

# THE EFFECT OF USING MODULAR NECKS WITH AN UNCEMENTED HIP STEM ON PRIMARY STABILITY

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## INTRODUCTION

Total Hip arthroplasty (THA) carried out using modular implants affords the surgeon greater intra-operative flexibility [1] and permits more controlled stem positioning.

Long term survivorship of a hip stem can be predicted in terms of primary and secondary stability; a lack of primary stability is associated with early loosening [2].

The aim of this study was to compare a modular neck design to a proven uncemented stem design using finite element analysis and to look at the primary and secondary stability of each.

## METHODS

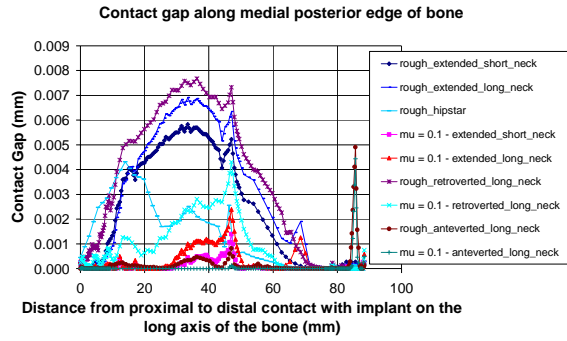
An uncemented modular-neck THA (Profemur-Z, Wright Medical, USA) and a Zweymuller type device (Hipstar, Stryker, Europe) were separately modelled implanted in the same femoral geometry, an intact femur using the Muscle Standardised Femur (MuscleSF) [3]. Effects of a short extended (41mm), long extended (50mm), long retroverted and a long anteverted modular neck were examined. The interface surfaces between the implant and bone were represented with contact models. Bonded (no sliding or separation), and rough (separation permitted but no sliding) contact were used to investigate the secondary stability of the stems, and a Coulomb

frictional contact model ( $\mu$  ranged from 0.1 to 0.5) was used to investigate the primary stability of the stems. A physiological loading condition simulating an instant at 10% gait of the gait cycle was applied to all models and solved using ANSYS. Boundary conditions at the distal femur simulated the physiological constraint from the tibial condyles and the patella. Linear elastic, isotropic material properties were assigned to the model materials.

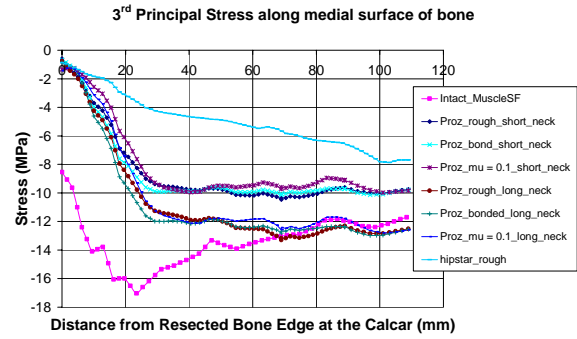
Principal stresses on the outer, medial surface of the cortical bone were compared between the Intact, Profemur-Z and Hipstar.

## RESULTS AND DISCUSSION

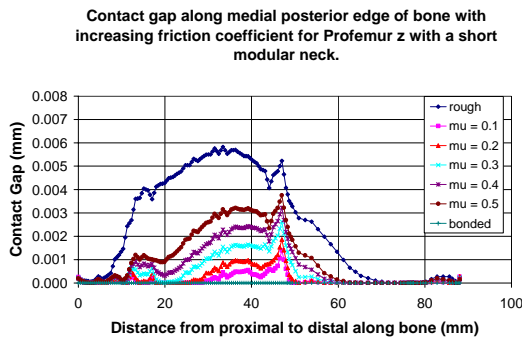
A contact gap of between 0 and 8 $\mu$ m was observed on the medial contact interface for each configuration (Figure 1). The contact gap between implant and bone changed significantly with the coefficient of friction (Figure 2). The surface roughness of an implant can promote bony in-growth, but may also result in a larger separation between the bone and implant. Surface roughness of the stem was more dominant than neck length when considering the interface surface gap. Furthermore, the longer neck design was more comparable to the intact femur (Figure 3). The modular-neck device did not differ significantly from the non-modular stem in terms of primary stability.



**Figure 1:** Contact gap on medial contact interface.



**Figure 3:** Variation of principal stress on the medial cortical bone surface.



**Figure 2:** Contact gap as a function of Friction coefficient

## REFERENCES

1. McCarthy, et al. *Clin. Orthopaedics*. **344**, 162-171, 1997.
2. Viceconti, et al. *J Biomech* **39**, 1169-1179, 2006.
3. Viceconti, et al. *J Biomech* **36**, 145-146, 2003.