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Original Article

Revision knee arthroplasty with a rotating-hinge design in elderly patients with instability following total knee arthroplasty

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ABSTRACT

Background: Revision knee arthroplasty with a rotating-hinge design could be an option for the treatment of instability following total knee arthroplasty (TKA) in elderly patients.

Purpose: To evaluate the clinical and radiographic results of revision arthroplasties in TKAs with instability using a rotating-hinge design in elderly patients.

Methods: We retrospectively reviewed 96 rotating-hinge arthroplasties. The average age of the patients was 79 years (range, 75–86 years); the minimum follow-up was 5 years (mean, 7.3 years; range, 5–10 years). Patients were evaluated clinically (Knee Society score) and radiographically (position of prosthetic components, signs of loosening, bone loss).

Results: At a minimum followup of 5 years (mean, 7.3 years; range, 5–10 years), Knee Society pain scores improved from 37 preoperatively to 79 postoperatively, and function scores improved from 34 to 53. ROM improved on average from -15° of extension and 80° of flexion before surgery to -5° of extension and 120° of flexion at the last followup ($p = 0.03$). No loosening of implants was observed. Nonprogressive radiolucent lines were identified around the femoral and tibial components in 2 knees. One patient required reoperation because of a periprosthetic infection.

Conclusions: Revision arthroplasty with a rotating-hinge design provided substantial improvement in function and a reduction in pain in elderly patients with instability following TKA.

Level of evidence: Level IV, therapeutic study.

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1. Introduction

It has been reported that knee prosthesis instability is the third most frequent cause of failure of total knee arthroplasty (TKA). In fact, 10–22% of revision surgeries after TKA are due to

instability.^{1,2} Current rotating-hinge total knee prostheses may be used for the management of instability because they provide a more congruent articulation.^{3–12} However, the follow-up of the case series reported has usually been very short.

The purpose of this study is to report clinical, functional and radiographic outcome of 96 rotating-hinge prostheses

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performed in our center using a rotating-hinge prosthesis for elderly patients with instability following TKA, at a minimum followup of 5 years.

2. Materials and methods

In this retrospective study, we reviewed 96 elderly patients (72 women, 24 men), treated with revision total knee arthroplasty in cases in which the rotating-hinge prosthesis was used for gross instability following primary TKA. In all patients, the revision TKA implanted was the Waldemar-Link rotating-hinge prosthesis (Waldemar Link Spain, Barcelona, Spain).

The minimum followup was 5 years (mean, 7.3 years; range, 5–10 years). No patients were lost to followup.

The mean body mass index was 30 (range, 17–51). The average age of the patients was 79 years (range, 75–86). All procedures were performed through a medial parapatellar arthrotomy and under tourniquet control. We used tibial and femoral cementation in all knees. Antibiotic-impregnated cement containing gentamicin was used in all knees. All bone defects were filled with cement (Figs. 1 and 2).

In approaching our revision procedures, we always considered the planning of the incision over a previously operated site, the condition of the soft tissue, the functionality of the extensor mechanism, the extraction of the primary

Fig. 1 – A–D: AP (A) and lateral (B) radiographs show severe instability in NexGen prosthesis. AP (C) and lateral (D) radiographs show the knee 4 years after rotating-hinge arthroplasty.

Fig. 2 – A–D: AP (A) and lateral (B) radiographs show severe deformity with instability. AP (C) and lateral (D) radiographs show the knee 5 years after rotating-hinge arthroplasty.

prosthesis, and the preservation of bone stock. Our primary goals included the restoration of anatomical alignment and functional stability, the fixation of the revision implants, and the accurate reestablishment of the joint line. The specific objectives of our revision procedures were: 1) Establish a prosthetic platform on solid existing tibial bone stock. This provided a reference plane for evaluating the flexion and extension gaps. 2) Stabilize knee in flexion. The femoral component size that will stabilize the knee in flexion was chosen and, if needed, augmentation to fit the femoral condylar bone stock was determined. 3) Stabilize knee in extension. An acceptable position for the joint line was estimated. It aided in the determination of the proper articulating surface thickness, distal femoral position, and femoral size that will stabilize the knee in extension. 4) Determine

patellofemoral function. Once the gaps have been balanced, the proper position of the joint line was considered. If the joint line had been significantly raised or lowered, patellofemoral problems can be encountered. It may be advisable to consider changing femoral component size and distal/posterior augment selections to optimize patellofemoral function.

We always used cemented stems, titanium alloy augments to replace femoral bone defects from 20 mm to 160 mm, titanium and UHMWPE augments to replace tibial bone defects. The design allowed high stability in extension, elastic rotatory force transmission by design to protect the fixation, and straightforward implantation.

The postoperative management was similar for all patients and weight-bearing with two crutches was allowed at 48 h. Physical therapy was started after the second postoperative day.

We assessed the clinical outcome before surgery and at the time of latest followup using the Knee Society score (KSS). Anteroposterior (AP) and lateral radiographs of the knee were reviewed in detail postoperatively, at 1 month, 3 months, 6 months, 1 year and then every year until the last followup. The KSS was compiled by an independent physician.

Changes in the KSS and ROM were evaluated via Student's *t* test, and the level of significance was set at $p < 0.05$.

3. Results

Overall, knee functioning improved in our series. Sixty-three patients were walking with one crutch and another thirty-three with two crutches at the last followup. The KSS improved ($p < 0.001$) from 37 points on average before surgery to a postoperative mean of 79 points; the functional score improved ($p = 0.09$) from 34 points to 53 points. ROM improved from -15° of extension and 80° of flexion before surgery to -5° of extension and 120° of flexion at the last followup ($p = 0.03$). None of the patients' knee pain or function worsened.

In the radiographic evaluation, nonprogressive radiolucent lines (>2 mm) were found around the femoral and tibial platforms or stems in two knees. These lines remained stable throughout the study period. No loosening or subsidence was encountered.

Medical complications included postoperative confusion (two patients), pulmonary embolus (one patient), urinary tract infection (one patient), and worsening of chronic renal failure (one patient). These complications were managed on medical therapy guidelines. One patient showed a periprosthetic infection that was treated by means of a two-stage revision arthroplasty.

4. Discussion

A number of factors can cause instability following TKA. The main specific patient-related risk factors are the following: aggressive ligament release, quadriceps weakness inducing recurvatum, weak hip abductors, posterior tibial tendon rupture and pes planus. These deformities cause valgus overloading at the knee. Obesity is also a risk factor because it makes surgical exposure more difficult, jeopardizes the collateral ligaments (the rate of avulsion of the medial collateral ligament in obese patients can reach 8%) and makes it difficult to see component position.²

Instability of the knee usually can be prevented with an adequate selection of implants and a good surgical technique.¹³ PS (posteriorly stabilized) implants must be used in patients with PCL insufficiency and in those with a high risk of posterior instability (rheumatoid arthritis, previous patellectomy or the need to resect the PCL to correct a ligamentous imbalance, flexion contracture or previous tibial osteotomy). A good balance of soft tissues and the correct implantation of the components in every plane, including the rotation of the femoral component, are paramount to get symmetric spaces on flexion and extension.

Malalignment and gap imbalance will ultimately destroy any constrained device, hinged or nonhinged by breakage or

loosening. That is why revision surgery for instability must include: correction of the mechanical axis of the limb; equalization of the flexion and extension gaps; assessment of ligament integrity and; availability of constrained implants as necessary.² When facing a primary TKA with gross instability in an elderly patient a rotating-hinge design must be indicated.^{3,12,14}

The main indications for a rotating-hinge revision arthroplasty are the following: medial or lateral collateral insufficiency, massive bone loss including the femoral condyles and the origins or insertions of the collateral ligaments, and severe flexion gap imbalance. Orthopaedic surgeons should always have the option of modifying the degree of constraint at the time of surgical intervention. Currently, many TKA implant systems offer such option.^{15,16}

Unfortunately, the literature does not clarify which design is most appropriate for an unstable primary TKA. Future studies should define the rates of recurrent instability after revision using implants with various degrees of constraint. Generally speaking, it is advised that the minimum amount of constraint needed to achieve stability should be used.¹³ With many types of designs and degrees of constraint, it can be a very difficult to select the ideal implant for a given patient. We must have the option of changing the degree of constraint during the surgical procedure. Nowadays, many TKA implant systems offer such possibility.

Rotating-hinge total knee prostheses may be used for the treatment of severe instability after a primary TKA. Our study has a main limitation: it is retrospective and noncontrolled.

It seems that a rotating-hinge prosthesis is a good option for ligamentous deficiencies in revision surgery in elderly patient. We found an improvement in function, pain, and ROM of the knee. No patient got worse compared with preoperative status. Postoperative radiographs showed nonprogressive radiolucent lines in only two knees. No loosening or subsidence of prostheses was encountered at followup. Despite the high mean age of the patients, medical complications were rare. Regarding orthopaedic complications, we observed only one periprosthetic infection.

The results and complications of the rotating-hinge TKA reported in the literature have been heterogeneous. Comparisons among rotating-hinge reports are difficult because they used different types of prostheses.^{2,3,5–13,17–20}

In conclusion, revision with a rotating-hinge prosthesis provided substantial improvement in function and a reduction in elderly patients with gross instability following TKA.

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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