

Institution: University of Edinburgh									
Unit of Assessment: 1									
Title of case study: M: Total hip replacement following hip fracture leads to better patient outcomes and long-term cost savings compared with reduction and fixation									
Period when the underpinning research was undertaken: 2000 – 2006									
Details of staff conducting the underpinning research from the submitting unit:									
<table border="1"> <tr> <th>Name(s):</th> <th>Role(s) (e.g. job title):</th> <th>Period(s) employed by submitting HEI:</th> </tr> <tr> <td>John Keating</td> <td>Honorary Professor and Consultant Orthopaedic Surgeon</td> <td>1994 – present</td> </tr> <tr> <td>John Forbes</td> <td>Reader in Health Economics</td> <td>1987 – 2013</td> </tr> </table>	Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:	John Keating	Honorary Professor and Consultant Orthopaedic Surgeon	1994 – present	John Forbes	Reader in Health Economics	1987 – 2013
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John Keating	Honorary Professor and Consultant Orthopaedic Surgeon	1994 – present							
John Forbes	Reader in Health Economics	1987 – 2013							
Period when the claimed impact occurred: August 2013 – December 2020									
Is this case study continued from a case study submitted in 2014? N									
<p>1. Summary of the impact</p> <p>Underpinning Research: A University of Edinburgh (UoE)-led randomised controlled trial (STARS) found that total hip replacement is the most clinically beneficial and cost-effective surgical procedure to treat displaced intracapsular fracture (hip fracture).</p> <p>Significance and Reach of Impact: More than 70,000 people are admitted to hospital in the UK every year with hip fracture. The UK's National Institute for Health and Care Excellence guidelines (updated in 2017) and American Academy of Orthopaedic Surgeons guidelines (2014) now recommend total hip replacement for patients with displaced intracapsular fracture, citing the STARS study. According to uptake surveys, 33.4% of eligible patients now receive total hip replacement surgery (n=4,383 in 2019 in England, compared with 2,099 in 2014).</p> <p>Use of total hip replacement rather than either of 2 alternative surgeries benefits patients through superior clinical outcomes (fewest subsequent hip-related hospital admissions and best self-rated functional outcomes) and saves the NHS GBP3,224 per patient, resulting in total savings of GBP59,300,000 for NHS England alone over the REF period.</p>									
<p>2. Underpinning research</p> <p>The Challenge: 3 main surgical options are possible for treating hip fracture</p> <p>Hip fractures are the most common serious injury in older adults, with over 70,000 people in the UK presenting at NHS secondary care with hip injury each year. 59% of these have displaced intracapsular fractures. The usual treatment options considered for hip fracture are reduction and fixation (attaching the displaced components of the hip joint together using metal hardware), bipolar hemiarthroplasty (replacing the femoral head on one side) and total hip replacement. In the 1990s, there was no consensus as to which of these was most beneficial, with each having its advantages and drawbacks, and the use of these options varied among surgeons and hospitals.</p> <p>UoE-led randomised controlled trial STARS compared the surgical options</p> <p>To address this uncertainty, the National Institute for Health Research, through its Health Technology Assessment programme, commissioned a clinical trial to compare the 3 procedures in otherwise healthy adults of 60 years and over. A GBP395,544 grant was competitively won by the UoE research team, who together with collaborators at 11 Scottish hospitals, led a multicentre randomised controlled trial (n=207), comparing outcomes of reduction and fixation with bipolar hemiarthroplasty and total hip replacement for the treatment of displaced intracapsular hip fractures. This Scottish Trial of Arthroplasty or Reduction for Subcapital Fractures (STARS) study was the first randomised trial directly comparing the 3 options in an otherwise healthy cohort.</p>									

The main functional outcome was self-rated hip function at 2 years after trial entry, measured using a hip-rating questionnaire which consisted of a 100-point scale giving equal weight to 4 domains: global (overall impact of the hip problem), pain, walking and function. The main clinical outcome measures were mortality, readmission to hospital and a reoperation. The trial also included, for the first time in this patient group, an economic outcome measure, which estimated the direct health service costs per patient for 2 years from trial entry.

Total hip replacement leads to the best functional and clinical outcomes

The results of the STARS study showed that the reduction and fixation group had inferior self-rated functional outcomes (significantly worse scores in the hip function questionnaire, with poorer scores on each of the 4 domains; **Table 1**) than both hemiarthroplasty and total hip replacement groups at 2 years. Between the latter 2 groups, total hip replacement led to significantly better functional scores after 2 years (mean overall score 73.8 in the hemiarthroplasty group versus 79.9 in the total hip replacement group, $p=0.04$) [3.1; 3.2].

Hip rating questionnaire	Fixation (n=110)	Hemiarthroplasty (n=102)	Total hip replacement (n=66)
Global	16.9 (7)	18.2 (6)	18.4 (5)
Pain	19.7 (6)	20.6 (5)	20.9 (5)
Walking	16.5 (6)	17.3 (6)	19.3 (6)
Function	20.1 (4)	20.0 (4)	21.2 (4)

Table 1. Patients' self-rated functional outcomes using a hip rating questionnaire (mean scores and standard deviation given), in the reduction and fixation, hemiarthroplasty and total hip replacement groups. Extracted from [3.1].

The clinical outcome data showed that the reduction and fixation group had the highest rates of reoperation, at 39%, compared with 5% in the bipolar hemiarthroplasty group and 9% in the total hip replacement group at 2 years; the latter difference was not statistically significant. There were no differences among the 3 groups in rates of mortality or readmission to hospital for non-hip related reasons.

Total hip replacement is the most cost-effective option

The cost-effectiveness analysis found that, although reduction and fixation was initially less costly than the other options due to the implants being cheaper and the operation time shorter, this short-term cost advantage was eroded by the costs of significantly increased subsequent health service usage. There was no significant difference in costs between hemiarthroplasty and total hip replacement [3.1; 3.2].

Thus, the STARS study established that bipolar hemiarthroplasty and total hip replacement were the most clinically effective and cost-effective operations, with total hip replacement leading to superior functional outcomes.

3. References to the research

[3.1] Keating, JF; Grant, A; Masson, M; Scott, NW; Forbes, JF. 2006. Randomized comparison of reduction and fixation, bipolar hemiarthroplasty, and total hip arthroplasty. Treatment of displaced intracapsular hip fractures in healthy older patients. *Journal of Bone and Joint Surgery* 88(2):249-60. [doi: 10.2106/JBJS.E.00215](https://doi.org/10.2106/JBJS.E.00215)

[3.2] Keating JF, Grant A, Masson M, Scott NW, Forbes JF. Displaced intracapsular hip fractures in fit, older people: a randomised comparison of reduction and fixation, bipolar hemiarthroplasty and total hip arthroplasty. *Health Technology Assessment* 2005; 9(41) [doi: 10.3310/hta9410](https://doi.org/10.3310/hta9410).

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4. Details of the impact.

Impact on clinical guidelines

The STARS clinical trial resulted directly in an update to the UK's National Institute for Health and Care Excellence (NICE) clinical guideline CG124 "Management of hip fractures in adults" in 2010, with the draft for consultation citing the STARS study 35 times in comparing the 3 surgical options in terms of outcomes for the patients and cost-effectiveness [5.1]. The final guideline recommended total hip replacement for displaced intracapsular fractures in patients who do not suffer from cognitive impairment and are medically fit to stand the surgery [5.2].

While the 2010 guideline was published outside the REF2021 census period, the NICE clinical guideline CG124 "Management of hip fractures in adults" was revised in 2017 and the recommendation for total hip replacement as the surgical option for displaced intracapsular fracture was reaffirmed [5.3a]. The STARS study was again mentioned in evidence 92 times, and was one of only 3 randomised controlled trials directly comparing the 3 surgical options in terms of clinical outcome and cost-effectiveness [5.3b].

In 2014, the American Academy of Orthopaedic Surgeons published an evidence-based clinical practice guideline, which concluded that strong evidence supports arthroplasty for patients with displaced fractures, and that "*The benefit of implementing this recommendation will be the avoidance of reoperations in this frail patient population. This has implications on cost savings to society.*" This conclusion was based on 6 studies classified as "high-strength", of which the STARS study was the only one to include an economic assessment [5.4].

Impact on clinical practice

As a baseline, in 2009 (the year before the NICE update), fewer than 5% of eligible patients with displaced intracapsular fracture were treated with total hip fracture [5.5]. The low uptake was largely due to the lack of evidence in favour of this procedure, and the unwillingness of many surgeons to resort to what they considered an unnecessarily invasive surgery, when more straightforward options, notably the reduction and fixation procedure, were available.

The uptake of the NICE guideline CG124 recommending total hip replacement for this group in England, Wales and Northern Ireland has been tracked annually by the National Hip Fracture Database (NHFD) since 2013. The overall proportion of eligible patients who received a total hip replacement has increased each year from 20.7% at the end of 2013 to 33.4% at the end of 2019 [5.6]¹.

The Royal College of Physicians is working together with hospitals to increase the uptake of total hip replacement; for example, a campaign at Royal Preston Hospital raised awareness of the benefits of total hip replacement, provided education for orthopaedic colleagues and junior surgical staff, made total hip replacement kits available at trauma units, appointed specialist staff and improved communication among surgical teams. This campaign succeeded in increasing the proportion of eligible patients receiving total hip replacement from a baseline of 33.3% in January 2013 to 72% in March 2017 [5.7].

Impact on health & welfare

According to NHFD data, 22,554 people with displaced intracapsular fractures received a total hip replacement between 2014 and 2018, out of 83,337 who would have been eligible [5.6]. Assuming that only 5% of this total (equating to 4,167 patients) would have received this treatment prior to the STARS study and the subsequent NICE guideline update, the remaining 18,387 patients have directly benefited from UoE research recommending total hip

¹The reason for compliance with NICE guidance falling short of the desired 100% is explained in all NHFD reports: it is chiefly the limited availability of appropriately qualified and experienced orthopaedic surgeons; individual hospital guidelines often require that patients with hip fracture receive treatment within 48 number of hours after admission, and it is not always possible to achieve that while waiting for the optimal surgeon to become available.

replacement over other surgical options, through superior outcomes, including reduced pain, improved walking and function, as well as suffering fewer hip-related complications leading to readmission and reoperation.

Economic impact

The NICE guideline development group used the economic analysis carried out as part of the STARS study, and concluded that over 2 years, a patient with displaced intracapsular fracture incurred a mean cost of GBP12,623 if they were treated with reduction and fixation, GBP9,897 if they were treated with bipolar hemiarthroplasty, and GBP9,399 if they were treated with total hip replacement [5.1]. These figures include the cost of the initial surgical procedure, but exclude any subsequent non-hip related admissions.

Thus, the NICE figures show that use of total hip replacement rather than a reduction and fixation procedure results in a mean saving of GBP3,224 per patient over 2 years. Extrapolating from this to calculate the impact in the REF2021 census period, between 2014 and 2018 in England alone, $18,387 \times \text{GBP}3,224 = \text{GBP}59,279,688$ worth of NHS funds was saved as a result of UoE research.

5. Sources to corroborate the impact

[5.1] NICE guideline consultation draft “The management of hip fracture in adults”, 2010, listing evidence considered and containing health economic analysis

[5.2] Published NICE guideline CG124, 2011, recommendation on p. 34

[5.3] NICE Guideline CG124, 2017 revision

- Published CG124; summary of changes on p. 4, recommendations on p. 7
- Addendum to guideline, listing the evidence considered (mention of 3 randomised trials on p. 12)

[5.4] American Academy of Orthopaedic Surgeons clinical guidelines, 2014; recommendation and quote on p. 99

[5.5] National Hip Fracture Database annual report from 2009

[5.6] National Hip Fracture Database annual reports published in 2014, 2015, 2016, 2017, 2018 and 2019 and email from NHFD. Data pulled from these sources shows that (THR = total hip replacement):

In 2014 report, 19.1% of 14,774 eligible patients received THR = 2,099

In 2015 report, 26.1% of 11,722 eligible patients received THR = 3,059

In 2016 report, 26.9% of 12,473 eligible patients received THR = 3,355

In 2017 report, 30.4% of 15,276 eligible patients received THR = 4,644

In 2018 report, 31.4% of 15,968 eligible patients received THR = 5,014

In 2019 report, 33.4% of 13,124 eligible patients received THR = 4,383

Total: 22,554 patients received THR out of 83,337 who would have been eligible

[5.7] NHFD annual report 2017, p. 10