

<b>Institution: University of Central Lancashire</b>
<b>Unit of Assessment: 26 - Sport and Exercise Sciences, Leisure and Tourism</b>
<b>Title of case study:</b> Uncovering the treatment effects for the conservative management of the knee
<p><b>1. Summary of the impact</b> (indicative maximum 100 words)</p> <p>The key driver for this research is to provide clinicians with robust tools that they can use to evaluate, treat and therefore improve the clinical outcome in their patients. Our research has assisted the development of the evidence base of many clinical treatments and assessment tools. This has led to the design and development of new rehabilitation products and medical devices in partnership with both large companies and small to medium sized enterprises. The core impact of this work has been improvements in patient care and quality of life by improving the efficacy and effectiveness in these areas with a particular focus on the advancement of conservative management and lower limb rehabilitation.</p>
<p><b>2. Underpinning research</b> (indicative maximum 500 words)</p> <p>Since 2004 Professor Jim Richards and Professor James Selfe have contributed to the clinical understanding of movement control and the effect of treatments of unstable and painful knee joints. This work has shown the biomechanical and clinical effectiveness of several different conservative and surgical managements and the efficacy of rehabilitation devices and led to the development of new outcome measures.</p> <p>Within knee osteoarthritis the most common treatments are surgical to realign the knee; from 2005 onwards research at the University of Central Lancashire has shown that the amount of physical correction possible with knee bracing is similar to that of some surgery procedures with similar associated reductions in pain and improvements in function. In addition our work on patellofemoral pain was the first to determine the biomechanical effects on the three dimensional movement and control of the knee when using taping and bracing in 2008. This work highlighted improvements in the knee control, and in collaboration with colleagues at the University of Manchester (Dr Mike Callaghan &amp; Prof Jackie Oldham) we have established that patellofemoral patients demonstrate clinically important proprioceptive deficits (2008), therefore identifying the possible proprioception and mechano-reception mechanism through which these treatments work. This work has changed clinical practice with the assessment and treatment of proprioception now routine in these patients. In 2011 clinical studies, derived from these early “proof of principle” studies, further explored the improvements in control and mapped to these improvements in self-reported pain and function in patellofemoral pain sufferers.</p> <p>Biomechanical and clinical data were collected to determine the mechanical efficacy and clinical effectiveness on a range of products for a range of musculoskeletal problems including Knee Osteoarthritis, Patellofemoral Pain and lower limb rehabilitation. One example of this came from our research on the exploration of the biomechanics of squatting tasks and their implications for lower limb rehabilitation. Single-limb squats on a decline angle have been suggested as a rehabilitative intervention to target the knee extensors, however very little empirical research exists documenting the optimum angle of decline. Our work explored the use of squatting using decline boards and aimed to determine the optimum angle and the most effective regimen. Our paper, published in the Journal of Athletic Training (Richards et al, 2008), was the first to determine the biomechanics of such exercises, and suggests the optimum angles for different rehabilitation purposes. This work led to the development of a new rehabilitation device, the “Rehab Angel”, which allows the decline angle to be adjusted based on our findings. This device is now commercially available and is being used in many rehabilitation centres and professional sports clubs in a variety of knee and other lower limb pathologies.</p>

Our research has also supported the development and product testing of many new devices that aim to reduce pain and improve function. This has assisted large companies from the USA through to small/medium-sized enterprises (SMEs) in the UK. Between 2007 and 2009 20 UK SMEs were assisted in product testing and development. This led to 20 new jobs being created and an increase in sales of £750k and £1.1 m sales safeguarded over this time period when audited by the European Regional Development Agency. This work led to several new products making it to market that have shown successful application in the clinical management of musculoskeletal problems.

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

1. Jones RK, Nester CJ, Richards JD, Kim WY, Johnson DS, Jari S, Laxton P, Tyson SF (2013). A comparison of the biomechanical effects of valgus knee braces and lateral wedged insoles in patients with knee osteoarthritis. *Gait Posture*,37(3):368-72.
2. Selfe J, Thewlis D, Hill S, Whitaker J, Sutton C, Richards J, (2011). A Clinical Study of the Biomechanics of Step Descent Using Different Treatment Modalities for Patellofemoral Pain. *Gait & Posture*,34(1):92-6.
3. Selfe J, Richards J, Thewlis D, Kilmurray S (2008). The biomechanics of step descent under different treatment modalities used in patellofemoral pain. *Gait & Posture*,27(2):258-263.
4. Callaghan M, Selfe J Henry A, Oldham J (2008) Effects of patellar taping on knee joint proprioception in patients with patellofemoral pain syndrome. *Manual Therapy*,13:192–199.
5. Richards J, Thewlis D, Selfe J, Cunningham A, Hayes C (2008). The biomechanics of single limb squats at different decline angles. *Journal of Athletic Training*,43(5):477-482.
6. Richards J, Sanchez-Ballester J, Jones RK, Darke N (2005). A comparison of the effectiveness of two knee braces in the treatment of subjects with medial compartment osteoarthritis of the knee during walking. *Journal of Bone and Joint Surgery*,87-B(7):937-939.

**Selected research grant support**

- Richards J and Selfe J. ERDF (European Regional Development Fund), £156,000. Biomechanical Testing Facilities in the North West. This project supported independent product testing for 20 Small/Medium Enterprises, 2006.
- Richards J and Selfe J. R&D funded by DJO global, £119,000. Independent research of products in the management of musculoskeletal problems and the development of new devices to reduce pain and improve function, 2008-2012.
- Richards J and Selfe J. TrustTECH (NHS Innovation) Pathfinder funding, £25,000. Testing of a new lower cost rehabilitation device, 2010.
- Richards J and Selfe J. TSB, Knowledge Transfer Partnership, £126,000. To introduce advanced biomechanics technologies to evaluate new designs of sports footwear and protective equipment used in sports leading to sustainable production of new products, 2011.
- Richards J and Selfe J. PhD studentship for 3 years DELSYS Inc., £53,000. The advanced use of electromyography in the assessment of musculoskeletal conditions, 2011.
- Selfe J, Callaghan M, Witwrouw E, Richards J, Dey M, Sutton C, Baltzopoulos B, Stokes M, Dixon J, Martin D, Polman R, Masters R, Hogarth R, Ritchie E, Arden N, Turner D. Arthritis Research UK (ARUK), £30,000. Targeted Intervention in Patellofemoral Pain Syndrome (TIPPS). Explores proximal, distal or local factors in Patellofemoral Pain Syndrome, 2011.
- Richards J, Selfe J, Chohan A. (Rophi Ltd.) Commercial funding for independent research, £30,000. To determine the effectiveness of a cushion designed to reduce back pain over standard clinical care, 2012.
- Richards J, Selfe J, Chohan A. SPARK Ventures £58,000. To determine the effectiveness of a passive gravity assisted spinal traction device, 2013.

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

The team’s research into Osteoarthritis was first reported in a paper published in *The Knee* in 2004 that led to subsequent development of “proofs of concepts” through to our current work. This led to the development of new methods of movement analysis and biomechanical modelling techniques that we are now using in our current work. With a mission to improve the quality of life of patients

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treated by Allied Health Professionals, our work pursues this goal by performing basic and applied research, and by developing new techniques in the assessment of musculoskeletal and neurological conditions. The team also advises medical staff on methods of conservative management of knee pain through invited talks to clinical groups internationally.

The applied clinical nature of the work is firmly rooted in the every-day world of clinical practice. Although some of the tools used in this research are very advanced and only available in specialist research units the focus has always to be to produce results that are clinically useful. When considering clinical utility the aim is to provide clinicians with evidence about patient management or new tools to assist in patient management. By helping to optimise clinical practice the health and well-being of patients attending for conservative management of musculoskeletal conditions is improved.

The findings of the research team suggest that there are many benefits in terms of joint stability and control that had gone previously undetected which had led many clinicians to doubt the therapeutic benefit of some conservative management. The research team at the University of Central Lancashire has now developed a program of work to systematically assess the effectiveness of different levels of conservative and surgical management. The effect of surgical management of knee osteoarthritis using total knee arthroplasty was initially tested by Dr Dominic Thewlis (a former PhD student and now a senior lecturer of University of South Australia). This has now been followed up by considering a spectrum of conservative and surgical managements to give comparative guidance of what biomechanical and clinical outcomes clinicians could expect.

Dissemination of these research findings has been to academic and professional conferences but often, more importantly, through specific CPD activities which are particularly effective at influencing clinical practice. Some of this research has been translated into other languages including Persian, Flemish and Chinese, and is cited by other international research groups. It appears that a wide international audience of clinicians and academics have been influenced.

From this research evidence base key members of staff have delivered expert advice to clinical groups in Europe (1995 onwards), USA (2007 onwards), China (2010 onwards) and South East Asia (2011 onwards), South America (2012 onwards), and receive invitations to speak at conferences worldwide on a regular basis. This has included over 150 invited talks to clinical groups, professional sports clubs, commercial companies, academic groups in over 20 different countries between 2008 and 2013. This dissemination has helped the acceptance of conservative treatment before surgical management in Europe and the US and is now being used throughout China and South East Asia, which has improved the clinical options of Allied Health Professionals and Orthopaedic Surgeons. This has led to more than 1,000 patients worldwide now receiving conservative management for Knee Osteoarthritis and Patellofemoral pain since 2010 as a direct result of this work who would not otherwise been treated conservatively (source DJO Global inc.). Since 2007 the research team have been directly involved in prototype development and testing of new knee braces and other conservative managements for many companies including DJO Inc., Vista California, USA with the focus being on maximising patient benefits.

The reach of our work can be further evidenced by the authoring of relevant books and being invited to contribute book chapters including; Clinical Case Studies in Physiotherapy (2008), Biomechanics in Clinic and Research (2008), Biomechanics in Clinic and Research: Chinese edition (2011) and the new edition of Whittles Gait Analysis (2012), Tidy's Physiotherapy 13<sup>th</sup>, 14<sup>th</sup> and 15<sup>th</sup> editions (2006 – 2012) and Mercer's Textbook of Orthopaedics and Trauma (2012). As a result of these academic contributions patients with complex musculoskeletal and neurological

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disorders are regularly referred from around the UK by GPs, Orthopaedic surgeons and Allied Health Professions for advanced biomechanical assessments to assist clinical decision making in their treatment.

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

**CONTACT 1:** Crystal Chan, Sales and Marketing Manager, DJO (DJO Asia Pacific).

**CONTACT 2:** Darren Marcangelo, Commercial Director, Harrison Spinks Ltd.

**CONTACT 3:** Martin Levermore, Chief Executive, MDTi (UK).

**CONTACT 4:** Simon Skirrow, Former Vice-President, Adidas.

**CONTACT 5:** Nicola Maffulli, Professor of Trauma and Orthopaedics & Consultant Orthopaedic Surgeon, Queen Mary University London.

**6. Supporting a UK Success Story:** The impact of university research and sport development. Rehabilitation Equipment. Second Impact Report, Universities UK (UUK).

**7. ERDF North West Of England Objective 2 Programme 2000-2006:** APP Project Ref No 1.4-16. 17 UK SMEs were assisted in product testing and development 20 new jobs created and an increase in sales of £750k and £1.1 m sales safeguarded. Neil Clatworthy, Northwest Universities European Unit Ltd, Albert House, 17 Bloom Street, Manchester. [nclatworthy@nwueu.ac.uk](mailto:nclatworthy@nwueu.ac.uk)

**8. Chartered Society of Physiotherapy Citation (2008).** Reproduced in full in Frontline, The Chartered Society of Physiotherapy Magazine (2009) 4 February Vol. 15 No 3 p14-15

**9. Development of consensus document: 1st International Patellofemoral Research Retreat, Baltimore, USA.** (Davies I & Powers C Patellofemoral Pain: Proximal, Distal, and Local Factors, JOSPT;40(3): A1-A48. doi:10.2519/jospt.2010.0302)

**10. Further development of consensus document: 2nd International Patellofemoral Research Retreat, Ghent, Belgium.** (Powers C et al, 2012 Patellofemoral Pain: Proximal, Distal, and Local Factors, JOSPT; 42(6): A1-A20. doi:10.2519/jospt.2012.0301).