procedure that spares healthy parts of the knee, which may lead to quicker recovery, less post-operative pain, and a smaller scar. The mechanics of the joint stay more simillar to undamaged knee (because only one part of the knee is replaced), the joint's natural movement and function are better preserved. The rehabilitaion process is faster (Foran, 2021).

BENEFITS OF KNEE ARTHROPLASTY

TKA provides patients with long term benefits from the surgery, with pain relief and improvement in stability and mobility of the joint. TKA effectively alleviates chronic knee pain and discomfort, allowing patients to return to a more active lifestyle. Knee endoprosthesis enhances joint function, restoring a wide range of motion and joint stability. Modern prosthetic components are designed to be durable, ensuring a longer lifespan for the replaced joint (Canovas and Dagneaux, 2018).

COMPLICATIONS DURING AND AFTER THE PROCEDURE

Just as any other surgical intervention, knee arthroplasty does not bring only good results, but it also brings some complications. While TKA is generally a safe and successful procedure, it carries potential

risks, including infection, blood clots, implant instability and loosening, nerve injury and persistent pain. It's important to discuss these risks with the surgeon and follow post-operative care instructions carefully. When PKA is made and if the disease progresses to other compartments in the future, conversion to a TKA may be necessary (Postler et al., 2018).

REHABILITATION INCLUDING STRENGTH AND PERFORMANCE-BASED FUNCTIONAL TESTS

Range of motion (ROM) and pain often define successful recovery after total knee arthroplasty (TKA) (Capin et al., 2022). The early postoperative period following TKA often includes a period of substantially reduced activity. Some postoperative protocols promote significant rest and carry strong warnings against too much activity during the first 2 weeks following TKA (Wickline, 2020). During early postoperative period, profound strength loss occurs throughout the lower extremities and especially in the quadriceps. Strength loss approaching or exceeding 50% occurs in both the quadriceps and hamstrings approximately 1 month after TKA (Mizner et al., 2005). However, clinical assessments and research studies should evaluate strength and function (using performance-based functional tests) in addition to the commonly used outcomes, knee range of motion (ROM) and perceived function and pain (ie, patient-reported outcomes [PROs]). These outcome measures provided within each category are not comprehensive but provide a framework for clinical evaluations and should be viewed as the "minimum dataset" rather than an all-encompassing list (Capin et al., 2022).

Several studies have reported the benefits of 4–8 weeks of preoperative rehabilitation before total knee arthroplasty (TKA) including improved knee muscle strength and reduced pre-operative knee pain (Cheshman and Shanmugan, 2017). In addition, postoperative pain was reduced by high-intensity strength training for 8 weeks before TKA (Calatayud et al., 2017). Additionally, a previous study reported that a 3-week resistance training program significantly increased lower body strength in healthy people. Ohno et al. (2022) found that 3-week preoperative training reduced knee pain and helped maintain physical activity after surgery in patients with severe osteoarthritis who underwent TKA. We emphasize the conclusions that preoperative rehabilitation could significantly shorten hospital stay, whereas there is not any conclusive evidence of the improvement of postoperative functions (Su et al., 2022). Accordingly, in-depth, a high-quality study should be conducted to confirm the effectiveness of preoperative rehabilitation in patients having received TKA. But there is an urgent need to deal with a long time waiting that may make the patient's muscle strength damage, reduce the range of motion, and have negative consequences for postoperative outcome (Schrorer et al., 2013). Additionally, preoperative weight loss protocols seem to be efficient strategy to optimize the post-recovery performance.

CONCLUSION

Knee problems can significantly affect a person's quality of life. When conservative treatments fail to provide relief, surgical solutions, such as knee arthroplasty, become essential for restoring function and reducing pain. It's crucial for patients to consult with orthopedic specialists to determine the most appropriate surgical intervention based on the nature and severity of their knee problems. Advances in medical technology and surgical techniques continue to improve outcomes, offering patients a chance to regain mobility and enjoy a higher quality of life even after facing challenging knee issues. TKA is a well-established and highly successful procedure that has improved the lives of countless individuals with severe knee joint problems.

The decision to undergo TKA should be made in consultation with an orthopedic surgeon, considering the patient's specific condition and needs. Partial knee arthroplasty is a valuable option for patients with localized knee joint damage. It allows for the preservation of healthy knee structures while addressing the specific area of degeneration or arthritis.

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