INTRODUCTION: The current Total Knee Arthroplasty techniques utilize accurate measured resection of bone to be replaced by the implant resurfacing. There are many implant designs to choose from and proper matching of patient to implant is critical. The anthropometric difference between genders makes this implant matching a challenge. If the implant choice is a wide design, metal overhang may occur in some patients and this can cause soft-tissue impingement. The senior author encountered such challenges in many cases. Most of the more difficult to fit cases were female and thus this study was performed to evaluate the anthropometric knee dimensions utilizing Magnetic Resonance Imaging (MRI).

METHODS: 100 patient knee MRI’s were randomly selected for this study. The specific clinical reason for the MRI was unknown to the authors. Virtual knee “cuts” were made on the MRI images to mimic knee replacement bone resections. The coronal image demonstrating the widest distal femur was selected. A virtual cut 9mm proximally from the distal medial condyle and 7mm from the distal lateral condyle was made. The medial-lateral (ML) width from cortex to cortex was measured on the line that transected the two proximal points. The axial image demonstrating maximal posterior condyle projection was chosen. The distance between the posterior lateral condyle and the highest point on the lateral patellar facet was measured. A virtual resection of 9mm was taken off of the anterior and posterior surfaces, leaving the remaining antero-posterior (AP) dimension. All measurements were independently measured by three investigators. This data was then analyzed and compared to the anterior-posterior and medial-lateral specifications of the femoral components from two of the knee implant designs. The MRI measurement was utilized to predict implant size in fifteen patients who went on to have total knee arthroplasty.

RESULTS: The median AP dimension for men was 5.10cm and for women 4.2cm (p<.001)(Fig. 1). The median ML dimension for men was 7.9cm and for women 6.9cm (p<.001) (Fig 2). The ML and AP plot (Fig 3) demonstrated the distinct gender groups and confirmed the above significance. The two implant plot lines were shifted above the two gender groups (implants too wide). This reveals that the implants could be fitted to the AP or ML dimensions but rarely both. The fifteen patients that went on to receive total knee arthroplasty had implant sizes accurately predicted in only 40% of cases.

DISCUSSION: The use of CT to measure knee sizing has been validated previously1. We found the reference points easy to pick and the interobserver variability low (<2mm). The virtual cuts were made to represent the common resections made. However, every implant design will vary this somewhat. In males by matching the implant size to the AP dimension an implant with a ML dimension was chosen that is small, thus leaving the distal femur uncovered. For females the opposite was true. Matching the AP provided an implant with metal overhang in the ML dimension. Matching the ML provided an implant that notched the anterior femur because it was too small. This forced the surgeon to compromise either the AP or ML coverage and/or use surgical maneuvers such as flexing the femoral component in order to fit the chosen prosthesis. The implant size prediction of only 40% was disappointing. The implants chosen were often one size smaller than the one predicted, but rarely larger. This points to the need for gender based implant designs once again2.

CONCLUSION: There is a significant anthropometric knee size difference between men and women. Women require narrower implants than men for the same antero-posterior dimension.

REFERENCES:

Figure 1: MRI anterior-posterior knee dimensions.

Figure 2: MRI medial-lateral knee dimensions.

Figure 3: Algorhythm for comparison of A-P and M-L implant dimensions.