

Total hip replacement (THR) versus hemiarthroplasty for intracapsular hip fracture: how should the HEALTH trial inform clinical guidelines and surgical decision making?

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The two operations most commonly used to treat displaced intracapsular hip fractures are total hip replacement (THR) and hemiarthroplasty. THR is a more complex procedure, takes longer, and is at higher risk of subsequent dislocation¹. However, some small randomised controlled trials have reported better functional outcomes, fewer wound complications, and less need for secondary procedures after THR^{1,2}. National guidelines therefore recommend offering THR to the fittest patients who are most likely to tolerate a bigger operation and also to benefit from better functional outcomes^{3,4}. However, these recommendations have not been universally implemented. An international survey of orthopaedic surgeons found that 73% prefer hemiarthroplasty⁵ and there is evidence of widespread variation in THR use for hip fracture around the world⁶⁻⁸. Data from the National Hip Fracture Database (NHFD) show that less than a third of eligible patients undergo THR⁷. There is considerable variation around the UK with the proportion of eligible patients receiving a THR ranging from 1 to 60% between individual hospitals⁷.

There are clear institutional challenges to widespread provision of THR, including availability of trained staff at weekends⁷. However, use of THR might also be affected by surgeons' preferences, judgement, and interpretation of the research evidence^{9,10}.

It was in this context that the orthopaedic community eagerly awaited the results of the Hip fracture Evaluation with Alternatives of Total Hip arthroplasty versus Hemiarthroplasty (HEALTH) trial¹¹. This large and important study was led by a group of well-respected researchers and involved 80 participating sites across 10 countries. It aimed to compare hemiarthroplasty with THR in the population of older adults with hip fracture that were independently mobile before injury. The primary outcome was any unplanned secondary hip procedure within 24 months of operation.

The key findings of the trial were: (a) no significant difference between the groups in terms of unplanned secondary procedures at 24 months and (b) a statistically significant functional benefit at 24-months in favour of THR as measured by the WOMAC total score (mean difference -6.37 (99% CI -9.18 to -3.56)). The authors concluded that "the incidence of secondary procedures did not differ significantly between patients... and total hip arthroplasty provided a statistically significant but clinically unimportant improvement... in function and quality of life over 24 months".

The HEALTH trial is a hugely important study so it is worth taking some time to understand the study results and how these will influence clinical practice guidelines.

First, the choice of primary outcome was surprising because the principal advantage of THR is often thought to be its perceived functional benefits. Previous work has suggested that the outcomes that matter most to hip fracture patients are mortality, pain, activities of daily living, mobility, and health-related quality of life¹². An excess of unplanned procedures would raise concern about an operation but more patient-focussed outcome measures were available. Although there was no difference in the number of unplanned secondary procedures at 12 or 24 months, there were significantly fewer unplanned procedures in the THR group *between* 12 and 24 months (hazard ratio 0.23 (95% CI 0.08 to 0.69). Further updates from the HEALTH team will hopefully clarify how time-dependent complications specific to hemiarthroplasty (e.g. acetabular erosion) will affect this outcome at later timepoints. There were also important differences in the *types* of unplanned procedures. The most frequent secondary procedure in the THR group was closed reduction of hip dislocation (29/57 events) and, in the hemiarthroplasty group, implant revision (36/60 events). Although the trial analysed unplanned secondary procedures as a binary outcome, there are differences in magnitude of risk between closed reduction (possibly under sedation in an Emergency Department) and revision surgery.

Second, the authors concluded that the statistically significant functional benefit in favour of THR was not clinically important. However, the upper limit of the 99% confidence interval for mean difference in EQ-5D utility index score (0.11) was higher than the minimum clinically important difference (MCID) that is often accepted for this outcome in the hip fracture population (0.08)¹³. Similarly, the upper limit of the WOMAC score confidence interval reported by HEALTH suggests that the trial may have detected a clinically meaningful difference. Importantly, the WOMAC has not been validated in the hip fracture population and so the authors relied on a range (9-22) determined from studies of patients undergoing THR for hip osteoarthritis. It is therefore possible that the reported mean difference of -6.37 (99% CI -9.18 to -3.56) represents a more clinically important functional benefit amongst older adults undergoing unscheduled trauma surgery. The functional and HRQoL benefits of THR are more likely to become apparent after a number of years¹⁴, and so may have been understated by the 24-month follow-up data reported by the HEALTH Trial.

Finally, the HEALTH trial collected WOMAC and EQ5D data at a number of time points: 1 and 10-weeks, 6, 9, 12, 18 and 24-months. However, these data have not been presented graphically and analysed using a longitudinal model for the trend over time and difference in means at each time point, which would have aided their interpretation. Analysis of the functional data did not follow an intention-to-treat analysis and was instead restricted to those with at least one follow-up score. This leaves the analysis vulnerable to responder (selection) bias, which is particularly important as the participants contributing HRQoL and functional data were notably healthier (younger with fewer co-morbidities) than those lost to follow-up.

The findings of the HEALTH trial are broadly consistent with a recent meta-analysis of five RCTs¹⁵⁻¹⁹, which also found higher odds of dislocation after THR, higher odds of revision surgery after hemiarthroplasty, and mixed evidence supporting a functional benefit after THR. One criticism of RCTs is that participants may be carefully selected (limiting generalisability) and receive better treatment than the wider patient population (introducing performance bias)²⁰. Importantly, a recent propensity score matched study using the NHFD did not find evidence that THR outcomes are worse in the “real world” and outside the controlled environment of clinical trials²¹. These findings can however only be generalised to the fittest patients with hip fractures.

The HEALTH Trial is an important contribution to the literature guiding treatment of displaced intracapsular hip fractures in independently mobile patients. The primary outcome measure provides very strong support for earlier evidence showing that THR is associated with a higher risk of dislocation but a lower risk of other secondary procedures^{1,2,21}. In terms of the more exploratory secondary outcomes, the mean difference in functional outcomes demonstrated in the HEALTH trial was smaller than those demonstrated in previous studies. However, the difference still favoured THR and a clinically important benefit to patients could not be ruled out. Furthermore, a previous RCT reported that such benefits become more obvious after a number of years¹⁴. The orthopaedic community look forward to further reporting of data from the HEALTH trial participants while recognising that this may be difficult to interpret as patients are lost to follow-up over time. In the meantime, we now have strong evidence that the rate of unplanned secondary procedures in the first 24 months is similar for THR versus hemiarthroplasty. The functional benefits of THR may not be as great as previously reported, but it may be premature to update national guidance to exclude THR for selected hip fracture patients based on the early functional outcomes reported in the trial.

REFERENCES

1. Liao L, Zhao J, Su W, Ding X, Chen L, Luo S. A meta-analysis of total hip arthroplasty and hemiarthroplasty outcomes for displaced femoral neck fractures. *Arch Orthop Trauma Surg*. 2012;132(7):1021-1029.
2. Burgers PT, Van Geene AR, Van den Bekerom MP, et al. Total hip arthroplasty versus hemiarthroplasty for displaced femoral neck fractures in the healthy elderly: a meta-analysis and systematic review of randomized trials. *Int Orthop*. 2012;36(8):1549-1560.
3. American Academy of Orthopaedic Surgeons (AAOS). *Moderate evidence supports a benefit to total hip arthroplasty in properly selected patients with unstable (displaced) femoral neck fractures*. 2015.
4. National Institute for Health and Care Excellence (NICE). *Hip fracture: management. Clinical Guideline (CG 124)*. 22 June 2011.
5. Bhandari M, Devereaux PJ, Tornetta P, 3rd, et al. Operative management of displaced femoral neck fractures in elderly patients. An international survey. *J Bone Joint Surg Am*. 2005;87(9):2122-2130.
6. Bunning T, Dickinson R, Fagan E, et al. *National Hip Fracture Database (NHFD) annual report*. 2018.
7. Perry DC, Metcalfe D, Griffin XL, Costa ML. Inequalities in use of total hip arthroplasty for hip fracture: population based study. *BMJ*. 2016;353:i2021.
8. Harris IA, Cuthbert A, de Steiger R, Lewis P, Graves SE. Practice variation in total hip arthroplasty versus hemiarthroplasty for treatment of fractured neck of femur in Australia. *Bone Joint J*. 2019;101-B(1):92-95.
9. Huxley C, Achten J, Costa ML, Griffiths F, Griffin XL. A process evaluation of the WHiTE Two trial comparing total hip arthroplasty with and without dual mobility component in the treatment of displaced intracapsular fractures of the proximal femur: Can a trial investigating total hip arthroplasty for hip fracture be delivered in the NHS? *Bone Joint Res*. 2016;5(10):444-452.
10. Griffin XL, Parsons N, Achten J, Costa ML. A randomised feasibility study comparing total hip arthroplasty with and without dual mobility acetabular component in the treatment of displaced intracapsular fractures of the proximal femur : The Warwick Hip Trauma Evaluation Two : WHiTE Two. *Bone Joint J*. 2016;98-b(11):1431-1435.
11. Bhandari M, Einhorn TA, Guyatt G, et al. Total Hip Arthroplasty or Hemiarthroplasty for Hip Fracture. *N Engl J Med*. 2019.
12. Haywood KL, Griffin XL, Achten J, Costa ML. Developing a core outcome set for hip fracture trials. *Bone Joint J*. 2014;96-B(8):1016-1023.
13. Sims AL, Parsons N, Achten J, Griffin XL, Costa ML, Reed MR. The World Hip Trauma Evaluation Study 3: Hemiarthroplasty Evaluation by Multicentre Investigation - WHITE 3: HEMI - An Abridged Protocol. *Bone Joint Res*. 2016;5(1):18-25.
14. Hedbeck CJ, Enocson A, Lapidus G, et al. Comparison of bipolar hemiarthroplasty with total hip arthroplasty for displaced femoral neck fractures: a concise four-year follow-up of a randomized trial. *J Bone Joint Surg Am*. 2011;93(5):445-450.
15. Blomfeldt R, Tornkvist H, Eriksson K, Soderqvist A, Ponzer S, Tidermark J. A randomised controlled trial comparing bipolar hemiarthroplasty with total hip replacement for displaced intracapsular fractures of the femoral neck in elderly patients. *J Bone Joint Surg Br*. 2007;89(2):160-165.
16. Cadossi M, Chiarello E, Savarino L, et al. A comparison of hemiarthroplasty with a novel polycarbonate-urethane acetabular component for displaced intracapsular fractures of the femoral neck: a randomised controlled trial in elderly patients. *Bone Joint J*. 2013;95-B(5):609-615.
17. Keating JF, Grant A, Masson M, Scott NW, Forbes JF. Randomized comparison of reduction and fixation, bipolar hemiarthroplasty, and total hip arthroplasty. Treatment of displaced

- intracapsular hip fractures in healthy older patients. *J Bone Joint Surg Am*. 2006;88(2):249-260.
18. Macaulay W, Nellans KW, Iorio R, et al. Total hip arthroplasty is less painful at 12 months compared with hemiarthroplasty in treatment of displaced femoral neck fracture. *HSS J*. 2008;4(1):48-54.
 19. Baker RP, Squires B, Gargan MF, Bannister GC. Total hip arthroplasty and hemiarthroplasty in mobile, independent patients with a displaced intracapsular fracture of the femoral neck. A randomized, controlled trial. *J Bone Joint Surg Am*. 2006;88(12):2583-2589.
 20. Stuart EA, Bradshaw CP, Leaf PJ. Assessing the generalizability of randomized trial results to target populations. *Prev Sci*. 2015;16(3):475-485.
 21. Metcalfe D, Judge A, Perry DC, Gabbe B, Zogg CK, Costa ML. Total hip arthroplasty versus hemiarthroplasty for independently mobile older adults with intracapsular hip fractures. *BMC Musc Dis*. 2019;20(1):226.