Hip osteoarthritis – from total hip endoprosthesis to rehabilitation

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Abstract
Osteoarthritis of the hip is a medical condition commonly present in elderly people. The condition, which occurs over time, includes the cartilage, which is present in the hip joint, to wear away. It becomes frayed and rough, resulting in minimal protective joint space, and increased friction and rubbing between acetabulum and femoral bone. This causes patients to experience daily pain, limiting them in their everyday activities. Osteoarthritis treatment includes patient education with teaching patients the importance of a healthy lifestyle, physical activity, and exercise. Other non-surgical treatments include pharmacological interventions (paracetamol and NSAIDs) and in selected cases intraarticular infiltrations. When all this is no longer effective, surgical relief of pain is recommended. Less invasive procedures include hip arthroscopy, hip biopsy, or simple core decompression (CD). The most invasive, but common and effective surgical treatment is total hip arthroplasty (THA), or hip replacement surgery. THA is a procedure during which the orthopaedic surgeon removes diseased or necrotic tissue from the hip joint and replaces it with artificial materials (hip endoprosthesis). The aim of THA procedure is to reduce pain and improve patient's mobility and quality of life. Keywords: Hip Osteoarthritis, Hip Endoprosthesis, Rehabilitation

Osteoartritis kolka – od totalne endoproteze kolka do rehabilitacije

Povzetek
Osteoartritis kolka je bolezen, ki je pogosto prisotna pri starejših ljudeh. Stanje, ki se pojavi sčasoma, vključuje obrabo hrustanca, ki je prisoten v kolčnem sklepu. Hrustančna struktura postane obrabljena in hrapava, kar povzroči minimalen zaščitni sklepni prostor ter povečano trenje in drgnjenje med acetabulumom in stegnenično kostjo. Zaradi tega bolniki doživljajo intenzivne bolečine, kar jih omejuje pri vsakodnevnih dejavnostih. Zdravljenje osteoartritisa vključuje izobraževanje bolnikov o pomenu zdravega načina življenja, telesne dejavnosti in gibanja. Druga nekirurška zdravljenja vključujejo farmakološke posege (paracetamol in NSAID) in v izbranih primerih intraartikularne infiltracije. Ko vse to ni več učinkovito, se priporoča kirurško lajšanje bolečin. Manj invazivni postopki vključujejo artroskopijo kolka, biopsijo kolka ali preprosto jedrno dekompresijo (CD). Najbolj invazivno, a pogosto in učinkovito kirurško zdravljenje je totalna artroplastika kolka (THA) ali operacija zamenjave kolka. THA je poseg, pri katerem ortoped odstrani obolelo ali nekrotično tkivo iz kolčnega sklepa in ga nadomesti z umetnimi materiali (endoproteza kolka). Cilj posega THA je zmanjšati bolečino in izboljšati bolnikovo mobilnost ter kakovost življenja. Ključne besede: Osteoartritis kolka, endoproteza kolka, rehabilitacija

INTRODUCTION - HIP OSTEOARTHRITIS

Osteoarthritis, or simply arthrosis, of the hip, is a medical condition that is commonly present in people over the age of 45. The condition occurs as day-to-day activities over time cause the cartilage, present in the hip joint, to wear away (Swiss Medical Network, 2023). During this process, the cartilage becomes frayed and rough, resulting in minimal protective joint space. The hip joint is a ball-and-socket joint, in which osteoarthritis can cause friction and rubbing between the acetabulum (socket part of hip joint) and femoral head (ball part of joint) (Foran, 2021). Such friction between the bones may also lead to bone spurs – bone growths on edges of the bone which cause a change in the bone's shape (Hopkins Medicine Org, 2023). Osteoarthritis causes patients to experience pain when engaging in daily activities, limiting them in their everyday lives. This causes patients to seek different types of orthopaedic treatment, in hopes of improving their quality of life. Ključne besede: Osteoartritis kolka, endoproteza kolka, rehabilitacija

NON-SURGICAL TREATMENT OF HIP OSTEOARTHRITIS

Osteoarthritis treatment has been changing over the past decades. This is a result of earlier diagnosis, patient education, and more in-depth knowledge of the biology of tissues involved. Patient education teaches patients and their families the importance of managing a healthy lifestyle, including physical activity, exercise, and weight loss. This can help the patient stay mobile, relieve pain, and reduce risk of other medical issues (Dunkin, 2023). Knowledge of hip joint tissues has been key in developing non-surgical treatments of hip osteoarthritis. Such treatments include infiltration of joint with either hyaluronic acid (viscosupplementation) or with platelet rich plasma which contains autologous growth factors (Innocenti et al., 2013). All said treatment is coupled with pharmacological interventions in the form of paracetamol and non-steroid anti-inflammatory drugs (NSAID). In cases where non-surgical treatment is no longer effective, surgical relief of pain is recommended (Poulsen et al., 2011).

SURGICAL TREATMENT OF HIP OSTEOARTHRITIS

Surgical treatments of hip osteoarthritis may be invasive, and they may delay the prosthetic hip replacement, which is an irreversible and final surgical solution. Less invasive procedures include hip arthroscopy, during which a surgeon creates a small incision at the joint area, through which they insert a narrow tube, attached to a fiber/optic video camera. This allows for the surgeon to view the inside of a patient’s joint on a monitor (Staff, 2022). Another possible procedure is hip biopsy or simple core decompression (CD). It is performed to decompress the femoral head in a condition called avascular necrosis. The latter is a condition where there is necrosis of bone components due to restriction of blood supply. If untreated, avascular necrosis causes osteoarthritis and bone collapse (Padmawar and Landge, 2021). It was, for many years, considered highly cost-effective, minimally invasive and had low complication rate in preventing THA. Nowadays, the procedure’s results are debated and controversial (Sadile et al., 2016).

SURGICAL TREATMENT OF HIP OSTEOARTHRITIS – TOTAL HIP ARTHROPLASTY (THA)

The most invasive, but common and effective surgical treatment method for osteoarthritis is total hip arthroplasty (THA), commonly referred to as hip replacement surgery. It is considered one of the most cost-effective and successful orthopaedic surgeries (Varacallo et al., 2017). THA is a procedure during which the orthopaedic surgeon removes diseased or necrotic tissue from the hip joint. This tissue includes bone, cartilage and surrounding muscle and fat tissue. The diseased parts of bone include femoral head and acetabulum, which are replaced with artificial materials, prosthesis. The aim of THA procedure is to reduce pain and improve patient's mobility and quality of life (Staff, 2022).

The hip endoprosthesis is made of two components: femoral and acetabular. Femoral component is nowadays made of two separate parts – a metallic stem and femoral head. Acetabular component is made of metal acetabular cup and acetabular interface (liner) (Baura, 2021). Endoprosthesis components may be composed of several different materials, each providing its own benefits and restrictions. Femoral stem is nowadays usually fabricated with stainless teel, titanium alloys or cobalt-chromium-molybdenum alloys (Merola and Affatato, 2019).

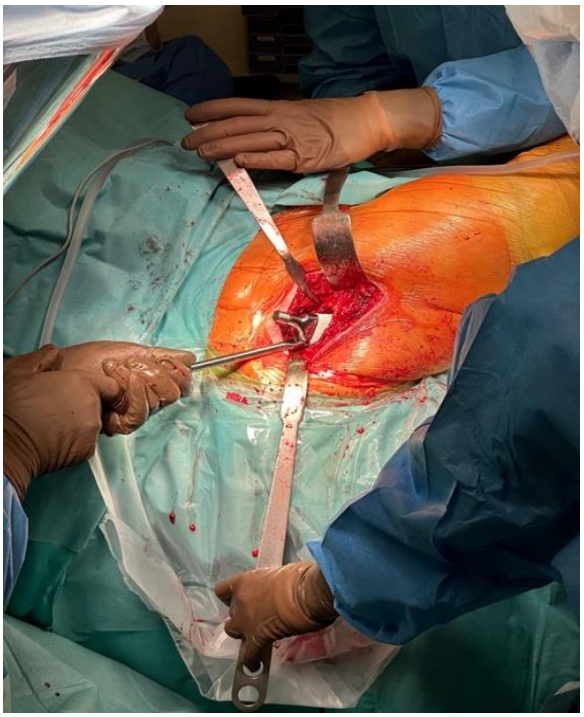
Cobalt-chromium (CoCr) alloy or aluminium alloy, while in the past it was also made from stainless steel (Baura, 2021). Prosthesis developments have, however, been largely targeted towards the articulating parts of prosthesis, the femoral head and acetabular component. In the past, femoral heads were mostly made from CoCr alloy, like the femoral stem, while acetabular cup was metal and its articulating interface either ultra-high molecular weight polyethylene (UHMWPE) (Gibon et al., 2013) or ceramic (Baura, 2021). Lately, in attempts to reduce friction and consequent particle debris formation, metal femoral heads have been replaced with either alumina and zirconia ceramics, and even a new material, oxidized zirconium. Ceramics demonstrated a reduction in friction and consequent longer prosthesis lifespan, but their toughness did not match that of metal. Still, they are the most used materials for femoral heads of hip endoprosthesis today (Salehi and Hunter, 2010).

There are three most common approaches for THA procedure (Varacallo et al., 2023). The most common approach for primary and revision cases is posterior approach. It includes blunt dissection of gluteus maximus muscle and sharp incision of fascia lata distally, avoiding hip abductors (Hyland, 2023). This approach is also favourable because of its good exposure of both acetabulum and femur, with the option for elongation of incision proximally or distally. However, some studies have cited higher dislocation rate in posterior approach compared to other surgical approaches (Varacallo et al., 2023). The second possible THA approach is the direct anterior (DA) approach, which is becoming increasingly popular. Its intermuscular interval is between tensor fascia lata and sartorius muscle superficially, and between gluteus medius and rectus femoris deep in the leg. The advantages of approach are the avoidance of hip abductors and reduced dislocation rates following surgery. However, its DA approach's reported disadvantages are increased wound complications, especially in obese patients, along with limited femoral exposure and risk of paraesthesia of lateral femoral cutaneous nerve (Varacallo et al., 2023). The least commonly used THA approach is the anterolateral or Watson-Jones approach. It utilises the intermuscular plane between tensor fascia lata and gluteus medius with a partial or complete detachment of anterior fibres of abductor muscles. In the past few years, incision or detachment of muscles or tendons has been avoided when performing THA (Lepri et al., 2020). The anterolateral approach theoretically offers decreased dislocation rate at the cost of postoperative limp (Varacallo et al., 2023).

Following incision and careful retraction of surrounding muscles, femoral neck osteotomy is performed. Usually, a reciprocating saw is used during this step, with the cutting beginning proximally to the lesser trochanter.

Osteotomy is continued in a proximal-lateral direction towards the base of the greater trochanter. Following neck osteotomy, soft tissue is removed (Varacallo et al., 2023). Retractors are then placed around the incision to provide acetabular visualization. Before acetabular component is placed, labrum (soft tissue surrounding hip joint) must be removed (Petis et al., 2015). This is done with a scalpel or an electrocautery. Then, acetabulum itself is prepared by reaming, starting with small-size machinery, gradually increasing sized for appropriate medialization of cup. This is demonstrated in Figure 1. Once sclerotic bone is removed and healthy bone is established, prosthetic acetabular component is inserted in a press-fit fashion. Then, corresponding liner is inserted (Varacallo et al., 2023). Then, the femoral canal is prepared for prosthesis insertion. This is done by broaches proximally and by cylindrical reamers distally. Both parts of the femoral endoprosthesis component are then inserted into the femur, which is demonstrated in Figure 2 (Fye et al., 1998).

Figure 1: Surgeon reaming acetabular cup. Source: author's own archive.



Prosthesis components may either be "press fit" into the bone, allowing it to grow around prosthesis, or they may be cemented into the bone. The quality and strength of patient's bone is a factor in choosing the right fixation method (Baura, 2021).

Acetabular and femoral components of the hip prosthesis may also be made from several different materials, such as metal alloys and different ceramics. The materials which these prostheses are made of should be biocompatible and enable long-term survivability of the implant, which is the surgery's main goal (Gibon et al., 2013).

Figure 2: Surgeon inserting femoral stem component of hip endoprosthesis. Source: Author's own archive.

REHABILITATION AFTER TOTAL HIP ARTHROPLASTY (THA)

Osteoarthritis and subsequent total hip arthroplasty (THA) lead to damages to hip joint mechanoceptors, which in turns lead to impairments in proprioception. One of the abilities mainly affected by an altered joint proprioception is balance. Balance and proprioception show impairments up to 5years after THA, increasing the risk of falls. However, patients with THA may benefit of an adequate balance training. Further research is needed to investigate the gaps in balance and proprioception assessment and training following THA surgery (Labanca et al., 2021). Moreover, balance and proprioceptive deficits are frequently persistent after total joint replacement, limiting functionality and involving altered movement patterns and difficulties in walking and maintaining postural control among patients. Domínguez-Navarro et al. (2018) showed that, in clinical terms, balance trainings are a convenient complement to conventional physiotherapy care to produce an impact on balance and functionality after knee replacement. If outcomes such as improvement in pain, knee range of movement, or patient quality of life are to be promoted, it would be advisable to explore alternative proposals specifically targeting rehabilitation goals.

Progressive resistance training (PRT) is one of the most used exercise methods after joint replacement, while its effectiveness and safety are still controversial. Therefore, it's vital to investigate the effect of PRT on muscle strength and functional capacity early postoperative total hip arthroplasty (THA) or total knee arthroplasty (TKA). Chen et al. (2021) concluded that PRT is one of the options for rapid rehabilitation after joint replacement.

Although traditional postoperative rehabilitation for TKR and THR patients improves patient's gait effectively, it is time- and energy-consuming. It is also difficult to maintain consistency of training intensity among different patients. Rehabilitation using innovative technologies – such as eHealth, telemedicine, wearables, virtual reality, and online education tools – are being applied on a trial basis in clinical trials (Christensen et al, 2013). Among these technologies, a type of wearable consisting of a robotic support structure is being tested. Robotic devices are suited to make intensive, task-oriented motor training for moving the patient's limbs, supervised by physical therapists, with a promising approach to rehabilitation and reducing the burden on caregivers (Calafiore et al., 2021; Bhardwaj et al., 2021) Lower limbs robot-assisted training has become of particularly interest as it can effectively resolve the problems traditional rehabilitation currently faces. Yo et al. (2022) suggested that RAR may be an effective treatment in TKR and THR patients. However, high-quality studies are needed to verify the long-term effects.

Early initiation of rehabilitation following total hip arthroplasty, total knee arthroplasty, or unicompartmental knee arthroplasty is associated with a shorter length of hospital stay, a lower overall cost, with no evidence of an increased number of adverse reactions. Additionally, high quality studies with standardized methodology are needed to further examine the impact of early initiation of physical therapy among patients with joint replacement procedures (Masaracchio et al., 2017).

PATIENT SATISFACTION FOLLOWING TOTAL HIP ARTHROPLASTY (THA)

In the recent years, there has been an increase in the number of both older and younger orthopaedic patients seeking surgical treatment. This is possibly due to the increasing number of sports injuries, as well as higher life standards patients wanting to perform everyday activities without limitations. Additionally, with increasing life expectancy, the world population is aging. As the incidence of hip osteoarthritis generally increases with age, this is leading to a higher demand for surgical intervention. This presents an increased burden on healthcare resources and hospital budgets (Nemes et al., 2014). Indications for THA have thus recently been expanded to include younger patients who are usually more active and recover more easily than older patients. Because of this, postsurgical activity levels and their return to sports are expected to increase, therefore also improving patient satisfaction post-surgery Fujita et al., 2022).

As patient satisfaction is an essential indicator in measuring the quality of care, several studies have attempted to measure patient satisfaction immediately and, in the years, following total hip arthroplasty (Varacallo et al., 2018; Okafor and Chen, 2019; Freudenberger et al., 2018). Said procedure is supposed to help with decreasing pain and improving motor function, patient mobility and quality of life [26].

Freudenberger et al (2018) cited almost 60% of THA patients being highly satisfied with their hospital experience (a rating of 9 or 10 out of 10) (Freudenberger et al., 2018). Varacallo et al. (2018) reported 78% of interviewed patients 2-4 years after surgery perceived their replaced hip as “native”, and 54% reported uninhibited function of replaced joint (Varacallo et al., 2018). Okafor and Chen (2019) found that older patients may experience greater post-operative, which might be due to their lower expectations of pain relief after having lived with the joint disease for years.

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