HK74: Does the type of spacer (hand-made vs manufactured vs primary implant) influence the outcome of two stage exchange arthroplasty?

Ewout S Veltman, Marijn H. Stelwagen, Gabriel Baron Girgulsky, Giorgio Cacciola, Henrique B. Cabrita, Ismail Ghadi, Dipak Dave

Answer:
Yes. The infection eradication rate is comparable for different types of spacers, but the risk of complications seems to be lower with the use of functional articulating spacers for both the hip and the knee. Patient function in the interval period may be better with a functional articulating spacer.

Strength of Recommendation: limited

Delegate Vote:

Rationale:
Spacers can be broadly categorized into three types: static spacers, prefabricated/molded spacers, and functional (implant) spacers. Static spacers are blocks or beads of antibiotic-loaded cement; Prefabricated/molded spacers come in various sizes and can be either commercially available off-the-shelf implants or made intraoperatively using a mold; Functional spacers consist of regularly used (primary of revision) hip or knee implants, which are covered in antibiotic-loaded cement which contains tailored antibiotics according to the causative pathogen. The use of all three types of spacers have been described in literature, for both the hip and the knee. Studies are prone for selection bias, as patient specific factors (bone loss, tissue compromise) may partly determine eligibility for some types of spacers. For clarity, we will evaluate the hip and the knee spacers separately.

The Hip

Studies report no difference in infection eradication rates between different types of antibiotic-loaded spacers for management of prosthetic joint infection of the hip.(1; 2; 3; 4; 5; 6; 7)

Studies generally do not report significant differences in functional outcomes among various types of hip spacers.(1; 3; 5; 7; 8; 9; 10; 11) A study by Cabrita et al. showed improved results in the spacer group versus Girdlestone.(12) Two retrospective studies by Wang et al. and Zhang et al. did report better hip function during the interim period, after resection arthroplasty and before reimplantation, when comparing functional spacers with handmade ones, though this difference was no longer evident at the final follow-up.(2; 4)

There seems to be a distinct disadvantage associated with static and prefabricated/molded spacers, as they are associated with an increased risk of complications, especially spacer fracture and dislocation, longer hospital stays and more frequent discharge to an extended care facility when compared to functional articulating spacers types.(2; 3; 4; 9; 10; 11; 13; 14) However, studies comparing functional spacers with prefabricated/molded spacers are scarce, and differences in complication rates are not always found.(5; 8) Kugelman et al. observed less leg

length discrepancy when utilizing functional spacers.(15) Additionally, patients were more likely to be discharged home.(15) Tseng et al. reported fewer reoperations after reimplantation when using a functional spacer.(9) A retrospective study by Jones et al. showed that dislocation was associated with reduced femoral offset, while periprosthetic fractures were linked to increased femoral offset.(16) Restoration of offset was best in the functional spacer group compared to hand-made and prefabricated hip spacers.(16)
For all spacers where cement articulates with bone there is a risk of acetabular bone loss. Significantly less acetabular bone loss is reported in spacers with an acetabular component compared to those without.(17) Increased acetabular bone loss subsequently results in a greater requirement for complex revision hardware.(18)

The Knee

Similar to the hip, antibiotic-loaded knee spacers, nearly all studies report no difference in infection eradication rates between the different types of spacers.(1; 7; 19; 20; 21; 22; 23) A systematic review by Guild et al. did demonstrate a significantly lower re-infection rate in dynamic knee spacers (both prefabricated/molded and functional), whereas four other systematic reviews did not observe this difference.(24; 25; 26; 27; 28)

Extensive comparative research has been conducted on static and dynamic knee spacers. Four systematic reviews report improved range of motion (ROM) after reimplantation with when utilizing dynamic spacers.(24; 26; 27; 28) However, only the review by Ding et al. also identifies a difference in functional scores.(26) A randomized controlled trial reported better ROM and KSS with dynamic spacers after 3.5 years of follow-up.(29)
A systematic review by Spivey et al. differentiates between various types of dynamic spacers: handmade, molded/prefabricated, and functional spacers.(25) Functional spacers demonstrated the best ROM during the interim period, while prefabricated spacers had the poorest ROM after reimplantation. Beyond this, no significant differences in functional outcomes were observed between the groups.(25) More recent retrospective studies present mixed results; Rossi et al. found no functional difference between functional and prefabricated/molded spacers.(30) Schneider et al. and Wu et al. reported better interim ROM with functional spacers, but this advantage was not present at follow-up.(20; 21) Roof et al., and Fei et al. demonstrated improved ROM at final follow-up with functional spacers.(22; 23)

When static spacers are compared with all types of dynamic spacers, no significant difference in overall complication risk is typically found, aside from greater bone loss during the interim period with static knee spacers.(24; 26; 27) This lack of difference may be attributed to the high incidence of spacer subluxation/dislocation, spacer fractures, and instability commonly observed with prefabricated/molded spacers.(24; 27) These issues are less frequent - or, in the case of spacer fractures, absent - with functional spacers, as shown in the systematic review by Spivey et al.(25) Additionally, more frequent use of complex revision hardware during reimplantation, longer hospital stays, and higher rates of discharge to extended care facilities have been reported with prefabricated/molded spacers compared to functional ones.(22; 23)

Conclusion

Although there is a lack of high-level data and considerable heterogeneity between studies and included groups of patients, the use of functional spacers (implants) seems to lead to a lower complication risk compared to other spacer types, while achieving a comparable infection eradication rate, for both the hip and the knee.

References:

1. Craig A, King SW, van Duren BH, Veysi VT, Jain S, Palan J. Articular spacers in two-stage revision arthroplasty for prosthetic joint infection of the hip and the knee. EFORT Open Rev. 2022 and doi:10.1530/EOR-21-0037, 7(2):137-152. Published 2022 Feb 15.

2. Wang B, Li M, Wang J, Han P, Wang Q, Shen H. Use of 1.5-Stage Functional Articulating Hip Spacers for Two-Stage Treatment of Hip Infection. J Arthroplasty. 2024 and doi:10.1016/j.arth.2024.05.014, 39(10):2591-2599.e1.

3. Rollo G, Logroscino G, Stomeo D, Cioffi R, Calvisi V, Meccariello L. Comparing the use of preformed vs hand-made antibiotic spacer cement in two stages revision of hip periprosthetic infection. J Clin Orthop Trauma. 2020 and doi:10.1016, 11(Suppl 5):S772-S778.

4. Zhang W, Fang X, Shi T, et al. Cemented prosthesis as spacer for two-stage revision of infected hip prostheses: a similar infection remission rate and a lower complication rate. Bone Joint Res. 2020 and doi:10.1302/2046-375, 9(8):484-492. Published 2020 Aug 2.

5. Veltman ES, Moojen DJ, Glehr M, Poolman RW. Similar rate of infection eradication for functional articulating, prefabricated and custom-made spacers in 2-stage revision of the infected total hip: a literature review. Hip Int. 2016 and doi:10.53, 26(4):319-326.

6. Veltman ES, Moojen DJF, Poolman RW. Improved patient reported outcomes with functional articulating spacers in two-stage revision of the infected hip. World J Orthop. 2020;11(12):595-605. Published 2020 Dec 18. doi:10.5312/wjo.v11.i12.595.

7. Jacobs C, Christensen CP, Berend ME. Static and mobile antibiotic-impregnated cement spacers for the management of prosthetic joint infection. J Am Acad Orthop Surg. 2009 and doi:10.5435/00124635-200906000-00004, 17(6):356-368.

8. Debbi EM, Rockov ZA, Schroeder IG, et al. Impact of Antibiotic-Impregnated Spacer Design in the Treatment of Periprosthetic Hip Infection. Arthroplast Today. 2022 and doi:10.1016/j.artd.2022.10.002, 18:168-172. Published 2022 Nov 2.

9. Tseng J, Oladipo VA, Acuña AJ, Jones CM, Tsintolas J, Levine BR. Evaluating Modern Spacer Options and Outcomes in Revision Hip Arthroplasty. J Arthroplasty. 2024 and doi:10.1016/j.arth.2024.05.017, 39(9S1):S236-S242.

10. Nahhas CR, Chalmers PN, Parvizi J, et al. Randomized Trial of Static and Articulating Spacers for Treatment of the Infected Total Hip Arthroplasty. J Arthroplasty. 2021 and doi:10.1016/j.arth.2021.01.031, 36(6):2171-2177.

11. Citak M, Masri BA, Springer B, Argenson JN, Kendoff DO. Are Preformed Articulating Spacers Superior To Surgeon-Made Articulating Spacers in the Treatment Of PJI in THA? A Literature Review. Open Orthop J. 2015 and doi:10.2174, 9:255-261. Published 2015 Jul 31.

12. Cabrita HB, Croci AT, Camargo OP, Lima AL. Prospective study of the treatment of infected hip arthroplasties with or without the use of an antibiotic-loaded cement spacer. Clinics (Sao Paulo). 2007 and doi:10.1590/s1807-59322007000200002, 62(2):99-108.

13. Faschingbauer M, Reichel H, Bieger R, Kappe T. Mechanical complications with one hundred and thirty eight (antibiotic-laden) cement spacers in the treatment of periprosthetic infection after total hip arthroplasty. Int Orthop. 2015 and doi:10.1, 39(5):989-994.

14. D'Angelo F, Negri L, Zatti G, Grassi FA. Two-stage revision surgery to treat an infected hip implant. A comparison between a custom-made spacer and a pre-formed one. Chir Organi Mov. 2005 and 90(3):271-279.

15. Kugelman D, Roof M, Egol A, et al. Comparing Articulating Spacers for Periprosthetic Joint Infection After Primary Total Hip Arthroplasty: All-Cement Versus Real-Component Articulating Spacers. J Arthroplasty. 2022 and doi:10.1016/j.arth.202, 37(7S):S657-S663.

16. Jones CW, Selemon N, Nocon A, Bostrom M, Westrich G, Sculco PK. The Influence of Spacer Design on the Rate of Complications in Two-Stage Revision Hip Arthroplasty. J Arthroplasty. 2019 and doi:10.1016/j.arth.2019.02.012, 34(6):1201-1206.

17. Burastero G, Basso M, Carrega G, et al. Acetabular Spacers in 2-Stage Hip Revision: Is it Worth it? A Single-Centre Retrospective Study. HIP International. 2016 and doi:https://doi.org/10.5301/hipint.5000446, 27(2):187-192.

18. Grosso MJ, Kozaily E, Cacciola G, Parvizi J. Characterizing Femoral and Acetabular Bone Loss in Two-Stage Revision Total Hip Arthroplasty for Infection. The Journal of Arthroplasty. Published online July 2020. doi:https://doi.org/10.1016/j.arth.2020.07.

19. Li Z, Xu C, Chen J. Articulating spacers: what are available and how to utilize them? Arthroplasty. 2023 and doi:https://doi.org/10.1186/s42836-023-00167-6, 5(1).

20. Wu B, Su J, Zhang Z, et al. Prosthetic spacers in two-stage revision for knee periprosthetic joint infection achieve better function and similar infection control. Bone Joint Res. 2024 and doi:10.1302/2046-3758.136.BJR-20, 13(6):306-314. Published 2024 Jun 19.

21. Schneider AM, Holzmeister AM, FrazzettA J, Adams W, Hopkinson WJ, Brown NM. New Primary Total Knee Arthroplasty Components Versus Other Contemporary Types of Spacers for the Treatment of Chronic Periprosthetic Knee Infection With a Two-Stage Protocol. Ort.

22. Roof MA, Baylor JL, Bernstein JA, et al. Comparing the Efficacy of Articulating Spacer Constructs for Knee Periprosthetic Joint Infection Eradication: All-Cement vs Real-Component Spacers. J Arthroplasty. 2021 and doi:10.1016/j.arth.2021.01., 36(7S):S320-S327.

23. Fei Z, Zhang Z, Wang Y, Zhang H, Xiang S. Comparing the Efficacy of Articulating Spacers in Two-Stage Revision for Periprosthetic Joint Infection Following Total Knee Arthroplasty: All-Cement Spacers vs Sterilized Replanted Metal-Polyethylene Spacers. Int.

24. Guild GN 3rd, Wu B, Scuderi GR. Articulating vs. Static antibiotic impregnated spacers in revision total knee arthroplasty for sepsis. A systematic review. J Arthroplasty. 2014 and doi:10.1016/j.arth.2013.08.013, 29(3):558-563.

25. Spivey JC, Guild GN 3rd, Scuderi GR. Use of Articulating Spacer Technique in Revision Total Knee Arthroplasty Complicated by Sepsis: A Systematic Meta-Analysis. Orthopedics. 2017 and doi:10.3928/01477447-20170208-06, 40(4):212-220.

26. Ding H, Yao J, Chang W, Liu F. Comparison of the efficacy of static versus articular spacers in two-stage revision surgery for the treatment of infection following total knee arthroplasty: a meta-analysis. Journal of Orthopaedic Surgery and Research. 20.

27. Pivec R, Naziri Q, Issa K, Banerjee S, Mont MA. Systematic Review Comparing Static and Articulating Spacers Used for Revision of Infected Total Knee Arthroplasty. The Journal of Arthroplasty. 2014 and doi:https://doi.org/10.1016/j.arth.201, 29(3):553-557.e1.

28. Voleti PB, Baldwin KD, Lee GC. Use of Static or Articulating Spacers for Infection Following Total Knee Arthroplasty. The Journal of Bone and Joint Surgery-American Volume. 2013 and doi:https://doi.org/10.2106/jbjs.l.01461, 95(17):1594-1599.

29. Nahhas CR, Chalmers PN, Parvizi J, et al. A Randomized Trial of Static and Articulating Spacers for the Treatment of Infection Following Total Knee Arthroplasty. J Bone Joint Surg Am. 2020 and doi:10.2106/JBJS.19.00915, 102(9):778-787.

30. Rossi SMP, Medetti M, Perticarini L, Ghiara M, Benazzo F. Customized intraoperatively molded articulating cement spacers for two-stage revisions TKA with major bone defects. Eur J Orthop Surg Traumatol. 2021 and doi:10.1007/s00590-020-02844-7, 31(6):1121-1128.