

## SUBSPECIALTY PROCEDURES

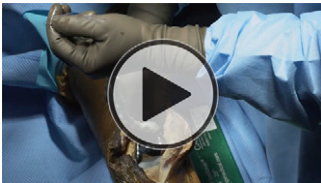
# THE DOUBLE DAIR: A 2-STAGE DEBRIDEMENT WITH PROSTHESIS-RETENTION PROTOCOL FOR ACUTE PERIPROSTHETIC JOINT INFECTIONS

Kade S. McQuivey, MD, Joshua Bingham, MD, Andrew Chung, DO, Henry Clarke, MD, Adam Schwartz, MD, Jordan R. Pollock, BS, Christopher Beauchamp, MD, Mark J. Spangehl, MD

Published outcomes of this procedure can be found at: *J Arthroplasty*. 2019 Jun;34(6):1207-13, and *Clin Orthop Relat Res*. 2010 Aug; 468(8):2029-38.

*Investigation performed at the Department of Orthopaedic Surgery, Mayo Clinic, Phoenix, Arizona*

COPYRIGHT © 2021 BY THE JOURNAL OF BONE AND JOINT SURGERY, INCORPORATED



Click the arrow above or go to [surgicaltechniques.jbjs.org](http://surgicaltechniques.jbjs.org) to view the video article described in this summary.

## Abstract

**Background:** Debridement and implant retention (DAIR) has variable success as a treatment for acute periprosthetic joint infection (PJI), with generally poor outcomes reported in the literature<sup>1</sup>. Because of the unacceptably high failure rate of DAIR, we implemented a 2-stage debridement protocol that includes the use of high-dose antibiotic beads between stages for the treatment of acute PJI. In 2 previous studies, with an average follow-up of 3.5 years in each study, we reported overall infection-control rates of 87% and 90%<sup>2,3</sup>.

**Description:** Following exposure of the joint, cultures are obtained, and all modular components are removed, scrubbed, and soaked in an antiseptic solution. A thorough irrigation and debridement with complete synovectomy is performed, followed by temporary reinsertion of the original modular parts. High-dose antibiotic cement beads are inserted into the joint, and the joint is closed. Approximately 5 to 6 days later, a second debridement is performed, the beads are removed, and the new modular, sterile components are implanted. The patient is placed on a course of intravenous and, later, oral antibiotics, in addition to a standard postoperative rehabilitation protocol.

## Alternatives:

- Long-term suppressive antibiotic therapy.
- One-stage DAIR.
- One-stage exchange arthroplasty.
- Two-stage exchange arthroplasty.
- Resection arthroplasty.
- Amputation.

**Rationale:** The treatment of acute PJI has historically consisted of a single irrigation and debridement, with exchange of modular parts and retention of

**Disclosure:** The authors indicated that no external funding was received for any aspect of this work. On the **Disclosure of Potential Conflicts of Interest** forms, which are provided with the online version of the article, one or more of the authors checked “yes” to indicate that the author had a relevant financial relationship in the biomedical arena outside the submitted work and “yes” to indicate that the author had other relationships or activities that could be perceived to influence, or have the potential to influence, what was written in this work (<http://links.lww.com/JBJSEST/A318>).

the components, followed by intravenous antibiotic therapy. Despite having lower rates of patient morbidity compared with a 2-stage exchange arthroplasty, this more traditional procedure also has a higher rate of failure, with reported rates as high as 60% to 84%<sup>4-12</sup>. The utility of component retention continues to be a topic of debate<sup>13</sup>. Alternatives to component retention include both 1- and 2-stage exchange procedures. Although these modalities offer potentially higher rates of infection control, they are associated with substantial patient morbidity, particularly in patients with well-fixed implants<sup>14-16</sup>. Furthermore, exchange procedures may result in substantial iatrogenic bone loss, which can be problematic in revision total joint arthroplasty procedures, in which bone stock may already be limited. The double-DAIR protocol offers infection-control rates that are comparable with those of component-exchange procedures, but with the lower patient morbidity associated with component-retention procedures. Furthermore, the double-DAIR procedure provides the added benefit of retaining important bone stock.

**Expected Outcomes:** The success rate for the double-DAIR procedure has been reproducible, with infection-control rates of 87% and 90% reported in 2 studies from a single cohort at our institution<sup>2,3</sup>. These rates represent a substantial improvement compared with a single irrigation and debridement<sup>1</sup>, and are on par with those reported for 2-stage exchange arthroplasty procedures<sup>17-21</sup>. The infection-control rates of the double-DAIR procedure did not significantly vary depending on whether infection occurred following a total knee or total hip arthroplasty. However, not surprisingly, patients who underwent debridement following a revision procedure had a lower rate of success (77.1% successful infection control) compared with patients debrided following a primary procedure (93.8% successful infection control). We could not demonstrate an association with organism and success or failure of treatment.

Although not significant, there was a trend toward an association between the time from symptom onset to initial treatment and infection control ( $p = 0.07$ )<sup>2</sup>. Patients with successful infection control underwent the initial debridement an average of 6.2 days after symptom onset, compared with 10.7 days in patients in whom treatment had failed. Several other studies have demonstrated that successful infection control is associated with earlier initial irrigation and debridement<sup>22-27</sup>. We strongly support that, in the setting of confirmed acute PJI, prompt initiation of treatment optimizes the chances for successful infection control.

### Important Tips:

- Thorough debridement is key to successful infection control of infection.
- Antibiotic-loaded bone cement has repeatedly been demonstrated to be safe, and we recommend its use<sup>28-31</sup>.
- Extended oral antibiotics following debridement with component retention can increase infection-free survivorship<sup>32</sup>.

Kade S. McQuivey, MD<sup>1</sup>

Joshua Bingham, MD<sup>1</sup>

Andrew Chung, DO<sup>1</sup>

Henry Clarke, MD<sup>1</sup>

Adam Schwartz, MD<sup>1</sup>

Jordan R. Pollock, BS<sup>1</sup>

Christopher Beauchamp, MD<sup>1</sup>

Mark J. Spanghel, MD<sup>1</sup>

<sup>1</sup>Department of Orthopaedic Surgery, Mayo Clinic, Phoenix, Arizona

Email address for K.S. McQuivey: mcquivey.kade@mayo.edu

ORCID iD for K.S. McQuivey: [0000-0002-6245-5831](https://orcid.org/0000-0002-6245-5831)

ORCID iD for J. Bingham: [0000-0003-1540-852X](https://orcid.org/0000-0003-1540-852X)

ORCID iD for A. Chung: [0000-0003-3942-9595](https://orcid.org/0000-0003-3942-9595)

ORCID iD for H. Clarke: [0000-0003-0654-9400](https://orcid.org/0000-0003-0654-9400)

ORCID iD for A. Schwartz: [0000-0002-1267-4462](https://orcid.org/0000-0002-1267-4462)

ORCID iD for J.R. Pollock: [0000-0003-1628-5162](https://orcid.org/0000-0003-1628-5162)

ORCID iD for C. Beauchamp: [0000-0002-7551-6998](https://orcid.org/0000-0002-7551-6998)

ORCID iD for M.J. Spanghel: [0000-0003-1090-9165](https://orcid.org/0000-0003-1090-9165)

## References

- Romanò C, Logoluso N, Drago L, Peccati A, Romanò D. Role for irrigation and debridement in periprosthetic infections. *J Knee Surg*. 2014 Aug;27(4):267-72. Epub 2014 Apr 21.
- Chung AS, Niesen MC, Graber TJ, Schwartz AJ, Beauchamp CP, Clarke HD, Spangehl MJ. Two-stage debridement with prosthesis retention for acute periprosthetic joint infections. *J Arthroplasty*. 2019 Jun;34(6):1207-13. Epub 2019 Feb 16.
- Estes CS, Beauchamp CP, Clarke HD, Spangehl MJ. A two-stage retention débridement protocol for acute periprosthetic joint infections. *Clin Orthop Relat Res*. 2010 Aug;468(8):2029-38.
- Brandt CM, Sistrunk WW, Duffy MC, Hanssen AD, Steckelberg JM, Ilstrup DM, Osmon DR. *Staphylococcus aureus* prosthetic joint infection treated with debridement and prosthesis retention. *Clin Infect Dis*. 1997 May;24(5):914-9.
- Burger RR, Basch T, Hopson CN. Implant salvage in infected total knee arthroplasty. *Clin Orthop Relat Res*. 1991 Dec;273:105-12.
- Deirmengian C, Greenbaum J, Lotke PA, Booth RE Jr, Lonner JH. Limited success with open debridement and retention of components in the treatment of acute *Staphylococcus aureus* infections after total knee arthroplasty. *J Arthroplasty*. 2003 Oct;18(7)(Suppl 1):22-6.
- Deirmengian C, Greenbaum J, Stern J, Braffman M, Lotke PA, Booth RE Jr, Lonner JH. Open debridement of acute gram-positive infections after total knee arthroplasty. *Clin Orthop Relat Res*. 2003 Nov;416:129-34.
- Hartman MB, Fehring TK, Jordan L, Norton HJ. Periprosthetic knee sepsis. The role of irrigation and debridement. *Clin Orthop Relat Res*. 1991 Dec;273:113-8.
- Marculescu CE, Barbari EF, Hanssen AD, Steckelberg JM, Harmsen SW, Mandrekar JN, Osmon DR. Outcome of prosthetic joint infections treated with debridement and retention of components. *Clin Infect Dis*. 2006 Feb 15;42(4):471-8. Epub 2006 Jan 5.
- Meehan AM, Osmon DR, Duffy MCT, Hanssen AD, Keating MR. Outcome of penicillin-susceptible streptococcal prosthetic joint infection treated with debridement and retention of the prosthesis. *Clin Infect Dis*. 2003 Apr 1;36(7):845-9. Epub 2003 Mar 20.
- Silva M, Tharani R, Schmalzried TP. Results of direct exchange or debridement of the infected total knee arthroplasty. *Clin Orthop Relat Res*. 2002 Nov;404:125-31.
- Teeny SM, Dorr L, Murata G, Conaty P. Treatment of infected total knee arthroplasty. Irrigation and debridement versus two-stage reimplantation. *J Arthroplasty*. 1990 Mar;5(1):35-9.
- Koyonos L, Zmistowski B, Della Valle CJ, Parvizi J. Infection control rate of irrigation and débridement for periprosthetic joint infection. *Clin Orthop Relat Res*. 2011 Nov;469(11):3043-8.
- Boddapati V, Fu MC, Mayman DJ, Su EP, Sculco PK, McLawhorn AS. Revision total knee arthroplasty for periprosthetic joint infection is associated with increased postoperative morbidity and mortality relative to noninfectious revisions. *J Arthroplasty*. 2018 Feb;33(2):521-6. Epub 2017 Sep 23.
- Leonard HAC, Liddle AD, Burke O, Murray DW, Pandit H. Single- or two-stage revision for infected total hip arthroplasty? A systematic review of the literature. *Clin Orthop Relat Res*. 2014 Mar;472(3):1036-42. Epub 2013 Sep 21.
- Parisi TJ, Konopka JF, Bedair HS. What is the long-term economic societal effect of periprosthetic infections after THA? A Markov analysis. *Clin Orthop Relat Res*. 2017 Jul;475(7):1891-900. Epub 2017 Apr 7.
- Durbhakula SM, Czajka J, Fuchs MD, Uhl RL. Antibiotic-loaded articulating cement spacer in the 2-stage exchange of infected total knee arthroplasty. *J Arthroplasty*. 2004 Sep;19(6):768-74.
- Goldman RT, Scuderi GR, Insall JN. 2-stage reimplantation for infected total knee replacement. *Clin Orthop Relat Res*. 1996 Oct;331:118-24.
- Haleem AA, Berry DJ, Hanssen AD. Mid-term to long-term followup of two-stage reimplantation for infected total knee arthroplasty. *Clin Orthop Relat Res*. 2004 Nov;428:35-9.
- Hirakawa K, Stulberg BN, Wilde AH, Bauer TW, Secic M. Results of 2-stage reimplantation for infected total knee arthroplasty. *J Arthroplasty*. 1998 Jan;13(1):22-8.
- Insall JN, Thompson FM, Brause BD. Two-stage reimplantation for the salvage of infected total knee arthroplasty. *J Bone Joint Surg Am*. 1983 Oct;65(8):1087-98.
- Mont MA, Waldman B, Banerjee C, Pacheco IH, Hungerford DS. Multiple irrigation, debridement, and retention of components in infected total knee arthroplasty. *J Arthroplasty*. 1997 Jun;12(4):426-33.
- Triantafyllopoulos GK, Poultsides LA, Sakellariou VI, Zhang W, Sculco PK, Ma Y, Sculco TP. Irrigation and debridement for periprosthetic infections of the hip and factors determining outcome. *Int Orthop*. 2015 Jun;39(6):1203-9. Epub 2015 Mar 31.
- Jiranek WA, Waligora AC, Hess SR, Golladay GL. Surgical treatment of prosthetic joint infections of the hip and knee: changing paradigms? *J Arthroplasty*. 2015 Jun;30(6):912-8. Epub 2015 Mar 9.
- Holmberg A, Thórhallsdóttir VG, Robertsson O, W-Dahl A, Stefánsdóttir A. 75% success rate after open debridement, exchange of tibial insert, and antibiotics in knee prosthetic joint infections. *Acta Orthop*. 2015;86(4):457-62. Epub 2015 Mar 9.
- Kazimoglu C, Yalcin N, Onvural B, Akcay S, Agus H. Debridement, antibiotics, irrigation, and retention (DAIR) of the prosthesis after hip hemiarthroplasty infections. Does it work? *Int J Artif Organs*. 2015 Aug;38(8):454-60. Epub 2015 Sep 6.
- Urish KL, Bullock AG, Kreger AM, Shah NB, Jeong K, Rothenberger SD; Infected Implant Consortium. A multicenter study of irrigation and debridement in total knee arthroplasty periprosthetic joint infection: treatment failure is high. *J Arthroplasty*. 2018 Apr;33(4):1154-9.
- Walenkamp GH, Vree TB, van Rens TJ. Gentamicin-PMMA beads. Pharmacokinetic and nephrotoxicological study. *Clin Orthop Relat Res*. 1986 Apr;205:171-83.
- Eckman JB Jr, Henry SL, Mangino PD, Seligson D. Wound and serum levels of tobramycin with the prophylactic use of tobramycin-impregnated polymethylmethacrylate beads in compound fractures. *Clin Orthop Relat Res*. 1988 Dec;237:213-5.
- Salvati EA, Callaghan JJ, Brause BD, Klein RF, Small RD. Reimplantation in infection. Elution of gentamicin from cement and beads. *Clin Orthop Relat Res*. 1986 Jun;207:83-93.
- Wahlig H, Dingeldein E, Bergmann R, Reuss K. The release of gentamicin from polymethylmethacrylate beads. An experimental and pharmacokinetic study. *J Bone Joint Surg Br*. 1978 May;60-B(2):270-5.
- Siqueira MBP, Saleh A, Klika AK, O'Rourke C, Schmitt S, Higuera CA, Barsoum WK. Chronic suppression of periprosthetic joint infections with oral antibiotics increases infection-free survivorship. *J Bone Joint Surg Am*. 2015 Aug 5;97(15):1220-32.