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Severe Femoral Bone Loss in Infected Total Hip Arthroplasty: Surgical Management

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Abstract

The management of severe bone loss in a patient with a chronically infected total hip arthroplasty is a complex surgical challenge. The surgical alternatives are numerous and include the use of allografts, both structural and morcellized; cemented and cementless femoral components; and segmental replacement megaprostheses.

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Infection following a total hip arthroplasty (THA) is a major complication with the potential for devastating long-term sequelae. The risk of infection is generally quoted as being 1%, with reported rates ranging from 0.3% to 2.2%.[1,2] A diagnosis of infection in patients presenting with a painful THA can be challenging, especially for a chronic infection. A delay in diagnosis can result in ongoing host bone destruction, which further hinders the surgeon's ability to perform a successful reconstruction. It is therefore paramount that the work-up of a painful THA includes appropriate measures for investigating infections.

Infected joint arthroplasties are classified based on the timing of presentation, initially described by Coventry:[3] stage I, acute infection within 6 weeks of the index surgery; stage II, delayed presentation with a chronic indolent infection; and stage III, acute presentation of infection secondary to hematogenous spread in a previously well-functioning hip arthroplasty. The management choices available to the treating surgeon include antibiotic suppression alone, débridement with retention of the prosthesis, excision arthroplasty, arthrodesis, amputation, and single- or two-stage revision. The choice of treatment modality will depend on the timing of the presentation, the feasibility of further reconstruction, and the overall health of the patient.

Patients presenting with a clinical scenario consistent with an acute infection (stage I or III) undergo serologic investigations, including erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), to rule out an infectious process. If these tests are positive, emergent irrigation and débridement with exchange of the modular components of the THA (for example, acetabular liner and femoral head) is performed, followed by 6 weeks of antibiotics directed toward the infecting organism.

If the symptoms are chronic, the diagnosis of an indolent infection (stage II) must be excluded. If the ESR is greater than 30 mm/h, the CRP is greater than 10 mg/L, or the clinical picture is highly suggestive of infection, the patient undergoes a

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Figure 1 Infected revision THA with segmental bone loss and extensive osteomyelitis, managed first with an antibiotic-loaded, long-stem facsimile of the proximal femur and snap-fit socket (PROSTALAC system).

hip aspiration, with three samples taken under sterile conditions. At least two of three hip aspiration samples must be positive for the diagnosis of infection. For patients in whom a chronic infection is diagnosed, a two-stage revision using an articulated spacer is presently the treatment of choice at most centers in North America and around the world, with reported success rates of 93% to 96%.[4,5]

Management of Bone Loss

An important characteristic of patients with an infected THA is the quality of the remaining femoral host bone. Patients may have severe bone loss secondary either to osteolysis before the onset of the infection or because a delay in the diagnosis of infection resulted in ongoing bone destruction. There are two vital issues to address when planning the surgical management of these patients: how to successfully complete the first-stage procedure to ensure eradication of infection and optimize function while awaiting definitive management; and how to optimally treat the severe bone loss during the second-stage definitive procedure.

Ninety-nine patients who had undergone two-stage revision surgery for infected THA were reviewed in a 10- to 15-year follow-up study.[6] The final recurrence rate of infection was 4%, and a high success rate was also achieved in patients with severe femoral bone loss. These results supported the use of a PROSTALAC (prosthesis of antibiotic-loaded acrylic cement) system (DePuy, Warsaw, IN) for the first stage in these uniquely difficult cases (Figure 1). This has been standard practice at the University of British Columbia since 1986 for maintaining limb length and joint stability, while facilitating early mobilization of the patient as well as the technical details of the second stage.

The surgical options for the management of severe bone loss following the successful eradication of infection are similar to the choices available for the treatment of Vancouver B3 periprosthetic fractures. The surgical alternatives can be divided into three groups: complex reconstruction of the deficient proximal femur with secure distal fixation; segmental substitution of the proximal femur with a megaprosthesis or allograft/prosthesis composite (Figure 2, *A*); and distally fixed replacement with a modular stem that acts as a scaffold around which the remaining deficient proximal bone can be assembled, with or without supplemental bone graft (Figure 2, *B*).

Several of these surgical alternatives require the use of allograft, either morcellized or structural, during the second-stage procedure. Although allograft has been widely used in aseptic revision, there is a theoretical concern that its use following infection may increase the rate of recurrence. Most published articles on the use of allograft in the management of infection have reported excellent success, with recurrence rates ranging from 0 to 7.5%.[7-10] A 2004 report by Ammon and Stockley[11] noted recurrence rates of 14% with the use of allograft at revision for infection. They reviewed 57 patients treated with a two-stage revision for infection with acetabular impaction grafting, femoral impaction grafting, or a combination of these, with 12 requiring a large circumferential allograft. Eight patients had recurrent infections.

The use of a cementless prosthesis at the second stage has been questioned, with early studies reporting rates of reinfection as high as 18% and additional occurrence of loosening.[12] More recent investigations have reported rates of reinfection between 7% and 10%.[13-16] These more promising results demonstrate that modern cementless components can be used at the time of the second-stage revision, with the potential advantage of enhanced survival of the implant. This finding assumes that the infection has been eradicated as a consequence of the first-stage intervention and subsequent antimicrobial management.

The following discussion provides a brief outline of selected articles reporting the results of the various surgical options for the treatment of severe bone loss in infected THAs.

Complex Reconstruction of the Deficient Proximal Femur With Secure Distal Fixation

Circumferential Mesh With Impaction Allografting

English and associates[7] reviewed 53 patients who underwent impaction allografting during the second stage of a two-stage revision for an infected THA. All patients underwent a Girdlestone excision arthroplasty, received local and systemic antibiotics, and subsequently underwent reconstruction using femoral impaction grafting. Four patients (7.5%) had recurrence of their infection.

Bicortical Strut Allografting With Distally Fixed Stem

Although there are no published reports specifically addressing the use of bicortical structural allograft in the setting of infection, Emerson and associates[17] have demonstrated that single cortical struts unite consistently by 8 months with a union rate of 96%.

Resection of the Proximal Femur With Segmental Substitution

Allograft-Prosthetic Composite

Alexeeff and associates[8] reviewed 11 patients treated with two-stage revision and structural allograft for infection. There was no recurrence of infection with mean follow-up of 47.8 months (range, 24 to 72 months). Nusem and Morgan[9] reported on the use of structural allografts for bone stock reconstruction in two-stage revision for infected THA in 18 patients. Outcomes were good in 16 of 18 patients followed for 5 to 14 years, with one recurrence of infection. Hsieh and associates[10] reported on the treatment of deep infection of the hip with two-stage revision and structural allograft in 24 patients. There was no recurrence of infection at a mean follow-up of 4.2 years (range, 2 to 7 years).

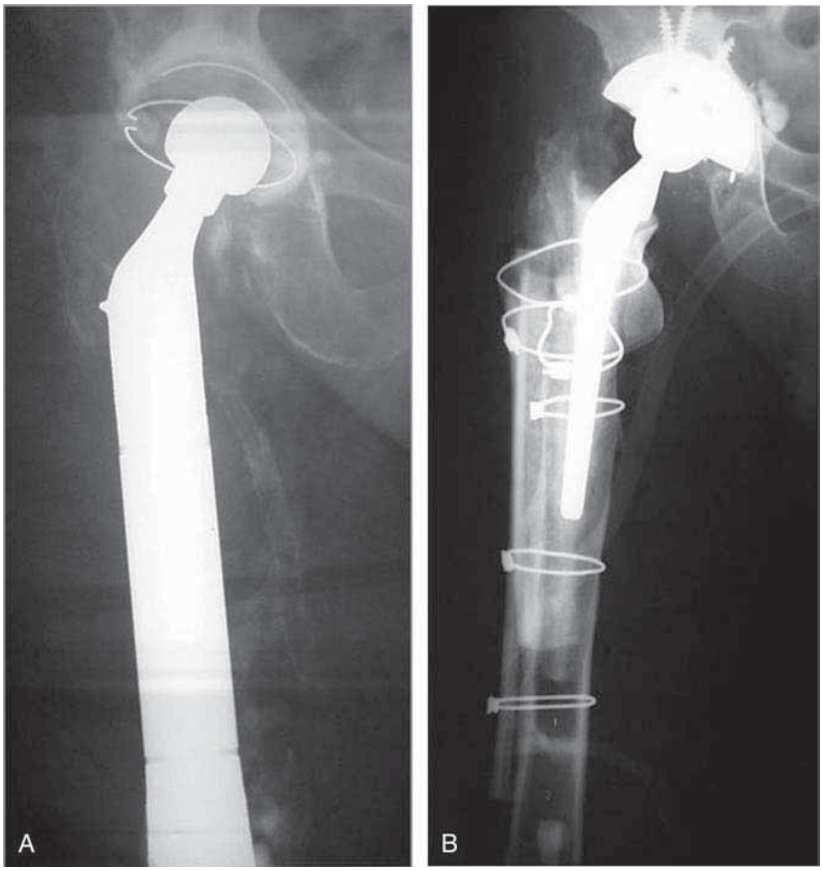

Figure 2 **A,** Postoperative radiograph of a megaprosthesis used for the second-stage revision of a previously infected THA. **B,** Postoperative radiograph of the scaffold technique using a modular tapered titanium femoral component augmented with allograft.

Proximal Femoral Replacement

Parvizi and associates[18] reported on 43 patients undergoing proximal femoral replacement for nonneoplastic disorders (13 for deep infection). The mean follow-up was 36.5 months, with excellent or good functional outcomes in 22 patients, fair in 10, and poor in 11. Using revision as the end point, the survivorship of the implant was 87% at 1 year and 73% at 5 years. One patient in the series developed a postoperative infection, although it was not stated whether this represented a recurrent infection.

Distally Fixed Replacement That Acts as a Scaffold for the Remaining Proximal Host Bone

This final surgical alternative is a relatively novel technique. The concept is that the deficient proximal femur is wrapped around the proximal part of a distally fixed stem and then secured with cables. Using a modular titanium tapered stem provides a scaffold that encourages healing and possible reconstitution of the proximal femur. This tech-

nique requires sufficient proximal host bone support to provide rotational stability of the implant. The adequacy of the remaining host bone is evaluated intraoperatively based on the rotational stability of trial components. Although there are no published reports on the outcome of this technique for the management of infection, early reports of the technique for the management of severe bone loss have been promising.[19]

Summary

The treatment protocol at our institution for a chronic infection with associated severe bone loss remains a two-stage exchange arthroplasty procedure with an antibiotic-loaded facsimile of the joint and proximal femur in the interval between stages. At present, the use of the scaffold technique (distally fixed replacement that acts as a scaffold for the remaining proximal host bone) is recommended during the definitive second stage. Further studies are required to determine the outcome of the scaffold technique for the management of severe bone loss in infections.

References

1. Lidwell OM: Clean air at operation and subsequent sepsis in the joint. *Clin Orthop Relat Res* 1986;211: 91-102.
2. Sculco TP: The economic impact of infected total joint arthroplasty. *Instr Course Lect* 1993;42:349-351.
3. Coventry MB: Treatment of infections occurring in total hip surgery. *Orthop Clin North Am* 1975;6:991-1003.
4. Garvin KL, Fitzgerald RH Jr, Salvati EA, et al: Reconstruction of the infected total hip and knee arthroplasty with gentamicin-impregnated Palacos bone cement. *Instr Course Lect* 1993; 42:293-302.
5. Younger AS, Duncan CP, Masri BA, McGraw RW: The outcome of two-stage arthroplasty using a custom-made interval spacer to treat the infected hip. *J Arthroplasty* 1997;12: 615-623.
6. Kostamo T, Biring GS, Masri BA, Garbuz D, Duncan CP: Two-stage hip revision for infection: A 10-15 year follow-up study in 103 patients. *75th Annual Meeting Proceedings.* Rosemont, IL, American Academy of Orthopaedic Surgeons, 2008, p 391.
7. English H, Timperley AJ, Dunlop D, Gie G: Impaction grafting of the femur in two-stage revision for infected total hip replacement. *J Bone Joint Surg Br* 2002;84:700-705.
8. Alexeeff M, Mahomed N, Morsi E, Garbuz D, Gross A: Structural allograft in two-stage revisions for failed septic hip arthroplasty. *J Bone Joint Surg Br* 1996;78:213-216.
9. Nusem I, Morgan DA: Structural allografts for bone stock reconstruction in two-stage revision for infected total hip arthroplasty: Good outcome in 16 of 18 patients followed for 5-14 years. *Acta Orthop* 2006;77:92-97.
10. Hsieh PH, Shih CH, Chang YH, Lee MS, Yang WE, Shih HN: Treatment of deep infection of the hip associated with massive bone loss: Two-stage revision with an antibiotic-loaded interim cement prosthesis followed by reconstruction with allograft. *J Bone Joint Surg Br* 2005;87:770-775.
11. Ammon P, Stockley I: Allograft bone in two-stage revision of the hip for infection: Is it safe? *J Bone Joint Surg Br* 2004;86:962-965.
12. Nestor BJ, Hanssen AD, Ferrer-Gonzalez R, Fitzgerald RH Jr: The use of porous prostheses in delayed reconstruction of total hip replacements that have failed because of infection. *J Bone Joint Surg Am* 1994;76: 349-359.
13. Haddad FS, Muirhead-Allwood SK, Manktelow AR, Bacarese-Hamilton I: Two-stage uncemented revision hip arthroplasty for infection. *J Bone Joint Surg Br* 2000;82:689-694.
14. Fehring TK, Calton TF, Griffin WL: Cementless fixation in 2-stage reimplantation for periprosthetic sepsis. *J Arthroplasty* 1999;14:175-181.
15. Masri BA, Panagiotopoulos KP, Greidanus NV, Garbuz DS, Duncan CP: Cementless two-stage exchange arthroplasty for infection after total hip arthroplasty. *J Arthroplasty* 2007; 22:72-78.
16. Kraay MJ, Goldberg VM, Fitzgerald SJ, Salata MJ: Cementless two-staged total hip arthroplasty for deep periprosthetic infection. *Clin Orthop Relat Res* 2005;441:243-249.
17. Emerson RH Jr, Malinin TI, Cuellar AD, Head WC, Peters PC: Cortical strut allografts in the reconstruction of the femur in revision total hip arthroplasty: A basic science and clinical study. *Clin Orthop Relat Res* 1992;285: 35-44.
18. Parvizi J, Tarity TD, Slenker N, et al: Proximal femoral replacement in patients with non-neoplastic conditions. *J Bone Joint Surg Am* 2007;89:1036-1043.
19. Berry DJ: Treatment of Vancouver B3 periprosthetic femur fractures with a fluted tapered stem. *Clin Orthop Relat Res* 2003;417:224-231.