Survivorship of the St Georg Sled medial unicompartmental knee replacement beyond ten years

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There have been several reports of good survivorship and excellent function at ten years with fixed-bearing unicompartmental knee replacement. However, little is known about survival beyond ten years.

From the Bristol database of over 4000 knee replacements, we identified 203 St Georg Sled unicompartmental knee replacements (174 patients) which had already survived ten years. The mean age of the patients at surgery was 67.1 years (35.7 to 85) with 67 (38.5%) being under 65 years at the time of surgery. They were reviewed at a mean of 14.8 years (10 to 29.4) from surgery to determine survivorship and function. There were 99 knees followed up for 15 years, 21 for 20 years and four for 25 years. The remainder failed, were withdrawn, or the patient had died.

In 58 patients (69 knees) the implant was *in situ* at the time of death. Revision was undertaken in 16 knees (7.9%) at a mean of 13 years (10.2 to 21.6) after operation. In seven knees (3.4%) this was for progression of arthritis, in three (1.5%) for wear of polyethylene, in four (2%) for tibial loosening, in two (1%) for fracture of the femoral component and in two (1%) for infection. Two knees (1%) were revised for more than one reason.

The mean Bristol knee score of the surviving knees fell from 86 (34 to 100) to 79 (42 to 100) during the second decade. Survivorship to 20 years was 85.9% (95% CI 82.9% to 88.9%) and at 25 years was 80% (95% CI 70.2% to 89.8%). Satisfactory survival of a fixed-bearing unicompartmental knee replacement can be achieved into the second decade and beyond.

There are now many reports of the good results obtained with the use of unicompartmental knee replacement (UKR) during the first decade,[1-9] and it seems that with the appropriate selection of patients and modern surgical techniques, the discouraging early reports of over 25 years ago can be ignored.[10,11] Comparison of UKR with tibial osteotomy[12] and total knee replacement has previously been described.[13,14] However, there remains a perception that UKR does not last satisfactorily beyond the first ten years. To our knowledge there have been only five small series reported with a follow-up exceeding ten years, four with a fixed-bearing knee[15-18] and one with a mobile-bearing device.[19] They showed excellent survivorship in the early part of the second decade. The only study to report results beyond 20 years[17] included a mixture of medial and lateral UKRs. In a large series of patients we have therefore attempted to establish the rate of failure of a well-tried fixed-bearing medial UKR with a follow-up of 10 to 29 years.

Patients and Methods

Between November 1, 1974 and December 23, 1994, 497 medial UKRs were performed on 413 patients. By October 2005, 174 of these patients (203 knees) were known to have had their original prosthesis *in situ* for at least ten years. This series of 203 knees forms the material for our study.

The St Georg Sled prosthesis (Waldemar-Link, Hamburg, Germany) was used in all patients. It has a flat all-polyethylene tibial component with a biconvex femoral component (Fig. 1). All were cemented.

The indications were arthritis affecting principally the medial compartment of the knee, less than 15° of fixed-flexion deformity and less than 15° of varus alignment in the coronal plane with intact ligaments. Patients were excluded if they had medial or lateral subluxation greater than 0.5 cm or deficiency of the anterior cruciate ligament. Asymptomatic narrowing of the joint space or the presence of osteophytes in either of the other two compartments was not considered to be a contraindica-

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tion.[20] The patients' weight and age were not considered as excluding factors. The early results, indications and complications have previously been published.[21]

Most of the patients had osteoarthritis, with only small numbers having rheumatoid arthritis, post-traumatic arthritis, avascular necrosis or crystal arthropathy (Table I). There were 110 women and 64 men with a mean age at the time of the initial procedure of 67.1 years (35.7 to 85.9). Of these patients, 67 (38.5%) were under 65 years of age at the time of surgery. Bilateral procedures had been performed on 29 patients of whom 23 had simultaneous procedures.

All patients had been followed up regularly during the first ten years after surgery, and subsequent reviews were carried out at 10, 12, 15, 18, 20, 22 and 25 years from the initial procedure. Patients were usually seen in a designated research clinic and were assessed by a research nurse. All completed the Bristol knee score[22] which allows separate assessment of pain, overall function, knee movement, deformity and stability with a maximum available score of 100 points.

Radiographs were taken at each interval to monitor the knee for signs of failure, such as movement of the prosthesis, fracture of the cement or the component, and progressing arthritis. Six patients were too elderly and infirm to attend the clinic. They were either assessed in their nursing home by the research nurse or contacted by telephone to determine whether the original implant was still surviving.

Revision was the final determinant of survivorship although patients recording severe pain on the Bristol knee score were also regarded as failures. Survivorship tables and a Kaplan-Meier survivorship analysis with 95% confidence intervals (CI) were constructed.

A secondary study was performed on the knees of those patients who were seen clinically, to determine the rate of deterioration of the knee during the second decade after surgery and to determine the current state of the knee.

Fig. 1a

Fig. 1b

Figure 1a – Diagram of the St Georg Sled femoral component before 1990. Note the narrow angular fins and cross bars. Figure 1b – Photograph of the current device which has round pegs and a small fin. This was introduced in 1990 and no fractures have been associated with its use.

Results

Between 1974 and 2005, only nine patients were lost to follow-up. The mean time to the last follow-up for the 203 knees with implants *in situ* for more than ten years was 14.8 years (10 to 29.4). Of these, 69 were in patients who had died during the second or third decade with their prosthesis *in situ* and functioning well at the last review.

Only 16 of the 203 knees (7.9%) subsequently required revision. The rates of revision during the two- or three-year review intervals across the second decade were 3.1%, 4.9%, 0.0%, 6.1%, 5.9% and 0.0% giving an overall revision rate of 1.6% per year which is similar to that previously reported during the first decade.[21] Survivorship for the group was 85.9% (95% CI 82.9% to 88.9%) between 18 and 20 years, which fell to 80.0% (95% CI 70.2% to 89.8%) from 20 years (Table II; Fig. 2).

Revision. In the 16 knees which required revision the reasons included progression of arthritis in another compartment (7, 3.4%), wear of polyethylene (3, 1.5%), tibial

Table I. Details of the 203 knees (174 patients)

Mean age (range) at UKR* in yrs	67.1 (35.7 to 85.9)
Number of patients < 65 yrs at time of surgery (%)	67 (*38.5*)
Gender (%)	
Male	64 (*37*)
Female	110 (*63*)
Pre-operative Bristol knee scores	
Pain	13.0/40
Function	15.5/27
Movement	16.7/20
Deformity	7.6/10
Stability	2.0/3
Total	54.8/100
Diagnosis (%)	
Osteoarthritis	155 (*91.2*)
Rheumatoid arthritis	4 (*2.4*)
Post-traumatic arthritis	3 (*1.8*)
Crystal arthropathy	3 (*1.8*)
Avascular necrosis	2 (*1.2*)
Unknown/not documented	4
More than one diagnosis	3

* UKR, unicompartmental knee replacement

Table II. Life-table with revision, due to any cause, as failure

Years since operation	Number at start of interval	Failed	Died	Withdrawn	Number at risk	Success rate for interval (%)	Cumulative survival rate for this study (%)	95% Peto CI[32]
10 to 12	203	6	16	20	193	*96.9*	*96.9*	*1.4*
12 to 15	177	7	23	71	141.5	*95.1*	*92.0*	*1.5*
15 to 18	99	0	16	57	70.5	*100.0*	*92.0*	*2.0*
18 to 20	42	2	5	19	32.5	*93.9*	*85.9*	*3.0*
20 to 22	21	1	6	8	17	*94.1*	*80.0*	*4.3*
22 to 25	12	0	1	8	8	*100.0*	*80.0*	*5.6*
25+	4	0	0	4	2	*100.0*	*80.0*	*9.8*

Table III. Reasons for revision in 16 knees during the second decade

Reason for revision	Number * (%)	Mean time to revision in yrs (range)	Mean (range) age at initial procedure (yrs)
Progression of disease	7 (*3.4*)	13.1 (11.2 to 13.9)	52.3 (35.7 to 76.9)
Polyethylene wear	3 (*1.5*)	14.4 (10.9 to 21.1)	65.3 (59.2 to 76.9)
Tibial loosening	4 (*2*)	10.4 (10.2 to 13.1)	66.8 (56.6 to 76.9)
Fracture of femoral component	2 (*1*)	16.2 (13.3 to 19.1)	61.1 (60.1 to 62.2)
Infection	2 (*1*)	11.3 (11.1 to 11.5)	62.5 (57.8 to 67.1)

* two knees required revision for more than one reason

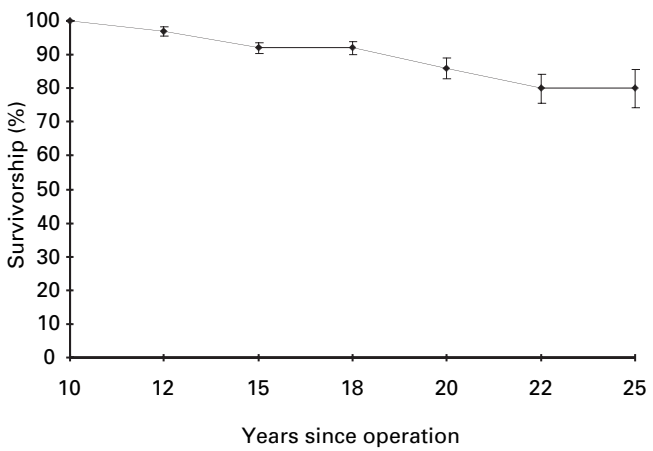

Fig. 2

Kaplan-Meier survivorship curve from 10 to 25 years with revision due to any cause as the end-point, with 95% Peto confidence intervals.

loosening (4, 2%), fracture of the femoral component (2, 1%) and infection (2, 1%) (Table III). Two knees required revision for more than one reason. One patient aged 35.7 years who had multiple reasons for revision had bilateral simultaneous UKRs performed for rheumatoid arthritis, initially limited to the medial compartment. Her knees were revised at 13.5 years and 13.8 years for progression of the disease in the lateral compartment and patellofemoral joint.

Of the 16 knees, 12 (75%) were revised to a standard total knee replacement (TKR) without the need for bone grafting or wedge augmentation, and four (25%) were revised to another St Georg Sled UKR. In two of these latter knees this was done for fracture of the femoral component and in the other two for tibial loosening. Both of the fractures of the femoral component occurred in implants of the old design (Fig. 1a). No knee required a second revision and all the revised knees were functioning satisfactorily at the final review at a mean of 7.3 years (2.1 to 14.1) after revision.

The mean time from the initial procedure to revision was 12.9 years (10.2 to 21.6) with relatively few occurring after a longer interval. This may reflect the fact that as the patients' age advanced they placed less demand on their replacements. The mean age at operation for the whole group was 67 years (35.7 to 85.9) while in those whose knees were revised in the second decade it was 60.5 years (35.7 to 76.9). In addition, the group revised for progression of disease had a mean age at the initial implantation of only 52.3 years (35.7 to 76.9), possibly reflecting our preference for UKR as opposed to tibial osteotomy in the younger patient.

At all time intervals the mean Bristol total knee score (lowest of 79 at 20 years and highest of 86 at 25 years) was substantially greater than the mean pre-operative value of 55 (34 to 86). During the follow-up period of this study there was very little change in the knee score with respect to pain, patient function or range of movement (Fig. 3).

Radiological follow-up was incomplete due to a large number of missing radiographs. Of those reviewed, the dishing seen in Figure 4 was a frequent finding, whilst lysis and radiolucencies around the components were rarely seen.

Discussion

The benefits of UKR compared with TKR are a better range of movement, faster recovery and greater patient satisfaction in the short term.[3,13,23] Reports have shown that UKR

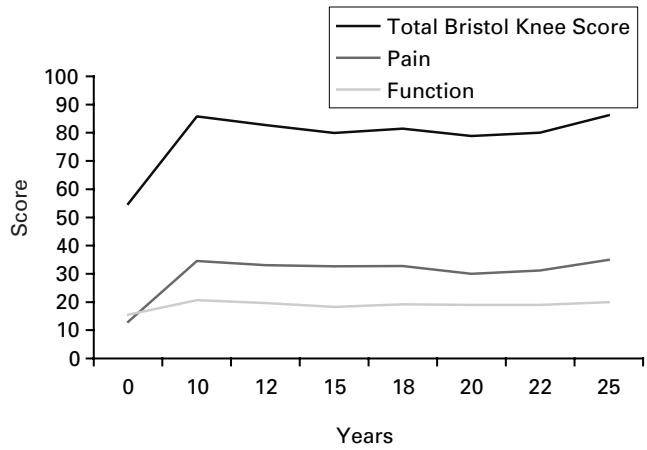

Fig. 3

Details of Bristol knee scores in the 174 patients.

continues to give a result as good as TKR at 10 to 14 years.[15,16,18,19] Our findings confirm that fixed-bearing UKRs can function well in relatively elderly patients for a considerable period of time with little clinical or radiological evidence of prosthetic failure leading to the need for revision even after 20 years.

During the period of our study there was surprisingly little evidence of deterioration in the function of the knee. Bremner Smith, Ewings and Weale[24] showed that the Bristol and other knee scores tended to decline with advancing age, but our results do not show this, presumably because a higher proportion of patients with a poor score were leaving the study, either because death followed a period of infirmity, or because the knee had failed and had been revised. However, the fact that there seems to be little change in the knee score with the passage of time suggests that impending failure of the implant is unlikely.

The main reason for failure after ten years was progression of arthritis (3.4%). It is known that progression after medial UKR is uncommon during the first decade.[3,25] Great care must be taken in the selection of younger patients since our series included two knees with a diagnosis of rheumatoid arthritis and three with crystal arthropathy. The former condition should certainly be regarded as a contraindication to UKR but opinion differs as to whether the presence of chondrocalcinosis, which probably increases the risk of crystal arthritis, should be viewed as a contraindication. In our study these patients who did progress gained a mean of 13.1 extra years (11.2 to 13.9) before they required a TKR. It is important to note that in all the UKR revisions, patients were only revised to either another UKR or a standard TKR. We suggest that UKR is a good procedure for these patients and emphasise that early radiological changes in the other compartments are not an absolute contraindication to UKR.

The other main causes of failure were polyethylene wear (1.5%) and associated tibial loosening (2%). We know from experience with TKR that a good cementing technique, an optimal position of the implant and the use of high-quality polyethylene are important for minimising failure.[26] It must be emphasised that these procedures were carried out between 1974 and 1994 when poorer cementing techniques and polyethylene of inferior quality were used. In addition, implantation occurred using crude instrumentation and often with undercorrection of the varus deformity. This prosthesis tolerates these failings because it is totally unconstrained and therefore is initially more able to withstand torque and shearing forces. It has

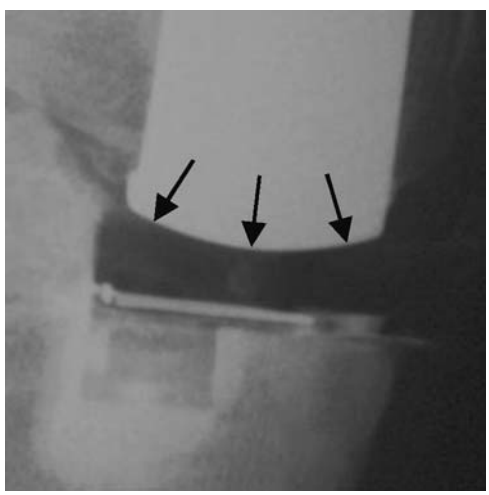

Fig. 4a

Fig. 4b

Figure 4a – Radiograph at 12 years. 'Dishing' has occurred which results in greater conformity with the curved femoral component. Figure 4b – Photograph of a revision at 16 years of a left-sided St Georg Sled unicompartmental knee replacement with 'dishing' of the tibial component.

previously been shown that wear of polyethylene occurs at a relatively low rate perhaps because the prosthesis develops its own congruence,[27] a phenomenon which we have termed 'dishing' (Fig. 4). While it is possible that the presence of polyethylene wear debris contributed to some of the revisions recorded as being due to tibial loosening, osteolysis was not encountered during revision and it is probable that the tibial loosening seen, relates more to poor prosthetic placement due to the freehand manner in which most procedures were conducted.

Clinically, there was a slight deterioration during the second decade as recorded by the Bristol knee score, mainly because of poorer functional scores as the patients aged. It was no more than has been noted previously in an ageing population without a knee replacement. Most surviving knees remained free from pain and were functioning well.

Our results not only show that fixed-bearing medial UKRs can survive and function well for many years but that when failure occurs it is not always because of wear of polyethylene. In our series two failures occurred due to late infection, as could arise with any implant, and two were due to fracture of the femoral component. The latter is extremely unlikely to occur in a modern implant. Overall, this fixed-bearing UKR gave good long-term function. We noted that the patients in whom failure occurred were younger than the group as a whole which gave rise to the suggestion that a mobile device could have helped in the more active young group since these have been shown to have a very low rate of polyethylene wear.[28,29] The recently reported ten-year survivorship of the mobile-bearing Oxford device is 91%[30] in patients under 60 years old, which is comparable with the 11-year survivorship of 92% reported for a fixed-bearing device in a similar young group of patients.[31] The challenge remains to treat this younger group of active patients successfully and reproducibly, but for more elderly patients with unicompartmental disease, our results support the use of a fixed-bearing cemented device.

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