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PURPOSE:

Total knee arthroplasty (TKA) has been a tremendously successful procedure for degenerative joint disease, yet concerns regarding implant malalignment remain. Numerous comparative studies have demonstrated computer-assisted surgical (CAS) techniques to improve component alignment versus conventional intramedullary (IM) and extramedullary (EM) alignment methods1. However, concerns regarding increased operative times, cost, learning curve, and additional equipment associated with CAS have limited its widespread acceptance1.

The KneeAlign2™ system (OrthAlign Inc., Aliso Viejo, CA) is an accelerometer based, hand-held surgical navigation system for performing the proximal tibial and distal femoral resections in TKA (Fig. 1). It does not require the use of a large computer console as with most CAS systems, and relies on accelerometer-based navigation, versus CT-guided, image based, or imageless navigation technologies. The objectives of our study were to determine the accuracy of the KneeAlign2™ system in obtaining a coronal tibial component and femoral component alignment perpendicular to the mechanical axis, a tibial component posterior slope of 3°, and an overall mechanical axis alignment within 3° of neutral to the mechanical axis. This is the first report of the use of accelerometer-based navigation to perform both the distal femoral and proximal tibial resections in TKA.

MATERIALS & METHODS:

From May to June 2011, 15 consecutive patients and a total of 20 knees (13 left, 7 right) were included in this study. The patients had a mean age of 63.0 ± 9.3 years, and a mean BMI of 31.9 ± 7.9 kg/m². Each patient received a TKA utilizing the KneeAlign2™ system to perform both the proximal tibial and distal femoral resections. The KneeAlign2™ system is a hand-held surgical navigation system, 2 × 4 × 2 inches in size. To perform the proximal tibial resection, the display console is attached to an EM tibial jig similar to conventional, EM alignment systems. The KneeAlign™ tibial jig is used to register the medial and lateral malleoli to establish the tibial mechanical axis, and once anatomic landmarking is complete, the display console provides real-time feedback to both the cutting block of varus/valgus alignment and posterior slope.

To perform the femoral resection, the KneeAlign™ femoral jig is secured to the distal femoral condyles, at the approximate midpoint of the most distal point of the sulcus of the trochlea. The KneeAlign™ display console and reference sensor are attached to the jig, and the display console registers the cutting block’s initial position. The hip center of rotation is next registered by maneuvering the femur in a circular motion. The cutting block is set to the desired varus/valgus and flexion/extension angles, as the display console provides real-time feedback of its orientation relative to the hip center of rotation. Once in the desired alignment, the cutting block is secured to the anterior femur with two headless pins, after which the distal femoral resection is performed.

At 6 weeks postoperatively, standing AP hip-to-ankle radiographs and standing lateral knee-to-ankle radiographs were obtained for each TKA, from which the tibial component varus/valgus alignment, the tibial component posterior slope, the femoral component varus/valgus alignment, and the overall lower extremity alignment were measured (Figure 2). For standardization, all measurements with negative values correspond with valgus alignment, and positive values correspond with varus alignment.

RESULTS:

The mean preoperative mechanical alignment was 7.0° ± 3.3° for varus knees, and -8.0° ± 5.3° for valgus knees. Postoperatively, the mean tibial component varus/valgus alignment was -0.2° ± 1.0°, with 100% of the components within 2° of perpendicular to the tibial mechanical axis. The mean tibial posterior slope was 3.4° ± 1.2°, with 95% of the components within 3° ± 2°. The mean femoral component varus/valgus alignment was -0.5° ± 2.0°, with 95% of the components within 2° of perpendicular to the femoral mechanical axis. The mean overall mechanical alignment of the lower extremity was -0.5° ± 2.0°, with 95% of the TKAs within 3° of neutral to the mechanical axis.

DISCUSSION:

The KneeAlign2™ system provides intraoperative, real-time feedback to the surgeon without having to consult a monitor outside of the operative field, as with most large console CAS systems. In addition, it is compatible with all TKA systems, making it more user-friendly for surgeons acclimated to the use of tibial extramedullary alignment guides and femoral intramedullary alignment guides, while avoiding the costs of capital equipment purchases associated with CAS systems. While future studies with randomization and larger sample sizes are required, this study demonstrates accelerometer based navigation to be a promising alternative to large console CAS systems, as it improves the accuracy of both femoral and tibial component alignment compared to conventional alignment guides.

SIGNIFICANCE:

The accuracy of accelerometer based navigation for tibial and femoral component alignment in total knee arthroplasty (TKA) has not been studied. Portable accelerometer-based, hand-held navigation systems improve postoperative mechanical alignment and represent a promising alternative to large console CAS systems in TKA.

REFERENCES: