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## Rotating Hinge Implants for Complex Primary and Revision Total Knee Arthroplasty

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### ABSTRACT

**Background:** Contemporary rotating hinge knee (RHK) prosthesis has shown improved survival rates over earlier generations. However, reports of high complication and mechanical failure rates highlight the need for more clinical outcome data in the complex primary and revision setting. The purpose of this study is to report our results of using a contemporary rotating hinge for complex primary and revision total knee arthroplasty.

**Methods:** Using a prospectively maintained surgical database, 79 knees in 76 patients who underwent an RHK of a single design for either a complex primary (14 knees) or revision total knee arthroplasty (65 knees) were identified. This included 19% undergoing an RHK for periprosthetic joint infection and 32.9% who had concomitant extensor mechanism repair. The cohort consisted of 60 women and 16 men with a mean age of 66.7 years (range 39–89) at the time of surgery. Patient outcomes were assessed using Knee Society Scores and radiographs were reviewed for signs of wear and loosening. Failure rates were estimated using Kaplan-Meier survival curves.

**Results:** At a minimum of 2 years, 13 patients had died and 4 were lost to follow-up, leaving 62 knees in 59 patients who were followed for a mean of 55.2 months (range 24–146). The mean Knee Society Scores improved from 35.7 to 66.2 points ( $P < .01$ ). The incidence of complications was 38.7%. The most common complications were periprosthetic fracture, extensor mechanism rupture, and periprosthetic infection. Estimated survival was 70.7% at 5 years.

**Conclusion:** Despite improvements in design and biomaterials, there remains a relatively high complication rate associated with the use of a modern RHK implant. While aseptic loosening was rare, periprosthetic fracture, infection, and extensor mechanism failure were substantial emphasizing the complex nature of these cases.

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In complex revision knee arthroplasty, enhanced implant constraint may be required to obtain adequate stability [1]. When soft tissue balancing and bone loss cannot be managed with constrained condylar implants, hinged knee implants become a viable option [2]. Such complex cases often occur in patients with a history of multiple prior revision surgeries, extensor mechanism disruption, and periprosthetic joint infections (Fig. 1). Hinged knee

implants are commonly included in the category of “limb salvage” procedures when other options such as arthrodesis or amputation are considered, further emphasizing the challenging nature of these procedures. In primary total knee arthroplasty (TKA), hinges may be required as well for pathology including hyperextension from neuromuscular disease, severe deformity, and instability. These indications present similar challenges to revision indications where the enhanced stability, only achieved with hinge knee replacements, is required [3].

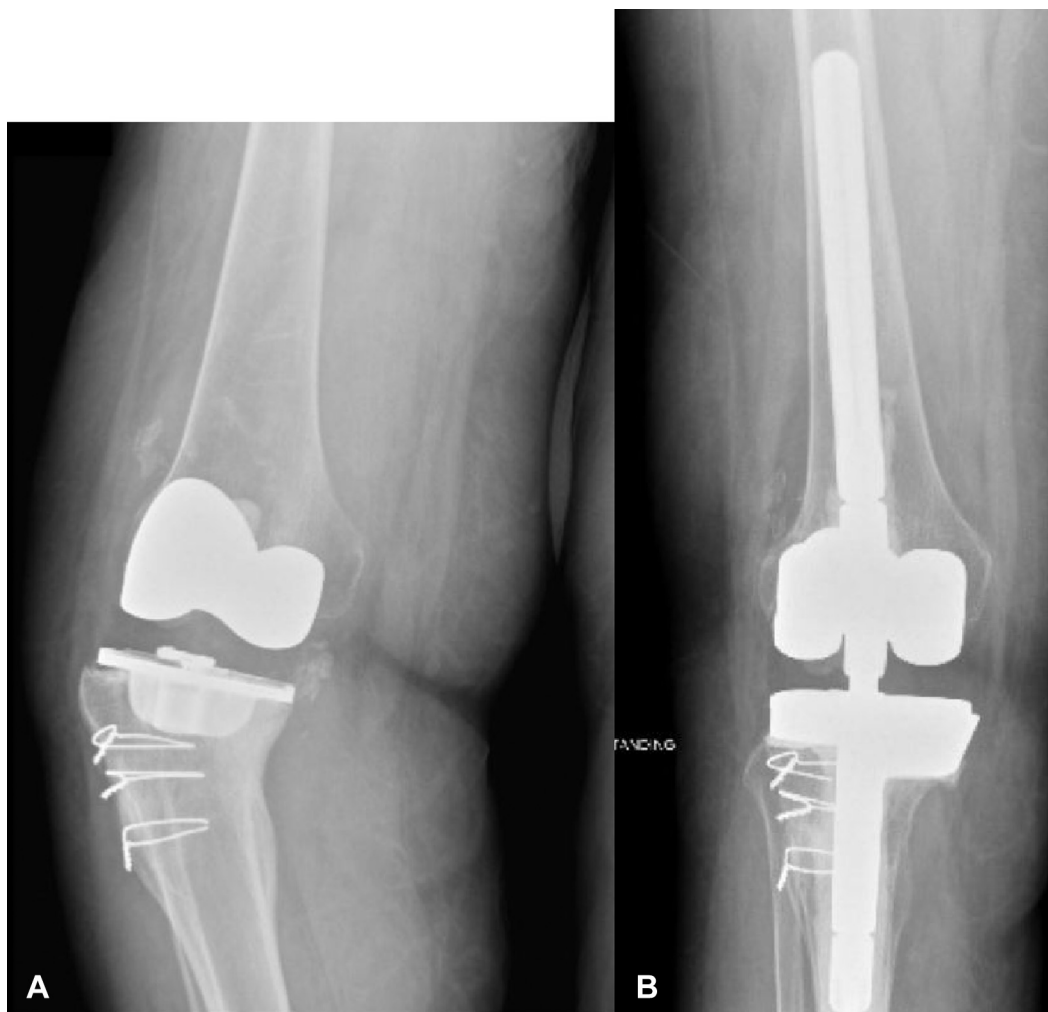
In the context of these reconstruction indications, several studies have demonstrated acceptable long-term results [4–7] and improved survival rates with contemporary rotating hinges compared to earlier-generation counterparts. This is potentially related to design features and material improvements, including axial rotation (rotating hinge) of the femoral-tibial articulation

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**Fig. 1.** An anteroposterior radiograph of a preoperative (A) and postoperative (B) right knee. This patient's history includes previous total knee replacement, complicated by a patella fracture nonunion, subsequent extensor mechanism allograft, and finally a tibial osteotomy for malunion of a tibia stress fracture. The patient presented with a varus deformity and loose tibial component intraoperatively.

affording a reduction in forces transmitted to the bone-cement interface. Additionally, increased modularity of modern implants allows for long stems and metaphyseal sleeves/cones to manage bone loss and fixation, while improving overall outcomes [7]. Even with these design and outcome improvements, some authors have highlighted high complication rates [8] and reports of mechanical failure [9,10]. Therefore, more clinical outcome data in complex reconstruction cases will aid in identifying the best indications and contraindications when selecting hinged knee implants. The purpose of this study is to report our experience using a modern rotating hinge knee (RHK) implant in the complex primary and revision setting.

## Methods

After institutional review board approval, the database of the senior authors, all fellowship trained in adult reconstruction, was queried for cases using an RHK of a single design (NexGen RHK; Zimmer, Warsaw, IN), between the years 2003 and 2014. Inclusion criteria were all nononcological primary and revision indications. Exclusion criteria were cases involving the use of a distal femoral replacement (15 procedures).

There were 79 knees in 76 patients who underwent an RHK for either a complex primary (14 knees) or revision (65 knees) knee arthroplasty (Table 1). This represents 5.4% of all revision TKAs during that time. In the primary and revision setting, the authors used an RHK to manage recurvatum deformities, instability associated with neuromuscular disease, deformity/bone loss that resulted in complete loss of the collateral ligaments, or instability that was not correctable by a constrained condylar implant. This included deformities in the coronal plane that were not correctable with a constrained condylar implant or in cases in which flexion-extension balancing was not possible without a hinged implant.

For patients who underwent a revision, the mean number of previous surgeries was 2.1 (range 1–20) including the index primary knee replacement and preceding cement spacer procedure if the indication for revision was a prosthetic joint infection (Table 2). All periprosthetic joint infections were treated in a 2-stage manner. A concomitant extensor mechanism reconstruction with allograft was performed in 26 (32.9%) procedures, including 1 primary and 25 revision procedures. Femoral or tibial Trabecular Metal cones (Zimmer, Warsaw, IN) were used in 26 (32.9%) of all procedures. Cones were used if the bone defect fits or could be easily machined to fit the shape of a cone and stems in all

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