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Why are revision knee replacements failing?

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ABSTRACT

Aim: The number of knee revisions worldwide has been steadily increasing. While being complex and expensive operations, a high percentage of knee revisions fail early. This study was conducted to evaluate the causes of failure of revision knee replacements.
Patients and methods: This study retrospectively evaluated 95 patients following knee revision surgery and who underwent further knee revision operations. Indications for index revision as well as the reason for re-revision were recorded. Follow-up was from 30 to 97 months (mean 62 months).
Results: The main cause of failure of revision knee replacements was infection (31 of 95, 32.6%) followed by aseptic loosening (30.5%). Indications for re-revision were instability in 12.6%, persistent stiffness in 10.5%, ongoing pain in 7.3%, extensor mechanism problems in 5.2%, and suspected metal allergy in one.
Conclusion: Infection and loosening continue to be the main reasons for failure of knee revisions. Improving outcomes for infection management and improved fixation methods may help reduce failed knee revisions.

1. Introduction

Total knee replacement is an increasingly common operation, with over 90,000 performed in the UK annually. Coupled with the increase in primary knee replacement surgery, revision knee replacements have also followed a progressive increase in numbers, with >6000 knee revision operations reported in the UK in 2015 [1]. The high number of revision knee replacements has financial implications. The cost of revision knee replacement can be from £9655 for aseptic revisions to £30,011 for revisions performed for infected joint replacements [2]. Results of revision knee surgery are generally not as good as those obtained after primary knee replacement surgery [3–5]. Consequently, revision knee replacements have a high failure rate, which in turn leads to further surgery. This effect is further enhanced in young patients having knee replacement [6]. Data from national joint registries and multiple-studies case series give a good understanding of the reasons for failure of primary knee replacement, and indications for revision knee replacement. However, there is insufficient data on the failure of revision knee replacement surgery.

For the purpose of description in this study, the first revision operation on the knee joint was designated as R1, and subsequent revision operations labelled as R2, R3, and so on. This study was undertaken to identify reasons for failure of revision knee replacements, (failure of R1) which, if further surgery were offered, would be the indication for R2.

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2. Methods

A retrospective study was conducted with prior approval of the institutional Audit Department. This involved evaluation of existing clinical records and radiographs. Clinical information included indication and date of index revision operation, duration between index revision and re-revision operation, and indication for the revision operation. Demographic data and associated co-morbidities were also recorded, as were any additional procedures. Radiographic information included the type of implant, type of fixation, extent of bone loss, use of augments, level of constraint, and any implant-related complications. Patients with infection had a review of microbiological profile.

Re-revision was identified as the third or further knee joint replacement procedure (R2 or further), in each of which at least one prosthetic component was removed, inserted or changed. Each patient was included only once, and if a patient had a second revision (R2) at the current centre, further revision on the same patient was not included in this study. In cases with multiple causes of failure, the dominant mechanism was considered for the purpose of data analysis. Notably, the first revision at the current centre was considered as R1, and revisions performed prior to referral to the current centre were not included in the analysis, due to lack of adequate data from the referring units.

The period of study included notes from 2007 to 2014. All clinical notes and radiographs were accessed through the hospital database. The indication for revision surgery was documented by the operating surgeon prior to surgery and recorded in the clinical notes. Only revision of a total knee replacement implant was considered as an index revision. Hence, patients with unicompartmental knee replacement revised to total knee replacement were not considered as index revision. Minimum follow-up was 30 months and maximum follow-up was 97 months (mean 62 months). This indicated the time between surgery and last documented clinical assessment.

Infection was diagnosed on the basis of microbiological evidence from pre-operative samples, intra-operative samples, presence of draining sinus or presence of pus in the joint. Instability was diagnosed from a history of knee 'giving way', difficulty in going up and down stairs or rising from a chair, clinical evidence of collateral laxity, and evidence of gap imbalance on weightbearing AP radiographic images of the knee. The alignment of the prosthesis was assessed on plain radiographs. Rotational alignment was assessed by computed tomography (CT) scans when necessary. Long leg views from hips to ankles were used to assess limb alignment. All this was in accordance with departmental practices. Patients were not contacted, and no intervention was carried out as part of this study.

3. Results

A total of 109 patients were identified who had re-revision knee replacement (R2) during the study period. Fourteen patients were excluded for inadequate information, leaving 95 patients in the study group. The mean age at the time of index revision was 64 years (range, 33–89); 53% were right sided operations and 48% were men. The mean duration from revision (R1) to re-revision (R2) was 31 months (range, one to 119), as shown in Figure 1. The average number of revision operations per patient was three,

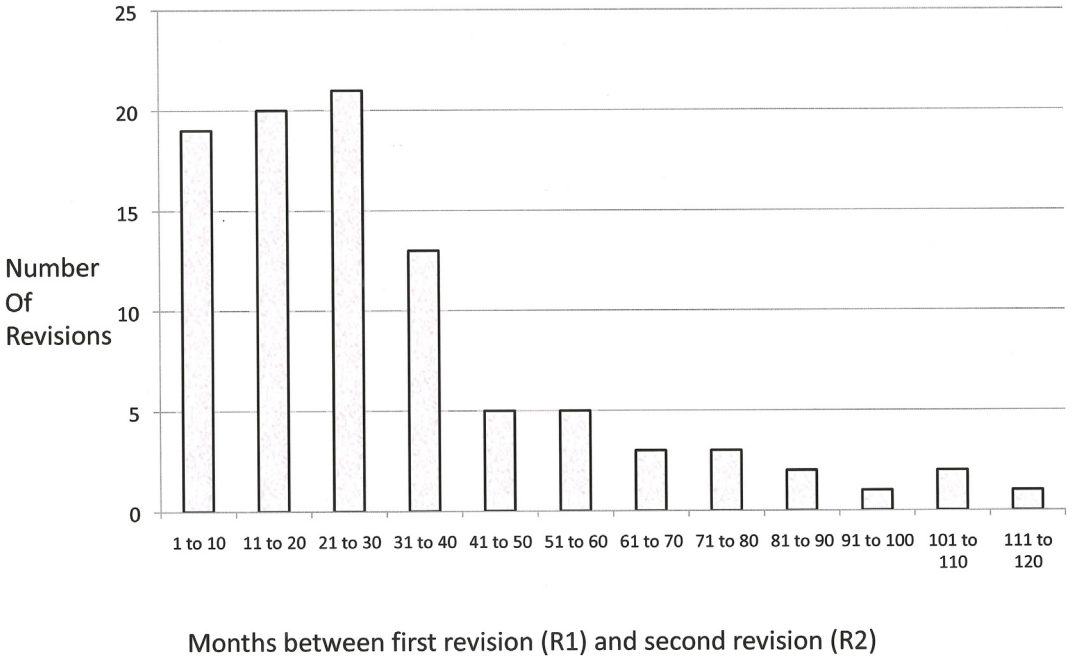

Figure 1. Timescale for re-revision knee replacement.

with minimum of two revisions and a maximum of nine revision operations. A total of 63% of knee revisions failed within 30 months of the operation and the failure rate reduced with time. Of the 95 patients, 47 had undergone one or more revision operations prior to referral to the current centre. Medical co-morbidities were recorded on the Charlson index and the mean index in the study group was three. The main cause of failure of revision knee replacements was infection (31 of 95, 32.6%) followed by aseptic loosening (30.5%). Indications for re-revision were instability in 12.6%, persistent stiffness in 10.5%, ongoing pain in 7.3%, extensor mechanism problems in 5.2%, and suspected metal allergy in one. The indication for index revision (R1) was linked with the indication for re-revision (R2) and the summary is presented in Figure 2.

4. Discussion

Revision knee replacement imposes a substantial financial burden on modern health services. As the number of primary knee replacement surgeries continues to rise every year, the number of revision knee replacements is projected to rise [7]. Continuing improvements in implant materials, techniques and understanding of biomechanics has not been able to stem the rise in revision surgery. Young patients may account for a substantial proportion of patients having knee replacements in the coming years, with a high risk of early prosthetic failure [6,8,9], and lower satisfaction rate after primary surgery [10]. Alongside, the cost of revision surgery has been reported to rise independently [11]; this is mainly due to increasing costs of investigations and implants, and revisions for sepsis carry a much higher cost compared with aseptic revisions [2].

Multiple studies have shown that the survival of revision knee replacement is inferior to primary knee replacements [4,5,12]. Suarez et al. reported on 68 knees that were re-revised over a 20-year period at a single centre [5]. This represented a 12% re-revision rate at minimum two-year and mean six-year follow-up. Infection was the predominant reason for re-revision in 46% patients. The mean time to re-revision was 40.1 months from the revision operation. A higher failure rate of revision surgery was found in younger patients, and those having isolated polyethylene revisions. One contributing factor for high failure of isolated polyethylene revisions could be the use of this procedure in sepsis. Over 50% failures in their series were within two years of the revision knee procedure. The current results for timescale are consistent with these figures.

Another report on multiple revisions found that the cumulative survival rate for revision knee was 71% in younger patients (first revision before the age of 55 years) at six years compared with 66% at six years in an older cohort [9]. This included 25 patients in the younger cohort and 26 in the older group. They also reported 2.7-times increase in risk of further revision surgery if the primary revision was performed for infection. Aseptic loosening (27%) and infection (23%) were the predominant indications for index revision surgery.

Hardeman et al. reported on 146 knee revisions and their indications [13]. Revisions performed within two years of the primary knee replacement were labelled as early revisions. They found a higher failure rate of 17.5% in early revisions compared with 2.4% failure rate for late revisions. Early failures were mainly due to infection and instability, and late failures were caused

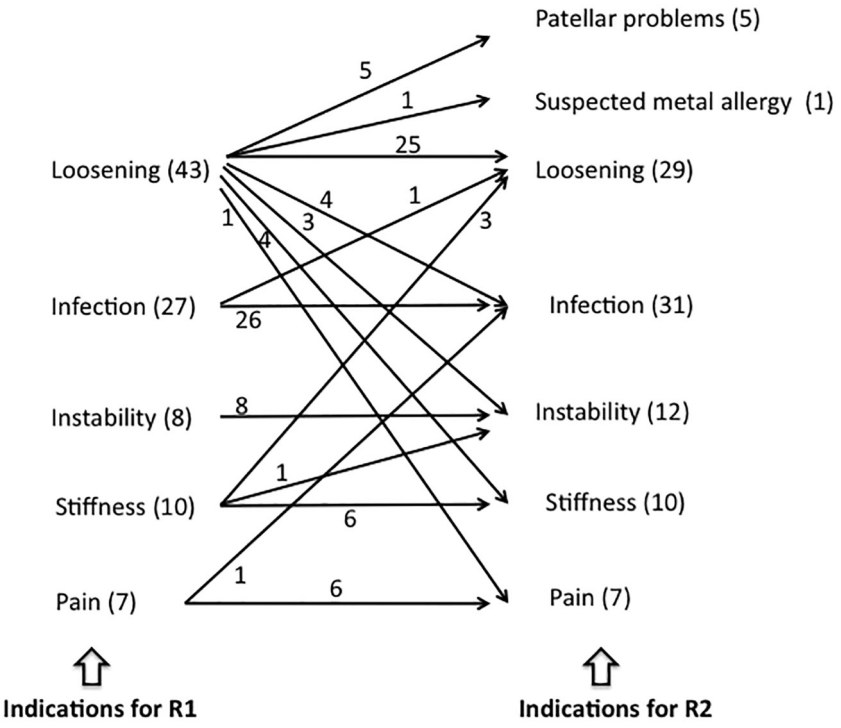

Figure 2. Linking indications for first revision (R1) to second revision (R2) knee replacement.

by polyethylene wear and loosening. Notably, their study evaluated indications for revision knee replacement (R1), and not the causes of failure of revision knee, leading to re-revision surgery.

A joint registry-based study reviewed 145 failed aseptic revision knee replacements [14]. First-time revisions for infection were excluded from this series. Despite this, infection was the predominant cause of failure (28%) of revision surgery, followed by instability (26%). An important conclusion from the study was that revision of a single component – femoral or tibial – had a 1.7-times higher relative risk of further revision compared with revision of the entire prosthesis. The New Zealand registry showed a 23% re-revision rate at 10 years in 428 revision knee replacements in the 2016 report [15].

The current study is one of the largest series reported in literature on the causes of failure of revision knee arthroplasty. It raises many important issues. First, there is a high early failure rate of revision knee replacement. Contrary to primary knee replacements, revision knee replacements have a higher failure rate in the first three years, and failure rate tends to reduce as the follow-up period increases. In the current study, 63% of patients had further revision within 30 months of the index revision. It is important to note a higher revision rate compared with registry data. Registry data regards the first revision as R1, while the current study considered the first revision in our institution as R1. Forty seven patients had undergone previous one or more revision surgeries, and hence the complexity of cases included in this study did not mirror the complexity of cases included in registry data. Another study reporting on survival of revision knee replacement showed a mean duration of 27 months in young cohort and 28 months in older cohort of patients [9]. A report on 499 knee revisions found 20.4% failure rate (102 failures) of knee revisions at 64.8 months follow-up [16]. Among the failed knee revisions, 83% failed within the first two years and infection was the predominant (44.1%) cause of failure; stiffness was the cause in 22.6% and aseptic loosening in 4.9%. Interestingly, wear was not a cause of failure in any of the patients. This could be because of the relatively short duration between revision and re-revision.

Second, in the majority of current patients, the indication for second revision was the same as the indication for first revision. Over the study period, 119 patients had a revision for infection. Of these, 92 were infection-free at last follow-up. Twenty-seven patients had a re-revision for infection and 26 of these had a further revision for infection. This is not a reflection on the success rate of revisions for infection, as this number does not include the patients who had a revision for infection and achieved a good outcome with no further operations. It also does not include the previous revisions undergone by patients prior to having a revision for infection (R1) at the current institution. However, it does highlight that the majority of patients (26 of 31) undergoing re-revision for infection had the index revision for infection. In a retrospective study, 23 of 91 patients revised for infection underwent further revision for recurrent infection [17]. The rate of re-revision for infection was 21% in patients with infection compared to 5% in patients without infection in the index operation. Additionally, survivorship of revision total knee replacement for infection reduces with longer follow-up [18]. Multiple revision surgeries for infection also have a progressively declining success rate. In a recent study, 44 patients with failed two-stage revisions, 36.4% reached the second stage of two-stage exchange [19]. Additionally, patients with more than five revisions had a significantly higher risk of poor outcome compared with those who had fewer than five revision operations.

Improvement in results of revision for infection will help to reduce re-operations for persistence of infection. The study period pre-dates the establishment of formal multidisciplinary arthroplasty infection meetings at the current department. Similarly, 25 of 43 patients who had revision for aseptic loosening had a further revision for the same indication. This may have been due to excess bone loss and inadequate primary stability achieved at the time of first revision. There is an increasing trend for zone 2 cementless fixation, which may help reduce the incidence of aseptic loosening [20]. Stiffness is another indication that is a cause for persistent symptoms. With restriction of movements, soft tissue stiffness and contracture tend to recur. It has to be emphasised that with progression of understanding of managing stiffness after total knee replacements, outcome of surgical management of stiffness is likely to improve [21].

It is imperative to understand the mechanisms of failure of revision knee replacement. The high percentage of early failure in revision knee replacement is a matter of concern [22]. In the UK, 60% of hospitals offering knee revision surgery perform fewer than 10 procedures annually. Establishment of tertiary referral centres specialising in revision knee replacements will help improve care in these complex clinical situations. Multiple revisions inevitably compromise outcome. It would be interesting to see further studies with modern management strategies for infection and prosthetic fixation, and the impact of these on long-term survival of revision knee replacements. Incorporation of revision surgery data in National Joint registries will help provide further data on failed revision surgeries.

Declaration of interest

None.

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