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Review

A case for one-stage revision in infected total knee arthroplasty?

Richard W. Parkinson [a,*], Peter R. Kay [b], Arvind Rawal [a]

[a] Wirral University Teaching Hospital NHS Foundation Trust, Arrowe Park Hospital, Arrowe Park Road, Upton, Wirral, Merseyside, CH49 5PE, United Kingdom
[b] Wrightington, Wigan and Leigh NHS Foundation Trust, Wrightington Hospital, Appley Bridge, Wigan, WN6 9NP, United Kingdom

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ABSTRACT

Infection in total knee replacement is a rare but devastating complication. The current literature tends to support a two-stage revision as definitive treatment of established deep infection. Despite the fact that single stage revision is a well recognised treatment for the infected hip replacement, it has not gained the same level of support in the knee.
This article reviews the literature of two-stage and single stage revision and reports the senior author's experience with the latter.

Contents

Deep infection represents one of the most devastating complications of total knee arthroplasty (TKA). It imposes a heavy emotional and financial toll on patient and surgeon alike.

1. Epidemiology

Most studies report an infection rate of 1% to 2% following TKA, but some studies have shown an incidence as high as 16% in certain patient populations [1]. At the Mayo Clinic, 1.2% of 3000 consecutive primary TKAs developed infection [2]. Bengtson et al. [3] reviewed data from the Swedish Knee Arthroplasty Register and found infection rates of 1.7% after TKA performed for osteoarthritis and a 4.4% for rheumatoid arthritis (RA) in a series of 12,118 primary total knee arthroplasties. In the United Kingdom, Blom et al. [4] reported infection rate of 1% for primary TKA and 5.8% for revision knee arthroplasty.

2. Risk factors

Although infection after TKA is not common, there are some recognised risk factors which increase the chance of infection. Patients at higher risk for infection include those with haemophilia (16%) [1], RA (2.4–3.2%) [3], diabetes (1.2–6.8%) [5].and the obese (10%) [6]. Wilson et al. [7], reported that patients with RA, skin ulceration, and a history of previous surgical procedures showed a statistically significant increased infection rate. There was also a tendency for patients with recent urinary tract infections and those taking oral corticosteroids to be in a higher risk group. In a large retrospectiverereview, Peersman et al. [8] also confirmed an increased risk in patients with diabetes, poor nutrition, hypokalemia, and those who smoked. Increased operative time also was found to be relevant.

* Corresponding author. Tel.: +44 151 6047023; fax: +44 151 6047078.
E-mail address: richard.parkinson@whnt.nhs.uk (R.W. Parkinson).

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3. Management options

The options for the treatment of an infected TKA include:

(1) Antibiotic suppression,
(2) Open debridement,
(3) Resection arthroplasty,
(4) Arthrodesis,
(5) Amputation and
(6) Revision surgery.

The purpose of this article is to discuss the options of one and two-stage revision for deep infection.

4. Two-stage revision

Two-stage revision for established deep infection involves prosthesis removal followed by delayed reimplantation and has been the commonest method of treatment for years. It is widely regarded as the gold standard. Insall et al. [9] described two-stage revision in 1983. The technique involves debridement of the soft tissues, bone and all non-viable tissues, removal of all cement and the prosthesis followed by implantation of an antibiotic-impregnated cement spacer. The patient is usually given 6 weeks of parenteral antibiotics. A new prosthesis is then implanted at a second stage after an interval of 6 weeks or more. Goldman et al. [10] reported results of two-stage revision in 64 patients using a similar protocol. Their success rate was 91%.

The use of an antibiotic loaded cement spacer helps to preserve leg length and reduce the soft tissue contracture. It also delivers a significant dose of antibiotic locally. Block spacers have disadvantages too. Dense scar tissue often forms and bone erosion can progress. Surgical exposure for the second stage is sometimes problematic and often necessitates the use of a tibial tubercle osteotomy or patellar turndown [11,12].

Some authors advocate the use of articulating spacers to minimise stiffness and scar formation. Haddad et al. [13] reported a series of 45 patients with a 91% success rate using such a technique.

Although there is no doubt that two-stage revision has a reasonably good success rate, there are disadvantages of this procedure compared to a single stage operation. In two-stage revision the interval between stages is often associated with impaired mobility, joint stiffness and pain. Development of arthrofibrosis can make reimplantation difficult. Two-stage surgery obviously involves two major procedures with the associated cost and sometimes a prolonged length of hospital stay.

Trezies et al. [14] reported their results using an articulating spacer for infected TKA. They used a standard cobalt chrome femoral component and a tibial insert without its metal base plate as an articulating spacer. Eleven patients were treated this way and eight of them did not subsequently opt for the second stage. Two patients had a second stage procedure for pain but not for recurrence of infection. Only one patient was revised for infection. It is interesting to note that although this study was designed as two-stage procedure, most of the patients did not require the second stage.

5. Single stage revision

Single stage revision for infection is well established for total hip arthroplasty. Wrobleski [15] first published his experience in 1986 and subsequently published his long term results in 1995. More recently Callaghan et al. [16] and Rudelli et al. [17] reported their long term result at 10 years (8% recurrence) and 5 years (6% recurrence) respectively. It is perhaps surprising that single stage revision is widely accepted in hip arthroplasty but to date it does not carry the same level of support in the knee.

Single stage revision for infection in TKA involves removal of the implant followed by debridement and immediate reimplantation of a new prosthesis, usually with antibiotic loaded cement (Table 1). This technique appears to be gaining popularity.

Initial reports from the Endoklinik [18] in Germany reported success rate of 73%. Goksan and Freeman [20] published their result in 1992 and only had recurrence in one patient out of 18. Buechel et al. [19] in a series of 22 patients showed a 90.9% success rate at an average of 10 years.

We (Parkinson et al.) [21] presented our results at the 2008 BOA congress in Liverpool, and American Knee Society meeting, Boston in October 2009 describing a “two in one” technique. Twelve patients with infected TKA were treated with a single stage revision with an average follow-up of 2 years. There were no cases of recurrent infection despite two patients in the series having an actively discharging sinus at the index procedure.

Our technique of single stage revision [21] referred as “two in one” technique is similar to a two-stage procedure except that the interval between the first and second stage is only a few minutes instead of 6 weeks, just allowing enough time to regown and redrape to utilise a second set of sterile instruments. It is considered very important to identify the infecting organism prior to the single stage revision. This was often done by arthroscopy to obtain tissue samples and for a culture and sensitivity report. Very often additional antibiotic is added to the pre-prepared gentamicin-loaded PMMA cement, in most cases vancomycin was added to the pre-prepared gentamicin-loaded PMMA.

Single stage revision avoids most of the drawbacks of a formal two-stage approach. It largely avoids the problems of stiffness and arthrofibrosis which sometimes bedevil two-stage surgery. It is much more cost effective by saving the patient from having to undergo a second major surgery. All these factors make single stage revision an attractive option.

Bauer et al. [22] published a multicentric retrospective study comparing single and two-stage revisions for infection and concluded that there was no difference between the two techniques in eradicating the infection. They also observed that after two-stage procedures, the knee outcome was excellent in 33% of patients while 40% of the knees had an excellent outcome after one-stage revision. More research is needed to compare the outcomes of single stage verses a traditional two-stage procedure. If results of single stage revision are similar or even better, then there are huge advantages for patients with infected TKA.

6. Illustrative case report

A 54 year old male patient underwent TKA in January 2006 for osteoarthritis. This patient developed deep infection postoperatively

Table 1

Two-in-one revision (key points)
• Preoperative identification of infective organism (usually by arthroscopic biopsy). Take multiple samples for culture and sensitivity.
• At revision, thorough debridement and irrigation with removal of implants.
• Break for a few minutes.
• Rescrub, redrape and use new set of instruments with modular revision prosthesis. Usually add extra antibiotic to bone cement.
• Start immediate postoperative antibiotic according to advice from microbiology and continue for 6 weeks parenterally or orally.
• Adjust antibiotics according to the final microbiology result.
• Allow immediate weight bearing and range of movement exercises.