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One or Two-Stage Exchange Using Prosthetic Spacer for Treatment of Periprosthetic Joint Infection

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Abstract

Periprosthetic joint infection is serious complication of total joint arthroplasty that is one of the most common reasons for revision surgery in the United States. Surgical treatment options have largely been divided between one-stage and two-stage modalities, which have their respective advantages and disadvantages. This article describes a prosthetic spacer technique that can be used as either a one-stage or two-stage revision for treatment of PJI and to report a case series of patients treated using this technique. The technique involves the use of vancomycin and tobramycin intraoperatively mixed with cement and Steinmann pins to secure new knee or hip components as a prosthetic spacer, which can be left as a one-stage revision or replaced in a two-stage revision depending on the patient's clinical course. This technique was used in 20 cases of revision TKA or THA, which all achieved PJI eradication according to a Delphi-based international multidisciplinary consensus definition. These results suggest this prosthetic spacer technique as a safe and effective treatment for PJI that provides the option of one or two-stage revision.

Keywords: Periprosthetic joint infection; Revision arthroplasty; Spacer; One-stage revision; Total knee arthroplasty; Total hip arthroplasty; Sepsis

Abbreviations: PIJ: Periprosthetic Joint Infection; IDLE: Irrigation and Debridement with Liner Exchange; TKA: Total Knee Arthroplasty; THA: Total Hip Arthroplasty

Introduction

Periprosthetic joint infection (PJI) is a feared and potentially catastrophic complication of joint replacement surgery. The National Inpatient Sample estimated a 2.0 to 2.4% incidence of PJI for total hip arthroplasties (THA) and total knee arthroplasties (TKA) performed in the United States [1]. PJI is the most common reason for revision TKA, accounting for 25% of cases, and the third most common reason for revision THA, accounting for 15% [2]. PJI imposes both a critical threat to patient outcomes and a substantial economic burden for healthcare systems, with an annual cost projected to exceed $1.62 billion by 2020 [1,2].

Surgical treatment options for PJI include irrigation and debridement with liner exchange (IDLE), one-stage

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revision, and two-stage revision. Indications for IDLE are restricted to acute PJI cases and may be further limited by comorbidities, pathogen type, component stability, and soft tissue status [3,4]. Furthermore, numerous studies have reported high failure rates and poor outcomes for isolated IDLE as treatment for PJI [5-10]. One-stage revision is more commonly performed in Europe and is likewise limited by a range of contraindications including generalized sepsis, drug resistant pathogens, and poor soft tissue envelope [3,11,12].

Two-stage revision is currently the gold standard for definitive treatment of PJI in North America [13,14]. The development of dynamic articulating spacers that can deliver high local concentrations of antibiotics has improved range of motion and re-infection outcomes, while providing superior function and preventing soft tissue contracture during the interval between stages [13,15,16]. Despite such improvements, the process of two-stage revision retains the disadvantages of the morbidities associated with multiple surgeries, as well as the delay in final treatment of the PJI. Furthermore, it has been shown to be about 1.7 times more expensive than one-stage revision [17].

Given the aforementioned advances in surgical technique and potential risks of two-stage revision, some patients may achieve outcomes after a first stage satisfactory enough that the treatment "becomes" a one-stage revision. Thus, there is potential demand for techniques that leave one-stage revision open as such an option. The purpose of this article is to describe a prosthetic spacer technique that can be used as either a one-stage or two-stage revision for treatment of PJI and to report a case series of patients treated using this technique.

Materials and Methods

Surgical technique

The procedure begins with induction of anesthesia and routine sterilization, draping, and other perioperative preparations. The incision is made along the previous surgical wound and the appropriate arthrotomy is performed to expose the operative joint. Intraoperative findings of the infection are observed, and cultures are taken. The previous implants and cement are removed with care to conserve bone stock. Cultures are taken and and I&D is performed. The antibiotic cement is mixed using one 5-gram vial of vancomycin, seven 1.2-gram vials of tobramycin, and a variable amount of cement. Two packs for hips, two or three for knees. The components for the spacer are trialed, and the appropriate components are coated with the antibiotic cement for implantation.

In the knee, a primary or revision femoral component is implanted with the antibiotic cement. An antibiotic-coated Steinmann pin is inserted in the canal. Instead of a base plate or premade spacer, a Steinmann pin is drilled into a tibial polyethylene insert. The construct is coated with antibiotic cement (Figure 1). In the hip, a revision femoral component is coated with the antibiotic cement. Cement is not pressurized into the canal. The back of a 40 mm ID polyethylene liner is abraded and inserted into the acetabular bed using antibiotic cement (Figure 2). The acetabular component is hand pressurized using the same technique as cemented cup insertion. Routine closure and postoperative protocols are observed. Patients receive at least 6 weeks IV antibiotics based on sensitivities. All patients are followed by both the orthopaedic and infectious disease services. All procedures were performed by the senior author (EMA).

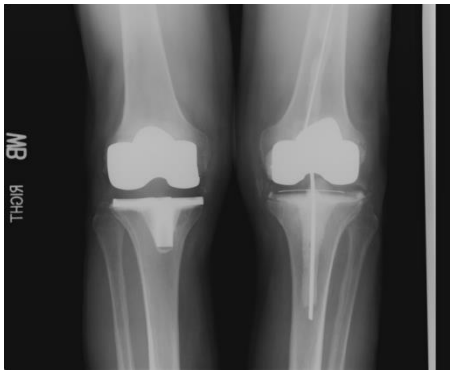

Figure 1: The prosthetic spacer (left) compared to a conventional TKA (right).

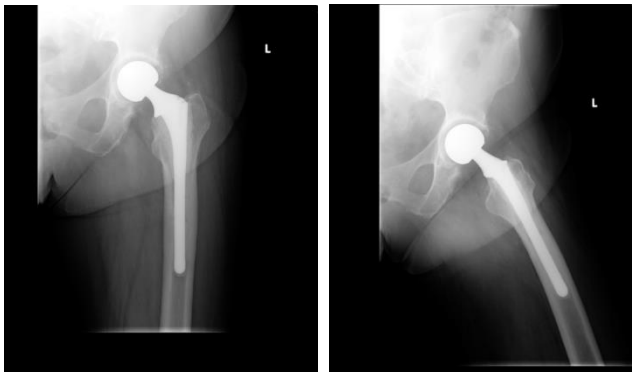

Figure 2: Two views of the prosthetic spacer for revision THA.

Case series

Patients were eligible for inclusion if they underwent revision TKA or THA using the prosthetic spacer technique for treatment of chronic PJI. Acute cases of septic arthritis were excluded. A retrospective chart review was performed over the study period of October 2012 to April 2018. Patients were evaluated for infection eradication according to a Delphi-based international multidisciplinary consensus definition [18]. Patient demographic information, reoperations, and systems at latest follow-up were collected.

Results

There were 20 cases of revision TKA or THA using the prosthetic spacer technique during the study period, comprising 12 TKAs and seven THAs. One case was excluded due to acute septic arthritis. At latest follow-up, 10 patients had converted to a second stage of revision, and nine had retained the prosthetic spacer as a one-stage revision. A two-stage procedure was performed when patients developed pain secondary to mechanical loosening. The one-stage patients were significantly older (p = 0.001) at a mean of 71.7 years compared to the two-stage group, which had a mean of 56.9 years. There were no statistically significant differences in sex, BMI, or operative joint between the group that had reoperation and the group that did not (Table 1). At latest follow-up, none of the one-stage patients had complaints of pain or instability, and all had eradication of their PJI.

Reoperation?	Yes	No	p-value
PATIENTS	10	9	
AGE (years)	56.9 ± 9.7	71.7 ± 5.9	0.001
SEX			0.65
FEMALE	7 (70.0%)	5 (55.6%)	
MALE	3 (30.0%)	4 (44.4%)	
BMI (kg/m2)	30.9 ± 6.1	30.7 ± 6.7	0.927
JOINT			0.17
KNEE	8 (80.0%)	4 (44.4%)	
HIP	2 (20.0%)	5 (55.6%)	

Table 1: Joint between the group that had reoperation.

Discussion

The purpose of this paper is to describe a prosthetic spacer technique that can be used as either a one-stage or two-stage revision for treatment of PJI and to report a case series of patients treated using this technique. Among the 19 patients included in the study, nine had retained the prosthetic spacer as their revision implant at latest follow-up. For all these patients, there was effective eradication of the PJI according to a Delphi-based consensus definition. Only patients who developed pain secondary to mechanical loosening had a two stage exchange.

TKA and THA are exceptionally common procedures, with an estimated seven million Americans living with a knee or hip replacement [19]. As the US population grows and ages and the indications for joint replacement surgery are expanded, the demand for TKAs and THAs is projected to continue to increase rapidly [19-22]. Thus, PJI can be expected to become an increasingly prominent issue, and the optimization of its treatment is an important direction to be pursued.

Although two-stage revision has been considered the gold standard treatment for PJI, there are some signs that this paradigm may be shifting. A number of studies have reported low re-infection rates after one-stage revision for PJI that are similar to those of two-stage revision, with a common theme of careful patient selection [23-26]. There is less information available on functional outcomes, but some studies have demonstrated promising results for one-stage revision. In a series of 50 consecutive patients with infected THAs, Oussedik *et al*. reported significantly higher mean Harris Hip Scores at a mean follow-up of 6.8 years in 11 patients that underwent one-stage revision compared to 39 that underwent two-stage revision (87.8 and 75.5 respectively, p = 0.0003) [27]. Haddad *et al*. compared 28 patients that underwent one-stage revision for infected TKA to 74 patients that underwent two-stage revision. At a mean follow-up of 6.5 years, none of the one-stage patients had developed re-infection, and they had a significantly higher mean Knee Society Score of 88 compared to 76 in the two-stage group ($p < 0.001$) [28]. Larger randomized control studies that directly compare re-infection rates and functional outcomes of one and two-stage revision are called for so that the relative benefits of these procedures may be better understood.

Given these results and the potential advantages in terms of morbidity, inpatient hospital stays and recovery time, cost, and mobilization [29], the option of one-stage revision may be appealing for many patients. The authors offer the technique described in this paper to provide such an option. The prosthetic spacer is implanted with anticipation of continuing to a second stage that uses a conventional revision TKA or THA. However, if the patient has a good outcome with the prosthetic spacer, or is debilitated from proceeding to the second stage by comorbidities, this spacer may be retained as a one-stage revision. These spacers are technically easy to fashion. Removal during a second stage procedure is not difficult as the cement has not been pressurized into the canals.

In particular, older patients with lower functional demands may be able to do well with the spacer over their life span. This may be the reason for the significantly higher mean age in the one-stage patients. Even if the patient goes on to require a second stage, this prosthetic spacer technique allows for normal use of the joint during the interim period and avoids the pain that is associated with some premade spacers. Another advantage of this technique is that by forgoing the acetabular shell or tibial base plate components, the cost of the procedure is reduced and there is less surface area of cement-to-metal interface for re-infection to develop. As in conventional one-stage revision, patient selection is critical to the success of this technique. Contraindications include generalized sepsis, unknown or drug-resistant infections, and severe soft tissue deficiency [4].

Limitations

The authors acknowledge several limitations in this study. The sample size is relatively small, so the findings may not be generalizable. All procedures were performed by a single surgeon at one center, so the results may not be reproducible. Patient-reported outcome scores were not collected, so the relative successes of the one and two-stage procedures are not quantifiable. This study is subject to the inherent limitations of any retrospective study, including selection bias.

Conclusion

The prosthetic spacer technique safely and effectively treats PJI while providing the option of one or two-stage revision.

References

1. Kurtz SM, Lau E, Watson H, Schmier JK, Parvizi J (2012) Economic burden of periprosthetic joint infection in the United States. J Arthroplasty (27): 61–65.

2. Bozic KJ, Kamath AF, Ong K, Lau E, Kurtz S, et al. (2015) Comparative Epidemiology of Revision

3. Arthroplasty: Failed THA Poses Greater Clinical and Economic Burdens Than Failed TKA. Clin Orthop 473(6): 2131–2138.

4. Jiranek WA, Waligora AC, Hess SR, Golladay GL (2015) Surgical Treatment of Prosthetic Joint Infections of the Hip and Knee: Changing Paradigms? J Arthroplasty 30(6): 912–918.

5. Parvizi J, Gehrke T, Chen AF (2013) Proceedings of the International Consensus on Periprosthetic Joint Infection. Bone Jt J 95–B(11): 1450–1452.

6. Romanò CL, Manzi G, Logoluso N, Romanò D (2012) Value of debridement and irrigation for the treatment of peri-prosthetic infections. A systematic review. Hip Int J Clin Exp Res Hip Pathol Ther 22 Suppl 8: S19-24.

7. Romanò C, Logoluso N, Drago L, Peccati A, Romanò D (2014) Role for irrigation and debridement in periprosthetic infections. J Knee Surg 27(4): 267–72.

8. Koyonos L, Zmistowski B, Della Valle CJ, Parvizi J (2011) Infection control rate of irrigation and débridement for periprosthetic joint infection. Clin Orthop 469(11): 3043–3048.

9. Fehring TK, Odum SM, Berend KR, Jiranek WA, Parvizi J,et al. (2013) Failure of irrigation and débridement for early postoperative periprosthetic infection. Clin Orthop 471(1): 250–257

10. Flierl MA, Culp BM, Okroj KT, Springer BD, Levine BR, (2017) Poor Outcomes of Irrigation and Debridement in Acute Periprosthetic Joint Infection With Antibiotic-Impregnated Calcium Sulfate Beads. J Arthroplasty 32(8): 2505–2507.

11. Urish KL, Bullock AG, Kreger AM, Shah NB, Jeong K, et al. (2018) A Multicenter Study of Irrigation and Debridement in Total Knee Arthroplasty Periprosthetic Joint Infection: Treatment Failure Is High. J Arthroplasty 33(4): 1154–1159.

12. Gehrke T, Kendoff D (2012) Peri-prosthetic hip infections: in favour of one-stage. Hip Int J Clin Exp Res Hip Pathol Ther 22 Suppl 8: S40-S45.

13. Lichstein P, Gehrke T, Lombardi A, Romano C, Stockley I, et al. (2014) One-stage versus two-stage exchange. J Orthop Res Off Publ Orthop Res Soc 32 Suppl 1: S141-S146.

14. Kini SG, Gabr A, Das R, Sukeik M, Haddad FS (2016) Two-stage Revision for Periprosthetic Hip and Knee Joint Infections. Open Orthop J 10: 579–588.

15. Charette RS, Melnic CM (2018) Two-Stage Revision Arthroplasty for the Treatment of Prosthetic Joint Infection. Curr Rev Musculoskelet Med 11(3): 332–340.

16. Guild GN, Wu B, Scuderi GR. Articulating vs (2014) Static antibiotic impregnated spacers in revision total

knee arthroplasty for sepsis. A systematic review. J Arthroplasty 29(3): 558–563.

17. Romanò CL, Gala L, Logoluso N, Romanò D, Drago L(2012) Two-stage revision of septic knee prosthesis with articulating knee spacers yields better infection eradication rate than one-stage or two-stage revision with static spacers. Knee Surg Sports Traumatol Arthrosc Off J ESSKA 20(12): 2445–453.

18. Klouche S, Sariali E, Mamoudy P(2010) Total hip arthroplasty revision due to infection: a cost analysis approach. Orthop Traumatol Surg Res OTSR 96(2): 124–132.

19. Diaz-Ledezma C, Higuera CA, Parvizi J (2013) Success after treatment of periprosthetic joint infection: a Delphi-based international multidisciplinary consensus. Clin Orthop 471(7): 2374–2382.

20. Maradit Kremers H, Larson DR, Crowson CS, Kremers WK, Washington RE, et al. (2015) Prevalence of Total Hip and Knee Replacement in the United States. J Bone Joint Surg Am 97(17): 1386–1397.

21. Kurtz S, Ong K, Lau E, Mowat F, Halpern M (2007) Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am 89(4): 780–785.

22. Cram P, Lu X, Kates SL, Singh JA, Li Y (2012) Total knee arthroplasty volume, utilization, and outcomes among Medicare beneficiaries, 1991–2010. JAMA 308(12): 1227–1236.

23. Kurtz SM, Lau E, Ong K, Zhao K, Kelly M (2009) Future young patient demand for primary and revision joint replacement: national projections from 2010 to 2030. Clin Orthop 467(10): 2606–2612.

24. Negus JJ, Gifford PB, Haddad FS (2017) Single-Stage Revision Arthroplasty for Infection-An Underutilized Treatment Strategy. J Arthroplasty 32(7): 2051–2055.

25. Leonard HAC, Liddle AD, Burke Ó, Murray DW, Pandit H (2014) Single- or Two-stage Revision for Infected Total Hip Arthroplasty? A Systematic Review of the Literature. Clin Orthop 472(3): 1036–1042.

26. Nguyen M, Sukeik M, Zahar A, Nizam I, Haddad FS (2016) One-stage Exchange Arthroplasty for Periprosthetic Hip and Knee Joint Infections. Open Orthop J 10: 646–653.

27. Rowan FE, Donaldson MJ, Pietrzak JR, Haddad FS M(2018) The Role of One-Stage Exchange for Prosthetic Joint Infection. Curr Rev Musculoskelet Med 11(3): 370–379.

28. Oussedik SIS, Dodd MB, Haddad FS (2010) Outcomes of revision total hip replacement for infection after grading according to a standard protocol. J Bone Joint Surg Br 92(9): 1222–1226.

29. Haddad FS, Sukeik M, Alazzawi S (2015) Is single-stage revision according to a strict protocol effective in treatment of chronic knee arthroplasty infections? Clin Orthop 473(1): 8–14.

30. Gehrke T, Kendoff D (2012) Peri-prosthetic hip infections: in favour of one-stage. Hip Int J Clin Exp Res Hip Pathol Ther 22 Suppl 8: S40-S45.