

UPOTREBA IMPLANTA SA DIZAJNOM ROTIRAJUĆE ŠARKE U REVIZIONOJ TOTALNOJ ARTROPLASTICI KOLENA

PRIKAZ SLUČAJA

CASE REPORT

THE USE OF ROTATING HINGE KNEE PROSTHESIS IN REVISION TOTAL KNEE ARTHROPLASTY

Danilo Jeremić^{1,2}, Želimir Jovanović^{1,3}, Branislav Krivokapić^{1,2},
Draško Vasović^{1,2}, Boris Zekić¹, Nikola Žarković^{1,2}

¹ Institut za ortopediju „Banjica“, Beograd, Srbija

² Univerzitet u Beogradu, Medicinski fakultet, Beograd, Srbija

³ Univerzitet u Banjoj Luci, Medicinski fakultet, Banja Luka, Bosna i Hercegovina

¹ Institute for Orthopedic Surgery “Banjica”, Belgrade, Serbia

² University of Belgrade, Faculty of Medicine, Belgrade, Serbia

³ University of Banja Luka, Faculty of Medicine, Banja Luka, Bosnia and Herzegovina

SAŽETAK

Uvod: Broj totalnih artroplastika kolena pokazuje rastući trend u svim svetskim ortopedskim centrima. Iako totalna artroplastika kolena pokazuje odličnu stopu dugoročnog preživljavanja, ne iznenađuje činjenica da će, imajući u vidu produženje životnog veka i sve stariju populaciju sa većim brojem komorbiditeta, i učestalost revizionih artroplastika kolena takođe rasti. Česte indikacije za reviziju totalne artroplastike kolena predstavljaju aseptično razlabavljenje i periprotetski prelomi.

Prikazi slučajeva: Pacijentkinja starosti 60 godina javila se u našu ustanovu zbog tegoba u vidu bola i nestabilnosti desnog kolena. Primarna artroplastika urađena je u drugoj ustanovi pre 9 godina. Radiografska evaluacija pokazala je aseptično razlabavljenje komponenti totalne endoproteze kolena, sa utonućem tibijalne komponente u varusnoj poziciji. Pacijentkinja starosti 73 godine primljena je u našu ustanovu zbog povrede levog kolena nastale usled pada na ravnoj podlozi, 5 dana pre prijema. Primarna artroplastika urađena je pre 14 godina u našoj ustanovi. Trauma RTG snimci povređenog kolena ukazali su na Lewis tip IIB periprotetski prelom tibijalnog platoa. Kod obe pacijentkinje urađena je revizionna artroplastika koristeći implantat povećane stabilnosti sa dizajnom rotacione šarke. Postoperativni oporavak protekao je uspešno u oba slučaja. Radiografije kolena pokazale su adekvatnu poziciju implanta nakon perioda praćenja od 2 godine.

Zaključak: Upotreba implanta povećane stabilnosti sa dizajnom rotacione šarke u revizionoj artroplastici kolena pokazuje ohrabrujuće rezultate i ishode, naročito u slučajevima gde postoji značajan gubitak koštane mase, kao i ligamentarna nestabilnost.

Ključne reči: revizionna totalna artroplastika kolena, implant povećane stabilnosti sa dizajnom rotacione šarke, aseptično razlabavljenje, periprotetski prelomi kolena

ABSTRACT

Introduction: The number of total knee arthroplasty (TKA) procedures shows a growing trend in orthopedic hospitals worldwide. Although TKA has an excellent long-term survival rate, it is not surprising that, given the increased life expectancy and aging population with a more significant number of comorbidities, the frequency of revision TKA will also rise. Common indications for revision TKA represent aseptic loosening and periprosthetic fractures.

Case reports: A 60-year-old female patient presented to our hospital with complaints of pain and instability of her right knee, accompanied by decreased range of motion. Primary TKA was performed in another institution nine years ago. Radiographic evaluation demonstrated aseptic loosening of TKA components, with subsidence of the tibial component into varus malposition. A 73-year-old female patient was admitted to our Hospital because of an injury to her left knee resulting from a fall from a standing height that happened five days before the presentation. Primary TKA was performed 14 years ago in our Hospital. A trauma X-ray series of the injured knee revealed a Lewis type IIB periprosthetic fracture of the tibial plateau. In both patients, revision TKA was performed using a rotating hinge implant with augmentation of the tibial defect caused by loosening in the first case and fracture in the second case. Postoperative recovery was successful in both cases, with radiographic imaging showing adequate position of the implant at 2-year follow-up.

Conclusion: The use of rotating hinge knee prostheses in revision total knee arthroplasty demonstrates promising outcomes, particularly in cases involving significant bone loss and instability.

Keywords: revision total knee arthroplasty, rotating hinge knee, aseptic loosening, knee periprosthetic fracture

Autor za korespondenciju:
Nikola Žarković
Institut za ortopediju „Banjica“
Mihaila Avramovića 28, 11000 Beograd, Srbija
Elektronska adresa: nikola0605081998@gmail.com

Corresponding author:
Nikola Žarković
Institute for Orthopedic Surgery “Banjica”
28 Mihaila Avramovića Street, 11000 Belgrade, Serbia
E-mail: nikola0605081998@gmail.com

Primljeno • Received: March 23, 2025;

Revidirano • Revised: April 21, 2025;

Prihvaćeno • Accepted: June 10, 2025;

Online first: June 25, 2025

DOI: 10.5937/smcl6-57724

UVOD

Broj totalnih artroplastika kolena (TKA) pokazuje trend rasta u ortopedskim bolnicama širom sveta. Očekuje se da će se u Sjedinjenim Američkim Državama broj pacijenata koji se podvrgavaju TKA povećati sedam puta u periodu od 2004. do 2030. godine [1]. Iako TKA ima odličnu dugoročnu stopu preživljavanja - neke studije pokazuju da ona iznosi 89–96% u intervalu od 15 godina - nije iznenađujuće što će, s obzirom na produženje životnog veka i starenje populacije sa sve većim brojem komorbiditeta, učestalost revizionih TKA takođe rasti [2,3]. Više studija je ispitivalo epidemiološke aspekte revizionih TKA i otkrilo da su najčešće indikacije aseptično labavljenje, periprotetska infekcija zgloba (PJI), nestabilnost, patelofemoralne komplikacije i periprotetske frakture kolena [4,5].

Pored PJI i nestabilnosti, aseptično labavljenje predstavlja jedan od najčešćih razloga za reviziju kolenskih proteza. Ono je multifaktorijalne etiologije, a pretpostavljeni faktori rizika koji imaju ključnu ulogu u patogenetskim mehanizmima labavljenja komponenti proteze uključuju neuspeh u fiksaciji cementa (posebno na interfejsu cement-kost), osteolizu usled reakcije histiocitnih ćelija na habanje polietilena, malpoziciju komponenti, upotrebu ograničenih dizajna proteza i neadekvatan napon mekih tkiva i ligamenata [6].

Za razliku od aseptičnog labavljenja, periprotetske frakture predstavljaju retku indikaciju za revizionu TKA. Njihova učestalost se kreće od 0,3% do 5,5%, pri čemu su frakture distalnog femura češće od fraktura proksimalne tibije [7]. Međutim, neke studije prikazuju jednaku učestalost fraktura i na femoralnoj i na tibijalnoj strani, sa stopama od 0,3% do 2,5% za femur i od 0,4% do 1,7% za tibiju [8]. Felix i saradnici razvili su najčešće korišćeni sistem klasifikacije periprotetskih fraktura proksimalne tibije, koji ima izuzetnu kliničku vrednost jer usmerava i olakšava izbor plana lečenja [9].

Revizionu TKA karakterišu veliki izazovi za ortopedске hirurge. Najvažnija pitanja koja treba rešiti tokom operacije uključuju poravnanje komponenti, nivo zglobne linije, neusaglašenost između ekstenziona i fleksiona faze, kao i biomehaniku patelofemoralnog zgloba i aparata za ekstenziju. Obimni gubitak kosti i nestabilnost u frontalnoj i sagitalnoj ravni često zahtevaju upotrebu ograničenih, šarki dizajna implantata sa metalnim augmentima i stemovima koji se fiksiraju pod pritiskom ili cementiraju [10].

Ova serija slučajeva prikazuje dva primera u kojima je revizionu TKA bila indikovana zbog aseptičnog labavljenja i periprotetske frakture tibije, a u kojima je revizionu proceduru izvedena korišćenjem NexGen® Rotirajuće Šarke Kolena (Zimmer Biomet, Warsaw, Indiana, Sjedinjene Američke Države).

INTRODUCTION

The number of total knee arthroplasty (TKA) procedures shows a growing trend in orthopedic hospitals worldwide. It is expected that in the United States, the number of patients undergoing TKA will increase sevenfold from 2004 to 2030 [1]. Although TKA has a great to excellent long-term survival rate, with some studies demonstrating this rate to be 89–96% in 15-year interval, it is not surprising that, given the increased life expectancy and aging population with a more significant number of comorbidities, the frequency of revision TKA will also rise [2,3]. Several studies have examined the epidemiological aspects of revision TKA. They discovered that the most common indications are aseptic loosening, periprosthetic joint infection (PJI), instability, patellofemoral complications, and periprosthetic knee fractures [4,5].

Alongside PJI and instability, aseptic loosening is one of the most common reasons for revision of knee arthroplasties. It is multifactorial in origin, and presumed risk factors that have a crucial role in pathogenetic pathways of prosthesis component loosening include failure of cement fixation (at the cement-bone interface in particular), osteolysis due to the response of histiocytic cells to polyethylene wear, component malalignment, use of constrained prosthetic designs, and improper soft tissue and ligament tension [6].

Unlike aseptic loosening, periprosthetic fractures represent a rare indication for revision TKA. Their prevalence ranges from 0.3% to 5.5%, with distal femur fractures being more common than proximal tibia fractures [7]. However, some studies demonstrate an equal occurrence of fractures on the femoral and tibial sides, with rates ranging from 0.3% to 2.5% on the femoral side and from 0.4% to 1.7% on the tibial side, respectively [8]. Felix et al. developed the most frequently used classification system for proximal tibial periprosthetic fractures, which has excellent clinical value because it guides and facilitates the choice of treatment plan [9].

Revision TKA represents a great challenge for orthopedic surgeons. The most critical issues that should be addressed during surgery include component alignment, joint line level, extension-flexion gap mismatch, and the biomechanics of the patellofemoral joint and extensor apparatus. Extensive bone loss and instability in both the coronal and sagittal planes often necessitate the use of a constrained, hinged implant design with metal augments and press-fit or cemented stem extensions [10].

This case series demonstrates two cases in which revision TKA was indicated due to aseptic loosening and periprosthetic tibia fracture, in which the revision procedure was performed using NexGen® Rotating Hinge Knee (Zimmer Biomet, Warsaw, Indiana, United States).

PRIKAZI SLUČAJEVA

Slučaj 1

Pacijentkinja stara 60 godina javila se u našu ustanovu zbog bolova i nestabilnosti desnog kolena, praćenih smanjenim obimom pokreta i otežanim hodanjem. Primarna TKA urađena je u drugoj ustanovi pre devet godina zbog primarnog osteoartritisa kolena. Prvi simptomi su se pojavili tri godine pre dolaska, a značajno su se pogoršali tokom poslednjih nekoliko meseci, ozbiljno narušavajući sposobnost obavljanja svakodnevnih aktivnosti (ADL). Pacijentkinja nije imala značajnu medicinsku anamnezu povezanu sa trenutnim problemom kolena.

Tokom kliničkog pregleda uočili smo antalgijski i nestabilan obrazac hoda, karakterisan varusnim trzajem i deformitetom hiper-ekstenzije (recurvatum). Hodanje je bilo onemogućeno bez korišćenja pomoćnih sredstava (štike) u obe ruke. Pri inspekciji, dok je pacijentkinja bila udobno smeštena na pregledu, uočeno je blago oticanje desnog kolena, koje je bilo u varus položaju. Na prednjem delu desnog kolena nalazio se stari, zarastao hirurški ožiljak, bez znakova zapaljenja. Aktivni obim pokreta (ROM) iznosio je 0–90°, dok je pasivni ROM bio -10–100°, sa 10° hiperekstenzije. Prisustvo nestabilnosti kolena potvrđeno je varus stres testom, koji je pokazao značajno otvaranje sa lateralne strane. Vaskularni i neurološki status desne noge bio je očuvan. Na kraju fizičkog pregleda izmereni su klinički i funkcionalni skorovi Američkog društva za koleno (Knee Society Scores – KSS), koji su iznosili 35 i 27.

Radiološka procena obuhvatila je standardnu seriju rendgenskih snimaka desnog kolena (Slika 1). Ante-

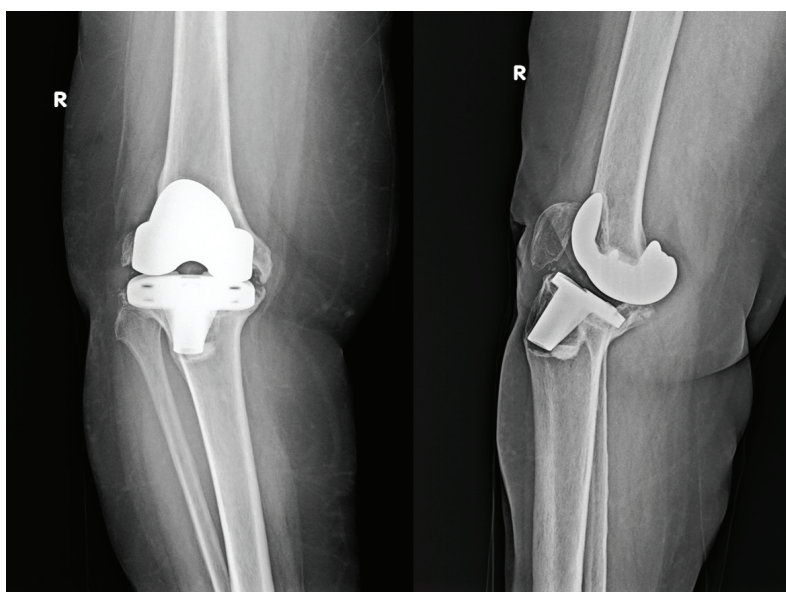
CASE REPORTS

Case 1

A 60-year-old female patient presented to our hospital with complaints of pain and instability of her right knee, accompanied by decreased range of motion and difficulty walking. Primary TKA was performed in another institution nine years ago because of primary knee osteoarthritis. The first symptoms appeared three years before presentation, and they worsened significantly throughout the last couple of months, interfering significantly with the performance of activities of daily living (ADL). The patient did not report any other notable medical history related to the current knee problem.

During the physical examination, we initially observed an antalgic and unstable gait pattern, characterized by varus thrust and recurvatum deformity. Ambulation was impossible without assistive devices (crutches) in both arms. Upon inspection, with the patient comfortably positioned on the examination bed, we found minor swelling in the right knee, which was in varus alignment. There was an old, healed surgical scar on the anterior aspect of the right knee, with no signs of inflammation. The active range of motion (ROM) was 0–90°, and the passive ROM was -10–100°, with 10° of hyperextension. The finding of knee instability was confirmed while performing a varus stress test, which demonstrated a significant opening on the lateral side. The vascular and neurologic status of the right leg was intact. We obtained clinical and functional American Knee Society Scores (KSS) at the end of the physical exam, which were 35 and 27, respectively.

The radiologic assessment included a standard X-ray series of the right knee (Figure 1). AP and lateral views



Slika 1. Preoperativni AP i profilni snimak desnog kolena pacijentkinje starosti 60 godina koji pokazuje aseptično razlabavljenje totalne endoproteze kolena, sa teškom malpozicijom tibijalne komponente u varusu i femoralne komponente u ekstenziju

Figure 1. Preoperative right knee AP and lateral view of 60-year old female patient suffering from aseptic loosening of total knee prosthesis, with severe malposition of tibial component into varus and femoral component into extension

roposteriorni (AP) i bočni prikazi pokazali su ozbiljno labavljenje komponenti, sa radiolucenim zonama širim od 5 mm oko i tibijalne i femoralne komponente. Tibijalna komponenta je potonula u varus položaj, a vrh tibijalnog nastavka gotovo da je probijao lateralni plato. Na bočnom snimku se uočavala femoralna komponenta u položaju ekstenzije i značajno povećanje zadnjeg nagiba tibije.

Uzimajući u obzir kliničke nalaze (teška, dvosmerna nestabilnost) i očekivani gubitak kosti vidljiv na radiografiji kolena, odlučili smo da izvedemo revizionu TKA sa implantatom u obliku rotirajuće šarke. Nakon razgovora sa pacijentkinjom o terapijskim opcijama, mogućim komplikacijama i postoperativnim funkcionalnim očekivanjima, dobijena je informisana saglasnost. Pacijentkinja je primljena u bolnicu dan pre planirane operacije. Profilaksa protiv tromboembolije (niskomolekularni heparin – LMWH) započeta je dan pre operacije i nastavljena tokom pet nedelja. Imajući u vidu višu učestalost periprotetskih infekcija nakon revizije TKA, antibiotska terapija (cefazolin) uvedena je preoperativno i nastavljena tokom pet dana posle operacije.

Nakon standardne preoperativne pripreme operativnog polja i u uslovima opšte anestezije, izveden je longitudinalni rez na prednjoj strani desnog kolena, prateći stari hirurški ožiljak. S obzirom na očekivano produženo trajanje operacije, odlučeno je da se revizionu TKA izvede bez naduvavanja pneumatske manžetne. Nakon disekcije mekih tkiva, urađena je standardna medijalna parapatelarna artrotomija i otvorena je zglobna šupljina. U početku su uklonjena fibrotična ožiljna tkiva i priraslice iz suprapatelarnog džepa, kao i iz medijalnih i lateralnih kanala. Zglobna tečnost i uzorci tkiva poslati su na mikrobiološku analizu za intraoperativnu (ekstemporalnu) biopsiju, kako bi se isključilo prisustvo patogenih bakterija.

Nakon oslobađanja mekih tkiva, Homan retraktori su postavljeni posteriorno, što je omogućilo luksaciju kolenske proteze. Zatim je započeto uklanjanje olabavljenih komponenti proteze. Polietilenski umetak uklonjen je pomoću specijalnog ekstraktora. Femoralna komponenta je razdvojena na spoju komponenta-cement upotrebom uskih osteotoma i recipročne testere, uz izuzetnu pažnju da se izbegne jatrogeno oštećenje kosti. Ekstrakcija femoralne komponente završena je korišćenjem tzv. „slap hammer” alata. Tibijalna komponenta je uklonjena na sličan način pomoću recipročne testere.

Nakon procene gubitka kosti i stabilnosti ligamentata, pristupilo se pripremi intramedularnog kanala tibije korišćenjem reamera sa postepenim povećanjem prečnika. Tibijalna površina je resecirana kako bi se izravnala i omogućilo postavljanje trabekularnog bloka pune veličine (10 mm) i augmenta polubloka (5 mm)

demonstrated severe component loosening, with more than 5 mm of radiolucent zones surrounding both the tibial and femoral components. The tibial component subsided into a varus position, with the tip of the tibial keel nearly protruding through the lateral plateau. The lateral view also showed a femoral component in the extended position and a significant increase in posterior tibial slope.

Given the clinical findings (severe, bidirectional instability) and the expected bone loss evident on knee radiographs, we decided to perform a revision TKA with a rotating hinge knee implant. We obtained informed consent after discussing treatment options, possible complications, and postoperative functional expectations with the patient. The patient was admitted to the Hospital one day before the planned surgery. Thromboembolic prophylactic therapy (low molecular weight heparin, LMWH) was started one day before the surgery and continued for five weeks. Given the higher incidence of periprosthetic joint infection after revision TKA, antibiotic treatment (cefazolin) was started preoperatively and continued for five days after surgery.

After standard preoperative preparation of the surgical field, under the conditions of general anesthesia, a longitudinal incision was made in the anterior aspect of the right knee following the old surgical scar. Given the expected prolonged surgical time, we decided to perform a revision TKA without inflating the tourniquet. After soft tissue dissection, standard medial parapatellar arthrotomy was done, and the joint space was revealed. Initially, we removed the fibrotic scar tissue and adhesions from the suprapatellar pouch and medial and lateral gutters. Joint aspiration fluid and tissue samples were sent to the microbiology department for extempore biopsy to check for the possible presence of pathogenic bacteria. After soft tissue release, Homan retractors were placed posteriorly, allowing for the luxation of the knee prosthesis. We then began by extracting the loosened prosthesis components. The polyethylene insert was removed using a special extractor. The femoral component was then detached at the component-cement interface using narrow osteotomes and a reciprocating saw, with extreme care being taken to avoid any iatrogenic bone loss. Extraction of the femoral component was completed with the use of a slap hammer. The tibial component was removed in a similar fashion using a reciprocating saw.

After assessing bone loss and ligamentous stability, we proceeded with preparing the medullary canal of the tibia using reamers of progressively increasing diameter. A tibial recut was made to flatten the surface of the tibial plateau and allow the accommodation of a trabecular whole block (size 10 mm) and a half block augment (size 5 mm), which was placed medially. After

koji je postavljen medijalno. Nakon izbora odgovarajuće veličine tibijalne platforme i određivanja njene pozicije, započeta je priprema distalnog femura. Intramedularni kanal femura reamiran je istom tehnikom kao kod tibije. Procena veličine i rotacije femoralne komponente izvršena je uzimajući u obzir mediolateralni prečnik izmeren između epikondila. Probna femoralna komponenta je postavljena i izvršeno je balansiranje fleksionog i ekstenzionog razmaka.

Zbog preoperativno prisutnog recurvatum deformiteta, jedan od imperativa bio je postavljanje femoralne komponente distalnije, što je zahtevalo upotrebu distalnih augmenata. Neusklađenost između fleksije i ekstenzije rešena je posteriornim augmentima na femuru. Pored pravilnog poravnanja i stabilnosti u ekstenziji i fleksiji, procenjen je i nivo zglobove linije korišćenjem dostupnih anatomske repera, kao što su medijalni i lateralni epikondil, kao i patela.

Nakon probnog postavljanja komponenti, verifikovani su kinematika kolena i stabilnost kroz puni obim pokreta. Potom je turniket naduvan, a koštane površine očišćene pulsirajućim ispiranjem. Cement je apliciran u intramedularne kanale tibije i femura, a konačne komponente su postavljene. Nakon očvršćavanja cementa, postavljen je završni polietilenski umetak i montiran je mehanizam šarke. Rana je potom temeljno isprana i zatvorena po anatomske slojevima.

Rehabilitacija je započeta prvog postoperativnog dana, u skladu sa protokolima bolnice. Rana mobilizacija uključivala je pasivne i aktivne vežbe obima pokreta radi poboljšanja fleksibilnosti i smanjenja ukočenosti zgloba. Puna težinska opterećenja bila su dozvoljena u skladu sa tolerancijom pacijenta, uz korišćenje pomoćnih sredstava poput štaka ili hodalice radi stabilnosti pri hodu. Postizanje adekvatnog obima fleksije kolena bilo je prioritet, što je podsticano korišćenjem uređaja za kontinuirani pasivni pokret (CPM), koji je bio podešen na unapred određenu brzinu i obim, uz postepeno prilagođavanje u skladu sa tolerancijom i napretkom pacijenta.

Postepeno su uključene vežbe za jačanje kvadricepsa, zadnje lože i okolne muskulature kako bi se podržala stabilnost i funkcija zgloba. Takođe, edukacija pacijenta je uključivala savete o svakodnevnim aktivnostima i strategijama za zaštitu zgloba radi optimizacije funkcionalnog oporavka. Rehabilitacioni plan bio je individualno prilagođen potrebama svakog pacijenta, uz blisko kliničko praćenje radi prepoznavanja eventualnih komplikacija i postizanja optimalnih rezultata.

Postoperativni tok bio je uredan, bez komplikacija, i pacijentkinja je otpuštena iz bolnice petog postoperativnog dana. Prva postoperativna kontrola zakazana je mesec dana nakon operacije, kada je pacijentkinja prikazala značajno poboljšan obrazac hoda i izraženo povećanje

selecting the appropriate size of the tibial platform and determining its position, we prepared the distal femur. We began by reaming the medullary canal, following the same procedure as for the tibia. We then assessed the size and rotation of the femoral component, taking into account the mediolateral diameter calculated from the trans-epicondylar distance. We then placed the trial femoral component and performed balancing of flexion and extension gaps.

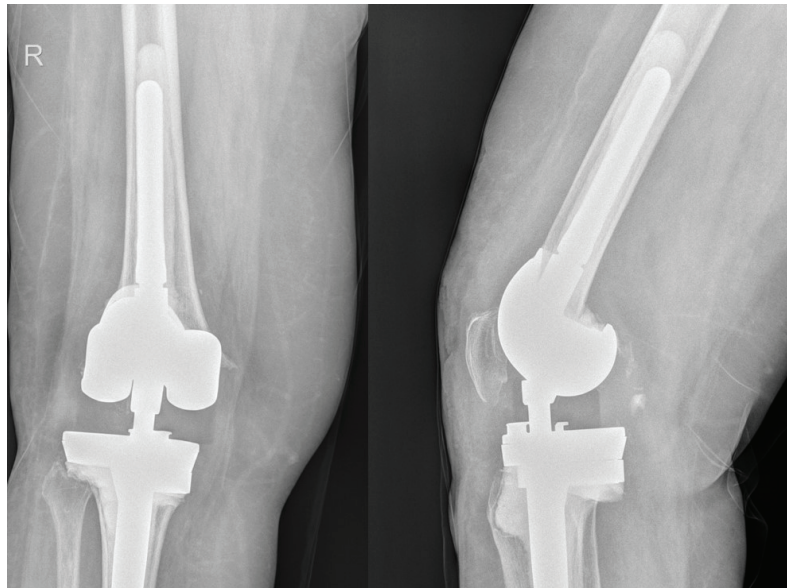
Given the preoperative recurvatum deformity, one of the imperatives was to put the femoral component more distally, which necessitated the use of distal augments. The resultant flexion-extension gap mismatch was solved with posterior femoral augments. Besides proper alignment and stability in extension and flexion, the joint line level was assessed using available anatomic landmarks, such as the medial and lateral epicondyles and the patella.

After trial reduction, knee kinematics and stability were verified through a full range of motion. The tourniquet was then inflated, and bone surfaces were cleaned with a pulsatile lavage system. Cement was applied into the medullary canals of the tibia and femur, and final components were placed. Once the cement was cured, the final polyethylene insert was inserted, and the hinge post mechanism was assembled. The wound was then thoroughly irrigated and sutured following the anatomic layers.

Rehabilitation began on the first postoperative day, following the hospital's protocols. Early mobilization included passive and active range-of-motion exercises to promote flexibility and reduce joint stiffness. Full weight-bearing was permitted as tolerated, with patients using assistive devices such as crutches or a walker to ensure stability during ambulation. Achieving an adequate range of knee flexion was a priority, reinforced through the use of a continuous passive motion (CPM) apparatus, typically set at a predetermined speed and range and adjusted gradually based on patient tolerance and progress.

Gradual progression of strengthening exercises targeting the quadriceps, hamstrings, and surrounding musculature was initiated to support joint stability and function. Additionally, patient education emphasized activities of daily living and joint protection strategies to optimize functional recovery. The rehabilitation plan was tailored to meet the individual needs of each patient, with close clinical monitoring to address any complications and facilitate optimal outcomes.

The postoperative course was uneventful, and the patient was discharged from the Hospital on the 5th postoperative day. The first postoperative control was scheduled one month after surgery, and the patient



Slika 2. Postoperativni AP i profilni snimak iste pacijentkinje učinjen na kontrolnom pregledu 2 godine nakon operacije, koji pokazuje urednu poziciju proteze, bez znakova razlabavljenja

Figure 2. Postoperative AP and lateral views of the same patient at 2-year follow-up, showing no signs of component malalignment or loosening

obima pokreta desnog kolena. Praćenje je nastavljeno dve godine, a pri poslednjoj kontroli pacijentkinja je u potpunosti povratila normalnu funkcionalnost bez ikakvih simptoma. Ovo poboljšanje je dodatno potvrđeno kliničkim i funkcionalnim KSS skorovima, koji su iznosili 88 i 95. Kontrolne radiografije su pokazale dobro postavljene komponente TKA bez znakova labavljenja (Slika 2).

Slučaj 2

Pacijentkinja stara 73 godine primljena je u našu bolnicu zbog povrede levog kolena nastale usled pada sa visine stajanja, koja se dogodila pet dana pre javljanja. Glavna tegoba bila je bol u levom kolenu prilikom pokušaja oslanjanja na nogu. Primarna TKA urađena je pre 14 godina u našoj ustanovi. Fokusiranim fizikalnim pregledom u urgentnoj jedinici utvrđeno je prisustvo izraženog otoka i deformiteta levog kolena, dok je pokretljivost kolena bila ograničena zbog bola. Na prednjoj strani levog kolena uočen je stari hirurški ožiljak. Nisu zapažene kožne promene niti poremećaji lokalnog vaskularnog i neurološkog statusa.

Urađena je trauma serija rendgenskih snimaka povređenog kolena. Prikazana je periprotetska fraktura tibijalne ploče, tip IIB, prema klasifikaciji koju su predložili Lewis i saradnici (fraktura koja zahvata celu proksimalnu tibiju uz labavljenje tibijalne komponente) (Slika 3). Tibijalna komponenta je propala u varus položaj, a njen vrh je probio kroz anterolateralnu korteksu proksimalne metafize tibije. Na bočnom snimku uočen je drastično povećan tibijalni nagib.

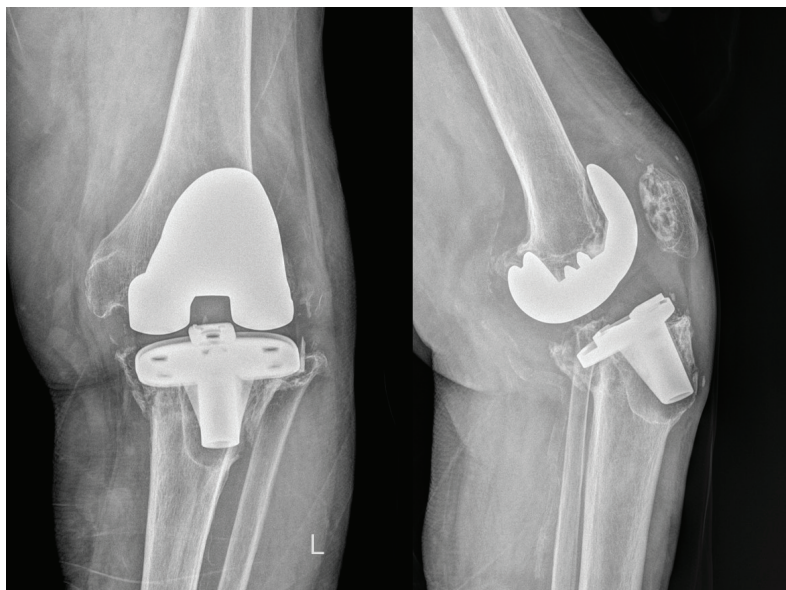
Zbog otkaza tibijalne komponente izazvanog periprotetskom frakturom, odlučeno je da se uradi revi-

presented with a significantly improved gait pattern and a notable increase in right knee range of motion. Follow-up continued for two years, and at the last visit, the patient returned entirely to normal functional status and was free of any symptoms. This improvement was further confirmed with clinical and functional KSS, which measured 88 and 95, respectively. Control radiographs confirmed well-positioned TKA components without signs of loosening (Figure 2).

Case 2

A 73-year-old female patient was admitted to our hospital because of an injury to her left knee that resulted from a fall from a standing height that happened five days before the presentation. Her chief complaint is pain in the left knee in an attempt to bear weight. Primary TKA was performed 14 years ago in our Hospital. A focused physical examination at the Emergency Unit revealed significant swelling and deformity of the left knee, with movement of the left knee inhibited by pain. An old surgical scar was inspected on the front aspect of the left knee. There were no skin lesions or disturbance of local vascular and neurologic status.

A trauma X-ray series of the injured knee was obtained. They demonstrated a periprosthetic fracture of the tibial plateau, type IIB, according to the classification system proposed by Lewis et al. (fracture spanning across the entire proximal tibia with tibial component loosening) (Figure 3). The tibial component subsided into a varus position, with its tip protruding through the anterolateral cortex of the proximal tibial metaphysis. The lateral view also demonstrated a drastically increased tibial slope.



Slika 3. Preoperativni AP i profilni snimak levog kolena pacijentkinje starosti 73 godine koji pokazuje periprotetski prelom proksimalne tibije nakon pada na ravnoj podlozi

Figure 3. Preoperative left knee AP and lateral view of 73-year old female patient who suffered from proximal tibia periprosthetic fracture following fall from standing height

ziona TKA uz primenu implantata sa rotirajućom šarkom (RHK). Nakon dobijanja informisanog pristanka pacijentkinje, sprovedena je preoperativna priprema. Primijenjen je isti protokol za tromboembolijsku i antibiotsku profilaksu, s obzirom na složenost operacije i visok rizik od komplikacija u ovoj starosnoj grupi.

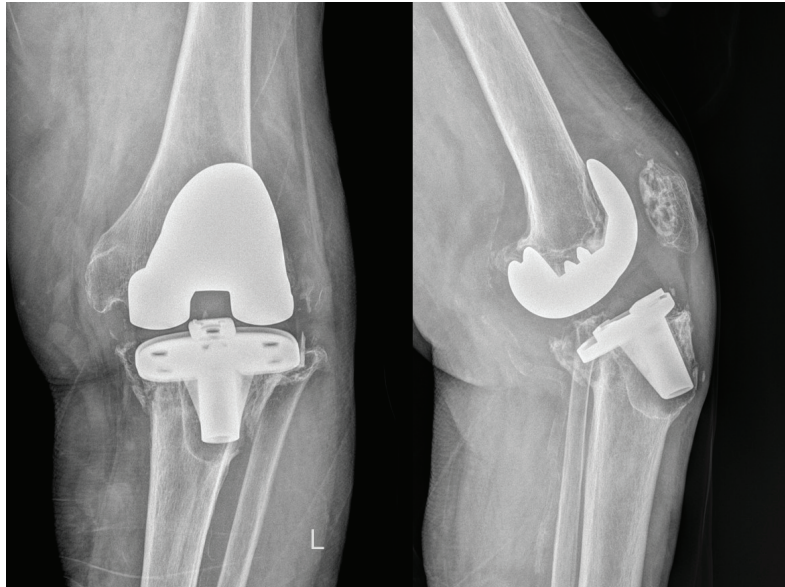
Hirurški zahvat izveden je u opštoj anesteziji. U dogovoru sa anesteziologom, odlučeno je da se koristi "Cell Saver" aparat za prikupljanje i obradu aspirirane krvi, koja se potom vraćala pacijentkinji, imajući u vidu očekivani gubitak krvi tokom intervencije. Hirurška tehnika se ni u jednom aspektu nije razlikovala od one primenjene u prvom slučaju. Posebna pažnja posvećena je ekstrakciji tibijalne komponente, kako bi se očuvalo što više kosti. Zbog obrasca preloma i lošeg kvaliteta kosti, bilo je neophodno resecirati deo proksimalne tibije kako bi se došlo do zdravog koštanog tkiva koje bi omogućilo pravilno postavljanje tibijalne komponente.

Radi rešavanja problema sa nivoom zglobove linije i očekivane labavosti u ekstenzionom i fleksionom razmaku, odlučeno je da se tibija augmentira trabekularnim blokom pune veličine od 10 mm. Takođe je bila neophodna i revizija femoralne komponente, kako bi se obezbedio prostor za veliki okvir potreban za smeštaj mehanizma šarke. Priprema femura zahtevala je upotrebu distalnih i posteriornih augmenata. Dugme patele je uklonjeno zbog znakova istrošenosti, a s obzirom na loš kvalitet preostale kosti, odlučeno je da se ne ugrađuje nova komponenta patele.

Primijenjen je identičan protokol rehabilitacije kao i u prethodnom slučaju, s tim što puna težinska opte-

Given the failure of the tibial component caused by a periprosthetic fracture, we decided to perform a revision TKA again using an RHK implant. We obtained informed consent and proceeded with the preoperative preparation. The same protocol for thromboembolic and antibiotic prophylactic therapy was followed, given the complexity of surgical treatment and the high risk of complications in this age group. The procedure was performed under general anesthesia. After consultation with the attending anesthesiologist, we decided to use a Cell Saver machine to collect and process the aspirated blood and then return it to the patient due to the expected blood loss during the surgery. The surgical technique did not differ in any aspect from the first case. Special care was taken during the extraction of the tibial component to preserve as much bone as possible. Given the fracture pattern and poor bone quality, we had to resect part of the proximal tibia to reach good-quality bone that would allow for proper seating of the tibial component. To resolve the problem with the joint line level and the expected loose extension and flexion gap, we again decided to augment the tibia with the 10 mm whole block trabecular augment. A revision of the femoral component was also required to accommodate the large box necessary to seat the hinge mechanism. Femoral preparation also necessitated the use of distal and posterior augments. The patellar button was removed due to evidence of wear, and we did not want to pursue implanting another button, given the poor quality of the remaining bone.

The identical rehabilitation protocol was followed in this case, except that full weight-bearing was not



Slika 4. Postoperativni AP i profilni snimak iste pacijentkinje učinjen na kontrolnom pregledu godine nakon operacije, koji pokazuje urednu poziciju proteze, bez znakova razlabavljenja

Figure 4. Postoperative AP and lateral views of the same patient at 2-year follow-up, showing no signs of component malalignment or loosening

rećenja nisu bila dozvoljena tokom prve tri postoperativne nedelje. Pacijentkinja je otpuštena iz bolnice sedmog postoperativnog dana i vraćena na redovnu kontrolu mesec dana nakon operacije, sa zadovoljavajućim rezultatima. Kontrolni rendgenski snimak levog kolena, urađen dve godine nakon operacije, pokazao je dobro postavljene komponente bez znakova otkaza implantata (Slika 4).

Informisani pristanak za objavljivanje ovih slučajeva dobijen je od pacijentkinja, u skladu sa etičkim standardima.

DISKUSIJA

Lečenje kompleksnih revizija TKA i dalje predstavlja veliki izazov u ortopedskoj hirurgiji, naročito kada se radi o slučajevima sa značajnim gubitkom kosti, ligamentarnom nestabilnošću ili prethodnim višestrukim operacijama. U takvim situacijama, tradicionalne proteze sa fiksnim ležištem ili polu-konzervativne proteze kolena možda neće obezbediti potrebnu funkcionalnu stabilnost i opseg pokreta. Ova serija slučajeva prikazuje primenu proteza sa rotirajućom šarkom kao održivo rešenje kod revizionih TKA intervencija kod pacijenata sa navedenim komplikacijama.

Proteze sa rotirajućom šarkom nude više prednosti u poređenju sa konvencionalnim dizajnima, prvenstveno zbog svoje urođene stabilnosti i prilagodljivosti kompromitovanim anatomskim uslovima. Ove proteze imaju mehanizam rotacije koji omogućava prošireni opseg pokreta, smanjuje mehanička uklještenja i poboljšava dinamiku fleksije i ekstenzije. Ovo može biti posebno korisno u revizionim slučajevima kod kojih je

allowed for the first three postoperative weeks. The patient was discharged from the Hospital after seven days and returned for regular control one month after the surgery with satisfactory results. The control X-ray of the left knee, taken 2 years after surgery, showed well-positioned components with no signs of implant failure (Figure 4). Informed consent was obtained from the patients for the publication of their cases, in accordance with ethical standards.

DISCUSSION

The management of complex revisions in TKA remains a formidable challenge in orthopedic surgery, particularly when addressing issues such as significant bone loss, ligamentous instability, or multiple prior surgeries. In these scenarios, traditional fixed-bearing or semi-constrained knee prostheses may not provide the necessary functional stability and range of motion. This case series highlights the application of rotating hinge knee prostheses as a viable solution in revision TKA for patients experiencing these complications.

Rotating hinge prostheses offer several advantages over conventional designs, primarily due to their inherent stability and adaptability to anatomical conditions that are compromised. The design features a rotating mechanism that allows for an enhanced range of motion, reduces impingement, and facilitates better flexion-extension dynamics. This can be particularly beneficial in revision cases where the integrity of the soft tissue envelope is compromised, allowing for more predictable outcomes and improved patient satisfaction [11,12]. Our findings are consistent with previous

narušena integritet mekih tkiva, jer omogućava predvidljivije ishode i povećano zadovoljstvo pacijenata [11,12]. Naši nalazi su u skladu sa prethodnom literaturom, koja takođe ukazuje na poboljšane funkcionalne rezultate i stabilnost implantata kod sličnih grupa pacijenata [13,14].

Naša serija slučajeva je pokazala zadovoljavajuće kliničke ishode, uključujući smanjenje bola i poboljšanje funkcionalnih rezultata, što se poklapa sa postojećom literaturom koja podržava primenu rotirajućih šarki u sličnim revizionim situacijama [15]. Posebno značajno jeste uključivanje procene pacijenata putem subjektivnih pokazatelja (PROMs), što je naglasilo važnost procene ne samo kliničkih parametara, već i percipiranog kvaliteta života nakon operacije. Upoređivanje naših rezultata sa prethodnim istraživanjima naglašava kliničku važnost rotirajućih šarki u postizanju balansa između stabilnosti i pokretljivosti u složenim revizionim slučajevima.

Međutim, upotreba rotirajućih šarki nije bez izazova. Potrebna je složenija hirurška tehnika, postoji povećan rizik od komplikacija kao što su infekcije i labavljenje komponenti, a neophodno je i pažljivo preoperativno planiranje i procena. Rizici uključuju mehanički otkaz (npr. dislokaciju šarke ili frakturu), aseptično labavljenje i infekciju – sve to može negativno uticati na ishod i zahtevati dodatne operacije. Strategije za smanjenje tih rizika uključuju pažljiv odabir kandidata, detaljnu procenu kvaliteta kostiju i interdisciplinarnu saradnju radi optimalnog perioperativnog vođenja [15]. Prepoznavanje ovih potencijalnih ograničenja u skladu je sa nalazima iz literature, koja ističe da dugoročna izdržljivost ovih proteza ostaje oblast za dalja istraživanja.

Na kraju, iako primena proteza sa rotirajućom šarkom u revizionoj TKA donosi specifične prednosti, ona zahteva sveobuhvatno razumevanje indikacija i kontraindikacija, kao i otvoren dijalog o očekivanjima pacijenata. Ova serija slučajeva podseća na važnost individualizovanog pristupa hirurškom lečenju u kontekstu revizije artroplastike, pomerajući granice onoga što je moguće postići u rekonstrukciji složenih povreda kolena. Potrebne su daljnje studije velikih razmera sa dužim praćenjem kako bi se ovi nalazi potvrdili i ustanovili dugoročni rezultati ovog pristupa [16].

ZAKLJUČAK

Upotreba proteza kolena sa rotirajućom šarkom u revizionim totalnim artroplastikama kolena pokazuje ohrabrujuće rezultate, naročito u slučajevima sa značajnim gubitkom kosti i nestabilnošću. Ova serija slučajeva naglašava značaj individualizovanog hirurškog planiranja i detaljne preoperativne procene u posti-

literature, which demonstrates improved functional outcomes and implant stability in similar patient populations [13,14].

Our case series demonstrated satisfactory clinical outcomes, including pain reduction and improved functional scores, aligning with the existing literature advocating for the use of rotating hinge prostheses in similar revision scenarios [15]. Notably, the incorporation of patient-reported outcome measures (PROMs) underscored the importance of assessing not only clinical metrics but also the perceived quality of life among patients post-operatively. Comparing our results with prior research emphasizes the clinical significance of rotating hinge designs in achieving a balance between stability and mobility in complex revision scenarios.

However, the use of rotating hinge knee prostheses is not without its challenges. The increased complexity of surgical technique, potential for higher rates of complications such as infections and component loosening, and the need for meticulous preoperative planning and assessment must be emphasized. Risks include mechanical failure (e.g., hinge dislocation or fracture), aseptic loosening, and infection – all of which can adversely impact outcomes and may require further surgical intervention. Strategies to mitigate these risks include the careful selection of candidates, thorough evaluation of host bone quality, and interdisciplinary collaboration for optimal perioperative management [15]. Recognizing these potential limitations align with findings from the literature, which note that long-term durability remains an area for ongoing investigation.

Ultimately, while the adoption of rotating hinge knee prostheses in revision TKA presents unique advantages, it necessitates a comprehensive understanding of the specific indications and contraindications, as well as an open dialogue about patient expectations. This case series serves as a reminder of the importance of tailored surgical solutions in the context of revision arthroplasty, pushing forward the boundaries of what can be achieved in complex knee reconstructions. Further large-scale studies with extended follow-up are warranted to validate these findings and establish long-term outcomes associated with this approach [16].

CONCLUSION

The use of rotating hinge knee prostheses in revision total knee arthroplasty demonstrates promising outcomes, particularly in cases involving significant bone loss and instability. This case series underscores the importance of individualized surgical planning and thor-

zanju optimalnih rezultata kod pacijenata. Potrebna su dodatna istraživanja kako bi se ovi nalazi potvrdili i ustanovila dugoročna efikasnost ove metode.

Zahvalnica

Nemamo posebne zahvalnice za isticanje.

Sukob interesa: Nije prijavljen.

ough preoperative assessment in achieving optimal patient outcomes. Further research is necessary to validate these findings and establish long-term efficacy.

Acknowledgements

There are no acknowledgments to declare.

Conflict of interest: None declared.

LITERATURA / REFERENCES

1. Kurtz SM, Lau E, Ong K, Zhao K, Kelly M, Bozic KJ. Future young patient demand for primary and revision joint replacement: national projections from 2010 to 2030. *Clin Orthop Relat Res*. 2009 Oct;467(10):2606-12. doi: 10.1007/s11999-009-0834-6.
2. Gioe TJ, Novak C, Sinner P, Ma W, Mehle S. Knee arthroplasty in the young patient: survival in a community registry. *Clin Orthop Relat Res*. 2007 Nov;464:83-7. doi: 10.1097/BLO.0b013e31812f79a9.
3. Long WJ, Bryce CD, Hollenbeck CS, Benner RW, Scott WN. Total knee replacement in young, active patients: long-term follow-up and functional outcome: a concise follow-up of a previous report. *J Bone Joint Surg Am*. 2014 Sep 17;96(18):e159. doi: 10.2106/JBJS.M.01259.
4. Neuhaus HJ, Maier K. Rotating hinge prosthesis for primary and revision knee arthroplasty: comparison and indications. *Biomed Res Int*. 2022 Jan 30;2022:9930675. doi: 10.1155/2022/9930675.
5. Ucpunar H, Camurcu Y, Buyuk AF, Aydin A, Tas SK, Sahin V. Comparison of contemporary surgical indications for revision total knee arthroplasty between 2005-2011 and 2012-2017 in a Referral Center. *Arch Bone Jt Surg*. 2022 Jan;10(1):32-7. doi: 10.22038/ABJS.2021.47457.2326.
6. Tarazi JM, Chen Z, Scuderi GR, Mont MA. The epidemiology of revision total knee arthroplasty. *J Knee Surg*. 2021 Nov;34(13):1396-401. doi: 10.1055/s-0041-1735282.
7. Smolle MA, Hörlesberger N, Maurer-Ertl W, Puchwein P, Seibert FJ, Leithner A. Periprosthetic fractures of hip and knee – a morbidity and mortality analysis. *Injury*. 2021 Nov;52(11):3483-8. doi: 10.1016/j.injury.2021.01.015.
8. Canton G, Ratti C, Fattori R, Hoxhaj B, Murena L. Periprosthetic knee fractures. A review of epidemiology, risk factors, diagnosis, management and outcome. *Acta Biomed*. 2017 Jun 7;88(25):118-28. doi: 10.23750/abm.v88i2-S.6522.
9. Felix NA, Stuart MJ, Hanssen AD. Periprosthetic fractures of the tibia associated with total knee arthroplasty. *Clin Orthop Relat Res*. 1997 Dec;(345):113-24.
10. von Hintze J, Niemeläinen M, Sintonen H, Nieminen J, Eskelinen A. Outcomes of the rotating hinge knee in revision total knee arthroplasty with a median follow-up of 6.2 years. *BMC Musculoskelet Disord*. 2021 Apr 7;22(1):336. doi: 10.1186/s12891-021-04205-9.
11. Lim JBT, Pang HN, Tay KJD, Chia SL, Lo NN, Yeo SJ. Increased constraint of rotating hinge knee prosthesis is associated with poorer clinical outcomes as compared to constrained condylar knee prosthesis in total knee arthroplasty. *Eur J Orthop Surg Traumatol*. 2020 Apr;30(3):529-35. doi: 10.1007/s00590-019-02598-x.
12. Malcolm TL, Bederman SS, Schwarzkopf R. Outcomes of varus valgus constrained versus rotating-hinge implants in total knee arthroplasty. *Orthopedics*. 2016 Jan-Feb;39(1):e140-8. doi: 10.3928/01477447-20151228-07.
13. Kouk S, Rathod PA, Maheshwari AV, Deshmukh AJ. Rotating hinge prosthesis for complex revision total knee arthroplasty: a review of the literature. *J Clin Orthop Trauma*. 2018 Jan-Mar;9(1):29-33. doi: 10.1016/j.jcot.2017.11.020.
14. Spranz DM, Koch KA, Reiner T, Hetto P, Gotterbarm T, Merle C. Mid-term results of complex primary total knee arthroplasty using a rotating-hinge implant. *Knee*. 2022 Jan; 34:34-41. doi: 10.1016/j.knee.2021.10.001.
15. Efe T, Roessler PP, Heyse TJ, Hauk C, Pahrman C, Getgood A, et al. Mid-term results after implantation of rotating-hinge knee prostheses: primary versus revision. *Orthop Rev (Pavia)*. 2012 Dec 11;4(4):e35. doi: 10.4081/or.2012.e35.
16. Schlechter M, Theil C, Gosheger G, Moellenbeck B, Schwarze J, Puetzler J, et al. Good mid-term implant survival of a novel single-design rotating-hinge total knee arthroplasty. *J Clin Med*. 2023 Sep 22;12(19):6113. doi: 10.3390/jcm12196113.