Comparison of flexion stability and clinical outcomes between robotic and navigation systems in total knee arthroplasty

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Introduction: Total knee arthroplasty (TKA) is an established, standard treatment for end stage knee osteoarthritis. Accurate limb alignment restoration and proper stability have been cited as the two most important factors for a successful TKA, as mal-positioning of femoral or tibial components or gap imbalance can lead to knee instability, patellofemoral complications, chronic pain, and early revision. During conventional TKA, even when intramedullary alignment systems are used, surgeons find it difficult to place knee implants within 2 to 3° of valgus or varus alignment. Furthermore, sagittal and rotational alignments of components are even less reliably achieved in TKA, and these types of mal-alignments can lead to knee instability and dysfunction. Hence, computer assisted surgery (CAS) was introduced to improve implant positioning during TKA, and a continuous stream of technologic improvements, such as, navigation and robotic TKA, have increased the popularity of CAS. Although robotic surgery has definite disadvantages, such as, increased operative time, higher overall costs, and longer skin incisions, its advantages, in terms of, enabling accurate CT–based preoperative planning and precise execution, help surgeons restore mechanical axes and position components more accurately. A meta-analysis of navigation versus conventional TKA demonstrated that navigation provides significant improvements in prosthesis alignment. Similar conclusions were drawn from studies comparing robotic and conventional TKA. However, few studies have evaluated flexion stabilities after computer assisted TKA. Therefore, we undertook this study to compare not only the flexion stabilities, but also the clinical outcomes, and complications in cases of TKA using either the robotic technique or navigation-assisted technique.

Materials and Methods: One hundred-nine patients (robot group (ROB-TKA, 53 knees) and navigation group (NA-TKA, 56 knees) that underwent primary cruciate retaining TKA using a robot or navigation system for degenerative knee osteoarthritis were assessed for varus and valgus laxity at 90° of knee flexion after a minimum three-year follow-up. Robotic TKA was carried out in two steps, first a CT-based preoperative planning was done using ORTHODOC system and then the actual robot-assisted surgery using the ROBODOC® Surgical Assistant was executed. On the other hand, navigation assisted TKAs were performed using the Orthopilot® (version 4.08, Aesculap; Tuttinglen, Germany) navigation system. All prostheses, (NexGen fixed-bearing CR (cruciate retaining) knee (Zimmer, Warsaw, USA) in robotic and e-motion mobile-bearing CR knee (Aesculap; Tuttinglen, Germany)) in the navigation group, were fixed with cement and patellar tracking was tested using the towel clip method after final prosthesis implantation. All patients were evaluated preoperatively and at follow up. These evaluations included KS knee and function scores, Western Ontario and McMaster University (WOMAC) scores, and ranges of motion. To evaluate flexion stability, varus and valgus laxities at 90° of knee flexion were measured using stress (150 N force) radiographs, as previously described. Varus and valgus laxities were defined with respect to the opening angles on stress radiographs.

Results: KS knee and function scores and WOMAC scores were significantly improved at last follow-up. However, no significant difference was found between the ROB-TKA and NA-TKA groups for any clinical outcome parameter till the last follow-up. And, no significant intergroup differences were found in
mechanical axis or coronal alignments of femoral or tibial prostheses between two groups. The mean varus laxities in the ROB-TKA and NA-TKA groups were 5.6±3.1° and 5.3±2.8°, respectively, and mean valgus laxities were 5.1±2.6° and 5.4±2.2°, respectively, with no significant intergroup difference. Furthermore, no significant difference was found for varus-valgus imbalance at 90° of knee flexion (0.4° in the ROB-TKA group and 0.5° in the NA-TKA group). Complications differed in the two groups, whereas 1 case of MCL avulsion and two cases of patellar mal-tracking occurred in the ROB-TKA group, 3 cases of patellar mal-tracking and 1 case of hyperextension greater than 5 degrees occurred in the NA-TKA group. However, none of the cases were severe enough to warrant a revision.

**Conclusion:** Both robotic and navigation assisted TKAs were found to restore good coronal leg and prosthesis alignments and good flexion stabilities. However, clinical knee scores and flexion stabilities were no better in short term for robot assisted TKA than for navigation assisted TKA.