Annotation

CAN WE IMPROVE THE RESULTS OF REVISION ARTHROPLASTY FOR INFECTED TOTAL HIP REPLACEMENT?

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Most studies of revision for infected total hip arthroplasty (THA) have focused on control of the infection and provided limited information about the functional outcome, although both aspects are equally important to the patient and the surgeon. Identifying the best means of achieving both goals requires comparison of one-stage and two-stage exchange arthroplasty of prostheses either fixed with antibiotic-loaded cement or without cement, and evaluation of surgical techniques such as femorotomy, the implantation of a spacer and other methods.

This review compares a recent report of 349 revision arthroplasties from various centres in France with previous studies.

Control of infection and functional outcome

Control of infection is usually achieved in more than 80% of patients in published studies. A review of 29 recent articles identified by a Medline search provided information on control of infection in 1641 patients. There were four types of treatment:

- 1) two-stage exchange with antibiotic-loaded cement in 251 patients;¹⁻⁷
- 2) direct exchange with antibiotic-loaded cement in 722 patients;^{3-5,7-12}
- 3) two-stage exchange in 522 patients either without cement¹³⁻¹⁷ or using plain cement only;^{1,18-26} and
- 4) direct exchange either without cement or plain cement only in 136 patients.^{1,19,21,22,25,27}

Control of infection was achieved (Fig. 1) in 93% (233/251) of those with two-stage exchange with antibiotic-loaded cement, in 86% of those with two-stage exchange without antibiotic-loaded cement and of those with direct

exchange and antibiotic-loaded cement, and in 59% of those with two-stage exchange without cement. These results suggest that two-stage exchange with antibiotic-loaded cement may be the best choice. However, although the control of infection may be better, this may not produce a superior functional outcome, since the complexity of the procedure will increase the risk of mechanical complications. Simpler operations may provide similar control of infection with a better functional outcome.

Vielpeau, Lortat-Jacob and Coll²⁸ have recently reported the results of a study which was sponsored by SOFCOT (Société Française de Chirurgie Orthopédique et Traumatologique). A retrospective review was carried out in 14 French teaching centres with a special interest in infected prostheses. There were 349 fully-documented patients who were followed up for at least two years after exchange arthroplasty; 18% of potentially eligible patients were excluded because they had died or were lost to follow-up within two years of the operation but their results in the short term did not appear to be significantly different from those of the main series. The study shows closely similar rates of control of infection with different methods of treatment, with a rate of 88% achieved in the 127 patients treated by direct exchange and of 85% in the 222 patients treated by a two-stage procedure. More complex operations produced higher rates of complication with less satisfactory functional outcomes.

Three notable findings emerged from the study.

Control of infection. Similar rates were seen in one- and two-stage procedures (88% and 85%, respectively), and in uncemented prostheses and those fixed with antibiotic-loaded cement (85% and 90%, respectively), in spite of patients in the one-stage group having factors of adverse prognostic significance, such as aggressive organisms, draining sinus tracts, multiple surgical procedures and loss of bone requiring allografting.

Mechanical complications. These were increased in the two-stage group indicating the possibility of a shorter survival of the prosthesis (Table I). Mechanical complications requiring further surgery occurred in 20% of patients in the two-stage group²⁹ and 9% of patients in those having a direct exchange.³⁰ The proportion of patients with a leg-length discrepancy of at least 2 cm was 50% in the two-stage group and 7% in those with a one-stage procedure.

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Fig. 1

Control of infection according to strategy (direct or two-stage exchange) and local antibiotics.

Table I. Mechanical complications with either direct or two-stage exchange

	Direct exchange (%)	Two-stage exchange (%)
Early mechanical complications requiring reoperation	9	20
Fractures	5	15
Perforations	7	16
Dislocations		12
Length discrepancy >2 cm	7	50
Aseptic loosening at five years	6	16

The corresponding figures were 15% v 5% for intraoperative fractures and 16% v 7% for perforation. Each surgical stage gave rise to complications. The two-stage procedure produced twice the rate of intraoperative fractures as the single-stage operation. Dislocation occurred in 12% of the two-stage patients. The overall rate of aseptic loosening was 6% with a direct and 16% with a two-stage procedure, although this finding may indicate either that repeated surgery adversely affected the quality of fixation, or that the poor texture of the bone was the reason for preferring the two-stage operation.

More invasive techniques were not associated with better infection control. Femorotomy,³¹ in which a longitudinal incision is used to open the femur, was used in only 70 patients, 20%. This technique had no influence on the control of the infection but was associated with a rate of fracture of 14%, as compared with 4% without femorotomy. Femorotomy can be recommended to facilitate the removal of fully-coated ingrowth stems or adherent distal cement³² but not to improve the control of infection.

Spacers were used in only 63 of the 222 patients (35%) treated by the two-stage procedure.³³ They had no effect on the control of infection, but improved functional outcome by preserving limb length and allowing earlier rehabilitation.

Discussion

The results of this study should not be construed as evidence that all treatments are appropriate provided they are used properly. Although the rates of control of infection were similar using the various methods of management, particularly when comparing single- and two-stage operations, the selection of treatment was based on the presumed severity of the infection. Less aggressive strategies used to treat less aggressive infections produced similar outcomes to those obtained when complex procedures were used to treat very severe infections. Thus, in the direct-exchange group, 34% had infection with methicillin-resistant *Staphylococcus aureus* (MRSA), 14% had draining sinus tracts, in 46% the duration of infection was for over one year, and 31% required allografting. The corresponding figures in the two-stage group were 68% for MRSA, 20% for draining sinus tracts, 53% for duration of infection and 47% for allografting. Although the rates of control of infection were similar in the two groups, direct exchange was used when there were fewer poor prognostic factors.

In the group treated with uncemented prostheses, 30% had an MRSA infection whereas in those in which vancomycin-impregnated cement had been used, 55% were infected with MRSA. The similar rates of control indicate that a more complex strategy used to treat severe infection produced similar results to a simpler method of treating moderate infection.

The discrepancy between the SOFCOT series, in which the rate of control of infection was similar across treatments, and previous studies, which found higher rates of control of infection with two-stage operations employing antibiotic-loaded cement, is therefore only apparent rather than real. When interpreting data from the literature, the heterogeneity of patient populations in terms of severity of infection must be borne in mind. If we compare two series of exchanges, each including 50% moderate and 50% severe infections, achieving a rate of control of infection of 80%

with direct exchange, and 91% with a two-stage procedure, these results do not mean that failures are more likely to occur with the former (20%) than with the latter (9%), whatever the severity of infection. It indicates that in the direct exchange group, there was a rate of control of 90% for moderate infection and 70% for severe infection, and thus 80% for the whole group. In the two-stage group, the rate of control was 92% for moderate infection and 90% for severe infection, with 91% for the whole group. If we consider only the moderate infections, the control rate was almost the same (90% and 92%). Direct exchange should be preferred to the two-stage operation in moderate infection, since it achieves a similar control but with a better functional outcome. In patients with moderate infection, aggressive treatment does not significantly increase the rates of control of infection but is associated with a two-fold increase in mechanical complications, greater functional impairment, longer duration of treatment, more pain, and considerably higher costs. Aggressive treatment should be restricted to severe infection.

Selection of the strategy for treatment

The strategy of treatment should be decided according to the severity of infection, the aggressiveness of the surgical programme and the expected functional results. In assessing the results, the severity of the infection in individual patients must be considered. This can be classified into three groups as follows.

Severe infections. These include cases in which the micro-organisms cannot be identified, where previous direct exchange has failed or those where there are two or more factors of concern, either related to the presence of multiple or aggressive micro-organisms or methicillin-resistant *Staphylococcus aureus*, or in the presence of unfavourable local conditions such as fibrosis, repeated surgery, sinus formation or bone loss requiring cortical allografting.

Intermediate infection. This is defined by the presence of one of the above factors for a poor prognosis.

Low-grade infection. This does not include any factor for a poor prognosis.

In low-grade infections, excellent results can be obtained by direct exchange with surgical excision of necrotic tissue and appropriate antibiotic treatment for four months. An uncemented prosthesis can be used. Hydroxyapatite-coated stems may produce better outcomes in this setting than porous ingrowth stems.³⁴

In severe infections, control of the infection is the priority, even if this requires more aggressive surgery. The preferred treatment is a two-stage procedure with local antibiotic therapy by way of an antibiotic-loaded spacer and, if needed, fixation of the exchange prosthesis with antibiotic-loaded cement.

In patients with infection of intermediate severity, both single- and two-stage procedures using antibiotic cement and two-stage operations without antibiotic cement, give

similar rates of control. We recommend the one-stage operation since its greater simplicity is associated with a lower rate of mechanical complications and may increase survival of the prosthesis. A single surgical operation gives a significant advantage in debilitated or elderly patients. The fact that antibiotics diffuse out of the impregnated cement has been convincingly demonstrated by pharmacokinetic studies³⁵ and by clinical studies when it has been used as prophylactic^{36,37} or curative treatment.^{38,39} It does not increase the risk of mechanical complications since its strength is equivalent, of allergies (provided there is no intolerance to vancomycin⁴⁰), or of the development of resistant organisms.⁴¹

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