The Rotaglide mobile bearing knee arthroplasty
A 10- to 13-year review from an independent centre

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ABSTRACT

The Rotaglide knee arthroplasty has a highly congruent mobile meniscal bearing allowing both rotation and antero-posterior translation. We reviewed 137 consecutive primary arthroplasties in 120 patients at mean 11.1 years (10.9–11.9) following surgery. No cases were lost to follow-up. Hospital for Special Surgery (HSS) and American Knee Society (AKSS) scores were recorded at a review clinic. Radiographs were assessed using the Knee Society’s roentgenographic evaluation system. Forty-two patients had died, leaving 78 patients (87 knees) available for review. Sixty-four patients (70 knees) were assessed at a clinic and in 14 (17 knees) clinical outcomes were obtained via telephone and their most recent radiographs were assessed. There were three cases of aseptic loosening and one deep infection requiring revision surgery. Two meniscal bearings were replaced with thicker inserts, one following bearing fracture and one following bearing dislocation. Survival at 11 years for aseptic loosening was 97.6% (95% CI 94.3 to 1.0) and survival using re-operation for any cause was 95.3% (95% CI 90.8 to 99.8). The Rotaglide mobile-bearing total knee replacement demonstrates good survivorship and outcome scores at 11 years following surgery.

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1. Introduction

Although total knee replacement (TKR) with fixed bearing implants has been shown to produce good long-term results [1–3], concerns about polyethylene wear and aseptic loosening have been reported with some fixed implants [4–7]. Mobile bearing designs attempt to address these issues by improving congruity between the femoral component and its polyethylene insert throughout the knees range of motion, reducing stress at the bone-implant interface and contact stress within the polyethylene bearing, with a resultant reduction in wear [8].

The Rotaglide total knee arthroplasty (Corin Ltd, Cirencester) is a highly congruent, fully mobile prosthesis. Its mobile polyethylene meniscal bearing, by allowing both rotation and anteroposterior translation, aims to more closely approximate the movements of the natural knee than the fixed-bearing devices (Fig. 1). The Rotaglide TKR has been shown to function well in all ages of patient in the short to medium term (maximum mean follow-up of 8.5 years) with survival rates and outcome scores equal or better than that of other implants [9–11]. The theoretical advantages of the mobile design over fixed bearing devices may however only be fully born out with longer-term follow-up studies. We present the first long term follow-up of the Rotaglide mobile bearing implant.

2. Patients and methods

Between September 1994 and October 1997 120 patients (137 knees) underwent primary total knee replacement with the Rotaglide mobile bearing knee arthroplasty in our department. All surgery was performed by two senior surgeons or by trainees under their direct supervision. All the knees were implanted using a midline incision and medial parapatella approach, using manual alignment instruments and cemented [PALACOS (Heraeus Medical, Wehrheim, Germany) with Gentamicin] in situ. The patella was routinely resurfaced in all cases by one surgeon and conversely not routinely resurfaced by the other.

The fate of all knees was known, with no cases lost to follow-up. The case notes and radiographs from the most recent follow up were assessed for those who had deceased. All surviving patients were invited to attend a routine review at a dedicated clinic. Those unable to attend were interviewed via telephone and their most recent radiographs were assessed. Patients were assessed clinically and radiographically by a senior arthroplasty nurse (KB). The Hospital for Special Surgery (HSS) [12] and American Knee Society (AKSS) [13] scores were recorded. Routine standard radiographs; weight-bearing anteroposterior and lateral were performed. Care was taken to standardise the lower limb rotation while obtaining radiographs. The radiographs were assessed to ensure they were of adequate technical quality and between subsequent follow-up films to ensure similar limb rotation had been achieved, and only good-quality radiographs were accepted. Radiographs were assessed for the presence of radiolucent lines at the bone cement interface of the three.
components using the Knee Society’s roentgenographic evaluation system [14] (Fig. 2). Earlier radiographs were compared to assess for progressive lucency.

3. Statistical method

For analysis purposes the experimental unit was a knee. Comparisons for AKSS pain scores, AKSS function scores, combined AKSS scores and HSS scores using the Mann–Whitney test were performed between groups with and without lucent lines on follow-up radiographs. Analyses were done using Minitab (version 15) with a significance level of 5%.

A Kaplan–Meier [15] survival analysis was conducted on the sample using revision of any of the components as the endpoint. Survival analysis was also performed using revision due to aseptic loosening alone as the criteria. Patients who had died were recorded as censored data.

4. Results

The fate of all 120 patients (137 knees) is known, with no cases lost to follow-up. At time of the review 42 patients had died, representing a typical mortality rate for a cohort of elderly arthroplasty patients [2,3,16]. The mean elapsed time between their last clinical review and date of death was 15 months (2–47). This left 78 patients (87 knees) available for review at mean 11.1 years (10–12.9). Of the initial study group four had undergone full revision surgery, three for aseptic loosening and one for deep infection. One of the revision patients had died with three still alive, available for review. Sixty-four patients (70 knees) were assessed at a clinic and in 14 (17 knees) clinical outcomes were obtained via telephone and their most recent radiographs were assessed. None were awaiting revision surgery.

Of the initial group there were 57 male patients (67 knees) to 63 female patients (70 knees) with a mean age at time of surgery of 69 years (38–88). Mean age at review was 80 (49–100). Mean follow-up was 11.1 years (10–12.9). The primary diagnoses were osteoarthritis in 122 out of 137 knees (89.1%) and rheumatoid arthritis in 15 out of 137 (10.9%).

Mean AKSS combining clinical and functional scores at 11.1 years was 155 (50–200), with a pain score component of 88 (40–100) and a functional score of 66 (0–100). Mean HSS at the same time point was 67 (18–100). The mean range of motion in the replaced knee was 96° (35–130) at 11.1 years post-surgery. The above knee scores at the final follow-up were compared for those who had undergone routine patella resurfacing at the time of primary TKR versus those who had not. No significant difference was noted.

4.1. Implant survival/revision procedures

Six out of 137 knees had undergone revision surgery for any cause, giving an 11-year survival of 95.3% (95% CI 90.8 to 99.8) (Fig. 3). Survival analysis using implant failure due to aseptic loosening (three revisions) showed an 11-year survival of 97.6% (95% CI 94.3 to 1.0) (Fig. 4). For the three cases of aseptic loosening; one occurred at 38 months in which all components were loose and one occurred at 66 months with a loose tibia only. One was revised at 55 months following a traumatic supracondylar fracture when the tibia was found to be loose at time of surgery. There was one case of deep infection (20 months) requiring a two-stage revision. Two knees had the meniscal bearing replaced; one following a fracture of the polyethylene bearing and one following bearing dislocation. Both knees were felt to be lax in flexion at the time of revision surgery requiring insertion of a thicker polyethylene bearing. Both have gone on to satisfactory longer-term outcomes. There was one case of secondary patella resurfacing alone (47 months) and one patient known to have radiographic evidence of aseptic loosening (132 months) that did not wish surgery. There were no cases of bearing exchange for polyethylene wear.

For the purposes of this study we defined a poor outcome as judged by a clinical score as a combined AKSS < 100 out of a potential 200 points. Three out of 87 knees (3.4%) were identified with a mean score of 76.7 (50–95). The mean age at follow-up was 85.3 (81–88). Two patients were wheelchair bound, one due to a generalised severe osteoarthritis and the other due to an advanced rheumatoid arthritis, accounting for their poor score rather than a direct result of the replaced knee. The other, an 88 year old female, had no specific issues related to the knee with normal radiographs.

but was mobilised with a cane due to generalised poor mobility. Function was scored as zero, zero and 50 out of 100 respectively.

4.2. Radiological assessment

Radiographic evidence of lucent lines below the tibial tray was present in 31.3% cases (40 out of 128 radiographs) at mean 11.1 years post surgery, in Fig. 5. Ninety-two percent was medial (AP zones 1 and 2), with depth less than 1 mm in 46%, <2 mm in 25%, <3 mm in 13% and <4 mm in 8%. Sixty-nine percent was anterior (lateral zone 1) and <1 mm in 51% or <2 mm in 49%. When compared to the 5-year review films it had progressed (by 1 mm) in three cases, four showed a new lucent line not previously seen, with the remainder unchanged. Outcomes were compared between groups with and without radiographic evidence of lucency and there was no difference in the mean scores between groups (combined AKSS score p = 0.631, HSS score p = 0.018).

5. Discussion

The Rotaglide TKR performs well in the short to medium term with a maximum mean follow-up to date of 8.5 years [9–11]. We present the first long term results of this mobile bearing implant. Six out of 137 knees had undergone revision surgery for any cause giving an 11-year survival of 95.3%, while survival with failure due to aseptic loosening alone (three revisions) was 97.6% at 11-years.

The Rotaglide mobile-bearing TKR allows 5 mm of anteroposterior translation and a rotational component of 12.5° on either side of the midline. This allows a more anatomical translation during knee flexion and permits lateral rollback [11,17]. Two metal pegs on the superior surface of the tibial tray prevent bearing dislocation. The superior surface of the bearing is spherical allowing congruent articulation throughout the range of motion; the inferior surface is highly polished and flat. Both surfaces aim to reduce contact stress and subsequently reduce polyethylene wear debris [11]. This may address some of the concerns about polyethylene wear and aseptic loosening that have been reported with some fixed bearing implant designs [4–7].

The Rotaglide TKR has been shown to function well in all ages of patient, in the short to medium term [9–11]. Previous work from this unit reported a five year survival including revision for any cause of 97.4% [9]. A review of the Rotaglide used in 63 young active patients (80 knees) with a mean age at time of surgery of 50.7 years, showed survival rates of 96% at mean 7.3 years, taking revision for any cause [11]. The previous longest follow-up of the Rotaglide TKR, in 77 patients (85 knees) demonstrated survival rates of 93.5% for all component revisions and 89.7% if they included re-operation of any type, at a mean follow-up of 8.5 years [10]. Our study demonstrates good survival at 11 years, which is comparable to the published results from other implants [1–3,18,19].

All patients in our series received the same mobile bearing TKR and therefore, from this study alone, we cannot draw any conclusions on the benefits that the Rotaglide may have over its fixed bearing counterparts. We know of one randomised control trial of this implant with an identical but fixed bearing device which showed no difference in clinical outcome between designs at two year follow-up [20]. However, perhaps...
the theoretical advantages of the mobile bearing (improved stress distribution, less force at the bone-implant interface and decreased polyethylene wear [21]) may only become apparent with time. This study adds to the body of evidence demonstrating good performance of the mobile bearing design in the longer-term.

This implant displays good knee scores at mean 11.1 years, comparable with other implant designs at the similar length of follow-up [1,6,19,22]. It is worth noting that the mean age at final follow up is 80 years old, as it has been repeatedly shown that scores, particularly functional scores, will naturally diminish with advancing age [23,24]. This reflects our mean functional component of the AKSS being lower than the pain component.

In the 5-year review from our centre we reported a 30.8% incidence of radiographic evidence of lucency (predominantly in zones 1–4 below the tibial tray) [9]. This incidence has remained similar, 31.3% at 11.1 years. There has been little progression observed, with a progression of 1 mm in three cases over a 5-year period of radiographic review. Furthermore, there was no significant difference in scores between groups when outcome was compared with those in whom no lucent lines were present. Our findings differ to those reported for the same implant, from the designing centre, used in younger patients, reported as showing no radiolucent lines at 7.3 years [11]. Other studies have reported similar rates of lucent lines to ours both in mobile (25%) and fixed (30%) cemented TKR [1]. This finding is therefore of interest but it does not appear to represent a progressive process and has not been associated with a worse outcome or revision to date.

Some authors have reported concern about increased polyethylene wear of the lower surface “backside wear” in mobile bearing designs of knee replacement as a result of motion between the metal modular tibial tray and the polyethylene insert [25]. There were no apparent clinical concerns relating to this potential problem noted in this series.

With any mobile bearing knee replacement dislocation of the bearing is a potential problem, with reported rates of 1.2–2.5% in other series [18,19,26–28]. In our study there was one dislocation (incidence 0.7%). This 64 year old gentleman developed sudden pain when walking, radiographs confirmed meniscal dislocation. At time of surgery the knee was found to be lax in flexion, good stability was achieved by inserting a thicker insert. One 66 year old gentleman had mild pain in his knee for 4 weeks; he then developed increased pain in the knee following a fall. Radiographic assessment revealed that the bearing had fractured, the exact cause of which was unknown. Revision surgery simply required polyethylene exchange with a thicker insert achieving good stability. Both cases have achieved a satisfactory long term outcome. It is likely that failure to achieve a proper flexion extension balance may be a significant causal factor responsible for developing instability of the meniscal bearings [27].

We had no cases requiring bearing exchange for wear, which has been reported in other mobile bearing series, with a typical incidence of 2.4–2.9% [18,19].

The Rotaglide TKR demonstrates good survivorship, 97.6% at 11 years. This fully mobile meniscal bearing implant produces good long-term results, with survival rates and outcome scores equal than that of other mobile or fixed bearing implants.

Conflicts of interest statement

The authors declare there are no conflicts of interest.

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References