Clinical Abstract

Revision after joint replacement – routine or risk?

The replacement of a joint prosthesis is a challenge for any surgeon because the intervention is technically more sophisticated than primary joint replacement. In addition, there is a higher incidence of intraoperative and postoperative complications. Enhanced surgical techniques and the use of antibiotic-loaded bone cement (PALACOS® R+G, COPAL®) reduce the postoperative infection rate.

Summary

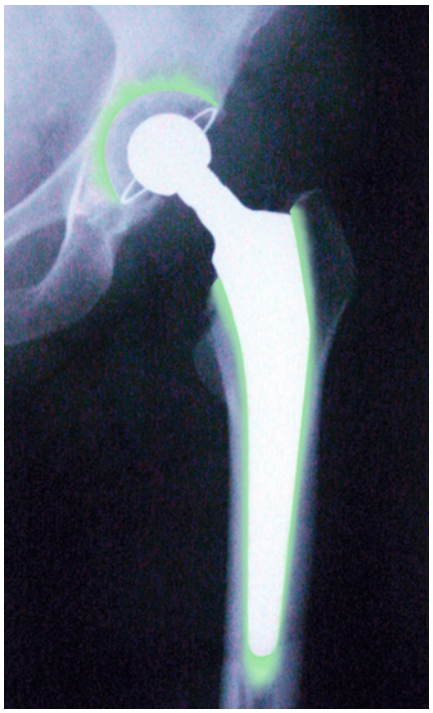
- Revision surgery: risky for patients, demanding for surgeons
- Diagnosis: careful examination of bacterial colonisation
- Revision management: use of antibiotic-loaded bone cement
- Aim: to reduce the revision rate

Endoprosthesis loosening as the cause

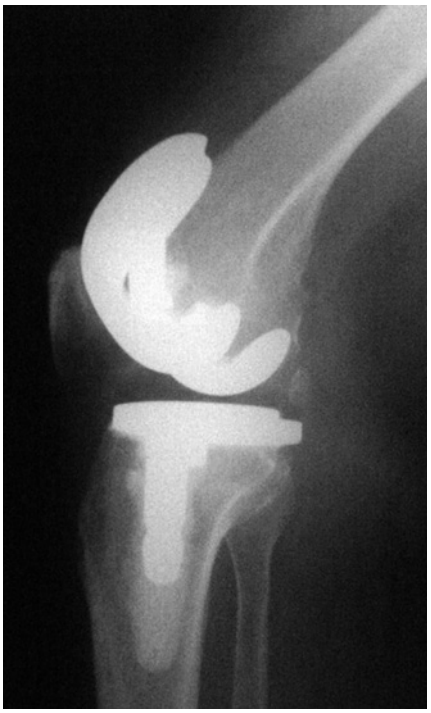
After operative replacement of damaged hip or knee joints by an endoprosthesis a revision may be necessary on account of loosening. Generally this depends on the patient, the material used and the surgical technique (1). Owing to increasing life expectancy and the resulting rise in the number of joint replacements the revision rate also increases.

Swedish hip register

According to the Swedish hip register about 90 % of all total hip endoprostheses are still intact after 13 years. Even lifetimes of over 20 years are achieved with cemented joint prostheses (2). 9 % of total hip endoprostheses and 8 % of total knee endoprostheses are revised (3, 4).



Hip joint replacement without signs of loosening (7).



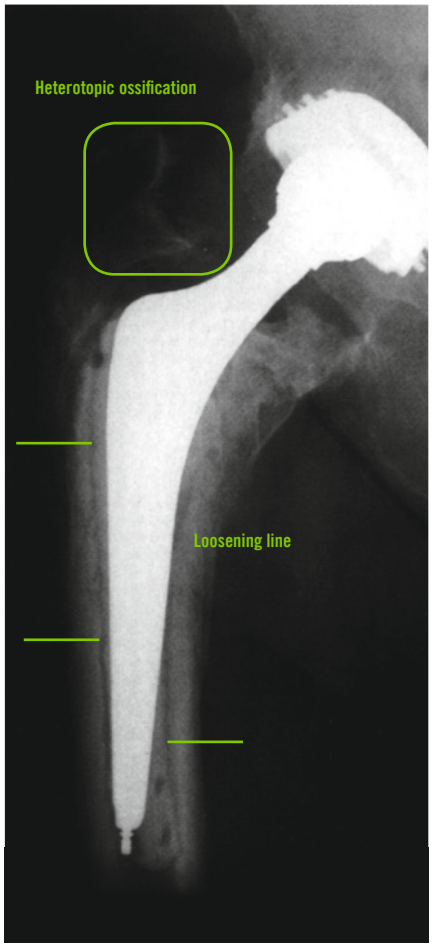
Knee joint replacement without signs of loosening (7).

Causes of prosthesis loosening include not only signs of wear but also infections. In a study (n=370) Morawietz et al. conducted a histopathological classification using periprosthetic membranes taken from revision operations (5).

Pathogenetic classification

I = abrasive particle type (54.3 %)
II = infection type (19.7 %)
III = combined type from I and II (5.4 %)
IV = undefined type, no criteria of I or II (15.4 %)

This largely agrees with the current figures from microbiological diagnosis regarding the pathogenesis of prosthesis loosening (**44 %–70 % aseptic, 15 %–20 % septic**) (6).



Aseptic prosthesis loosening (according to (11)).

Radiological signs of loosening

- Osteolyses
- Lytic line > 2 mm
- Fusion > 2 mm, implant migration
- Bone absorption or apposition
- Implant damage

Aseptic or septic prosthesis loosening?

Diagnostic differentiation of aseptic and septic prosthesis loosening is difficult in many cases. On account of imperfect diagnostic method joint infections can remain undetected and prosthesis loosening is classified as aseptic. Information on this is provided by the results of the "Norwegian Arthroplasty Register" (8): **owing to the use of antibiotic-loaded bone cement for primary joint replacement there was a decrease in the incidence of prosthesis loosening diagnosed as aseptic.**

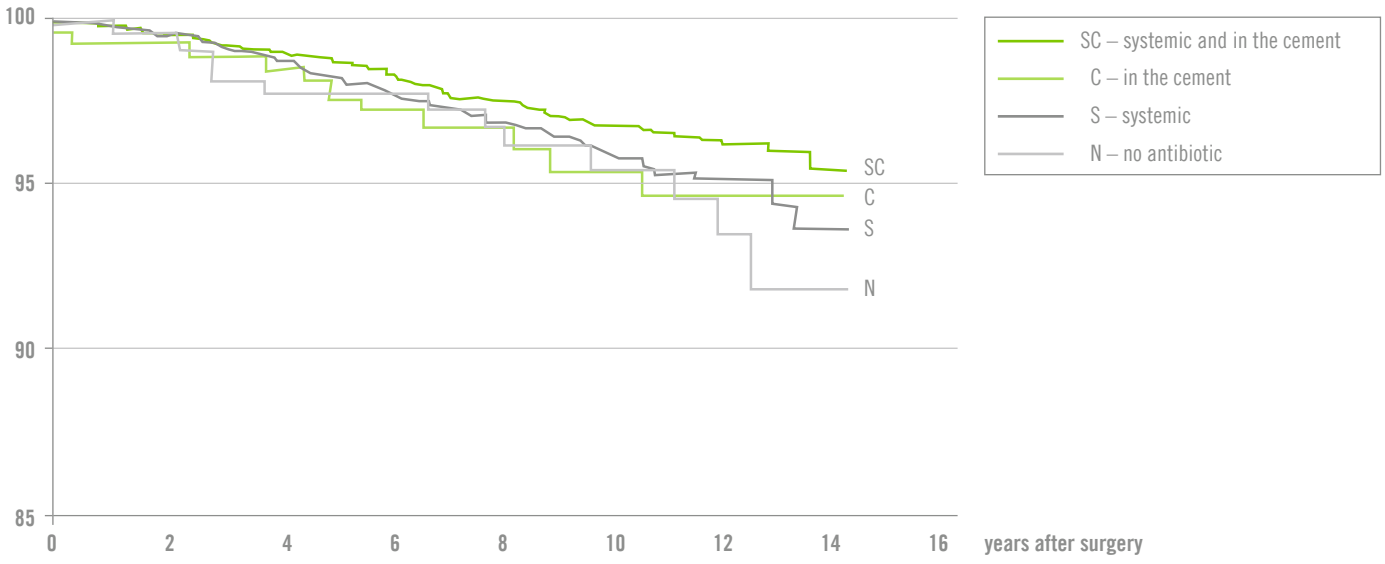
Precision biopsy and specimen processing is essential to ensure accurate identification of the bacteria responsible, as is demonstrated by Neut et al. (9) in their study of 22 clinically infected joint prostheses. Intraoperative specimens were taken by two different methods and subjected to further processing:

- Firstly, tissue particles were taken conventionally which were cultivated in the laboratory within 4 hours and were incubated under aerobic and anaerobic conditions over a period of 5 days.
- Secondly, the prosthesis parts removed were packed under sterile conditions, transported at 4° C and subjected to further processing within 4 hours. For this purpose material was scraped off the surface of the prosthesis and samples of tissue were taken. Aerobic/anaerobic incubation took place over a period of 7 days.

There was bacterial infection in 41 % of samples cultivated by the conventional method. By comparison, bacterial growth was found in 64 % of the tissue samples and 86 % of the samples scraped off the prostheses which had been incubated by the modified method.

Moreover, a longer incubation time leads to detection of polymicrobial infection, whereas with conventional incubation only one pathogen is usually found (9, 10). To summarise one can say that careful determination of bacterial infection is important for further treatment.

Survival rate of hip endoprostheses in %



Survival rate after hip joint replacement – comparison of different antibiotic regimens (according to (12)).

Accurate bacterial diagnosis

Accordingly there are four factors which are crucial for the detection of bacterial infection:

- Sampling from prosthesis material direct
- Careful, sterile packaging
- Swift transport to the laboratory
- Long incubation time

Revision management

Aseptic loosening of the prosthesis

Surgery for aseptic prosthesis loosening is a single-stage procedure and is largely the same as for a first implantation, apart from the need for management of bone defects. A bone cement mixed with antibiotic (e.g. PALACOS® R+G) is used for infection prophylaxis.

Septic loosening of the prosthesis

In the case of septic prosthesis loosening **two-stage revision** is currently the standard procedure: in addition to removal of extraneous material and excision of necrotic bone tissue the bone bed is subjected to thorough debridement. In doing so, careful, swift biopsy and specimen storage are essential to ensure accurate diagnosis of bacterial colonisation. In order to immobilise the patient in the meantime, in Europe a spacer made of antibiotic-containing bone cement is implanted in most cases. This not only has an antibiotic effect but also prevents the surrounding muscles from shrinking (8).

After a few weeks or months a new endoprosthesis is implanted in a second operation. In this context the option of taking a "second look" is an advantage: the surgeon assesses the tissue in situ and can perform further debridement if necessary.

Single-stage revision is possible with early septic prosthesis loosening. For this, accurate identification of the bacteria responsible is a requirement. Special attention must be paid to the biopsy procedure, specimen transport and incubation time.

When a new joint prosthesis is being implanted, antibiotic-loaded bone cement is normally used. In doing so it is important to match the added antibiotic to the antibiogram of the bacteria responsible. That is why accurate diagnosis of microbial infection is a basic requirement for successful treatment.

Antibiotic-loaded bone cement

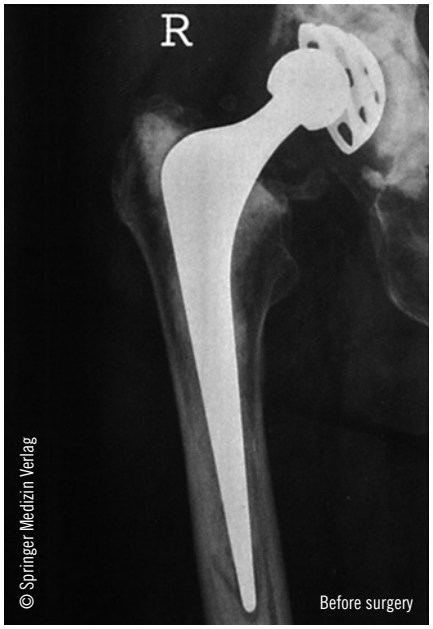
…develops antibiotic effect even after years (9):

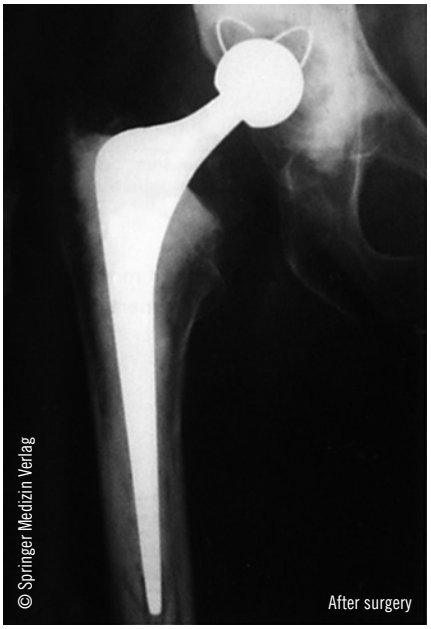
gentamicin-loaded bone cement from a revised joint produced a significant inhibition zone for staphylococci on the culture medium – five years after the original implantation.

At all events, industrially manufactured cement-antibiotic mixtures are preferable to ones made manually; unfortunately there is no clinical data available on the effectiveness of industrially manufactured mixtures. Bone cements with double antibiotic protection comprising of gentamicin and clindamycin (COPAL®) have a synergistic bactericidal effect on more than 90 % of all bacteria which can occur in joint surgery infections.

High complication rate after revision

- Infection risk 5 % – 8 %
- Limited wound healing
- Functional limitation due to muscle lesions
- Leg length difference
- Fracture risk
- Dislocation risk 5 % – 30 %
- Repeated prosthesis loosening





Acetabular cup and stem change after detection of loosening (according to (13)).

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