

Institution: University of Warwick		
Unit of Assessment: UOA2 - Public Health, Health Services and Primary Care		
Title of case study: Changing clinical practice in trauma and orthopaedic surgery		
Period when the underpinning research was undertaken: 1 January 2012- 31 December 2018		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Professor Damian Griffin	Professor of Trauma and Orthopaedics	August 2002 - present
Professor Matthew Costa	Professor of Trauma and Orthopaedics	January 2006 – May 2017
Dr Nick Parsons	Associate Professor of Statistics	October 2007 - present
Dr Andrew Metcalfe	Associate Professor of Trauma and Orthopaedics	July 2015 - present
Professor Norman Waugh	Professor of Public Health	June 2011 – present
Professor Aileen Clarke	Professor of Public Health	March 2007 – present
Dr Amy Grove	Associate Professor	June 2011 – present
Dr Paul Sutcliffe	Associate Professor	May 2008 - present
Dr Hema Mistry	Associate Professor in Health Economics	January 2013 - present
Period when the claimed impact occurred: 1 August 2013 - 31 December 2020		
Is this case study continued from a case study submitted in 2014? N		
<p>1. Summary of the impact (indicative maximum 100 words)</p> <p>A large multi-centre randomised trial from the University of Warwick has led to demonstrable changes in the UK-wide treatment of serious wrist fractures requiring surgery. Surgical intervention using Kirschner wires (performed around 9,000 times per year in the UK) is now recommended in the 2016 NICE guidance. After the trial, a major reduction in the use of more expensive (and higher risk) plates has been observed, saving GBP2,000,000 every year for the NHS. NICE guidance on the treatment of lower limb open fractures, a common injury, has been informed by a major randomised trial from Warwick demonstrating that expensive negative pressure wound therapy offered no benefits compared to cheaper standard wound dressing, saving GBP80 per patient. Based on extensive Warwick clinical effectiveness reviews and complex health economic modelling, NICE gave its first approval for a regenerative medicine product in 2017, for the repair of damaged articular cartilage of the knee, estimated to benefit 500 patients per year enabling a return to normal activities and reduction in risk of later osteoarthritis. The management of end-stage arthritis of the hip has been informed by a Warwick randomised trial and a large technology assessment of clinical and cost-effectiveness, demonstrating that, cheaper total hip replacement is comparable to resurfacing arthroplasty with reduced revision rates. The change in NICE guidance informed by this research has resulted in 9% decrease in the use of the more expensive resurfacing arthroplasty in the NHS from 10% of all hip replacements to 1% with over 106,000 hip procedures performed in the UK per year.</p>		
<p>2. Underpinning research (indicative maximum 500 words)</p>		

Under the leadership of Professor Griffin, trauma and orthopaedic surgery research at Warwick delivers world leading, large scale pragmatic clinical trials and clinical effectiveness research informing trauma surgery, sports and arthroscopic surgery, and joint replacement surgery. This primary research feeds into evidence synthesis and health economic evaluations undertaken by Warwick Evidence, led by Professor Aileen Clarke and now by Drs Paul Sutcliffe and Amy Grove, as part of Health Technology Assessments (HTA) commissioned by NICE to improve clinical practice and outcomes for patients.

Trauma surgery – Wrist fractures and open fractures of the lower limb

Wrist fractures (distal radius fractures) are common injuries, with around 100,000 fractures treated in the NHS every year. While most can be treated without surgery, serious fractures require surgical fixation, and around 9,000 are performed each year. The NIHR-funded UK Distal Radius Fracture Fixation Trial (DRAFFT), led by Costa, was the first multicentre randomised trial to compare the effectiveness of simpler wire fixation with more expensive locking plate fixation for wrist fractures for 461 patients across 18 trauma centres between January 2011 and July 2012. Contrary to the rapidly increasing use of locking-plate fixation, the trial found that there was no difference in patients' wrist function or quality of life between the quick and cheaper wire fixation and locking-plates, both at 12 months and more recently at five years [3.1].

Lower limb fractures are common injuries. While the skin is intact (closed) for most fractures, some fractures are open, with the broken bone exposed to contamination and major complications. Costa's Wound management of Open Lower Limb Fractures (WOLLF) trial was the first large scale trial to compare negative pressure wound therapy and standard wound management after the first surgical debridement of the wound. The trial assessed the disability, infection, and quality of life in 460 patients in 24 major trauma hospitals with severe open fracture of the lower limb between July 2012 and December 2015. The results provided significant evidence that the use of negative pressure wound therapy did not improve self-rated disability at 12 months compared with standard wound dressing [3.2].

Surgery for damage to the articular cartilage in the knee

The layer of cartilage that covers the ends of the femur and tibia in the knee joint - articular cartilage - heals poorly if injured. Damage to the articular cartilage is a common injury and may lead to osteoarthritis and a need for knee replacements later in life. Commissioned by the UK HTA Programme in 2014 [3.3], Waugh, Mistry, Metcalfe and others provided a HTA to help NICE assess the effectiveness and cost-effectiveness of autologous chondrocyte implantation (ACI), a procedure to replace the damaged cartilage. The substantial review examined a wide range of evidence and undertook sensitivity analyses to overcome the lack of evidence for long term results for newer generations of ACI. The HTA concluded that long-term results were better with ACI than with microfracture, that the incremental cost-effectiveness ratios for ACI were within a range usually considered acceptable by policy makers, and ACI reduced the need for further repairs.

Joint replacement surgery - hip replacement

Hip replacement is a common type of surgery, with over 111,000 hip procedures undertaken in the UK in 2019. Total hip replacement (THR) is the replacement of the hip joint with an artificial hip prosthesis whereas resurfacing arthroplasty involves the replacement of the joint surface with a metal surface covering. The Warwick Arthroplasty Trial (WAT), led by Costa and Griffin, was the first randomised clinical trial to compare the clinical and cost-effectiveness of total hip arthroplasty with resurfacing arthroplasty. The results provided evidence that there was no difference in hip function, disability rating or activity between treatment groups at 12 months after surgery in 126 patients with severe arthritis of the hip [3.4]. Subsequently, Clarke, Grove, Mistry, Costa, and Sutcliffe were commissioned by the UK HTA Programme to examine the clinical and cost-effectiveness of different types of THR and resurfacing arthroplasty for the treatment of pain and disability in people with end stage arthritis of the hip. This was the first systematic review and economic analysis to assess five different types of hip replacement. The findings indicated that mean costs for resurfacing arthroplasty were higher compared to THR, with the incremental

costs of resurfacing arthroplasty of GBP11,284. The HTA demonstrated that the revision rate of resurfacing arthroplasty was 11%, compared to 3% of those undergoing THR by 9 years [3.5] and subsequent analyses of registry data suggested that the current revision rate benchmark should be at least halved from 10% to less than 5% at 10 years [3.6].

3. References to the research (indicative maximum of six references)

- [3.1] **Costa ML, Achten J, Parsons NR, Rangan A, Griffin D, Tubeuf S and Lamb, SE** . (2014) Percutaneous fixation with Kirschner wires versus volar locking plate fixation in adults with dorsally displaced fracture of distal radius : randomised controlled trial. *BMJ*, Volume 349 . pp. 1-10. Article number g4807. doi:10.1136/bmj.g4807
- [3.2] **Costa ML, Achten J, Bruce J, Tutton E, Petrou S, Lamb SE, Parsons NR**;(2018) UK WOLFF Collaboration. Effect of Negative Pressure Wound Therapy vs Standard Wound Management on 12-Month Disability Among Adults With Severe Open Fracture of the Lower Limb: The WOLFF Randomized Clinical Trial. *JAMA*. 2018 Jun 12;319(22):2280-2288. doi: 10.1001/jama.2018.6452.
- [3.3] **Mistry H, Connock M, Pink J, Shyangdan D, Clar C, Royle P, Court RA, Biant LC, Metcalfe AJ, Waugh N** (2017) Autologous chondrocyte implantation in the knee: systematic review and economic evaluation. *Health Technology Assessment*. 21 (6). pp. 1-294. doi:[10.3310/hta21060](https://doi.org/10.3310/hta21060)
- [3.4] **Costa ML, Achten J, Parsons NR., Edlin RP, Foguet P, Prakash U. and Griffin DR** (2012) *Total hip arthroplasty versus resurfacing arthroplasty in the treatment of patients with arthritis of the hip joint : single centre, parallel group, assessor blinded, randomised controlled trial*. *BMJ*, Vol.344 (No.1). e2147-e2147. doi:[10.1136/bmj.e2147](https://doi.org/10.1136/bmj.e2147)
- [3.5] **Tsertsvadze A, Grove AL, Freeman K, Court RA, Johnson SA, Connock M, Clarke A and Sutcliffe P** (2014) *Total hip replacement for the treatment of end stage arthritis of the hip : a systematic review and meta-analysis*. *PLoS One*, Volume 9 (Number 7). Article number e99804. doi:[10.1371/journal.pone.0099804](https://doi.org/10.1371/journal.pone.0099804)
- [3.6] **Kandala NB, Connock M, Pulikottil-Jacob R, Sutcliffe P, Crowther MJ, Grove A, Mistry H, Clarke A.** (2015) *Setting benchmark revision rates for total hip replacement : analysis of registry evidence*. *BMJ (Clinical research ed.)*, 350 . h756. doi:[10.1136/bmj.h756](https://doi.org/10.1136/bmj.h756)

Funding grants

1. PI Matthew Costa, A randomised controlled trial of percutaneous fixation with Kirschner wires versus volar locking-plate fixation in the treatment of adult patients with a displaced fracture of the distal radius, NIHR HTA, July 2010- December 2013, GBP1,300,498.87
2. PI Matthew Costa, A randomised controlled trial of standard-of-care wound management versus negative pressure wound therapy in the treatment of adult patients with an open fracture of the lower limb, NIHR HTA, April 2012- April 2017, GBP2,047,962.49
3. PI Norman Waugh, Autologous chondrocyte implantation for repairing symptomatic articular cartilage defects of the knee [ID686], NIHR HTA, May 2014- April 2015, GBP350,000
4. PI Matthew Costa, The Warwick Arthroplasty Trial (PB-PG-0706-10080), NIHR, May 2007- May 2012, GBP312, 968
5. PI Aileen Clarke, Total hip replacement and surface replacement for the treatment of pain resulting from end stage arthritis of the hip (Review TA2 and TA44) (ID540), NIHR HTA, February 2013 - November 2013, GBP175,000

4. Details of the impact (indicative maximum 750 words)

Warwick-led research in Trauma and Orthopaedic surgery has directly changed clinical practice and underpinned NICE guidelines and clinical guidance for trauma surgery, regenerative medicine, and joint replacement surgery. These have led significant NHS cost savings, more effective clinical practice and improved long-term patient outcomes.

Improving treatment of wrist fractures and open fractures of the lower limb

1,800,000 fractures occur in England each year. Wrist fractures (distal radius fractures) are very common, representing up to 20% of all fractures treated in emergency departments. Warwick research [3.1] underpinned the change in NICE guidance *Fractures (non-complex): assessment and management (NG38)* in February 2016 [5.1] recommending “Kirschner wire should be used

in favour of internal fixation to treat distal radial fractures that require fixation.” Before the DRAFFT trial 75% of patients were treated with plate fixation versus 12% with Kirschner wires, whereas in the three years after publication, the number of patients treated with locking plates dropped to 48%, while Kirschner wires rose to 42% (Hospital Episode Statistics), demonstrating a strong change to clinical practice [5.2]. The cost saving to the NHS of this change has been calculated to be GBP2,000,000 every year [5.2]. The British Orthopaedic Association and the British Society for Surgery of the Hand’s Best practice for management of Distal Radial Fractures (2018) also recommends that “When surgery is needed for dorsally displaced distal radius fractures that can be reduced closed, offer Kirschner wire fixation and cast” [5.3].

Lower limb fractures are common injuries. Open fractures are exposed to contamination and infection rates can be up to 27%, even in specialist trauma centres. Previous international clinical guidelines recommended the use of expensive negative pressure wound therapy for open fracture wounds. Warwick research [3.2] prompted an exceptional review of NICE’s *Fractures (complex): assessment and management guideline (NG37)* in 2018 [5.4] and plan to update the NICE guideline based on the trial results. This change in practice is estimated to save the NHS at least GBP80 per patient, for an estimated 5000 patients every year across the UK who sustain these serious injuries.

Enabling NICE’s first regenerative medicine product approval to repair articular cartilage in the knee in the NHS

Damage to the articular cartilage in the knee is a common injury, particularly for young people during sport or in manual occupations, who are often too young to have knee replacements and available treatments were often unsatisfactory. Autologous chondrocyte implantation (ACI) uses healthy cartilage producing cells from the knee which are cultured and then inserted in the damaged part of the joint to produce new cartilage. While ACI has been available since 1987, in different, evolving forms, NICE recommended against routine ACI use in the NHS in 2000 and 2005 because of the shortcomings of the evidence base and doubts about cost-effectiveness (cost of GBP20,717) [5.5]. Between 2015 and 2017, the NICE Appraisal Committee considered Warwick’s HTA [3.4] and further Warwick analyses, with Waugh, Mistry and Metcalfe attending the Committee meetings, providing the underpinning evidence that enabled NICE to change their recommendation. Since October 2017, ACI has been available in the NHS (subject to certain restrictions) via the NICE *Autologous chondrocyte implantation for treating symptomatic articular cartilage defects of the knee Technology appraisal guidance [TA477]* (October 2017) [5.6], and *Autologous chondrocyte implantation using chondrosphere for treating symptomatic articular cartilage defects of the knee Technology appraisal guidance [TA508]* (March 2018) [5.7]. It is estimated that 500 people are eligible for ACI each year. ACI is the first NICE approved regenerative medicine product and surgeons and patients now have access to ACI. Patients are able to return to normal activities and their risk of later osteoarthritis is reduced. This NICE recommendation has also benefited ACI cell manufacturers in Germany; and Warwick research has attracted considerable interest overseas [5.8].

Improving long term outcomes for hip replacements

The WAT trial and a subsequent HTA [3.4, 3.5] directly underpinned NICE guidance on *Total hip replacement and resurfacing arthroplasty for end-stage arthritis of the hip (TA304)* published in February 2014 [5.9]. The guidance recommends that “Prostheses for total hip replacement and resurfacing arthroplasty are recommended as treatment options for people with end-stage arthritis of the hip only if the prostheses have rates (or projected rates) of revision of 5% or less at 10 years.” The Committee concluded “Revision rate was the most important key driver of costs and quality-adjusted life years in the model” [5.9]. This guidance has resulted in a 9% decrease in the use of the more expensive resurfacing arthroplasty in the NHS from 10% of all hip replacements to 1%. Commissioners or providers have a responsibility to provide the funding required to enable the guidance to be applied when individual health professionals and their patients wish to use it, in accordance with the NHS Constitution. Hip resurfacing has an additional risk that the patient may react to the metal bearing, resulting in early failure and complications which have consequently been avoided as a result of this change in practice.

Therefore, the change in guidance recommendations has contributed to improved long-term outcomes for patients undergoing hip replacement operations.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[5.1] *NICE guidance recommending Kirschner wire to treat distal radial fractures that require fixation*: Fractures (non-complex): assessment and management (NG38)

<https://www.nice.org.uk/guidance/ng38/evidence/full-guideline-pdf-2358460765>

[5.2] *Paper corroborating from Hospital Statistics that surgeons in the UK do change their practice in response to large, pragmatic, multicentre clinical trials*: Costa ML, Jameson SS, Reed MR. Do large pragmatic randomised trials change clinical practice?: assessing the impact of the Distal Radius Acute Fracture Fixation Trial (DRAFFT). *Bone Joint J.* 2016;98-B(3):410-3.

[5.3] The British Orthopaedic Association and the British Society for Surgery of the Hand's Best practice for management of Distal Radial Fractures *recommending use of Kirschner wire*(2018):

https://www.bssh.ac.uk/_userfiles/pages/files/professionals/Radius/Blue%20Book%20DRF%20Final%20Document.pdf

[5.4] Exceptional review of NICE's Fractures (complex): assessment and management guideline (NG37) 2018:<https://www.nice.org.uk/guidance/ng37/resources/2018-exceptional-surveillance-of-fractures-complex-assessment-and-management-nice-guideline-ng37-4913257789/chapter/Surveillance-decision?tab=evidence>

[5.5] *Annual cost of implementing guidance estimated in NICE Resource impact report TA477:*

Autologous chondrocyte implantation for treating symptomatic articular cartilage defects of the knee (TA477) <https://www.nice.org.uk/guidance/ta477/resources/resource-impact-report-pdf-4607377165>

[5.6] NICE Technology appraisal guidance TA477 *with the recommendation of ACI as an option for treating symptomatic articular cartilage defects of the knee based on Warwick research*

(Published date: 04 October 2017): <https://www.nice.org.uk/guidance/ta477>

[5.7] NICE Technology appraisal guidance TA508 *with the recommendation for ACI using chondrosphere for treating symptomatic articular cartilage defects of the knee based on Warwick research* (Published date: 07 March 2018):

<https://www.nice.org.uk/guidance/ta508>

[5.8] International Cartilage Repair Society (ICRS) newsletter *sharing the Warwick health technology assessment with the International Cartilage Repair Society*, (December 2017):

<https://cartilage.org/newsletters/icrs-newsletter-winter-2017/>

[5.9] NICE Technology appraisal guidance TA304 *resulting in a decrease in the use of the more expensive resurfacing arthroplasty based on Warwick research*: Total hip replacement and resurfacing arthroplasty for end-stage arthritis of the hip. Published date: 26 February 2014.

<https://www.nice.org.uk/guidance/ta304>