

# Management Of Early Deep Prosthetic Joint Infection

S Sinha, W Chang, A Campbell, A Braidwood

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## Abstract

We report a prospective study on the treatment outcome of three cases of early, deep prosthetic joint infection (PJI) managed by aggressive soft-tissue debridement and parenteral antibiotics with retention of prosthesis. The mean interval between prosthesis implantation and the first symptoms of PJI was 88 days (range, 28-174 days). The mean interval between the first symptoms of PJI and the first surgical intervention was 8 days (range, 1-16 days). Antibiotics were administered intravenously for a mean duration of 1 week (range, 3-10 days), followed by oral antibiotics for a mean period of 8 weeks (range, 5-14 weeks). The mean duration of follow up following debridement was 22 months (range, 10-38 months). All patients responded to our treatment protocol with eradication of infection being achieved in all of them. There were no re-infections, and no patient required further surgical intervention.

## MATERIAL AND METHODS

The study was undertaken in the Orthopaedic unit of Monklunds Hospital, Airdrie. All patients whose prosthetic joint infection was diagnosed between Nov 1996 and Dec 2000 were prospectively evaluated. Only early deep infections were included in the study. A six-month postoperative period was used to decide between early and late infections. During the period under study, one case of early deep infection occurred following 269 primary total hip replacements and two cases of early deep infection occurred following 246 primary total knee replacements.

These infections met at least one of the following criteria: 1) positive culture of joint aspirate; 2) purulence surrounding the prosthesis at the time of surgery; 3) acute inflammation consistent with infection on histopathologic examination; and 4) a sinus communicating with the prosthetic joint. Clinical signs and symptoms indicative of prosthetic joint infection (PJI) included fever, joint pain or effusion, erythema or warmth of the overlying skin, and purulent discharge from the joint.

Symptoms, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) level, and WBC count at the time of PJI diagnosis were recorded, as were the nature of the pathogen(s) isolated and the site from which they were isolated. The delay between arthroplasty and the first symptoms of PJI (age of the prosthesis at onset), and the interval between the first symptoms of PJI and the first

surgical intervention (treatment delay) were determined. The surgical and medical treatments were also recorded.

The patients underwent early, aggressive, soft-tissue debridement and copious lavage of the joint with chlorhexidine (1:200,000), with retention of the prosthesis. We replaced the femoral head in the infected hips and the polyethylene insert of the tibial component in the infected knees. Antibiotics were administered intravenously for a mean duration of 7 days (range, 3-10 days), followed by oral antibiotics for a mean period of 8 weeks (range, 5-14 weeks). Choice of antibiotic was guided by the culture and sensitivity results, while the duration of therapy was dependent on serial estimations of ESR, CRP level, and WBC count. The goal of treatment was eradication of infection defined as the absence of any signs or symptoms of PJI, and return of the blood markers to normal levels for at least one-year after the end of the antibiotic regimen. The three cases are now considered in more detail.

## CASE I

A 65-year-old man underwent an uncemented left total knee replacement. Within 6 months (at 178 days), he was re-admitted with a 1-day history of rigors and painful, swollen knee. On the day of admission an arthroscopic washout was carried out. Per-operative specimens cultured positively for group B haemolytic streptococci. At 48-hours following admission, the patient further underwent arthrotomy with aggressive soft-tissue debridement and exchange of plastic

spacer.

### CASE II

A 62-year-old woman who had undergone a right total hip replacement required re-admission 2 months after the index operation, with a 1-day history of fever with swelling and redness of the hip. Hip aspirate was negative on culture, but at arthrotomy done within 72-hours of admission, pus was noted in the joint. Biopsy of the intraoperative specimens later confirmed infection. Soft-tissue debridement after open dislocation with replacement of femoral head was done.

Vancomycin beads were placed (Fig 1).

### Figure 1

Figure 1: Post – debridement radiograph with Vancomycin beads in situ.



### CASE III

A 63-year-old woman underwent a cemented right total knee replacement. At 4-weeks, she was re-admitted with a discharging and dehiscent wound. Wound swab cultured positively for group B haemolytic streptococci and staphylococcus aureus. X-ray revealed gas within the joint. The patient underwent extensive soft-tissue debridement

with a gastrocnemius rotation flap.

### RESULTS

One patient with early deep infection following 269 primary total hip replacements and two patients with early deep infection following 246 primary total knee replacements were identified between Nov 1996 and Dec 2000. The mean age of the patients at the time arthroplasty was performed was 66.7 years (range, 62-73 years). The underlying disease necessitating joint replacement was osteoarthritis in two patients and rheumatoid arthritis in one patient.

The mean interval between prosthesis implantation and the first symptoms of PJI was 88 days (range, 28-174 days). The mean interval between the first symptoms of PJI and first surgical intervention was 8 days (range, 1 -16 days). The mean duration of hospitalisation was 20 days (range, 9 to 37days). The mean duration of follow up following debridement was 22 months (range, 10 -38 months).

All three patients responded to our early aggressive management protocol, with control of infection being achieved in all of them. There were no re-infections, and no complimentary surgical treatment was required in any patient subsequently.

### DISCUSSION

The most common causative agents in deep infections are *Staphylococcus aureus* and *Staphylococcus epidermidis*, which account for >50% of the pathogens isolated [8,9]. Much interest has been recently focussed on the ability of an infecting organism to produce a slime layer or glycocalyx. This ability to produce a slime layer permits the organism to divide into planktonic forms, which exist within a biofilm of glycocalyx. The production of a biofilm allows the organism to adhere to and survive on synthetic surfaces. Bacteria that exist within a biofilm are at least 500 times more resistant than the planktonic forms [10]. They are also relatively resistant to complement activation and ingestion by neutrophils. Biofilms require a certain minimum time to form after the inoculation of the infecting organism. In vitro evidence has suggested that infections can be eradicated with antibiotics while the inoculated organism is still in planktonic phase but not after a biofilm has formed [11]. This finding lends support to our use of debridement, administration of antibiotics, and retention of the prosthesis for the treatment of acute-onset infections in joints with recently fixed components.

Many species of *S. aureus* and *S. epidermidis* are slime

producers. Most gram-negative organisms, with the notable exception of *Pseudomonas* species, are poor slime producers.

It is generally accepted that the results of debridement with retention of the prosthesis in patients who have a chronic infection are poor [12]. This is in keeping with the ability of infecting organisms to adhere to the surfaces of the implant and to survive within a slime layer that isolates the organism from host defence mechanisms and the effects of systemic antibiotics. However, we also know that the slime layer takes some time to form after inoculation and that there is a potential so-called window of opportunity while the infecting organism is still in its planktonic form. If the infection is treated intensively with adequate debridement and appropriate systemic antibiotics, eradication should be possible.

Difficulties with this approach revolve around the determination of the time of onset of the infection and the establishment of a cut-off time beyond which it is no longer reasonable to attempt to retain the implant. Additional difficulty arises from the inability to recognise dead infected tissues that will act as an ongoing nidus of infection.

However, our practice to limit attempts at retention of the prosthesis to patients who have a recently fixed implant and a very clear, short history of symptomatic infection has been successful. We recommend early, aggressive intervention as soon as the patient presents. Patients in whom the distinction between acute and chronic infection could not be made with confidence were managed as chronic infection. Larger randomised, controlled studies are needed to improve the management of early deep prosthetic joint infection.

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### CORRESPONDENCE TO

Mr S Sinha, FRCS, Department of Orthopaedics, Monklands Hospital, Monkscourt Avenue, Airdrie, ML6 0JS, Scotland.  
Tel: 01236 748748(Bleep 167) Fax: 01236 713134 E-mail: write2satya@hotmail

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**Author Information**

**S. Sinha, MS (Orth), FRCS**

Staff Grade Surgeon, Department of Orthopaedic Surgery, Monklands Hospital

**W. R. Chang, MRCS (Ed)**

Specialist Registrar Orthopaedics, Department of Orthopaedic Surgery, Monklands Hospital

**A. C. Campbell, FRCS (Orth)**

Consultant Orthopaedic Surgeon, Department of Orthopaedic Surgery, Monklands Hospital

**A. S. Braidwood, FRCS**

Consultant Orthopaedic Surgeon, Department of Orthopaedic Surgery, Monklands Hospital