INTRODUCTION:

It has been suggested that anterior bowing of the femur has an unexpected effect on implant sizing. The placement of an intramedullary (IM) nail in the femur is affected by the bow of the femur. The orientation of the femoral component in a total knee arthroplasty is based on the IM canal of the femur. Traditional instrumentation relies on a rigid IM rod inserted into the IM canal. This rod does not take into account the bowing of the femur. The position of this rod will determine the distal femoral resection and will ultimately affect the size and orientation of the femoral component. It stands to reason that the bow of the femur may influence the orientation of the distal femoral resection. Tang et al. has shown that anterior bow of the femur is more prevalent in the Asian population. The purpose of this study was to determine the incidence of increased femoral bow in Asian population and determine if the flexible rod is more sensitive to the anterior bow of the femur versus the conventional rod.

METHODS:

A database containing over 600 femoral bone models derived from lower extremity computed tomography images, which have been compiled from patients with circulatory concerns has been utilized for this study. Customized software has been developed which accesses a template bone onto which the user can create reference structures and define measurements. These measurements are then automatically processed in a consistent manner across all bones selected for evaluation in the database. The reference structure for center point selection was defined by the anatomic plane, which was perpendicular to the coronal plane and passes through the IM axis. The center points of the cortical bone were then defined at three-tenths and seven-tenths of the distance from the proximal to distal tip of the bone along the anatomic plane. The top of the femoral intercondylar notch was selected and a point 5 mm anterior was created. A circle was then constructed in the anatomic plane using the three points. The femoral bow was calculated for all the bones in the database. These calculations were used to judge the overall bow sizes for the different populations. The data was then subdivided into patients of Asian descent and further organized into bones with an overall bow. The method to establish bow used in this work follows the principle of an overall radius of the femur. Distal third bow and proximal third bow are not properly captured in this analysis. Further refinements to these methods are needed for further characterization. For this study, only bones with an overall bow were selected for further analysis. The results of this protocol were then sorted and two extreme and an average case were selected to conduct a virtual surgery in Pro/ENGINEER (Parametric Technology Corporation, Waltham, MA).

RESULTS

The femoral bow was calculated for 518 bones. An average of 97 cm (±27 cm) was computed. A smaller circle radius implies a more significant the bow of the femur. The breakdown of femoral bow to ethnicity is listed in Table 1. The subgroup of Asian bones contained 93 femurs and the further subset of bones with an overall bow consisted of 54 femurs with an average bow of 98 cm (±20 cm). Three femurs were chosen from the subset with bows of 123 cm, 100 cm and 78 cm respectively. The femur with the greatest bow showed a difference between the rigid and flexible rod of 7.5 degrees. The femur that exhibited the average bow for the subgroup measured a 4.5 degree difference. The difference in placement between the rigid and flexible rod in the femur with the least significant bow was not significantly different as either rod could take on a similar orientation.

DISCUSSION:

The results of this study show that higher bowed femurs yielded a larger angular deviation between rigid and flexible rods for bones with an overall bow. The method to establish bow used in this work follows the principle of an overall radius of the femur. Distal third bow and proximal third bow are not properly captured in this analysis. Further refinements to these methods are needed for further characterization. Conventionally, rigid IM rods have been used to define the valgus angle. The rigid rod, by default, has reduced the sagittal orientation to an arbitrary plane. The flexible IM rod serves the same purpose of defining the distal valgus orientation but now allows a femoral component orientation in the sagittal plane closer to the anterior bow of the femur.

REFERENCES:

5. Stryker surgical Protocol, Triathlon MIS. On file