

# **Biomechanical Evaluation of Calcar Collar on Periprosthetic Femoral Fracture in Cementless Total Hip Arthroplasty**

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## **INTRODUCTION:**

Medial calcar collars have been shown to improve stability and fracture resistance in press-fit stems, decreasing rates of periprosthetic femur fractures (PFF) in clinical investigations. However, reasoning for this finding has only been hypothesized and never formally investigated through mechanical testing. The goal of this study was to evaluate biomechanical differences between collared and non-collared femoral stem implants, which may contribute to the decreased incidence of PFF.

## **METHODS:**

Preliminary testing was conducted using femur models with implanted collared and collarless femoral stems. Individual strain gauges were attached in groups of 3 to the anterior, posterior, medial, and lateral aspects of the proximal metaphysis and diaphysis of the femur for a total of 12 gauges. Specimens were stabilized distally in an aluminum potting cup while maintaining a femoral mechanical-anatomical angle of 6°. Static vertical loads were incrementally applied to the proximal end with the specimen oriented in 10° extension, 0°, and 30° flexion. The strain gauge data, forces and moments were recorded using superior and inferior multi-axis load cells throughout the loading process.

## **RESULTS:**

Our data demonstrated that collared stems consistently decreased strain on the model femur throughout the gait cycle conditions. For all 3 conditions, 10° extension, 0°, 30° flexion, the collarless stem consistently experienced higher axial, 1<sup>st</sup> principal and 2<sup>nd</sup> principal strain.

**DISCUSSION AND CONCLUSION:** Our findings contribute to the growing understanding of the biomechanical reasoning for decreased PFFs in collared press-fit stems. Specifically, this study suggests that a calcar collar may decrease strain on the femur throughout the gait cycle, thus increasing the load required to reach critical strain resulting in fracture.