**ELECTROMAGNETIC VS INFRARED SURGICAL NAVIGATION SYSTEMS FOR TKA: A COMPARISON OF ACCURACY**

*Stevens, F; +**Conditt, M A; **Kulkarni, N; **Ismaily, S K; *Noble, P C; +**Lionberger, D R

*Baylor College of Medicine, Houston, TX. +**The Institute of Orthopedic Research and Education, Houston, TX.

mconditt@bcm.edu

**INTRODUCTION**

Computer navigated TKA and THA are becoming increasingly popular because of the increased accuracy of alignment of the implanted components and elimination of outliers (1, 2). Traditional navigation systems utilize infra-red tracking devices which are relatively bulky, and require direct visualization of markers attached to instruments and implants during the operative procedure. This necessitates relatively large incisions and extends the durations of operative procedures. To overcome these drawbacks, navigation systems utilizing electromagnetic (EM) technology have been proposed for use in TKR. Although these EM systems offer the potential benefits of minimal invasiveness and ease of use, concerns have been raised concerning but have not yet been tested for accuracy. This study compares the accuracy of standard IR systems and EM systems to a known standard.

**METHODS**

A surrogate knee was prepared with precisely known measurements for: varus/valgus (actual value: 0.1deg), flexion/extension (0.0deg), lateral resection (-3.9mm) and medial resection (-3.9mm). Six total knee arthroplasties were performed on the surrogate knee using an infra-red surgical navigation system (Medtronic). IR systems consist of an infra-red camera which emits infra-red light, this light gets reflected off of spheres from trackers, (Figure 1) enabling the computer to track the position of the instrument and surrogate knee. Six additional surgeries were performed on the same surrogate knee using an EM system (Medtronic StealthStation Treon Plus and AxiEM) which consist of a magnetic field generator, mini-reference trackers and a computer system with tracking software (Figure 2). As the instrument is introduced into the magnetic field a disturbance is induced which enabled tracking. In both cases trackers are attached to femur and tibia. During the distal femoral resection, control measurements were taken for varus/valgus, flexion/extension, medial and lateral resection. All measurements were then compared to absolute values obtained from CMM measurements of the surrogate knee. An F-test was used to determine test if the standard deviations of the measurements from the two systems were equal.

**RESULTS**

The average of the RMS errors for the traditional IR system was 0.6±0.3deg compared to 0.7±0.2deg for the EM system. The maximum RMS errors for both systems were the internal/external rotation of the posterior femoral cut. The true internal/external rotation of the femoral cut was 0.1deg, while the averages of all the internal/external rotation measurements were 1.0±0.3deg for the EM system and -0.4±0.6deg for the IR system (p=0.001). However, the EM system produced lower errors when measuring the orientation of the cutting blocks in the flexion/extension plane (p<0.001) and varus/valgus plane (p<0.02). The standard deviations of all the measurements with the IR system were larger than the standard deviations of the all measurements with the EM system (p<0.04). The standard deviation of all the measurements from the IR system averaged 2 times greater than the standard deviations from the EM system.

**DISCUSSION**

This study compares the accuracy of infrared imageless surgical navigation systems and electromagnetic systems to a known standard. Measurements from both the infrared and electromagnetic surgical navigation systems were accurate within a degree of the true values. While the IR system measured internal/external rotation more precisely, the EM system proved significantly more precise than the IR system in measuring flexion/extension and varus/valgus. The many benefits of computer assisted total knee arthroplasty using electromagnetic technology compared to traditional infrared systems may be realized without sacrificing accuracy or precision. Computer assisted TKA using EM technology is promising as an accurate alternative to infrared systems.

**REFERENCES**