Commentary on: Ultrasonic cement removal in cement-in-cement revision total hip arthroplasty

WHAT IS THE EFFECT ON THE FINAL CEMENT-IN-CEMENT BOND?

R. de Steiger

The University of Melbourne, Melbourne, Australia

Keywords: Ultrasonic cement removal, Cement-in-cement, Revision hip arthroplasty, Cemented total hip arthroplasty

Due to the increasing burden of total hip joint arthroplasty,\textsuperscript{1} there will continue to be an increase in revision surgery in the coming decades, even though revisions are gradually falling as a proportion of all primary hip joint arthroplasties.\textsuperscript{2} The introduction of crosslinked polyethylene and ceramic-on-ceramic bearings has markedly reduced the revisions for loosening and lysis,\textsuperscript{3,4} which were commonly performed in the late decades of the 20th century and early 21st century due to wear of conventional polyethylene. Lysis was found around many cemented stems, which required removal of the cement prior to implanting a new prosthesis. Ultrasonic-driven tools, in conjunction with standard instruments to remove cement, became widely used. Although these tools were generally safe, complications have been reported.\textsuperscript{5,6} However, there has been an increasing use of cementless femoral fixation worldwide,\textsuperscript{4,7,8} and therefore cement removal prior to revision is now less frequently performed.

The experimental technique of cement-in-cement for revision hip arthroplasty was described by Greenwald et al\textsuperscript{9} in 1978, and the Exeter group has popularized cement-in-cement revision when femoral stem revision is required for reasons other than severe lysis with bony destruction.\textsuperscript{10} This is a reliable technique that has been used with other prostheses, and good outcomes have been reported from many centres.\textsuperscript{11-14} As Liddle et al\textsuperscript{15} have stated, cement-in-cement revision can avoid some of the major complications that can occur when trying to remove all the cement at the time of revision surgery.

In order to prepare the femoral canal prior to inserting a stem into a well-fixed cement mantle, surgeons have a number of options. They can use a burr, a broach of smaller sizes than the stem \textit{in situ}, a robot,\textsuperscript{16} ultrasonic cement removal devices, or a combination. The aim of the paper by Liddle et al\textsuperscript{15} was to investigate the use of ultrasonic devices on the final cement-cement bond strength in a cement-in-cement model, as this has not been previously described.

The authors use a previously reported technique to examine the sheer properties of polymethylmethacrylate mantles.\textsuperscript{17} Standard Stryker Simplex B Bone Cement (Stryker UK Ltd, Newbury, United Kingdom) was used with a total of 24 specimens, divided into three groups: a control group with no treatment to the cement mantle, a burr, and an ultrasonic device, orthosonics System for Cemented Arthroplasty Revision (oSCAR; Orthosonics, Maidenhead, United Kingdom). After preparation of the specimens, a further cement mix was then poured into the cylinder, and 5 mm discs were prepared, ensuring that the temperature upon cutting did not exceed 25°C. Mechanical testing was then performed to determine the interfacial shear strength of the central portion of the newly cemented disc. The results were somewhat surprising, in that the ultrasonic group had a wide shear strength distribution and a significantly lower mean interfacial shear strength compared with both the control and burr groups. The authors also demonstrated an unusual porous zone not seen in the preparation by burr.

There are some issues with the methods used to test the interfacial shear strength in this mechanical model, as generally the vast majority of surgeons would be inserting a smooth polished tapered stem within the...
prepared well-fixed cement mantle, and this construct loads in compression. Therefore, this in vitro study may not reflect current clinical practice; however, it does call into question routine use of OSCAR, or other ultrasonic devices, in the preparation of a cement-in-cement revision. While they are extremely useful in removing distal cement plugs, this is needed far less frequently with the current taper slip design femoral stems in current widespread use. However, if a composite beam stem is utilized in a cement-in-cement revision, the use of ultrasonic tools may not be an appropriate method to prepare the cement mantle.

References

1. Inacio MCS, Graves SE, Pratt NL, Roughhead EE, Nemes S. Increase in total joint arthroplasty projected from 2014 to 2046 in Australia: a conservative local model with international implications. *Clin Orthop Relat Res* 2017;475:2130-2137.
2. de Steiger RN, Graves SE. Orthopaedic registries: the Australian experience. *EFORT Open Reviews* 2019;4:198-204.
3. de Steiger RN, Lorimer M, Graves SE. Cross-linked polyethylene for total hip arthroplasty markedly reduces revision surgery at 16 years. *J Bone Joint Surg [Am]* 2018;100-A:1281-1288.
4. No authors listed. Hip, knee & shoulder arthroplasty: annual report 2018. Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR). 2018. https://aoanjrr.sahmri.com/documents/10180/576950/Hip%2C%20Knee%20%26%20Shoulder%20Arthroplasty (date last accessed 17 May 2019).
5. de Steiger RN, Pandey R, McLardy-Smith P. Ultrasonically driven tools. *J Arthroplasty* 1996;11:120-121.
6. Gardiner R, Hozack WJ, Nelson C, Keating EM. Revision total hip arthroplasty using ultrasonically driven tools. A clinical evaluation. *J Arthroplasty* 1993;8:517-521.
7. No authors listed. 15th annual report. National Joint Registry for England, Wales, Northern Ireland and the Isle of Man. 2018. https://www.hqip.org.uk/wp-content/uploads/2018/11/NJR-15th-Annual-Report-2018.pdf (date last accessed 17 May 2019).
8. No authors listed. Annual report 2018. Norwegian National Advisory Unit on Arthroplasty and Hip Fractures. 2018. http://nrweb.ihelse.no/eng/Rapporter/Report2018_en.pdf (date last accessed 17 May 2019).
9. Greenwald AS, Narten NC, Wilde AH. Points in the technique of recementing in the revision of an implant arthroplasty. *J Bone Joint Surg [Br]* 1978;60-B:107-110.
10. Duncan WW, Hubble MJ, Howell JR, et al. Revision of the cemented femoral stem using a cement-in-cement technique: a five- to 15-year review. *J Bone Joint Surg [Br]* 2009;91-B:577-582.
11. Amanatullah DF, Pallante GD, Floccoli LV, Vasilieadiis GI, Trousdale RT. Revision total hip arthroplasty using the cement-in-cement technique. *Orthopades 2017;40:e348-e351.
12. Cnudde PH, Kärrholm J, Rolfsen O, Timperley AJ, Mohaddes M. Cement-in-cement revision of the femoral stem: analysis of 1179 first-time revisions in the Swedish Hip Arthroplasty Register. *Bone Joint J* 2017;99-B(4 Suppl B):27-32.
13. Okuzu Y, Goto K, So K, Kuroda Y, Matsuda S. Mid- and long-term results of femoral component revision using the cement-in-cement technique: average 10.8-year follow-up study. *J Orthop Sci* 2016;21:810-814.
14. Stefanovic-Lovbuary NS, Parry MC, Whitehouse MR, Blom AW. Cement in cement revision of the femoral component using a collarless triple taper: a midterm clinical and radiographic assessment. *J Arthroplasty* 2014;29:2002-2006.
15. Liddle A, Webb M, Clement N, et al. Ultrasonic cement removal in cement-in-cement revision total hip arthroplasty: what is the effect on the final cement-in-cement bond? *Bone Joint Res* 2019;8:246-252.
16. Yamamura M, Nakamura N, Miki H, Nishii T, Sugano N. Cement removal from the femur using the ROBODOC system in revision total hip arthroplasty. *Adv Orthop* 2013;2013:743769.
17. Weinrauch PC, Bell C, Wilson L, et al. Shear properties of bilaminar polymethylmethacrylate cement mantles in revision hip joint arthroplasty. *J Arthroplasty* 2007;22:394-403.

Author contribution

R. de Steiger: Wrote the manuscript.

Funding statement

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

© 2019 Author(s) et al. This is an open-access article distributed under the terms of the Creative Commons Attributions licence (CC-BY-NC), which permits unrestricted use, distribution, and reproduction in any medium, but not for commercial gain, provided the original author and source are credited.