

Quality of life after knee revision arthroplasty

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Background and purpose Radiographic and clinical survival analyses of revision total knee replacement (TKR) are considered acceptable outcome measures. However, the full influence of revision knee replacement on the overall health status of patients remains poorly defined.

Methods We prospectively studied the health-related quality of life outcome in 94 patients who underwent revision knee replacement surgery over a 5-year period. Comparisons were drawn between the Nottingham health profile (NHP) scores and the Knee Society score pre-revision, and those obtained at 3 months, 1 year and 5 years after revision knee arthroplasty.

Results We found a significant improvement in Knee Society score and NHP pain scores 3 and 12 months after revision TKR ($p < 0.05$). No other modalities of the NHP showed a significant change. 5 years after surgery, pain was less than before revision ($p = 0.2$), but energy level was considered worse ($p = 0.07$). Knee Society scores were found to be higher pre- and post-operatively for patients undergoing revision for reasons other than sepsis than for patients with sepsis. Patients requiring implantation of a hinged prosthesis also had lower Knee Society scores than those patients receiving a non-hinged implant. Repeated revision was associated with a downward trend in Knee Society score with each surgical intervention.

Primary total knee arthroplasty has been shown to be as successful as total hip arthroplasty (Ranawat et al. 1993, Rissanen et al. 1995, Hawker et al. 1998, Birdsall et al. 1999, Ewald et al. 1999, March et al. 1999, Khaw et al. 2001). The survival

rate for revision knee arthroplasty has consistently been found to be less than for primary replacement (Ritter et al. 1991, Saleh et al. 2003). However, the true impact of revision knee replacement on patient health status remains poorly defined. Strong differences in degree of change in quality of life between revision hip arthroplasty and primary surgery have been identified for hip arthroplasty (Robinson et al. 1999).

We examined changes in different aspects of quality of life for all patients presenting at our unit for revision knee arthroplasty surgery over a defined period. We were particularly interested in the effects of successive revision procedures, the presence of local infection, and the degree of constraint of implanted prostheses on overall medium-term quality of life scores.

Patients and methods

We studied a series of 94 consecutive revision total knee arthroplasty procedures performed by or under the direct supervision of a single surgeon (IMP) at a single institution. Surgery had been carried out between 1992 and 1995. At the time of surgery, demographic and clinical details of the patient were recorded as part of a regional trial on outcome. Data were recorded preoperatively, 3 months after surgery, and also 1 year and at a minimum of 5 years after the index revision TKR procedure. At completion of this study, all case notes were again independently reviewed to confirm the accuracy of data. The clinical evaluation was not blinded or independent, but permitted calculation

Table 1. Indications for revision

Primary indication given for revision	No.
Aseptic loosening	43
Instability	14
Bone loss/fracture	10
Infection	6
Pain	5
Loss of range of movement	4
Polyethylene wear	4
Total	86

of the Knee Society score (Insall et al. 1989, Lingard et al. 2001). Health status was determined by the generic Nottingham health profile (NHP) score (Hunt et al. 1986). This scoring system has been validated to determine the general health status of an individual, and is a reliable scale covering a number of dimensions including physical, psychological and social functions. Part I comprises a questionnaire of 38 items addressing 6 modalities: energy, pain, sleep, emotional reaction, social isolation and physical mobility. Each is weighted to give a score from 0, the best perceived health status, to 100, the worst. Part I of the NHP has been well validated in the TKR setting (Hilding et al. 1997). The NHP also offers age- and sex-matched normal data which we used to compare scores for an equivalent group.

Aseptic loosening was the commonest cause of revision, and the Kinemax condylar was the commonest prosthesis, both removed and reimplanted (Tables 1 and 2). Of the 94 revision cases, 3 were excluded because of death from unrelated causes within 12 months of the index revision procedure. 5 patients underwent further surgery on the contralateral knee within 2 years of the index procedure, and they were thus excluded from the final analysis. Our study group therefore comprised 86 patients (54 females). The pathology was primary osteoarthritis in 47 patients and rheumatoid disease in 39 patients. For 52 patients this was the first revision; for 27 patients it was the second revision, the remaining 7 patients having undergone at least 2 previous substantial revision procedures prior to the index surgical intervention. 6 patients underwent 2-stage surgery for infection with both procedures being considered as a single event. We found that in this cohort, 18 hinged, 15 stabilized

Table 2. Prostheses removed and re-implanted at revision TKR

	Prosthesis removed	Prosthesis re-implanted
Kinemax condylar	46	46
Porous-coated anatomic	25	5
Kinemax super stabilizer	3	11
Duocondylar	3	
Kinemax stabilizer	3	4
Rotating hinge	2	14
Freeman-Samuelsen	1	
Miller-Galante	1	
Sheehan	2	
Coordinate		2
Custom-made (hinged)		4
Total	86	86

and 53 non-stabilized prostheses were re-inserted and this permitted subgroup analysis by degree of constraint. 18 patients required re-implantation of a hinged device (rotating hinge (n 14) or custom-made (n 4)). Health outcome data were available for 77/86 patients at 3 months, 72/86 patients at 12 months, and for 55/86 patients at 5 years. Knee Society data were available for 57/86 patients at 3 months and for 51/86 patients at 12 months.

Subgroup analyses

We specifically wished to compare the outcome for those patients who had undergone a first-revision knee procedure with that for those who had required further surgery. The influence of increased stability was arbitrarily assessed by subdividing the revision group into two groups, conversion to a hinged prosthesis (14 rotating hinge, 4 custom-made) or revision to a non-hinged stabilized prosthesis (n 17) or a non-stabilized implant (n 51). Furthermore, the importance of revision in development of sepsis was determined by comparing the cohort with no sepsis to the cohort of patients with sepsis.

Statistics

The mean differences between pre- and postoperative NHP and Knee Society scores for each patient were calculated together with the standard error of the mean (SEM). Statistical analysis was performed using SPSS software. Descriptive statistics were produced and then comparisons between

Table 3. Knee Society score (95% CI)

	Preoperative Knee Society score	Final review KSS
Sterile	85 (73–97)	128 (114–142)
Septic revision	72 (62–82)	113 (97–129)
First revision	90 (82–98)	138 (129–147)
Second revision	82 (73–91)	131 (119–143)
More than 2 revisions	74 (69–89)	110 (99–121)
Revision to unconstrained	76 (68–84)	128 (116–140)
Revision to constrained	84 (74–94)	103 (91–115)

preoperative and follow-up scores, for both Knee Society score and NHP scores, were performed with Student's paired t-test.

Results

With each successive revision there was a significant downward trend in the Knee Society score (Table 3). This perhaps reflects the loss of movement, associated scarring, progressive age of the patient cohort and concomitant bone loss with each surgical intervention. Reflecting this, again there was a significant difference in outcome between those patients requiring implantation of a hinged prosthesis (irrespective of presence of infection) and those who underwent revision to a non-hinged device. 4 patients required surgery for the presence of infection (1 required a hinged device, and 3 underwent 2-stage revision to a non-hinged implant). As expected, the outcome following revision for infection was not as good as that in the absence of local sepsis.

Table 4 gives the calculated mean NHP scores (with 95% CI) for each of the 6 dimensions of the

NHP including normalized age- and sex-matched controls at distinct time points for the cohort of patients as a single group. These relate to a time point prior to the index revision procedure, and 3 months, 1 year and 5 years after surgery. For the NHP, 100 indicates the worst possible perceived health status and zero indicates perception of health status to be optimal. We immediately found a significant difference between controls (age- and sex-matched normalized data produced for the original Nottingham health profile) and preoperative scores for energy, pain, sleep and mobility ($p \leq 0.001$). No significant changes with surgery or with time were seen for emotional reaction or social isolation. After revision surgery, there was a significant improvement in pain 3 and 12 months postoperatively. At 5 years, there was no difference in the level of reported pain from the pre-revision state. The mean 5-year pain score was less (i.e. less pain) than preoperatively, but this was not statistically significant ($p = 0.22$). At 5 years, energy was worse than preoperatively but this difference did not reach significance ($p = 0.07$).

Discussion

Through analysis of National Hospital Discharge Survey data, Kurtz et al. (2005) identified an increase in both the number and the rate of revision knee arthroplasty surgery procedures between 1990 and 2002. This trend was particularly marked in the 65–74 year age group. Such complex surgery is being carried out more frequently, and on a younger population, which means that there is a need for closer scrutiny of the effect of such intervention on quality of life. Previous stud-

Table 4. Mean (95% CI) NHP scores for each domain plotted against time, 100 being the worst possible score

Category	Sleep	Energy	Emotion	Mobility	Social isolation	Pain
Normalized control	22	24	13	12	4	15
Preoperative	41 (33–49)	45 (39–51)	17 (14–20)	52 (49–55)	10 (8–12)	61 (55–67)
3 months	44 (35–53)	48 (42–54)	19 (16–22)	54 (50–58)	16 (14–18)	48 (40–56)
1 year	43 (34–52)	48 (41–55)	21 (17–25)	53 (49–57)	15 (13–17)	48 (39–57)
5 years	50 (42–58)	56 (44–68)	18 (15–21)	48 (44–52)	15 (13–17)	56 (47–63)

Age- and sex-matched scores (at the time of revision) are included as controls; normalized data were produced when the NHP was first published.

$P = 0.01$ for 3- and 12-month pain compared to preoperative status.

ies have shown an improvement in quality of life (pain, sleep, physical mobility) after primary knee arthroplasty (Cloutier 1983, Rissanen et al. 1995, Hawker et al. 1998, Birdsall et al. 1999) and good survivorship after revision total knee replacement (Khaw et al. 2001). Hozack et al. (1997) showed that even with similar preoperative health dimensions using the SF-36 questionnaire, physical function and overall perception of health were significantly higher for patients undergoing a primary total hip replacement than for a revision study group. However, the authors did not report results concerning differences between primary and revision total knee arthroplasty.

We have found few studies that have examined the functional outcome after revision knee arthroplasty. Wang et al. (2004) compared the outcome for aseptic revision of all components (n 33) with that for septic revision (n 15). Both groups had an improvement in pain score and SF-12 score, with these differences being more marked in the aseptic group. Although the calculated clinical outcome scores for septic revision were less satisfactory for range of movement and knee score, with fewer patients reporting excellent results, it is interesting that the authors concluded that the two groups expressed equal satisfaction with revision surgery.

These results appear to mirror those found in a multicenter study where, at a median follow-up of 3 years in 3 centers, the authors identified a clear difference in postoperative range of motion and Knee Society scores with the infected group showing lower preoperative and postoperative knee scores (Barrack et al. 2000). The authors argued that through prospective review, their results confirmed the clinical impression that revision for sepsis is met with a poorer outcome than that for osteolysis, loosening or instability. We have found a similar trend after a minimum review period of 5 years.

The influence of revision to a hinged prosthesis (n 10) as opposed to a non-hinged variant (n 16) was examined in a cohort of 26 patients with (median) 20-month review (Fuchs et al. 2004). No significant differences between the two groups were found in HSS score, KSS, Tegner or visual analog pain score, although the non-hinged group did have greater range of movement after revision.

Again, we found lower Knee Society scores in the subgroup requiring conversion to a hinged implant, both before and after surgery. This was independent of the presence of local sepsis. We have not found any previously published prospective assessment of the effect of more than one revision knee arthroplasty procedure on reported functional outcome. In this respect, our study provides a unique insight into the effects of repeated surgical revision on quality of life.

We found an enduring positive effect of revision knee arthroplasty on health-related quality of life up to 5 years after surgery. We found a significant reduction in NHP pain at 3 and 12 months after revision surgery, but the reduction in NHP pain was more modest than after primary knee arthroplasty. This may be due to the more extensive nature of revision surgery, or perhaps to poorer muscle function in revision patients. However, in stark contrast to primary knee replacement studies (Birdsall et al. 1999, Wright et al. 2004), there were no significant improvements in any other domains of the NHP.

It is important to note that our study showed an excellent improvement in Knee Society scores at both 3 and 12 months, which is comparable with the improvement in Knee Society score for primary TKR. By 5 years, however, pain (from the NHP) had increased—although this was still less than pre-revision pain. With increasing age and associated increase in co-morbidity and loss of mobility, the perception of knee function does deteriorate in an equivalent age-matched control population (Schlenk et al. 1998) 5 years after primary TKR, although pain is still significantly less than preoperatively (Table 4). Perhaps this is not surprising, as both implant and patient age will have increased. Consequently, there may be worse muscle function and perhaps early signs of loosening.

Subjective reporting of pain remains the principal indication for primary joint replacement in the knee. Pain is also a pertinent outcome marker of failure in primary TKR (Murray and Frost 1998). We found that in a revision TKR population, it is pain that is the key indication for revision arthroplasty. With NHP pain as our yardstick, we could detect a significant improvement at 3 months after revision TKR. This reduction in NHP pain is maintained well at 1 year; by 5 years, in the worst case scenario it is no worse than pre-revision. This

change in NHP pain over time, for revision TKR, parallels that shown for primary TKR, but with change of lower magnitude (Birdsall et al. 1999, Ethgen et al. 2004). We found no other significant changes in NHP profile following revision TKR.

Our study has important limitations. The main purported advantage of a generic questionnaire such as the NHP is that the results are based upon the responses from the recipients of a surgical intervention. The use of such subjective measures may minimise observer bias. Potential disadvantages reflect the fact that these generic, wide-ranging outcome measures may be influenced by factors unrelated to the primary pathology or surgical intervention. Unrelated co-morbidity may contribute to the increase in NHP pain at 5 years in both primary and revision TKR. Further work is required to investigate the changes in quality of life in this cohort of patients up to 10 years after surgery. With greater numbers of patients, a retrospective analysis of those patients who ultimately came to require further revision surgery may identify changes or trends in one or more domains of the NHP or Knee Society score prior to consideration of repeat surgical intervention. Such screening might highlight individuals at high risk and allow closer surveillance.

Contributions of authors

DD wrote the paper and helped with data analysis. DD, JM and PB examined all data and compiled the data charts. IP performed surgery and initiated the study.

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