relationship to other metabolic parameters in osteoporosis, diabetes, metabolic syndrome and anorexia nervosa.

Brief CV

Research Area(s): Marrow changes in osteoporosis

Technical Expertise: Imaging (MRI, clinical CT, ultrasound, radiography)

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Professor James F Griffith MB, BCh, BAO, MRCP, FRCR, HKFAM (radiology), MD, studied medicine in University College Cork Ireland, practiced clinical medicine in the UK and underwent radiological training in the West Midlands UK. His current clinical practice comprises all aspects of musculoskeletal imaging. He has published almost 300 peer-reviewed papers with particular research interests being glenoid bone loss in should dislocation and the imaging of marrow fat and bone vascularity with a view to the early detect of osteoporosis.

Some representative papers are:

Griffith JF, Yeung DK, Ma HT et al. Bone marrow fat content in the elderly: a reversal of sex difference seen in younger subjects. J Magn Reson Imaging. 2012;36(1):225—30.

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Griffith JF, Yeung DK, Chow SK et al. Reproducibility of MR perfusion and (1)H spectroscopy of bone marrow. J Magn Reson Imaging. 2009 ;29(6):1438—42.

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RADIO-STEREOMETRIC ANALYSIS IN RESURFACING HIP ARTHROPLASTY

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RSA is a method which can measure small migration of prosthetic components in bone and wear of e.g. polyethylene. The radiographic method has been develop in Sweden during the 1970'ies and is today used as a tool documenting new implants in order to verify a stable implant in bone. Studies using the method have shown that early and continuous migration is one of the most important predictors of implant loosening and is thus a surrogate indicator for survival of the implant.

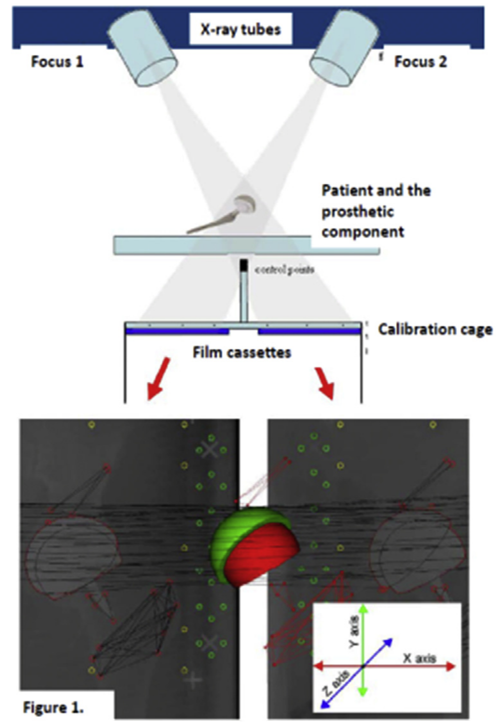
RSA requires simultaneous exposure of two X-ray tube creating two images (fig, 1 and 2.) In addition, a calibration cage, implant and bone markers are needed. A software program will translate these projections into a 3D coordinate system, calculation the distance between the rigid bodies of the cage, bone and implant. Changes, during follow-up between the relative position of bone and implant, mean that the implant is migrating in one or more directions.

The RSA method has in the present study been used to evaluate different types of hip arthroplasties.

Resurfacing hip arthroplasty (RHA) versus a standard total hip arthroplasty (THA) with a large diameter metal on metal heads (LDH-THA) stable.

The primary aim of this study was evaluate the implant stability of the DePuy ASR™ Hip Resurfacing by use of RSA, and secondly to compare it to a cup from a LDH-THA

Figure 1. The RSA method. Two x-ray tubes, the prosthetic component, calibration cage and films creating two images



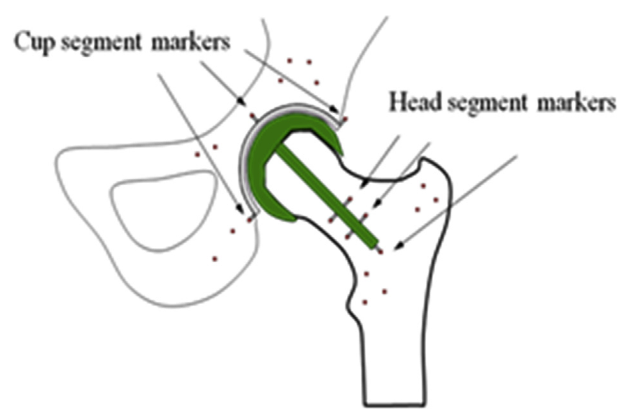


Fig. 2

Results

Cup:

The mean (sd) micro motion over the first two years of 18 ASR cups was a lateral movement of -0.115 (0.60) mm (p = 0.82), proximal migration of 0.075 (0.14)mm (p = 0.01), and anterior movement of 0.438 (0.88)mm (p = 0.04). 16 ReCap cups migrated 0.307 (0.53)mm (p = 0.01) medially, 0.282 (0.36)mm ($p < 0.001$) proximally and 0.343 (0.63)mm p = (0.03) posteriorly. On the z axis, both cups moved in opposite directions at 2 years ($p < 0.01$). No difference between the cups was found at 2 years for the X and Y axis. Fig. 2.

The proximal migration for the ReCap cup places it in an "at risk" group, whereas RSA failed to identify ASR cup as a problematic implant. We conclude that early migration is not the mode of failure for the ASR implant.

Stem.

The mean (sd) micro motion over the first two years of nineteen femoral Articular Surface Replacement (ASR) components was a lateral movement of 0.107 (0.513) mm, distal migration of 0.055 (0.204) mm, and anterior movement of 0.150 (0.413) mm. The backward tilt around the x axis was -0.08°(1.088), there was 0.165°(0.924) internal rotation and 0.238° (0.420) varus tilt. The baseline to 2 year varus tilt was statistically significant from zero movement, but on a group level no significant movement was present from 1 year onwards.
Conclusion.
We conclude that the ASR femoral implant achieves initial stability, and that early migration is not the mode of failure for the ASR implant.

Brief CV

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IN SILICO MULTISCALE SIMULATIONS OF BONE REMODELLING IN HEALTH, DISEASE AND TREATMENT

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Today, the exact spatial relationship between the micromechanical environment and consequent bone adaptation in health, disease and treatment is not well understood. A quantitative understanding of how the mechanical environment regulates bone remodeling could lead to an improved understanding of bone formation and bone quality maintenance as well as an ability to predict micro-architectural changes in bone geometry. Here a combined multiscale experimental and computational model is presented which is able to quantify, for the first time, the relationship between local events of trabecular bone remodeling and the local micromechanical environment. The in silico model includes a newly developed strain-adaptive feedback algorithm for the simulation of trabecular bone remodeling in response to loading and pharmaceutical treatment, which has recently been validated against in vivo reference data of bone adaptation using time-lapsed micro-computed tomography. For this purpose, the effects of anabolic, antiresorptive treatment, and mechanical loading on caudal vertebrae in a mouse model for postmenopausal osteoporosis were investigated. Simulations of bone remodeling and adaptation in 180 osteopenic mice were performed, and included a permutation of the conditions for loading of 8N or 0N, and treatments with bisphosphonates, or parathyroid hormone. Static and dynamic morphometry and local remodeling sites from in vivo and in silico studies were compared. For each study, an individual set of four model parameters was selected. Trabecular bone volume fraction was chosen as an indicator of the accuracy of the simulations. Overall errors for this parameter were 0.1—4.5%. Other morphometric indices were simulated with errors of less than 19%. Dynamic morphometry was more difficult to predict, which resulted in significant differences from the experimental data although overall patterns of local adaptation were well represented. In conclusion, a new algorithm for multiscale simulation of bone remodeling in health, disease and treatment was rigorously validated against in vivo data using time-lapsed micro-computed tomography. The results indicate that the simulations accurately reflect effects of treatment and loading seen in respective in vivo data. In the future this might help to better understand bone mechanobiology in humans using the model to stratify patient populations for risk of osteoporotic fractures in large clinical trials or even as a predictive tool to plan treatment in individual patients.

BIOMECHANICAL MODELING AND APPLICATION OF MUSCULOSKELETAL SYSTEM

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The numerical simulation has been a critical methodology in the biomechanical researches. This paper aims to present the finite element (FE) studies in the areas of orthopedics, stomatology, and injury prevention.
(1) Structure of woodpecker's head could protect brain from high impact. The drumming process was simulated with a FE model of woodpecker head. The results revealed special functions of beak and hyoid, and provided novel insight into protective design for human. (2) A FE model of human knee joint was validated and utilized to evaluate the post-operative mechanical environment after anterior cruciate ligament reconstruction. Local stress redistribution predisposing to surgical sequelae was quantified. Optimal surgical procedure was proposed. (3) Injury process of human eyeball was also investigated with an eyeball FE model. The simulation quantified intraocular stress wave during impact injury, and proposed the mechanism of amotio retinae. (4) A precise FE model of cervical spine was developed. The model has been used at areas of cervical spinal fusion and artificial intervertebral discs. The study provided mechanical knowledge of cervical spondylosis and could help improve the surgical techniques. (5) Bone remodeling phenomena in osteoporosis and post-operative rehabilitation were also researched with FE methodology. Particularly in oral implant, post-operative outcomes were predicted under a variety of implant and loading conditions.
The present FE studies provided insight from mechanical viewpoint into orthopedics, stomatology, and injury prevention, and could help advance theories and technologies in these areas.

Brief CV

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ACOUSTIC IMAGING FOR BONE DIAGNOSIS USING A HAND-HELD FOCAL QUANTITATIVE ULTRASOUND

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Introduction: In order to provide a non-ionizing, repeatable method of skeletal imaging, a novel hand-held scanning confocal quantitative ultrasound (QUS) device has been developed. A mobile scanning technology that can provide advanced risk and injury identification in high-risk areas where