Medium-term results with a primary cemented rotating-hinge total knee replacement
A 7- TO 15-YEAR FOLLOW-UP

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We reviewed 100 cemented Endo-model rotating-hinge (Waldemar Link GMBH & Co, Hamburg, Germany) total knee replacements in 80 patients with a mean age of 70 years (56 to 85) at a mean post-operative follow-up of 11 years (7 to 15). Good or excellent results were seen in 91% of knees and survival at 15 years was 96.1%. There were two deep infections, one dislocation and one supracondylar fracture. There were no peri-operative deaths and there was no loosening, malalignment, migration or wear.

We consider this prosthesis to be ideally suited for the replacement of the deformed knee when the use of an unconstrained design may be questionable.

A rotating-hinge total knee replacement (TKR) attempts to deal with deformed and destroyed knees with serious bony and ligamentous defects (Fig. 1). If unconstrained prostheses are used in such cases, a number of problems may occur. These include inadequate alignment,1-3 poor soft-tissue balance,4,5 post-operative instability6 and other longer term complications.7-9

Because of problems associated with a fixed-hinge design, developers have introduced a flexing and rotating system which aims to avoid the torsional stresses that may lead to loosening of the prosthesis.10,11 The rotating capacity of a modern replacement also helps to avoid the patellofemoral instability which has been reported.12 Hinged replacements are more prone to infection which may result in substantial loss of bone stock and serious consequences. A contributing factor to this is the large volume of implanted foreign material in rotating-hinge designs. We have routinely used the cemented, long-stemmed Endo-model rotating-hinge TKR (Waldemar Link GMBH & Co, Hamburg, Germany) for 15 years and present our medium-term results.

Patients and Methods
Between 1987 and 1995, we performed 105 TKRs using a rotating-hinge prosthesis. We were able to review 100 knees (80 patients) at a mean follow-up of 11 years (7 to 15). Twenty patients had had bilateral surgery. Five died from unrelated causes before the minimum follow-up period of seven years and were excluded from this survey. Six died from unrelated causes after the minimum follow-up period and were included. Of the 105 TKRs 94 were in women and 11 in men, with a mean age of 70 years (56 to 85). The underlying diagnosis was osteoarthritis in 86 (86%), rheumatoid arthritis in nine (9%), osteonecrosis in four (4%) and degenerative changes secondary to tuberculosis in one (1%).

In the design of rotating hinge which we used (Fig. 2), an anterior femoral flange was not included, although this was available if required. The prosthesis has antitorsional, antitilt and antimigration properties. The ability to rotate gives secure bonding at the interfaces. The central flexion-rotation system, which can be converted to an antisubluxation system, controls movement and stability. It also avoids sliding and shares load with the tibial polyethylene spacer. The femoral and tibial components are connected through a tibial guide pin and a femoral bushing.

The patella was not replaced and a lateral release only undertaken when necessary. An en bloc detachment of the femoral insertion of the collateral ligaments, posterior capsule, popliteus and lateral portion of the origin of gastrocnemius was performed.

Half of the procedures were carried out by the senior author (GP) and half by trainees. A standard operating theatre was used. A prophylactic, second-generation cephalosporin was used peri-operatively and for two days post-operatively. Thromboprophylaxis was with low-molecular-weight heparin adminis-
tered peri- and post-operatively for two weeks. A tourniquet was not used\(^\text{13}\) and spinal rather than general anaesthesia was preferred.\(^\text{14}\) A suction drain was retained until the second post-operative day. The mean volume of blood transfusion was 1200 ml and the mean duration of operation was 120 minutes.

Active exercises began on the first post-operative day, although passive knee flexion was kept to a maximum of 40° until five days after surgery in order to maintain oxygenation of the skin and to protect the retinacular sutures. Full weight-bearing, supported by crutches, was allowed on the third post-operative day. The patients were discharged soon after the second week.

We used the clinical rating system of the Hospital for Special Surgery\(^\text{15}\) and the clinical\(^\text{16}\) and radiological\(^\text{17}\) scoring systems of the Knee Society. For patellofemoral status we used the Outerbridge grading system\(^\text{18}\) and, for patellofemoral alignment a modification of the system of Laurin, Dussault and Levesque.\(^\text{19}\) We used the scale of Stern and Insall\(^\text{20}\) to assess anterior knee pain and graded the patients’ opinions with regard to patellofemoral symptoms by using a scale described by Barrack et al.\(^\text{21}\)

**Results**

**Clinical findings.** There was a substantial change between the pre- and post-operative performance as reflected in the Knee Society score, although the functional score was less impressive (Table I). The mean post-operative range of knee flexion was 120° (100 to 130). Only one patient required a post-operative manipulation. There was no evidence of post-operative tibiofemoral instability. The results in rheumatoid knees were less good than those in osteoarthritic knees and patellofemoral problems were a feature. In three rheumatoid knees, flexion was limited to 100°, with a residual lack of extension of 5°. In seven other knees, there was some lack of extension which was ascribed to malpositioning of the femoral component in slight flexion but without patellofemoral disturbances. Only two knees required a lateral release. Table II shows patellar alignment and the ability of patients to use stairs after surgery. By the two-year review, pain had decreased by three Barrack points and all except six patients were able to use stairs. These six patients had grade-IV patellar malalignment as judged by the modified classification of Laurin et al.\(^\text{19}\) Three had rheumatoid arthritis. There was no change in the incidence of patellofemoral symptoms after the second post-operative year. Six patients had patellar maltracking. Three had a good result as judged by the Hospital for Special Surgery knee score (Table III) and three had a fair result. There were no post-operative deaths, no revisions for loosening and no late infections.

**Radiological findings.** The tibiofemoral alignment of all knees was corrected at surgery to the built-in prosthetic angle of 6° of valgus and there was no evidence of any change in this alignment with time. Any subsequent reduction in patellar thickness was associated with either rheumatoid arthritis, osteoporosis or patellofemoral malalignment. From the plain post-operative radiographs we could find no evidence of migration of the prosthesis and were unable to assess rotation. Radiolucencies were seen in ten knees (10%) but were not sclerotic or progressive and always less than 1 mm in thickness. No difference was seen between the bone densities of the medial and lateral femoral condyles. When there was rarefaction, it was evenly dis-
tributed and attributed to underlying rheumatoid arthritis or osteoporosis. Occasionally, some increased bone density was seen around the stems of the components but no evidence of cortical hyperostosis was found. Wear of polyethylene, as assessed from plain radiographs, was insignificant.

Complications. Deep-vein thrombosis developed in three cases, limited skin necrosis in two, subcutaneous haematoma in five, intra-operative femoral fracture in two, intra-operative tibial fracture in two and early infection in two. The infections, both due to Staphylococcus aureus, did not respond to debridement and a subsequent arthrodesis was therefore performed. After this salvage surgery, both knees were free from infection and stable at ten and 14 years, respectively. Other complications included a painless synovitis in three knees, traumatic dislocation of the prosthesis in one, supracondylar femoral fracture in one, and patellar maltracking in six.

Survivorship analysis. This showed survival of 98% (95% confidence interval (CI) 95.5 to 100) at one year and of 96.1% (95% CI 92.2 to 99.9) at two years after surgery. Survival rates then remained stable until the end of our follow-up period (15 years). Failure was defined as revision for any cause and included infection (two knees), dislocation (one knee) and peri-prosthetic fracture (one knee). Survival was not influenced by diagnosis, age or body-weight. It was affected by gender, with knees in women having a better survival than those in men. If the five knees which had been lost to follow-up were assumed to be failures, the survival at 12 years decreased to 80.3% with 95% CI (68.6 to 94.1).

Discussion
Although we have abandoned the use of cement for total hip replacement surgery we continue to use it for TKR. A large quantity of cement is required when using a rotating-hinge knee replacement but it appears to give good fixation and stability with excellent results. Although the cement was inserted manually we did not find any evidence of loosening or migration of the components. This is in contrast to some multi-centre studies which have reported a rate of revision of 8% at ten years, 46% of which are for aseptic loosening. Early migration of the tibial component can be a problem, particularly with unconstrained TKRs. However, in our series there were no migrations, even in the

| Table I. | Mean (range) Knee Society scores for the patients |
|------------------|------------------|------------------|------------------|
| Patient category* | Number of knees† | Knee score | Functional score |
|                  |                  | Pre-operative | Post-operative | Pre-operative | Post-operative |
| A                 | 44               | 13.4 (0 to 46) | 95.3 (90 to 110) | 22.4 (0 to 50) | 84.2 (70 to 100) |
| B                 | 26               | 12.7 (0 to 31) | 93.6 (87 to 99)  | 22.1 (0 to 50) | 71.3 (60 to 80)  |
| C                 | 27               | 8 (0 to 38)    | 91.2 (75 to 99)  | 14.6 (0 to 40) | 53.6 (15 to 90)  |
| Total             | 97               | 11.4 (0 to 46) | 93.4 (75 to 100) | 18.7 (0 to 50) | 69.7 (15 to 100) |

* A, unilateral or bilateral (opposite knee successfully replaced); B, unilateral, other knee symptomatic; C, multiple arthritis or medical infirmity
† excludes three failures

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<tr>
<th>Table II. Ability of patients to use stairs after surgery correlated to patellofemoral joint (PFJ) and patellar alignment</th>
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<tbody>
<tr>
<td>Grade*</td>
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<tr>
<td>A; No symptoms; Able to use stairs</td>
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<tr>
<td>Grade I; Mild symptoms; Able to use stairs</td>
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<tr>
<td>Grade II; Severe symptoms; Unable to use stairs</td>
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<tr>
<td>Total</td>
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* ability of patients to use the stairs according to the scale of Stern and Insall‡
† according to Laurin et al: grade I, normal alignment; grade II, patellar shift; grade III, patellar tilt; and grade IV, patellar shift and tilt
‡ excludes three failures grading system modified

| Table III. Hospital for Special Surgery (HSS) knee scores in 100 knees |
|--------------------------|--------------------------|--------------------------|
| Knee score                | Number of knees          | Comments                  |
| Excellent (85 to 100)     | 70                       | Three patients with patellar maltracking included |
| Good (70 to 84)           | 21                       | Three patients with patellar maltracking included |
| Fair (60 to 69)           | 6                        | Failed fracture fixation (one patient) Infection with subsequent arthrodesis (two patients) |
| Poor (0 to 59)            | 3                        |                          |

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presence of osteoporosis or rheumatoid arthritis. Any bone grafts or cement which we had used to fill bone defects retained their integrity. Demarcations were minimal despite these being a significant problem reported elsewhere in the literature. Wear and osteolysis recognised problems of TKR were not seen in our series. The total infection rate (2%) is similar to that reported elsewhere and there were no late infections.

Our results with this prosthesis appear to match those using so-called ‘gold standard’ unconstrained components in which good and excellent results have been reported in 83% to 94% of patients. Our results are also comparable to those reported by other large or multicentre studies. The mean range of post-operative flexion (120°) is within the range to be expected after an unconstrained TKR.

Other authors have published excellent long-term results with the Endo-model rotating-hinge TKR. Although we have used the prosthesis in some younger patients, we would not advocate it as a routine procedure when a condylar prosthesis could be inserted. We do not replace the patella, although we do pay attention to correct patellofemoral alignment and patellar tracking. Patellar replacement does not guarantee the elimination of anterior knee pain and complications can be associated with it. We disagree with Kajino et al, who stated that patellofemoral pain occurs without patellar replacement, even with correct patellar tracking. However, they studied rheumatoid knees, whereas the knees in our series were mostly osteoarthritic. The literature has identified a number of causes for patellofemoral pain, including patella maltracking, patellar subluxation, and chondromalacia.

We found the subvastus approach to be essential in order to perform proper patellar alignment and tracking. In order to achieve proper patellar alignment and tracking we followed the guidance of several authors. We found the subvastus approach to be essential in order to retain an adequate dynamic quadriiceps balance. This avoids the need for a subsequent lateral retinacular release. Although we only performed two lateral releases some patients had patellar malalignment after surgery and may have benefited from a lateral release. It is thus our view that a lateral release should be considered and should most certainly be performed in the presence of patellar subluxation.

In summary, we have found the Endo-model rotating-hinge knee replacement to be ideally suited for the deformed or malaligned knee with, perhaps, serious bony and ligamentous defects. It has allowed us to correct such deformities effectively and prosthetic fixation, alignment, range of movement and survival have been excellent.

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.

References


