The Role of a New Hinged Total Knee Arthroplasty System for Use in a Variety of Complex Knee Scenarios: A Case Series

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ABSTRACT

Hinged knee arthroplasties are commonly used in scenarios where there are major ligament deficiencies or bone loss around the knee. They are applicable in native knees with major deformities and during revisions. They can also be used as a salvage procedure after distal femoral resection. The new modular hinged device system, namely the Triathlon Hinge Knee (THK) System (Stryker, Mahwah, New Jersey), reflects the advancements of third-generation design and enhances surgical flexibility by allowing streamlined integration with the Triathlon Total Stabilized (TS) System (Stryker, Mahwah, New Jersey) and the Global Modular Replacement System (GMRS, Stryker, Mahwah, New Jersey). Additionally, the Triathlon Revision Tibial Baseplate (Stryker, Mahwah, New Jersey) has been launched as part of THK and is compatible with the Modular Rotating Hinge (MRH , Stryker, Mahwah, New Jersey) femur, which allows the Revision Baseplate to replace the existing tibial component while leaving the existing MRH Femoral Component in place. The Triathlon Revision Tibial Baseplate enables orthopaedic surgeons to use constrained or hinged prostheses, including both distal and total femoral replacement options, without changing the Tibial Baseplate. This is because the TS, MRH, THK, and GMRS femurs are compatible with the new Triathlon Revision Tibial Baseplate. Additionally, the system can be augmented with metaphyseal cone constructs to help provide a stable foundation for reconstruction. This report explores the application of a new modular hinged device system in various scenarios, starting with (1) complex primary hinged knee arthroplasty, followed by revision hinged knee arthroplasty cases including (2) failed TKA with medial collateral ligament (MCL) dysfunction, (3) severe arthrofibrosis post-TKA, (4) revisions for prosthetic joint infection, (5) extensor mechanism deficiency, and (6) arthrofibrosis with extensor mechanism disruption, concluding with a case of (7) distal femoral arthroplasty for periprosthetic fracture post-failed TKA.

INTRODUCTION

Hinged knee arthroplasties, which emerged as the original prostheses for total knee arthroplasty (TKA) in the 1960s, have undergone a major design evolution over the decades.[1] The first-generation hinged designs were foundational, setting the stage for subsequent innovations that progressively enhanced the prostheses' functionality and durability. These advancements included the introduction of less constrained designs, which allowed for a greater range of natural knee motion and improved long-term outcomes.[1–3] Since then, hinged knee arthroplasties have maintained an important role, especially in patients for whom standard knee arthroplasties are not suitable, such as those who have major ligamentous deficiencies or major bone loss.[4]

More recent studies on subsequent designs have continued to show improved outcomes for hinged arthroplasty.[5–7] Early designs, such as the Walldius prosthesis developed in the 1970s, were simple hinged designs that failed to replicate the complex movements of the natural knee, leading to high failure rates due to early loosening and infection, with survivorship rates ranging from 75 to 81% and failure rates of 20 to 25% at three years.[2,8] In response to these limitations, subsequent generations of hinged knee designs introduced innovations aimed at improving durability and mimicking the knee's natural movement more closely. The introduction of rotating platforms in the second generation of hinged designs marked a major advancement, aiming to provide a more natural range of motion and reduce wear on implant components.[9] Survivorship improved dramatically in later designs, with reports of 90% at 10 years.[8,10,11] The third generation of hinged designs further evolved to help address the shear forces at the bone-implant interface and introduced modularity, allowing for a wide range of intraoperative conversions.

The new Triathlon Hinge Knee (THK) System (Stryker, Mahwah, New Jersey) was developed building on the Modular Rotating Hinge's (MRH, Stryker, Mahwah, New Jersey) 23 years of clinical success and incorporating a posterior hinge mechanism.[1] Additionally, features of the THK system include an anterior boss location, sizing options, and patella tracking modeled after the clinically-successful Triathlon TS.[8,12] New instrumentation was introduced to facilitate the implantation of these devices. The objective of this new hinge system is to address a diverse array of surgical challenges during complex total knee arthroplasty. Therefore, this case series will highlight its application in: (1) complex primary hinged knee arthroplasty; it will then cover revision hinged knee arthroplasty cases, including (2) failed TKA with medial collateral ligament (MCL) dysfunction; (3) severe arthrofibrosis post-TKA; (4) revision for a prosthetic joint infection; (5) extensor mechanism deficiency; and (6) arthrofibrosis with extensor mechanism disruption; and the series concludes with a (7) distal femoral arthroplasty for periprosthetic fracture post-failed TKA.

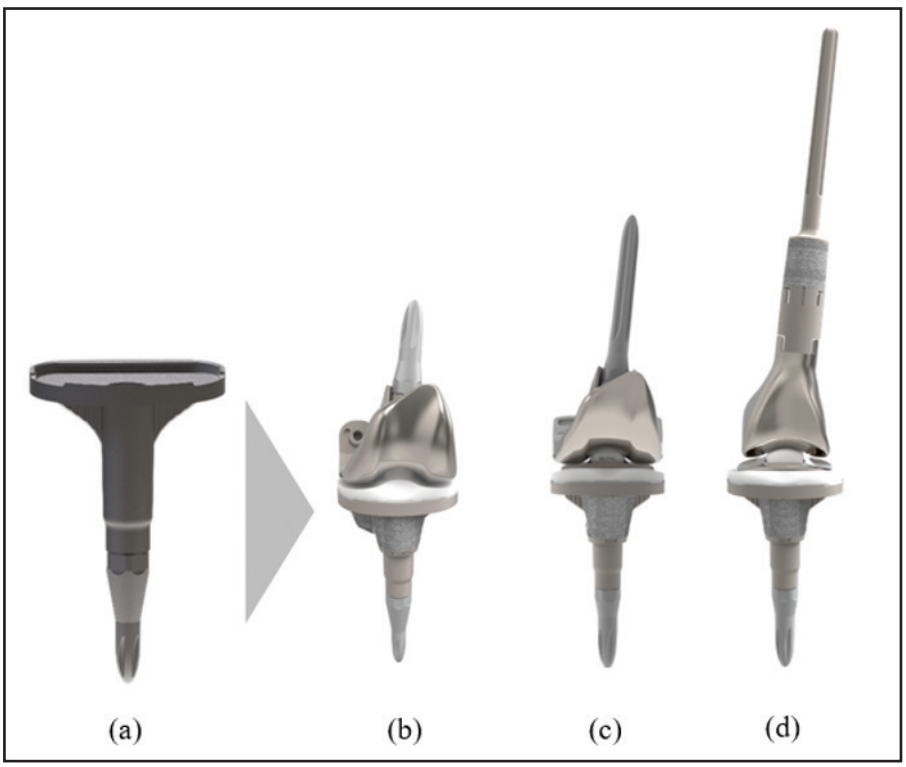

Figure 1. System compatibility. (a) Triathlon Hinge Revision Baseplate is compatible with (b) Triathlon Total Stabilized Femoral Component, (c) Triathlon Hinge Femoral Component, and (d) Global Modular Replacement System distal femoral component.

DESCRIPTION OF PROSTHESIS

The new THK is designed to incorporate third-generation design concepts and is known for its versatility. Overall, the new modular hinge system features a versatile baseplate compatible with a range of femoral components (Fig. 1a–d). The Triathlon Revision Tibial Baseplate, introduced as a part of the Triathlon Hinge Knee System, facilitates compatibility with the Femoral Components of both the Triathlon Total Stabilized (TS, Stryker, Mahwah, New Jersey) System and the Global Modular Replacement System (GMRS, Stryker, Mahwah, New Jersey), providing surgeons with multiple compatibility options and facilitating transitions between systems in revision cases as needed. Additionally, the new Triathlon Tibial Revision Baseplate is also compatible with the MRH femur, which allows the Revision Baseplate to replace the existing tibial component while leaving the existing MRH Femoral Component in place. The design enables orthopaedic surgeons to select between constrained or hinged prostheses while using the same new Triathlon Revision Tibial Baseplate, allowing for the simplification of inventory management and the reduction of time required for component selection and surgical preparation.[12] Additionally, the system supports the use of ancillary components such as metaphyseal cones aimed at providing a stable reconstruction foundation.[12]

The new Triathlon Hinge Knee System builds upon the clinical success of MRH and Triathlon TS[1,10,11] and offers

multiple tibial-bearing component options with varying posterior offsets. This design, featuring an anteriorized boss location and patello-femoral track based on Triathlon TS, aims to enhance extensor mechanism function by utilizing a longer moment arm, which is designed to increase the leverage during knee extension.

SURGICAL TECHNIQUE

As detailed in Hampp et al., the new modular hinge system surgical technique for knee arthroplasty begins with careful tibial preparation.[4] Using an intramedullary reamer, the surgeon methodically reams the tibial canal in 1mm increments for a suitable fit, followed by bone resection guided by a resection guide assembly. For those knees requiring a cemented stem, the updated workflow is intended to prioritize tibial coverage and is designed to enhance joint stability. The process begins with aligning the tibial template on the cut bone to help ensure adequate coverage, rather than strictly adhering to the canal orientation, and prepares for the integration of the boss, stem, and keel. In cases of bone loss, augments can be used to maintain the correct joint line height.

Femoral preparation involves reaming the femoral canal to accommodate the selected stem length, followed by distal femoral resection aimed at accommodating the knee's natural geometry. This step is crucial for ensuring the hinge prosthesis fits well within the joint space. An extension gap assessment is conducted to verify adequate joint space, adjusting as necessary to achieve the desired alignment and stability. The new Hinge Femoral Component was designed with 5mm of distal augment built in and can be further augmented up to 10 additional millimeters in 5mm increments.

Lastly, the trial and final implant placement stages allow for assessing the fit and joint stability of trial components before the final implants are assembled and placed. Adjustments are made to the insert trial thickness as needed to support proper size selection. This surgical approach, utilizing the new modular hinge system and associated instrumentation, is designed to achieve a well-aligned, stable knee construct with a functional range of motion, efficiently addressing both primary and revision knee arthroplasty situations, as detailed by Hampp et al.[4]

GROUP 1: PRIMARY KNEE ARTHROPLASTY WITH GMRS AND HINGED SYSTEMS IN NATIVE KNEE

Case 1

Case presentation

A 66-year-old woman presented with severe right knee pain and immobility six months following a retrograde intramedullary (IM) nailing for a distal femur fracture. Initial assessment revealed a complicated clinical picture: the patient's morbid obesity put her at a higher risk for post-surgical complications, and her history of a distal femur fracture complicated by nonunion and the development of post-traumatic arthritis in the right knee added further complexity to her case. Radiographs confirmed the nonunion and demonstrated degenerative changes in the right knee joint involving the medial compartment and patella-femoral joint (Fig. 2a and b). The patient's medical history was notable for controlled type 2 diabetes mellitus and hypertension. Following consideration of risks and benefits during consultation, knee arthroplasty using the new modular hinge system was chosen. The surgeon was aware that the higher body mass index (BMI) of this patient could impose greater loads on the prosthesis, but nevertheless, after a risk/benefit analysis and shared decision-making with the patient and her family, it was deemed appropriate to proceed with the proposed surgery.

Surgical technique

The operation began with the careful removal of the previous femoral hardware, acknowledging the potential for bone fragility and the need to preserve as much bone stock as possible. The distal femoral pathological bone was resected, and a lateral release with an extensor mechanism realignment was performed to correct the knee's alignment. The choice of the Triathlon Revision Tibial Baseplate and a GMRS Distal Femoral Component was made due to the patient's underlying arthrosis and distal femoral fracture nonunion.

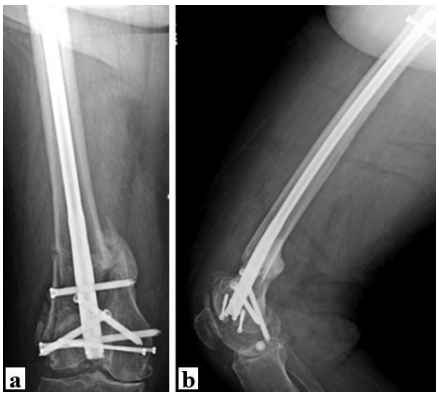

Figure 2a. Antero-posterior and (b) lateral radiographs of the right knee.

Postoperative course

Postoperatively, the focus was on facilitating knee functional recovery (Fig. 3a–d). Given the patient's obesity and diabetes, the rehabilitation program was carefully designed to strike a balance between promoting early mobilization to help prevent venous thromboembolism and managing the risk of prosthesis failure due to excessive load. The rehabilitation protocol included protection from full weight-bearing exercises, including the use of an assist device. Nutritional counseling was implemented to support weight management, reduce stress on the new joint, and promote overall health. Pain management was managed to facilitate active participation

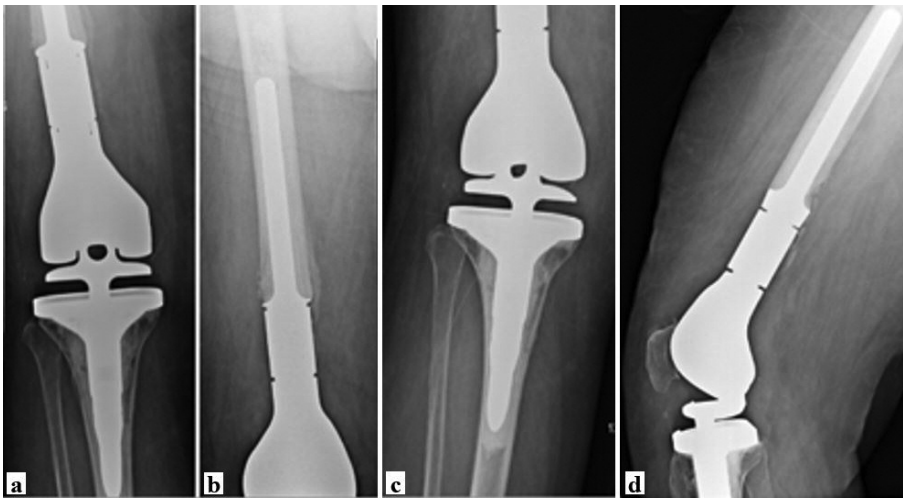

Figure 3a–c. Antero-posterior views of the right knee and (d) a lateral view with the revised implant.

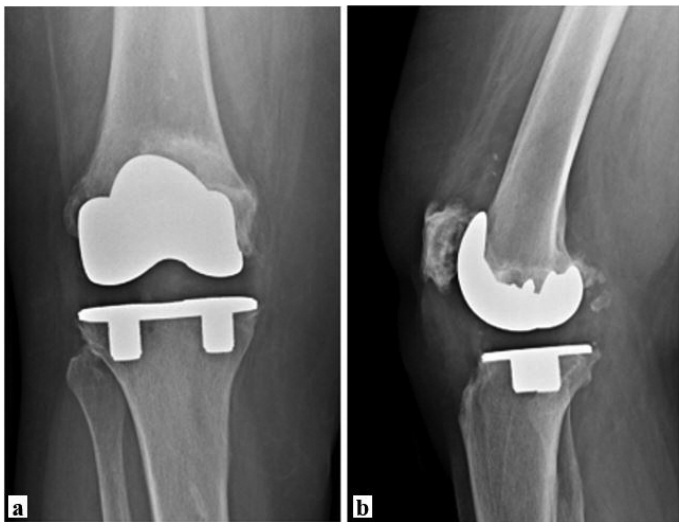

Figure 4a. Antero-posterior and (b) lateral radiograph of the right knee.

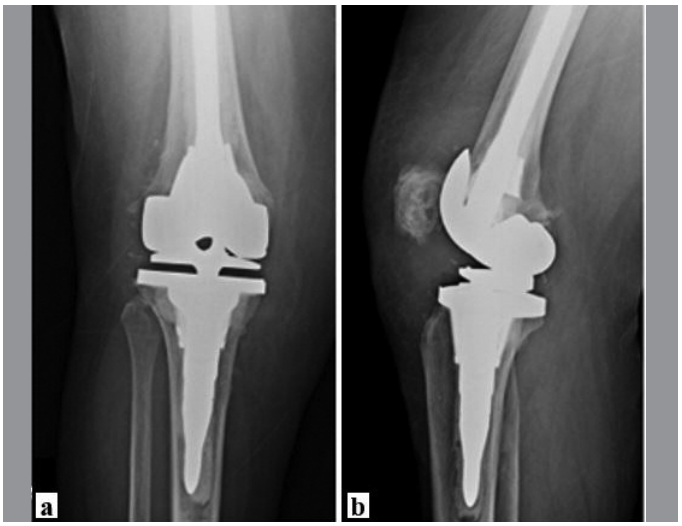

Figure 5a. Antero-posterior and (b) lateral radiograph of the right knee.

in physiotherapy. Regular follow-up appointments were scheduled to monitor the healing process, with radiographs taken to assess the progress of the union at the fracture site and the integration of the prosthetic components. At six months after the operation, the patient reported major improvement in knee function and pain relief.

GROUP 2: CONVERSION TO HINGED KNEE ARTHROPLASTY (REVISION)

Case 2

Case presentation

A 66-year-old woman faced a challenging situation with a failed right TKA, marked by aseptic loosening of the Femoral Component, substantial instability, and loss of medial collateral ligament (MCL) function. The failure of her initial TKA had left her with considerable discomfort and a markedly decreased quality of life, and she was unable to perform everyday activities without pain or risk of further injury. Her surgical history revealed multiple interventions that had compromised the integrity of the collateral ligaments, leaving her with few options for restoration of knee function and stability. Radiographic evaluation showed distal femoral bone loss, complicating the revision strategy (Fig. 4a and b). Following consideration of risks and benefits during consultation, revision knee arthroplasty using the new modular hinge system was completed.

Surgical technique

Revision surgery involved the implantation of a Triathlon Revision Tibial Baseplate and a Triathlon Hinge Femoral Component (Stryker, Mahwah, New Jersey). During the operation, it was observed that the MCL was completely deficient, contributing to the knee's instability and necessitating a hinged TKA system. Notably, a size 3 Revision Baseplate and a size 3 Hinge Femoral Component were utilized. Metaphyseal fitting cones were employed to help address metaphyseal bone loss, with the goal of providing additional support and fixation. Antibiotic cement was utilized for fixation in an effort to minimize the risk of prosthetic joint infection in this complex case.

Postoperative course

After her surgery, the patient's recovery was carefully monitored. The focus was on a physical therapy plan designed to improve the range of motion and function of her knee. By six months postoperatively, the patient had a stable, well-functioning knee with a return to her baseline activities (Fig. 5a and b).

Case 3

Case presentation

A 65-year-old woman who had a history of a left TKA presented with persistent knee stiffness and functional impairment attributed to severe arthrofibrosis and contracture. Her medical history revealed a previously failed TKA, which had been converted to a posterior stabilized (PS) TKA in an attempt to address these issues (Fig. 6a–c). Despite these interventions, the patient's condition did not improve, leading to limitations in daily activities and quality of life. Following consideration of risks and benefits during consultation, revision knee arthroplasty using the new modular hinge system was completed.

Surgical technique

The procedure involved the careful removal of the previous knee prosthesis, extensive resection of scar tissue, and selection of the revision hinged knee implant to address the arthrofibrosis with

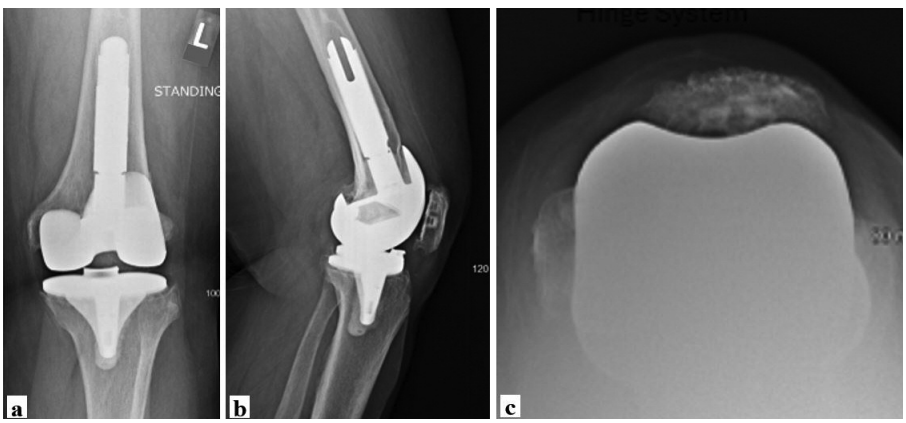

Figure 6a. Antero-posterior, (b) lateral, and (c) sunrise view of the left knee.

Figure 7a. Antero-posterior and (b) lateral view of the left knee.

Figure 8a. Antero-posterior and (b) lateral radiograph of the right knee..

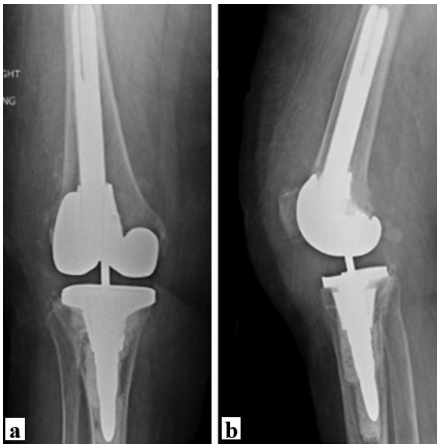

Figure 9a. Antero-posterior and (b) lateral view of the right knee.

resection of the scarred collaterals and posterior capsular structures. Specifically, the surgery utilized a size 4 Triathlon Revision Tibial Baseplate paired with a size 2B Tibial Cone to help create a stable foundation following the metaphyseal bone loss. To ensure stability and an appropriate fit within the patient's knee, a size 4 Triathlon TS Femoral Component, along with a metaphyseal fitting cone, was utilized. Additionally, the operation incorporated a size 3-4 Central Femoral Cone, a 12mm by 50mm cemented tibial stem, and a 14mm by 100mm fluted femoral stem, each selected for their roles in helping to achieve the desired stability, alignment, and mechanical integrity of the knee post-revision (Fig. 7a and b).

Postoperative course

The patient's postoperative course was overseen carefully due to the heightened risk of recurring stiffness and arthrofibrosis. The rehabilitation plan incorporated early mobilization, aiming to reduce stiffness and enhance joint function, with activities adjusted according to the patient's pain tolerance and clinical evaluations. Customized physical therapy included exercises designed to improve range of motion, build strength, and alleviate inflammation, all while being adaptable to the patient's ongoing recovery and feedback. Regular follow-up appointments involved close surveillance for any signs of stiffness, infection, or complications with the implant. This comprehensive and personalized approach not only addressed the technical challenges posed by arthrofibrosis post-total knee arthroplasty, but also helped to improve the patient's condition, aiding in a successful recovery. Also, the patient reported a notable enhancement in her quality of life by six months postoperative, with decreased pain and the ability to walk without ambulatory assistance.

Case 4

Case presentation

A 75-year-old woman presented for revision TKA. Her complex surgical history included treatment for a prosthetic joint infection (PJI) with implant removal and the insertion of an articulating antibiotic spacer (Fig. 8a and b). The patient subsequently presented over three months following the removal of her infected TKA implant and the insertion of her antibiotic spacer, along with six weeks of intravenous antibiotics for her second-stage reimplantation procedure, utilizing the new Triathlon Revision Hinge system. The workup consisting of knee aspiration, along with CRP and sedimentation rate, was negative for infection prior to the revision surgery.

Surgical technique

The articulating antibiotic spacer was removed using the prior parapatellar approach. Given the patient's age, a size 4 Revision Tibial Baseplate was selected to help enhance load distribution and joint stability, which are critical considerations in the elderly due to decreased bone density and altered biomechanical properties. Additionally, a size B tibial cone augment was utilized to help address the metaphyseal bone loss, with the goal of providing the necessary support to compensate for the weakened bone structure common in older adults. A size 5 Triathlon Total Stabilized Femoral Component with lateral and medial distal femoral augmentation blocks was utilized in an effort to restore the native joint line. A femoral metaphyseal cone was utilized to help address the metaphyseal bone loss, along with an intramedullary stem, in order to help enhance fixation. Antibiotic-impregnated simplex cement was utilized given the history of prior prosthetic joint infections.

Postoperative course

After the operation, imaging confirms that the implant achieved neutral alignment, within 3° of varus or valgus alignment relative to the knee's mechanical axis. The fixation is observed to be secure, with no signs of loosening or malpositioning, as evidenced by the uniform cement mantle and appropriate positioning of the prosthetic components relative to the surrounding bone structures (Fig. 9a and b). The patient's rehabilitation was customized to consider her obesity and past surgical issues. The focus was a gradual activity increase, aiming to improve joint function and stability while managing her weight to reduce stress on the new joint. The patient showed major mobility improvement, and she had almost no reported pain by six months postoperatively, with the ability to walk without ambulatory aids.

Case 5

Case presentation

A 68-year-old man who had a history of rheumatoid arthritis reported severe pain, swelling, and a noticeable decrease in mobility in his left knee following a minor fall at ground level. The patient had a prior TKA performed in 2011 that was functioning well. A year ago, he sustained a fall and had a rupture of his patellar and inferior poles. He underwent a primary repair of the tendon and augmentation with an artificial graft for supplementation. Unfortunately, this went on to fail, and the patient presented with a chronic disruption of his

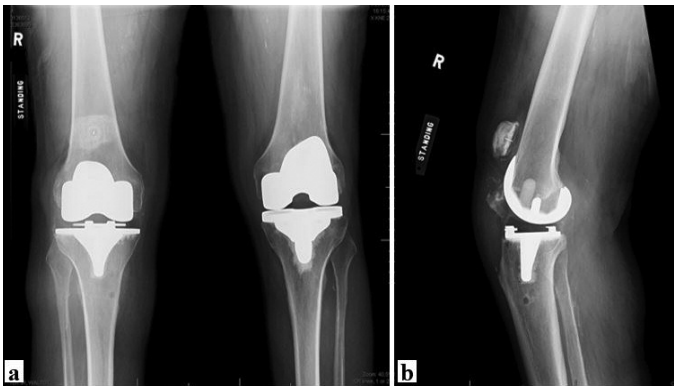

Figure 10a. Bilateral anterior-posterior radiograph of both knees and (b) a right knee lateral radiograph.

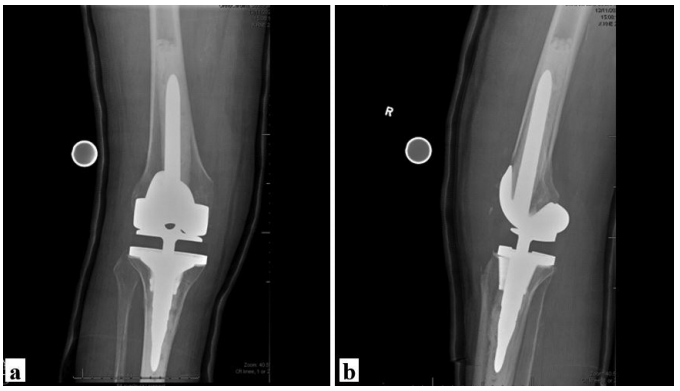

Figure 11a. Antero-posterior and (b) lateral radiograph of the right knee.

extensor mechanism, difficulty walking, and an inability to actively extend his leg with a 45° extensor lag. Radiographic imaging confirmed an inferior pole patella fracture, complicating the previously placed TKA (Fig. 10a and b). The patient's quality of life had deteriorated due to his inability to ambulate independently, contributing to his distress and urgency for a revision. Following consideration of risks and benefits during consultation, revision knee arthroplasty using the new modular hinge system was completed.

Surgical technique

The operation commenced under general anesthesia, with a midline incision exposing the compromised knee joint. Following the debridement of damaged tissue and the removal of patellar fragments, attention was turned to the selection and implantation of the Triathlon Hinge Femoral Component and Triathlon Revision Tibial Baseplate, designed to provide stability and support to the knee while accommodating for the extensive reconstruction needed. At the surgeon's discretion, a mesh was utilized to restore the extensor mechanism. The mesh was cemented between the metaphyseal cone and the intramedullary tibial stem. The mesh was tensioned and secured to the native extensor mechanism to help restore knee mechanics and stability.

Postoperative course

Postoperatively, the patient was placed in a long-leg cast for three months and allowed to be weight-bearing as tolerated. The cast was removed at three months, and he was placed in a hinged-knee brace and allowed to undergo gradual active flexion and extension of the knee. Following the surgical intervention, radiographic images showed the implant to be appropriately aligned (Fig. 11a and b). Over the following months, the patient demonstrated major improvements in knee function and pain relief and was able to resume light daily activities. Follow-up assessments showed stable mesh integration and no evidence of recurrent extensor mechanism dysfunction. By the six-month follow up, the patient reported a substantial improvement in quality of life, with regained independence in ambulation and a return to pre-injury levels of activity. The successful integration of the mesh and the absence of complications in the postoperative period underscored the potential efficacy of this reconstructive technique in helping to address an extensor mechanism deficiency.

Figure 12a. Antero-posterior and (b) lateral views of the right knee.

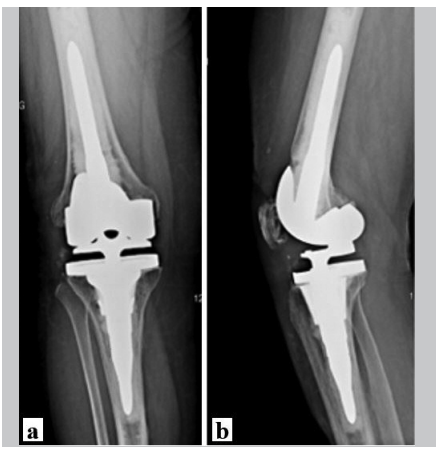

Figure 13a. Antero-posterior and (b) lateral views of the right knee.

Case 6

Case presentation

A 60-year-old woman presented with a complex clinical scenario characterized by startup pain with limited active knee flexion to only 70° secondary to arthrofibrosis (Fig. 12a and b). She had a prior tibial component revision for aseptic loosening of the index-cemented tibial implant initial and now has aseptic loosening of the femoral component along with a stiff knee. A decision to proceed with revision surgery using a hinged implant design was made due to the stiff knee and loosening of the femoral component. The preoperative workup for prosthetic joint infection was negative. Following consideration of risks and benefits during consultation, revision knee arthroplasty using the new modular hinge system was completed.

Surgical technique

Given the arthrofibrosis, the Triathlon Revision Tibial Baseplate was utilized with the goal of restoring range of motion and providing stability. The revision surgery included the removal of the failed components and the implantation of a Triathlon Hinge Femoral Component size 3, a Triathlon Revision Tibial Baseplate size 3, accompanied by a size 3–4 Central Femoral Cone and a size B Tibial Cone.

Postoperative course

After the operation, imaging confirmed that the implant had achieved

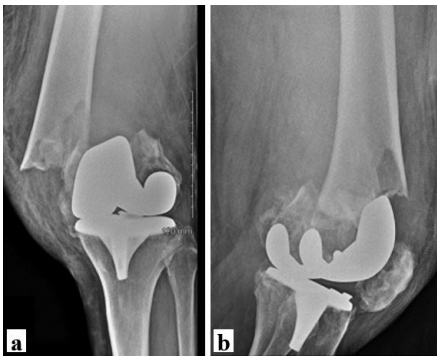

Figure 14a. Antero-posterior and (b) lateral radiographs of the left knee.

neutral mechanical alignment, within 3° of varus or valgus alignment relative to the knee's mechanical axis (Fig. 13a and b). Following the complex revision surgery, the patient was started on an aggressive range-of-motion physical therapy (PT) program. At six months postoperatively, she had a stable, well-fixed revision TKA with active knee flexion to 105°.

GROUP 3: EXTENSIVE REVISION TO DISTAL FEMORAL ARTHROPLASTY

Case 7

Case presentation

A 60-year-old man presented with a comminuted periprosthetic distal femur fracture with intraarticular extension (Fig. 14a and b). Given the complexity of the fracture, including bone loss and comminution of the metaphyseal condylar segment, the need for a tailored solution necessitated the use of the new revision modular hinge system with a distal femoral replacement prosthesis.

Surgical technique

The revision surgery employed a multi-component approach, utilizing a Triathlon Revision Tibial Baseplate and a GMRS Distal Femoral Component to address the failed primary TKA with a distal femoral peri-prosthetic fracture. The tibial side was reinforced with a size 6 Triathlon Revision Tibial Baseplate, a 15mm diameter x 50mm length cemented stem, and a size C Tibial Cone, with the goal of ensuring stable fixation. The GMRS femoral component was secured with a 65mm distal femoral replacement prosthesis and a 15mm x 127mm cemented stem.

Postoperative course

Postoperative radiography demonstrated implants to be well aligned with stable fixation. (Fig. 15a–c). The patient was started on immediate full-weight bearing with range-of-motion exercises. At six months following revision surgery, the patient had returned to their baseline activities along with an active knee range of motion of 110°.

DISCUSSION

This case series explored the capabilities of the new modular hinged system, which allows surgeons to easily transition between configurations while leveraging the same Tibial Baseplate. The cases highlight the new system's versatility, as it can be used for a range of challenging knee conditions, from constrained stems to modular rotating hinges. This versatility is useful for complex cases involving ligament deficiencies, significant bone deformities, or distal femoral resections. An aspect of this system's design that warrants further emphasis is the availability of several Tibial Baseplate sizes and the system's patello-femoral track, which is based on the current Triathlon Total Knee Arthroplasty design. The series evaluated the system's capabilities across scenarios such as native knee deformities, revisions of constrained knee arthroplasties, and complete distal femur arthroplasties, demonstrating its ability to deliver personalized, durable solutions. It demonstrated the following cases: (1) complex primary knee arthroplasty; (2) failed TKA with medial collateral ligament (MCL) dysfunction; (3) severe arthrofibrosis post-TKA; (4) revisions for prosthetic joint infection; (5) extensor mechanism deficiency; and (6) arthrofibrosis with extensor mechanism disruption; and concluded with a (7) distal femoral arthroplasty for a periprosthetic fracture post-failed TKA. Additionally, the compatibility of the new hinged system with the metaphyseal cone augments the emphasis that the system was designed with the goal of helping to improve reconstruction outcomes by aiming to enhance mobility, alleviate pain, and elevate the quality of life for patients.

Existing literature on existing hinged knee systems underscores the efficacy of hinged knee prostheses in managing severe knee conditions, with a special emphasis on their role in both primary and revision surgeries.[3,7,10,13,14] For instance, a meta-analysis by Yoon et al. comparing rotating hinge knee (RHK) and constrained condylar knee (CCK) prostheses in revision total knee arthroplasty found no significant differences in short-term (<5 years) survival rates (RHK 87.4%, CCK 75.0%; p=0.09) and mid-term (5 to 10 years) survival rates (RHK 81.3%, CCK 83.8%; p=0.88).[15] Furthermore, the study noted no significant differences in range of motion (p=0.07) and complication rates (p=0.46), although CCK groups reported significantly better pain (p=0.005) and function scores (p=0.05). Similarly, Castagnini et al. provided a comparative analysis of complex primary total knee arthroplasties (TKAs), reporting comparable 10-year implant survival rates

Figure 15a. Antero-posterior and (b) lateral radiographs of the left knee.

(RHKAs 91.9%, confidence interval [CI] 89.2–93.9%; CCKAs 93.4%, CI 90.3–95.6%), with periprosthetic infection being the leading cause for revision in both cohorts.[16] These studies affirm the hinged knee system's critical role in offering durable solutions for challenging knee pathologies and enhancing patient mobility and quality of life from their preoperative state.

Literature emphasizes the need for meticulous surgical techniques in hinged knee arthroplasty. This case series aims to demonstrate how detailed preoperative planning, the selection of prosthesis components using the new modular hinge system for the intended patient population, and customized postoperative care may improve surgical outcomes and potentially reduce complications, including loosenings, fractures, joint instabilities, or infections, compared to prior hinged designs. For example, Dauwe and Vandenneucker's review of the use of third-generation rotating-hinge devices in primary settings suggests their consideration in cases with major ligamentous tibio-femoral instability.[17] Linke et al. identify younger age and multiple previous surgeries as risk factors for aseptic loosening in TKA, underscoring the importance of precise preoperative assessments.[18] Furthermore, Petershofer et al. and von Hintze et al. highlight the good clinical outcomes and quality of life associated with rotating hinge implants in primary and revision arthroplasty.[14,19] These insights not only enhance hinged knee arthroplasty outcomes, but they also emphasize the nuanced approach necessary to fully leverage these advanced prosthetic systems' capabilities.

CONCLUSION

This case series not only emphasizes the versatility and importance of the new modular hinge system in treating complex knee conditions, but it also begins to address the challenges highlighted in the previous literature for these cases, although longer-term studies are needed. A variety of size options allows for a more nuanced approach to knee reconstruction, designed to help accommodate patients with differing tibial sizes and shapes without compromising the stability and integrity of the implant. The surgical techniques in each case study were based on the surgeon's clinical judgment based on an individual case review. By showcasing a range of successful outcomes to date in diverse and challenging clinical scenarios, this case series reinforces the new modular hinged knee system's role as a useful tool for reconstructive surgeons. These successes include achieving desired alignment and fixation, improved range of motion, and positive patient reports on returning to daily activities, highlighting the system's potential for enhancing patient quality of life. It illustrates the potential for major patient benefits, encouraging a more nuanced and comprehensive approach to the treatment of severe knee pathologies. STI

AUTHORS' DISCLOSURES

Dr. Mont is a board or committee member for the American Association of Hip and Knee Surgeons, Hip Society, and Knee Society. He holds stock in United States Medical Innovations, CERAS Health, MirrorAR, and PeerWell. Dr. Mont receives research support from Patient-Centered Outcomes Research Institute (PCORI), Organogenesis, CyMedica Orthopedics and the National Institutes of Health (NIAMS & NICHD), and he is on the editorial board for Surgical Technology International, the Journal of Arthroplasty, the Journal of Knee Surgery, and Orthopedics. He is a paid consultant for Kolon TissueGene, Ethicon, Exactech, Next Science, Pacira, Smith & Nephew, and Stryker. Dr. Mont receives royalties and research support from Stryker, UpToDate, and Wolters Kluwer Health - Lippincott Williams & Wilkins.

Dr. Springer is a board or committee member of the American Association of Hip and Knee Surgeons and IOEN. He is on the editorial/governing board of the Journal of Bone and Joint Infection, Journal of Arthroplasty, and Arthroplasty Today. Dr. Springer also receives royalties and/or is a paid consultant for Convatec, Osteoremedies, and Stryker

Dr. Malkani is a paid consultant and presenter/speaker for Stryker. He is also a paid consultant and receives research support from Stryker.

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