



THE INFLUENCE OF MODULARITY ON THE ENDURANCE PERFORMANCE OF THE PORTLAND ORTHOPAEDICS™ MODULAR HIP SYSTEM

Orthopaedic Research Laboratories
Lutheran Hospital
Cleveland Clinic Health System
Cleveland, Ohio

Paul D. Postak, B.Sc.
A. Seth Greenwald, D.Phil.(Oxon)

INTRODUCTION

Modularity in total hip arthroplasty design is an evolving concept that is receiving increased citation in the clinical literature. The advantages of these systems include off-the-shelf flexibility for customizing proximal and distal canal filling, as well as, accommodating difficult situations of femoral deformity and bone loss.

Clinical concerns in the application of modular hip designs include the maintenance of anatomical stability within the femoral canal, structural compromise at metal-metal interconnections due to cyclic microdisplacement (fretting), decoupling of modular components *in vivo* and increased potential for metallic wear debris generation.

This summary describes the fatigue characteristics of the Portland Orthopaedics™ Modular Hip System as influenced by its modularity.

METHODS AND MATERIALS

Nine stems were evaluated according to ISO 7206-4, with a minor modification in the potting level to better determine the influence of component fretting on the structural integrity of the assembled modular stem (Figure 1). The Portland Orthopaedics™ Modular Hip System incorporates a CoCr, hydroxyapatite coated, double threaded, cone shaped stem with modular necks of varying sizes. The dimensions of the components tested were: proximal stem diameter - 17 mm, distal stem diameter - 8 mm, stem length - 82.5 mm, neck height - 23 mm and neck offset - 31 mm. With the utilization of a 32 mm ceramic femoral head the resulting offset was 31 mm. This testing represents a worst-case loading scenario for this size configuration.



Figure 1: Test Assembly and Potting Level (-----) .

RESULTS AND DISCUSSION

The manner of assessment was to produce a structural fatigue curve (Figure 2), which required deliberate component failure of the Portland Orthopaedics™ Modular Hip System through a range of decreasing loading conditions to determine stem survivability. One of the goals of the study was to determine the structural endurance limit for a particular stem configuration. By definition, this is the applied load level below which the stem should theoretically never fail and is indicated by the horizontal line in Figure 2. The accepted survivability loading criterion is 10 million cycles and the ability to support the applied peak load. In this study, it was determined that the Portland Orthopaedics™ Modular Hip System had a structural endurance limit of 6200 N (633 kg) in this worst-case loading scenario. Therefore, it suggests system survivability for patients weighing less than 158 kg (348 lbf) based on a maximum hip joint loading criterion of 4 times body weight during walking gait.

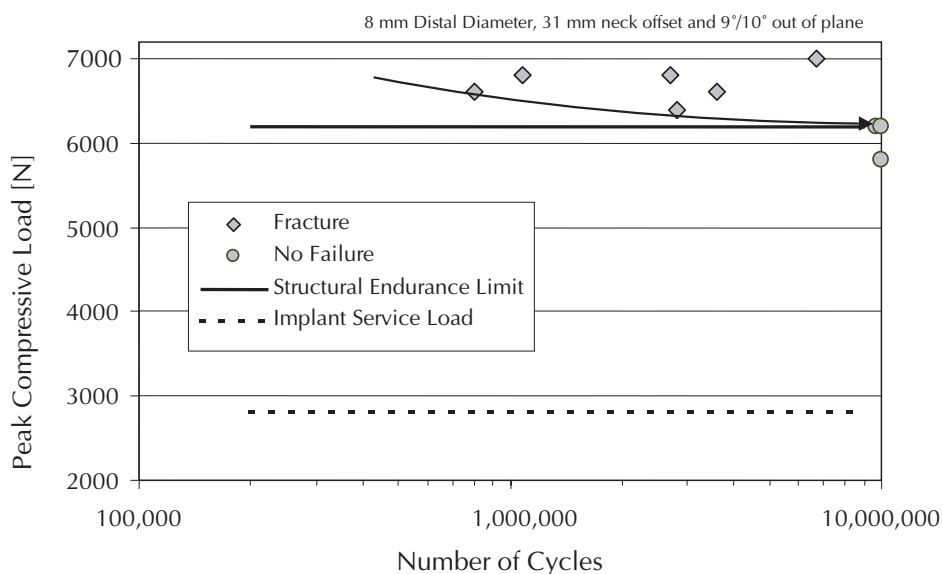


Figure 2: Structural fatigue curve for the Portland Orthopaedics™ Modular Hip System with torsion.

A further finding from this evaluation is that fretting is not a pre-emptive cause of premature structural compromise of this Portland Orthopaedics™ Modular Hip System configuration. It is also noted that the fatigue strength of this system compares favorably with other modular systems this laboratory has evaluated in both distal and proximal fixation conditions.

CONCLUSION

In summary, the structural characteristics of the Portland Orthopaedics™ Modular Hip System are such that it offers the prospect of *in vivo* longevity.