The benefit of computer assisted total knee arthroplasty in patients for whom it would be difficult to use the conventional technique

BAE DK, SONG SJ, HEO DB, NAM DC

Department of Orthopaedic Surgery, College of Medicine, Kyung Hee University, Seoul, Korea

songsangjun1@gmail.com

Introduction: Conventional technique is usually used to indirectly recreate the mechanical axis relative to the anatomical axis with alignment guide in total knee arthroplasty (TKA).[1] However, it might be difficult or inaccurate to use the conventional technique in patients with extraarticular deformity or internal devices. For example, there are excessive diaphyseal bowing, fracture malunion, hip arthoplasty state, retained fixatives for fracture stabilization, and so on.[2, 3, 4] Computer assisted total knee arthroplasty (CAS-TKA) can be effective method to restore the mechanical axis in these situations.[4] The purpose of present study was to evaluate the results of CAS-TKA in patients for whom it would be difficult to use the conventional technique. The hypothesis was that CAS-TKA would have satisfactory clinical results without complications specific to the navigation system and it could have some benefit for these patients.

Patients & Methods: One hundred fifty consecutive CAS-TKAs were performed in 132 patients. Among them, 34 CAS-TKAs were performed because it would be difficult to use the conventional technique for patients whose femoral or tibial diaphysis are extraarticularly deformed or implanted with internal devices. These patients were reviewed retrospectively. Indications for CAS-TKA included extraarticular deformity due to excessive disphyseal bowing (19 knees), fracture malunion (7 knees), multiple epiphyseal dysplasia (2 knees), and infection sequelae (1knee). Other indication included retained internal devices in cases of previous hip arthoplasty (2 knees), high tibial osteotomy (2 knees), and fracture stabilization with fixatives (1knee). All TKAs were performed using the Vector Vision® 1.1 (BrainLAB, Heimstetten, Germany) navigation system. The average age at the time of TKA was 65.5 years (range, 35–79 years). The average follow-up period was 3.0 years (1-7.1 years).

The Knee Society knee and function scores were used to evaluate pain and function, including range of motion (ROM), preoperatively and at the last follow-up examination.

The pre- and postoperative mechanical axes (MA) were defined as the angle between the femoral and tibial mechanical axes. Detailed analyses of the radiographs were conducted to determine the femorotibial, femoral (α), tibial (β), femoral flexion (γ), and posterior tibial slope (δ) angles, using the Knee Society radiographic evaluation method. We further assessed the postoperative complication or additional surgery which had been required.

Results: The average preoperative knee score was 48.3 ± 6.1 and increased significantly to 89.9 ± 4.3 at the last follow-up examination ($p < 0.001$). The average preoperative function score was 52.6 ± 6.1 and increased significantly to 92.2 ± 4.4 at the last follow-up examination ($p < 0.001$). The average ROM increased from 104.3 ± 29.3° preoperatively to 119.4 ± 15.9° at the last follow-up examination ($p = < 0.001$).

The MA was 17.9 ± 12.7° varus preoperatively and 1.5 ± 2.3° varus postoperatively ($p < 0.001$). Twenty-nine of 34 knees (85.3%) had a mechanical axis within ±3° from neutral. Using the Knee Society radiographic evaluation method, the position of the component was accurate and within the permissible range (Table 1).

Periprosthetic supracondylar fracture of the femur occurred in two knees, and was treated with open reduction and internal fixation. There was no other complication such as infection, loosening, wear, osteolysis or instability. No patients required additional surgery including brisement due to limited ROM.

Discussion: The most important finding of the present study was that CAS-TKA was useful for obtaining satisfactory clinical results and accurate restoration of alignment, in patients for whom it would be difficult to use the conventional technique. Extraarticular deformity can be occurred secondary to various causes such as excessive disphyseal bowing, fracture malunion, metabolic bone disease, previous osteotomies, and infection sequelae. Accurate restoration of limb alignment with conventional TKA in patients with extraarticular deformities is difficult and may not be feasible because anatomical axis is altered and landmarks are distorted. In addition, retained internal devices may render the use of conventional technique difficult because of obliteration of the intramedullary canal. CAS-TKA was a useful alternative for knee osteoarthritis with extraarticular deformity or in the presence of internal devices. The advantage of navigation in extraarticualr deformity and retained internal devices was found to be the planning and assessment of the accurate plane for the bone resection. Use of a navigation system instead of intramedullary guide rod saves time required to remove internal devices, and reduces the rate of the periprosthetic fractures because the remaining holes can be sites for stress fracture after removal of the internal devices.

Complications occurred in two knees of the present study, which had periprosthetic fractures of the distal femur. However, the fracture lines were not related to the pins used for tracker fixation. There was no major complication even in these complex situations, and we believed that CAS-TKA is safe.

In conclusion, the clinical and radiographic results of CAS-TKA were satisfactory without major complications in patients for whom it would be difficult to use the conventional technique due to the extraarticular deformity or internal devices. It was useful and safe without help of intramedullary or extramedullary guide system to use the navigation system in these patients.

	Preoperative	**Latest follow-up**
Mechanical axis	-17.9 ± 12.7°	-1.5 ±2.3°
Femorotibial angle	-13.1 ± 12.8°	3.9 ± 4.2°
α angle		96.2 ± 4.1°
β angle		90.4 ± 2.4°
γ angle		3.6 ± 1.4°
δ angle		87.9 ± 1.5°

Table 1. Radiographic results of computer assisted total knee arthroplasty in patients with extraarticular deformity or retained internal devices.
α, β, γ, and δ angles indicate the coronal or sagittal position of the femoral or tibial component using the Knee Society X-ray evaluation method.

References

1. Bottros J, Klika AK, Lee HH, Polousky J, Barsoum WK. The use of navigation in total knee arthroplasty for patients with extra-articular deformity. *J Arthroplasty.* 2008;23:74-78.
2. Chou WY, Ko JY, Wang CJ, Wang FS, Wu RW, Wong T. Navigation-assisted total knee arthroplasty for a knee with malunion of the distal femur. *J Arthroplasty.* 2008;23:1239 e1213-1239.
3. Fehring TK, Mason JB, Moskal J, Pollock DC, Mann J, Williams VJ. When computer-assisted knee replacement is the best alternative. *Clin Orthop Relat Res.* 2006;452:132-136.
4. Huang TW, Hsu WH, Peng KT, Hsu RW. Total knee replacement in patients with significant femoral bowing in the coronal plane: a comparison of conventional and computer-assisted surgery in an Asian population. *J Bone Joint Surg Br.* 2011;93:345-350.