Robotic arm-assisted Bi-Unicompartmental Knee Arthroplasty maintains natural knee joint line orientation compared to Total Knee Arthroplasty: A prospective, randomised controlled trial.

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Key words. 3-7 knee, arthroplasty, bi-unicompartmental, robotic, alignment, mechanical, kinematic

Background

Unicompartmental knee arthroplasty (UKA) is associated with faster postoperative recovery than total knee arthroplasty (TKA), sparing cruciate ligaments and normal joint surfaces. Although registry data indicate that revision rates are higher following UKA than TKA, robotic arm-assistance can improve accuracy of implant positioning and restoration of normal kinematics, when compared to manual implantation. Bi-unicompartmental knee arthroplasty (Bi-UCKA) with manual implantation has been demonstrated to maintain native joint obliquity better than TKA, but not as well as UKAs. There has been no RCT to date examining whether the benefits of UKA hold true for robotic-assisted Bi-UCKA compared to TKA.

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Objective

To measure coronal alignment change following surgery for osteoarthritis of the knee, comparing Bi-UCKA against TKA.

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Design and Methods

This was a prospective, randomised controlled trial undertaken at a single centre. 42 control patients received a fixed-bearing, posterior-stabilised TKA (NexGen LPS-Flex Fixed, Zimmer-Biomet, Warsaw, IN, USA), implanted without the aid of robotics or navigation, as per standard protocol at our institution. The aim of lower limb alignment in this group was an overall neutral mechanical axis. 34 patients randomised to Bi-UCKA simultaneously received fixed-bearing medial and lateral UKAs, implanted using robotic arm-assistance (MAKO Restoris MCK, Stryker, Kalamazoo, MI, USA). The aim for the Bi-UCKA group was to reconstruct each patient's constitutional joint alignment and re-tension the collateral ligament on the more affected side of the joint. Preoperative and 3 month postoperative CT scans were analysed to ascertain hip knee ankle angle (HKAA), medial distal femoral angle (MDFA), and medial proximal tibial angle (MPTA). Anatomical points marked on CT scans were analysed to calculate angles in 3-Matic design software (Mimics Materialise, Leuven, Belgium). 70 patients were included in the analysis (39 TKA; 31 Bi-UCKA). 5 patients were excluded due to inadequate CT scans (3 TKA and 2 Bi-UCKA) and 1(Bi-UCKA) dropped out post-surgery. Analysis was repeated for 10 patients by a second rater to validate CT measurement reliability by calculating the intra-class correlation coefficient (ICC).

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Results

Mean correction in HKAA towards neutral was 2.2° in TKA patients and 1.8° in Bi-UKA patients. This was not significantly different (p=0.6). Mean change in MDFA was 2.3° in the TKA group and 0.2° in the Bi-UCKA group, which was significantly different (*P* = 0.004). Mean change in MPTA was -3.3° in the TKA group and -0.6° in the Bi-UKA group, which was also significantly different (*P* = 0.0003). Mean postoperative MDFA and MPTA for TKAs were 89.8° (range, 86.0°-93.9°) and 89.7° (range, 85.7°-92.7°) respectively, indicating orientation of femoral and tibial components perpendicular to the mechanical axis. Mean postoperative MDFA and MPTA for the Bi-UCKAs was 90.9° (range, 85.1°-93.7°) and 87.2° (range, 81.3°-91.9°) respectively, indicating a more oblique joint line orientation.
Inter-rater agreement was excellent (ICC >0.99).
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Conclusions

Robotic arm-assisted, cruciate-sparing Bi-UCKA better maintains the natural anatomy of the knee in the coronal plane and may therefore preserve normal joint kinematics, compared to a mechanically aligned TKA. This has been achieved without significantly altering overall HKAA by creating of a more oblique joint line. These findings contrast with previous studies on manually-implanted Bi-UCKA, which reported that Bi-UCKAs correct HKAA significantly less than TKAs.

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