

Arthroscopic debridement in the treatment of the infected total knee replacement

P. Dixon, E. N. Parish, M. J. Cross

From the Australian Institute of Musculoskeletal Research

Infection is a potentially disastrous complication of total knee replacement (TKR). Retention of the prosthesis has been associated with high rates of persistent infection. Our study shows that in selected situations, arthroscopic debridement may allow retention of the prosthesis and eradication of the infection. However, the prosthesis must be stable, the surgical technique must be meticulous and specific antibiotics must be taken for a lengthy period. Arthroscopic debridement should be considered as an alternative to an open technique, or revision, for the infected TKR.

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Infection after a total knee replacement (TKR) may be a limb-threatening complication. Although advances in surgical technique and antibiotic prophylaxis have reduced the incidence of infection to approximately 1%, this still represents a substantial number of patients.

It is generally thought that if there is infection of a TKR, the components should be removed in order to eradicate the infecting organism. Indeed, the recognised treatment of choice is a two-stage revision with the interim implantation of an antibiotic-loaded spacer. Salvage of prostheses has always been associated with low rates of success. Rand¹ reported a success rate of 27% for open debridement. However, there are few reports of arthroscopic debridement. We found only one other series² and two case reports^{3,4} in the literature on its use for the infected TKR.

Patients and Methods

All cases of an infected TKR which had been treated by the senior author (MJC) from 1990 onwards were assessed retrospectively. Those patients who had undergone an arthroscopic debridement as part of their treatment were selected and their notes reviewed. Patients in whom the prosthesis had been salvaged after arthroscopic debridement were invited for clinical and radiological assessment. Clinical assessment was by means of the Knee Society clinical rating score.⁵ Weight-bearing anteroposterior and lateral radiographs were obtained and examined for evidence of loosening of the prosthesis and/or osteolysis.

Treatment protocol. Patients with an infected TKR had been selected to undergo arthroscopic debridement if they had no open wounds nor sinuses and no radiological evidence of prosthetic instability, such as lucent lines at the bone-prosthesis interface or evidence of osteomyelitis.

Arthroscopic debridement was performed with a motorised shaver using a four- or five-portal technique (anterolateral, anteromedial, superolateral, posterolateral, posteromedial) and a second normal saline inflow in order to ensure irrigation of the joint. The surgical technique was meticulous so as to ensure as complete a debridement as possible and to avoid damage to the prosthetic surfaces. Particular attention was given to viewing and debriding the bone-prosthesis interface and the posterior part of the joint. No drains were used at the end of the procedure.

The infecting organism was identified by either pre- or intra-operative aspiration. Antibiotics were given under the guidance of a microbiologist, although the choice of the initial antibiotic was empirical unless sensitivities were known from a previous culture. Specific antibiotics were commenced as soon as sensitivities were known. They were given intravenously for 14 days after operation and then continued orally. They were stopped when there was no clinical evidence of infection, and the ESR and level of C-reactive protein (CRP) had returned to normal.

Statistical analysis. This was performed using SPSS (version 10.0; SPSS, Chicago, Illinois) with significance recorded at $p < 0.05$. Differences between salvage operations and revision with use of cement were analysed by Pearson's chi-squared analysis. Differences between

P. Dixon, MB BCh, FRCS (Orth), Clinical Research Fellow
E. N. Parish, MHSc, Research Assistant
M. J. Cross, OAM, MB BS, MD, FRACS, Orthopaedic Surgeon
The Australian Institute of Musculoskeletal Research, 286 Pacific Highway,
Crows Nest, Sydney 2065, Australia.

Correspondence should be sent to Mr P. Dixon at the Sunderland Royal Hospital, Kayll Road, Sunderland SR4 7TP, UK.

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Table I. Details of the 15 patients with an infected TKR treated by arthroscopic debridement

Case	Gender Sex	Age at debridement (yrs)	Time since TKR (mths)	Primary or revision	Cemented or uncemented	Interim procedures	Infecting organism	Subsequent procedure 1	Subsequent procedure 2
1	M	62	100	Primary	Cemented	None	<i>Staph aureus</i>	Revision	-
2	F	71	127	Primary	Cemented	None	<i>Staph aureus</i>	Revision	-
3	M	71	20	Primary	Uncemented	None	<i>Staph aureus</i>	Revision	-
4	M	78	46	Primary	Uncemented	None	<i>Staph epidermidis</i>	Revision	-
5	F	57	9	Primary	Uncemented	None	<i>Strep viridans</i> <i>Staph epidermidis</i>	Arthroscopic debridement	Revision
6	F	72	10	Primary	Uncemented	None	<i>Staph epidermidis</i>	Revision	-
7	F	63	4	Primary	Uncemented	None	<i>Staph aureus</i>	-	-
8	M	58	48	Primary	Uncemented	Open synovectomy	<i>Staph epidermidis</i>	-	-
9	M	80	35	Primary	Uncemented	Arthrotomy and wash-out	<i>E. coli</i>	-	-
10	M	71	3	Primary	Uncemented	None	<i>E. coli</i>	-	-
11	F	73	66	Revision	Cemented	None	<i>Staph epidermidis</i>	-	-
12	M	60	38	Primary	Uncemented	Patellar replacement	<i>Serratia marcescens</i>	-	-
13	M	61	8	Primary	Uncemented	Patellar tendon repair	<i>Staph epidermidis</i>	Arthroscopic debridement	-
14	M	68	2	Revision	Uncemented	Arthroscopic wash-out	<i>Staph aureus</i>	-	-
15	M	53	4	Primary	Uncemented	None	<i>Staph aureus</i>	-	-

salvage and revision and the time between the TKR and debridement were analysed using an independent *t*-test.

Results

The senior author (HJC) has treated 32 infected TKRs since 1990. Of these, 15 had an arthroscopic debridement as part of their management. The details of these patients are shown in Table I; their mean age was 67 years (53 to 80) at the time of debridement. One patient (case 15) had died from a myocardial infarction two years after operation and was available for review for only nine months after operation. He retained his prosthesis at the time of death.

Six patients had required a subsequent revision procedure and nine had retained their prosthesis. All were available for review. One patient with a retained prosthesis had undergone a further arthroscopic synovectomy.

Two patients in the retained prosthesis group had already undergone a revision procedure. Most prostheses were uncemented with only one cemented prosthesis in the retained prosthesis group and two in the group requiring a subsequent revision. Five patients in the retained prosthesis group had received some form of interim surgery after their TKR (Table I).

The mean time between the TKR and debridement was 35 months (2 to 127). Two patients had undergone an arthrotomy after the TKR which may have precipitated the infection. No patient underwent a debridement within 30 days of either a TKR or any subsequent intervention.

Infecting organisms were mixed, most being staphylococcal species. In one patient (case 5) two organisms were identified and, after a further arthroscopic debridement, a

Table II. Successful outcome at follow-up

Case	Clinical rating score	Post debridement follow-up (mths)	Time on antibiotics (mths)
7	194	49	8
8	167	100	14
9	186	46	5
10	172	102	3
11	179	125	9
12	178	4	16
13	168	5	5
14	180	54	9
15	160	9	6

retained prosthesis group had an infection with *Escherichia coli* and one was infected with *Serratia marcescens*.

At review, the nine patients who retained their prostheses had a mean clinical rating score of 176 (160 to 194; Table II). The mean follow-up after debridement for this group was 55 months (4 to 125). Patients had remained on antibiotics for a mean of eight months (3 to 16), although there was one patient who was still taking antibiotics at the time of review.

Radiographs taken at review of eight of these cases showed no loosening of the prosthesis as indicated by lucent lines around the prosthesis and no focal areas of osteolysis or osteomyelitis.

Discussion

The retrospective nature of this study implies that the selection of the patients into the arthroscopic debridement group

was biased. Only 47% of infected TKRs underwent an arthroscopic debridement. Absolute contraindications for arthroscopic debridement were radiological evidence of loosening of the prosthesis, bone infection or an open wound. It was not possible to review all the patients who had been treated for an infected TKR in order to see if those excluded precisely fitted the absolute exclusion criteria.

Arthroscopy after TKR has become an accepted method of assessment for complications of TKR. It has been found to be safe and effective when assessing the soft tissues and when identifying wear or loosening of the prosthesis. There is a potential risk of damage to the prosthesis either by the arthroscope or operating instruments. Raab et al⁶ described an *in vitro* study which showed that cobalt-chromium surfaces can be damaged by the sleeves of the arthroscope. It is not known whether this is of clinical relevance. In our study, macroscopic damage to the prosthesis was avoided by the careful use of a multiportal technique. All prostheses were posterior-cruciate-ligament retaining. Arthroscopy may be more technically demanding, with a greater risk of damage, when undertaken in the presence of a more constrained type of prosthesis.

We consider that arthroscopic debridement is less likely to be successful when the prosthesis is cemented. This is supported by the study of Freeman et al⁷ who reported better eradication of infection in an uncemented TKR. The presence of cement was therefore a relative contraindication to arthroscopic debridement in our study. In our study two of six of the subsequent revisions and one of nine of the retained prostheses were cemented. Numbers are insufficient to reach significance but a trend is clear. Freeman et al⁷ suggested that polymethylmethacrylate interferes with the ability of the tissues to destroy bacteria. There is evidence for this in the literature.⁷⁻¹¹ We feel that the avascular cement-prosthesis interface may be a site where bacteria are protected from debridement and antibiotic penetration.

It is widely reported that the salvage of an infected prosthesis is more likely to be successful if the infection is acute rather than chronic. The definitions of these terms vary which makes comparison difficult.¹² None of our patients underwent a debridement within 30 days of their TKR, the mean period being 35 months after surgery. In the group with a retained prosthesis the time between TKR and debridement was less than in the group with a subsequent revision (23 and 52 months respectively; $p = 0.251$), although this was not significant. A mean of almost two years after TKR cannot be considered as an acute infection.

We were able to identify an infecting organism in all patients (Table I). Staphylococcal species were involved in all those cases which subsequently required revision procedure. This correlates with the work of Wilson, Kelley and Thornhill¹³ who reported lower success rates for salvage of the component in the presence of a staphylococcal infection. An earlier study¹⁴ also showed poor results in the presence of a Gram-negative infection. We did not find this to be the case for our patients.

Antibiotics are an integral part of the management of patients with an infected TKR. A microbiologist was involved early in all our cases to advise on the choice of antibiotic, the dose and duration of treatment. The mean length of time on antibiotics (eight months) is long and not without ramifications for the patient. However, even in the revision situation long-term antibiotics are often prescribed. The decision when to stop antibiotics is difficult and largely based on clinical factors. The use of the ESR and CRP as inflammatory markers is well established. We considered that normal levels were needed before cessation of antibiotics could be considered. This offered a more scientific approach to the length of the course of antibiotics rather than using empirical regimes.

No drains were used after arthroscopic synovectomy in our study in order to avoid the risk of super-infection. However, there is also an argument that any haemarthrosis after the procedure provides an ideal culture medium and should therefore be drained. We are not aware of any evidence to support either point of view.

Our results for arthroscopic debridement are as good as those for an open procedure,¹ and even when all the excluded infections from our study are considered, 28% of the infected prostheses were retained. In comparison with open debridement an arthroscopic procedure is non-invasive. This offers clear benefits to the patient. One disadvantage of the arthroscopic technique is that the polyethylene spacer is not exchanged and the space between it and the tibial base plate is not debrided. This offers an avascular area where infecting organisms may be protected from penetration of antibiotics in a similar way as at the cement-prosthesis interface.

We have found only one other series on the use of arthroscopic debridement for an infected TKR, and two case reports. Waldman et al² described six of 16 (38%) retained prostheses after undertaking arthroscopic debridement for an infected TKR. These results are similar to ours, although the small number of patients and variation in methodology make a direct comparison difficult. Important differences include the time of infection after TKR, the timing of the debridement, immunocompromised patients, the technique of debridement, the antibiotic regime and the presence of cement.

The eradication of an infection in a TKR is difficult but we believe that arthroscopic debridement offers a good chance of achieving this if certain criteria are met. The prosthesis must be stable with no evidence of lucent lines or focus of infection. The surgical technique must be meticulous in order to reduce the amount of infected material within the joint to a minimum. Specific antibiotics must be taken for a lengthy period in order to eradicate the infecting organism. The presence of cement may reduce the success of this technique and should be considered to be a relative contraindication. Arthroscopic debridement should be considered as an alternative to an open technique or revision for the infected TKR.

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