Three-Dimensional Metaphyseal Fit Analysis of Anatomic Stems

Justin Gerges¹, Jim Nevelos¹, Anthony Hedley², Kirby Hitt³, Victor Krebs⁴

¹Stryker Orthopaedics, Mahwah, NJ, USA; ²Arizona Institute for Bone and Joint Disorders, Phoenix, AZ, USA; ³Scott and White Memorial Hospital, Temple, TX, USA; ⁴Cleveland Clinic Foundation, Cleveland, OH, USA

Introduction
Anatomic stems have been used for over 30 years with clinical success as seen with the PCA and Citation families¹ as well as the ABG and ABG II monolithic families², Fig 1. The anatomic stem philosophy is intended to transfer loads more circumferentially through implant geometries which may better match the metaphyseal bone. The goals of this study are:

1. Analyze three dimensional contact patterns of two different anatomic hip stem designs
2. And determine if there are commonalities between the different designs

Methods
6 femurs were selected at random from a group of femurs about ± 1.5 times SD for femoral anteversion (FA) using SOMA³ database (n=1023, FA range: 8° to 32°). The Murphy Method was used to measure FA which takes into consideration femoral morphology. Implants (ABGII & Citation stems, Stryker Orthopaedics, Mahwah, NJ) were virtually implanted using Pro/Engineer Wildfire 5, based on the preoperative plan of 3 different surgeons, Fig 2. Assemblies of bones and implants were imported into Geomagic Qualify 2012 for 3D deviation analyses.⁴ The coated regions of the implant were analyzed noting the distance to the cortical/cancellous boundary as a color output.

Figure 1: Illustration of Citation and ABG II stems. The timeline shows the evolution of anatomic stems over the past few decades

Figure 2: Placement of implants in 3D bone models
Results

Bone morphology had the largest impact on fit pattern, Fig 3.

The same pattern was seen across different implant families, Fig 4.

Discussion

Proper load transfer is essential for positive bone remodeling for short/long term fixation.

As anatomic stems load femurs circumferentially, it is important to note that common features transfer load to bone potentially contributing to their success.

Previously, technology has not permitted circumferential analysis of implant fit on a wide scale, reproducible basis.

References