



Management of Gonarthrosis with a Rotating Hinge Prosthesis: Minimum 10-Year Follow-up

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Background: The use of hinged designs is usually reserved for severe deformities or instability in contemporary total knee arthroplasty (TKA). Results have been mixed with some authors reporting relatively high incidences of complications. The aim of this study is to present the results of primary TKA performed with a hinged prosthesis with a minimum 10-year follow-up. We also examined the factors that influence survivorship of this prosthesis.

Methods: A total of 238 primary TKA procedures were performed using hinged prostheses. Indications included osteoarthritis, rheumatoid arthritis, posttraumatic deformity, and arthritis. Clinical outcomes were assessed using the Hospital for Special Surgery score. Radiologic assessment was performed at each follow-up. Survivorship was calculated based on the Kaplan-Meier method. All complications were documented.

Results: Mean follow-up was 13.5 years (standard deviation [SD], 3.4). Mean flexion at final review was 118° (SD, 20°). Fifty-four percent and 20% reported excellent and good functional scores, respectively. Survivorship was 94% at 13.5 years in patients over 60 years of age and 77% in patients less than 60 years of age. Survivorship in patients with preoperative varus deformity was 96% and that in valgus knees was 79%.

Conclusions: The results of this study suggest that when rotating hinges are used for primary TKA, the best results are achieved in patients over 60 years old. The indications for this design in the setting of primary TKA include significant deformities, severe bone loss, and ligamentous laxity.

Keywords: *Hinge, Knee replacement, Rotating hinge, Valgus, Deformity*

The main indications for rotating hinge designs in the setting of primary total knee arthroplasty (TKA) are significant deformity or gross instability or both.¹⁻⁴ The use of unconstrained prostheses in these settings has been associated with an increased incidence of complications including poor soft-tissue balance and instability.⁵ The Endo Model Rotating Hinge Design (Waldemar Link, Hamburg, Germany) has been used extensively in our surgical units

in cases in which a hinged prosthesis was required for primary TKA.⁶⁻⁸ Encouraging mid-term results have been reported with the use of this prosthesis from the designer institution⁸ as well as other centres.⁹ Some authors have reported worrying complication rates with survivorship of 88.7% at 1 year after surgery¹⁰ with the use of the rotating hinge as a primary prosthesis. Mortazavi et al.¹⁰ recommended this design for revision procedures as opposed to primary TKA due to the high incidence of complications, which they encountered.

The aim of this study was to present the clinical and radiologic outcomes of the Endo Model rotating hinge prosthesis used for primary TKA with a minimum 10-year follow-up. We also examined anatomical and demographic factors that influence survival of this prosthesis.

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METHODS

A retrospective study was performed. A total of 238 primary TKAs were performed in 238 patients using the Endo Model Rotating Hinge Prosthesis (Waldemar Link) (Fig. 1) in 2008. One hundred and eighty-nine females and 49 males were included. The indications for the use of rotating hinged prostheses in primary TKA were advanced deformity (150 cases), significant bone loss (48 cases), and ligamentous laxity (40 cases). A total of 650 primary TKA procedures were performed in our unit that year. The mean age of patients was 67 years (range, 26–88 years). The prosthesis was inserted in 130 right and 108 left knees.

Indications for surgery included osteoarthritis (n = 208, 88%), rheumatoid arthritis (n = 12, 5%), posttraumatic arthritis (n = 12, 5%), osteonecrosis (n = 3, 1%), and tumors (n = 3, 1%). The average American Society of Anesthesiologists (ASA) score was 3 (range, 2–4) (Table 1).

Sixty-two patients (26%) died due to causes unrelated to their knee replacement procedures and 16 patients (7%) were lost to follow-up. One hundred and sixty patients were available for review. Nineteen patients (12%) had undergone revision surgery with prosthesis exchange at the time of final follow-up.

Evaluation

Survivorship was calculated using the Kaplan-Meier method. Patients who died or were lost to follow-up were censored.



Fig. 1. First-generation Endo Modell Rotating Hinge prosthesis. The Monobloc prosthesis is made of a cobalt chromium molybdenum alloy. A trochlear flange was not included in the first-generation design, which was the subject of this paper.

Surgical Technique

All procedures were performed by 6 consultants and 3 residents. A tourniquet was used in all cases. It was only inflated during cementation. A subvastus approach was used in all cases. The patella was not resurfaced in any case. The femoral attachments of the collateral ligaments were released during the surgical exposure. This was performed in order to optimize surgical exposure while minimizing iatrogenic damage to the ligaments and surrounding bone. If necessary, the popliteus tendon was divided and the lateral head of the gastrocnemius divided in large fixed valgus deformities.

One dose of prophylactic antibiotics was administered and low-molecular-weight heparin was used for thromboprophylaxis. A suction drain was used for 48 hours after surgery in all cases. Patients were allowed to fully weight bear and mobilize on day 1 after surgery. Average length of stay was 14 days. The cemented long-stemmed Endo Model Rotating Hinge prosthesis without an anterior femoral flange (Waldemar Link) (Fig. 1) was used in all cases. At this time this was the prosthesis of choice in the senior author's institution. Patients were assessed preoperatively as well as 2 weeks, 6 weeks, and annually thereafter. Clinical outcome was assessed using the Hospital for Special Surgery (HSS) score. This score is domain-specific and examines range of motion and level of pain experienced by the patient as well as functional level (ability to perform activities of daily living). The maximum

Table 1. Patient Demographics

Variable	Baseline	Final follow-up
Number	280*	160*
Male : female	49 : 189	125 : 35
Mean age (range, yr)		67 (26–86)
Average ASA score (range)		3 (2–4)
Number of patients revised		19
Procedure other than revision		9
Diagnoses		
OA	208	136
Rheumatoid arthritis	12	7
Post traumatic OA	12	12
Osteonecrosis	3	3
Tumor	3	2

ASA: American Society of Anesthesiologists, OA: osteoarthritis.

*Deceased, 62; Lost to follow-up, 16.

score is 100. A score of < 50 is poor, 50–69 fair, 70–89 fair, and 90–100 excellent. Patient satisfaction was assessed using a visual analog scale with a rating system of poor, fair, good, and excellent.

Radiographic assessment was performed preoperatively and at each follow-up visit. Each radiographic image was reviewed by 2 surgeons (DK and TG) looking for signs of loosening at the bone prosthesis and cement prosthesis interface as well as alignment of the prosthesis. Signs of loosening were considered to be present if there was a radiolucent line at the cement prosthesis interface or the cement bone interface of the femoral or tibial components, which was greater than 2 mm, or if there were progressive radiolucent lines on serial radiographic examinations.¹¹⁾

RESULTS

Mean follow up was 13.5 years (range, 13–14.5 years). Sixty-two patients died due to causes unrelated to their knee operations. None of these patients had complaints relating to their replaced knee. Sixteen patients (9%) were lost to follow-up as they had emigrated prior to their 10-year follow-up. Up to the point at which they emigrated, they had no complaints regarding their operated knees. One hundred and sixty patients were thus available for clinical follow-up. Nineteen patients (12%) underwent a revision procedure.

Eighty-six patients (54%) reported excellent results and 32 (20%) reported good results. Fair and poor results were reported by 19 (12%) and 22 (14%) patients, respectively. Review of the results based on the visual analog scale for patient satisfaction revealed that 125 (78%) of patients reported excellent results, 25 (16%) reported good results, 5 (3%) reported fair and 5 (3%) reported poor results. There was no evidence of progressive radiolucent lines around any component, radiographic signs of loosening, or impending revisions at the time of final follow-up. Mean arc of flexion at final review was 118° (standard deviation, 20°).

Revisions

Nineteen patients underwent revision procedures. Of these, 6 (32%) were for patella wear requiring patella resurfacing and 5 (26%) required revision due to deep infection. Three (16%) required revision for mechanical failure of the rotating hinge mechanism, 2 (11%) for dissociation of the hinge mechanism, 1 (5%) for aseptic loosening, 1 (5%) for extensor mechanism disruption, and 1 (5%) for a traumatic femoral fracture. All patients in this group required either partial or complete exchange of their pro-

theses or addition of a patellar component.

Nine patients underwent further surgical procedures to the knee but did not have revision or exchange of TKA components. Three underwent patella debridement and denervation. Two underwent lateral release and medial plication for patella dislocation, 2 underwent excision of the inferior pole of the patella due to inferior pole fractures, one for open arthrolysis secondary to stiffness, and one for fixation of a distal femoral fracture.

The overall reoperation rate at the time of final follow-up including these 9 cases was 17.5%. The incidence of revision of the tibial or femoral component of the hinge, which was inserted at the primary procedure, was 7%.

Implant Survivorship

The overall survivorship at a mean of 13.5 years of follow-up was 88% with failure defined as a revision of the prosthesis for any reason (Fig. 2). When we analyzed revision rates based on the age of our population, we found that survivorship for those over 60 years of age was 94% at 13.5 years of follow-up. Survivorship over the same time period was 77% in those under 60 years (Fig. 3). We also examined survivorship in relation to preoperative limb alignment. Patients with a preoperative varus alignment had survivorship of 96% at 13.5 years compared to 79% at the same duration of follow-up in those with a preoperative valgus deformity (Fig. 4).

Component survivorship in patients who were under 60 years of age and had a preoperative valgus deformity was 64% at 13.5 years. There was no difference in survivorship based on sex, previous surgery to the re-

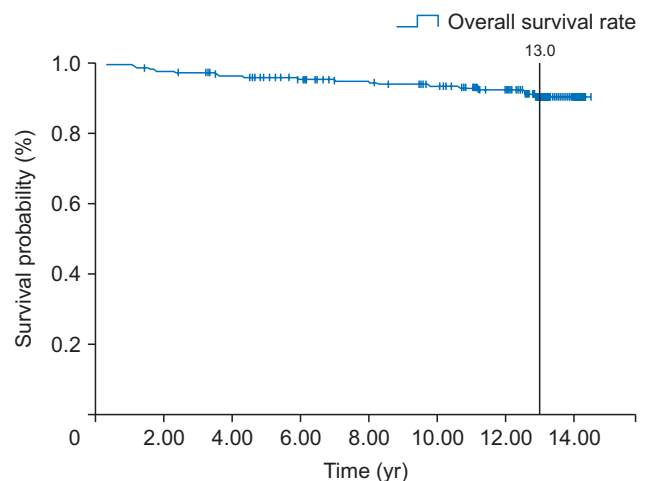


Fig. 2. Kaplan-Meier graph illustrating overall survivorship for the entire cohort. Patients who died or were lost to follow-up were censored. Survivorship at 13.5 year is 88%.

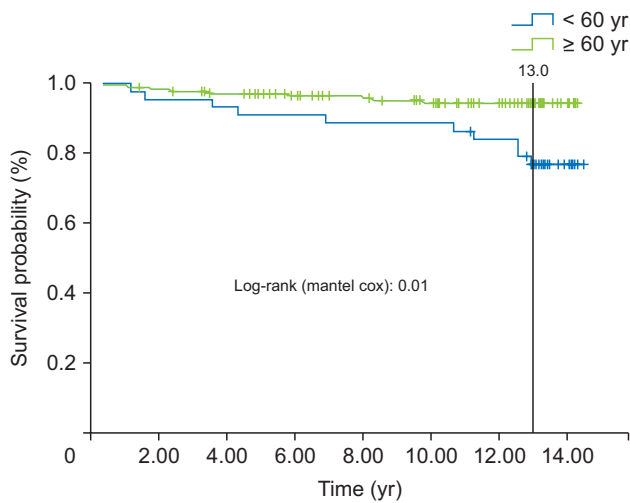


Fig. 3. Kaplan-Meier graph illustrating survivorship of patients based on age (< 60 and ≥ 60 yr).

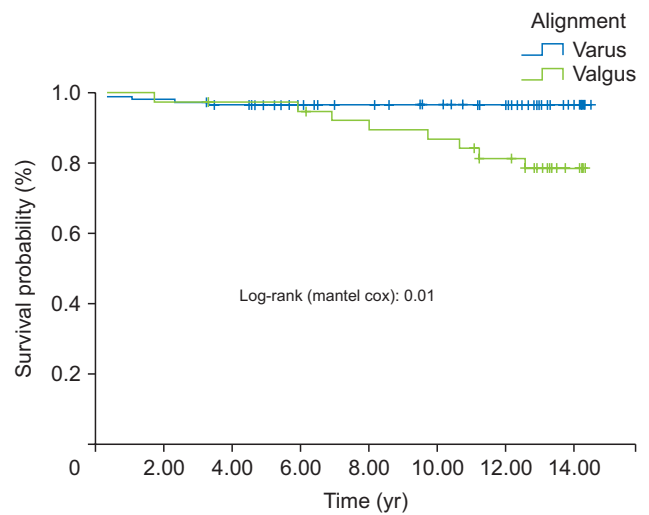


Fig. 4. Kaplan-Meier graph illustrating survivorship of patients based on preoperative knee alignment (varus and valgus).

placed knee (arthroscopies or meniscectomies), or the primary pathology (osteoarthritis, posttraumatic arthritis, or inflammatory arthritis).

DISCUSSION

The most important findings of this study are that when rotating hinges were used for primary TKA, the best results were achieved in patients over 60 years old with preoperative varus deformities. The main indications for the use of rotating hinged prostheses in primary TKA include advanced deformity, which is often associated with bone loss and ligamentous laxity. This design has been used extensively in the first author's institution.^{7,8)}

We were able to demonstrate in this series our 13-year results of the use of the rotating hinge prosthesis for primary TKA. The results of this study suggest that good or excellent clinical and radiographic results can be achieved in the majority of patients with the use of a rotating hinge prosthesis in primary TKA. This is reflected by an overall survival rate of 88% in our patient cohort. Most interestingly, the survival rate was found to be superior in patients with preexisting varus deformities in combination with a related age above 60 years at the time of surgery. This cohort revealed a survival rate of above 95% after 13 years.

In contrast to these findings, the combination of a valgus deformity with a relative young age of implantation (< 60 years) did show a survival rate of only 64% after the same time period. It is possible that in this younger, more active population, the forces acting on the hinge mecha-

nism and also the shear forces at the bone cement and prosthesis cement interfaces are higher leading to higher failure rates, but a clear reason has not been elucidated. Although our algorithm utilizing a rotating hinge implant in primary indications is rare in our current practice, we strictly avoid using a rotational hinge implant in younger patients with a severe valgus deformity and combined ligamentous instability. Based on these findings, we recommend the use of a fixed hinge implant in these patient groups in contrast to the literature.¹²⁾

The overall complication rate leading to any surgical revision was 11.5% after 13 years. This included an observed complication rate of 2% due to a deep infection and 3.5% due to secondary patellofemoral arthritis. This identified relevant patellofemoral limitation of the earlier implant design was based on the missing anterior femoral flange for an optimized patellar tracking. The design was subsequently changed to include an anterior flange for articulation with the patella. The current implant design has included this flange for the past 10 years. Over this time, we have observed that there has been a significant decrease in the incidence of symptomatic patellofemoral arthritis and need for secondary patella resurfacing.

The overall deep infection rate of 2% is consistent with most previous studies and with studies with comparable follow-up periods evaluating condylar unconstrained implants after 13 years. Based on the larger quantity of cement and intramedullary implant fixation, one might expect a higher infection rate, compared to "conventional" condylar type TKA implants. This, however, was not observed in our patient population and has been confirmed

by other authors and institutions. A study by Guenoun et al.¹³⁾ from 2009 revealed an unacceptably high complication rate of > 30% with the use of the rotating hinge prosthesis in primary indications and > 24% in revision cases. In addition, reported infection rates in these groups were significant with 11% in primary indications and 9% in revisions, respectively. Interestingly, the overall rate of aseptic loosening was found to be acceptable with 3.5% after 3 years of follow-up. The reasons for these findings are not clear. Such a reported high general complication rate needs to be monitored closely. It is possible that this is not related to a specific implant design.¹⁴⁻¹⁶⁾ Wear and osteolysis as in traditional TKA after 13 years were not found in our cohort.

Evaluating the clinical outcomes measures of our patients, most interestingly, we found inconsistency between the measured results of the HSS score and the patients' self-assessment.¹⁷⁾ While the HSS scores revealed over 20%

of patients had either fair or poor results, the patients' self-assessment revealed only 3% had fair and 3% had poor results with > 90 % having excellent and good results. Our study has some limitations. This was a retrospective evaluation with no available comparative patient or implant group¹⁸⁾ and 7% of all initial patients were lost to follow-up for various reasons. The results of this study suggest that good clinical and radiological results can be obtained with the use of rotating hinge prostheses in patients over 60 years of age and those with preoperative varus deformities. Survivorship is also encouraging in this group with the use of rotating hinge prostheses.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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