

Appendix

Computed Tomographic Measurements

In accordance with a standard protocol, we acquired three scans of the affected limb: the femoral head (a 50-mm scan with a 4-mm slice thickness), the knee joint (a 200-mm scan with a 1-mm slice thickness), and the center of the ankle (a 50-mm scan with a 4-mm slice thickness).

The following anatomical landmarks were determined in absolute spatial coordinates (X, Y, and Z) with ImageJ (a public domain software program of the U.S. National Institutes of Health): the center of the femoral head in the computed tomography slice with the greatest diameter (Fig. E-1, *A*); the lowest point of the sulcus between the attachment of the superficial and deep medial collateral ligaments (Fig. E-1, *B*); the highest point of the lateral epicondyle (Fig. E-1, *B*); the center of the knee joint, which was considered the geometric center of the polyethylene inlay (Fig. E-1, *D*); the medial third of the tibial tuberosity (Fig. E-1, *F*); and the center of the ankle, which was considered the geometric center of the trochlea of the talus (Fig. E-1, *G*).

The femoral mechanical axis was defined as the connecting line between the center of the femoral head and the center of the knee. The tibial mechanical axis was the line connecting the center of the ankle and the center of the knee. The spatial positions of the femoral and tibial implants were each defined by one vector, which was perpendicular to the distal femoral and the proximal tibial cut. These were produced as compensation lines (least-squares algorithm) of the geometric centers of the femoral fixation pins (Fig. E-1, *C*) and the tibial stem over the scan area (Fig. E-1, *E*).

The rotational deviation of the femoral component from the referenced axis was

determined by the angle between the line connecting the femoral fixation pins (Fig. E-1, *C*) and the surgical epicondylar axis (Fig. E-1, *B*). The tibial rotational error was defined as the angle between the angle bisecting the line of the tibial component fins (Fig. E-1, *E*) and the line between the medial third of the tibial tuberosity and the geometric center of gravity of the tibia (Fig. E-1, *F*).

Results of Three-Dimensional Computed Tomography (Table E-1)

Results of three-dimensional computed tomographic evaluations were similar in both the computer-assisted and the conventional total knee arthroplasty group with regard to the alignment of the knee and the position of the femoral and tibial components in the coronal, sagittal, and rotational planes. If one assumes a tolerance level of 3° , the prevalence of outliers was between 5% and 21% in the computer-assisted total knee arthroplasty group and between 9% and 24% in the conventional total knee arthroplasty group. These differences were not significant between the two groups ($p > 0.05$).

Compared with the femoral components, the tibial components showed a greater range of rotational deviation, with between 9.2° of internal rotation and 10.4° of external rotation and a mean deviation of $2.7^\circ \pm 3.1^\circ$ for conventional total knee arthroplasties. There was no significant difference in the rotational alignment of the tibial components implanted with computer-assisted navigation, which showed rotational deviation of between 9.8° of internal rotation and 9.0° of external rotation and a mean deviation of $3.9^\circ \pm 2.8^\circ$.

On the basis of the numbers available, no association was found between the deviations in the coronal and rotational planes or between component alignment and the early postoperative range of motion or the knee scores. All computed tomographic data between the two groups were not

different at three months, one year, and 3.4 years after the operation.

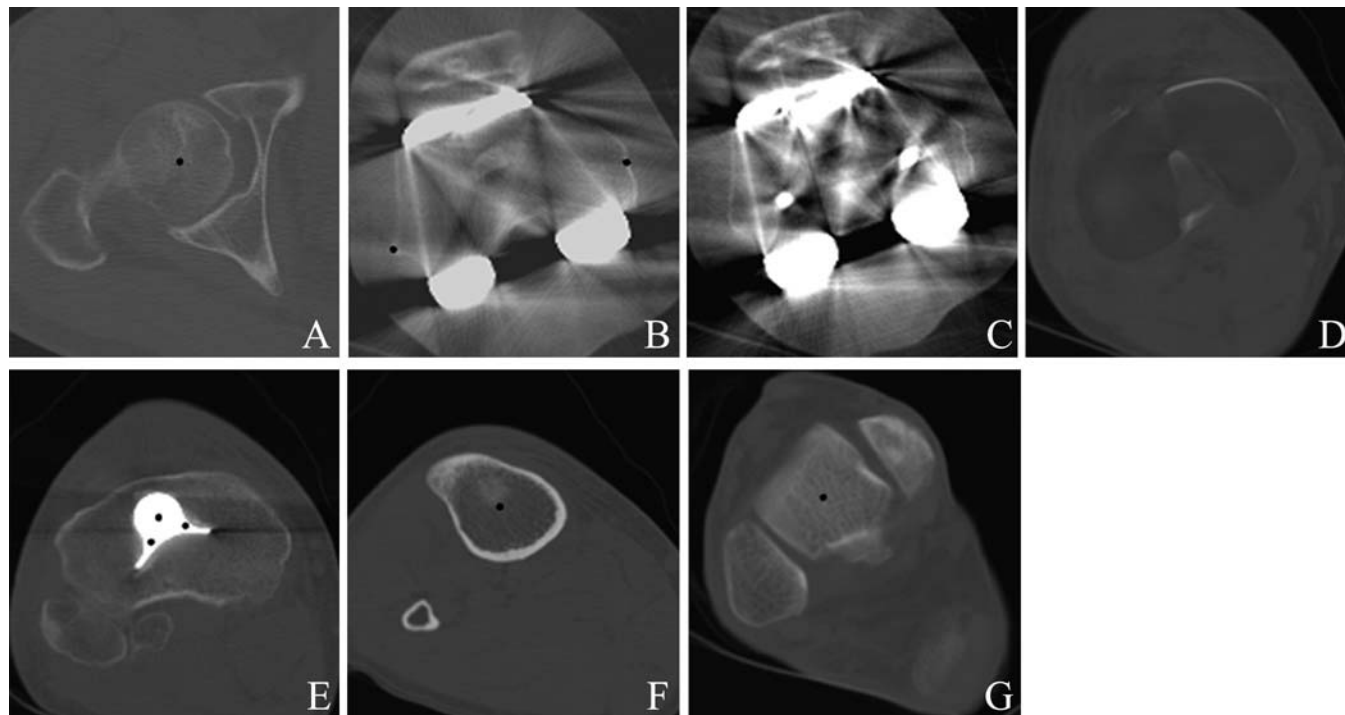


Fig. E-1

Determination of the femoral and tibial component alignment in relation to the bone landmarks.

A: Center of the femoral head. *B:* Medial and lateral epicondyles defining the surgical epicondylar axis. *C:* Femoral fixation pins used to determine axis and rotation. *D:* Center of the knee. *E:* Tibial stem with marked center and flanges used to determine axis and rotation. *F:* Medial third of the tibial tuberosity and center of the tibial cavity, defining the landmark for tibial component rotation. *G:* Center of the ankle.

TABLE E-1 Results of Three-Dimensional Computed Tomography at 3.4 Years of Follow-up

Parameters	Groups*		
	Computer-Assisted Total Knee Arthroplasty (160 Knees)	Conventional Total Knee Arthroplasty (160 Knees)	P Value
Mechanical axis (coronal plane)	4.8° varus to 3.9° valgus (mean deviation, 1.7°±0.7°) (CI; -1.1 to -0.1)	5.8° varus to 4.9° valgus (mean deviation, 2.9°±1.9°) (CI; -1.4 to -0.5)	0.812
Outliers (>3°)	16 of 160 knees (10%)	20 of 160 knees (13%)	0.524
Femoral mechanical axis (deviation from mechanical axis)	1.8°±0.6° (CI; -1.1 to -0.3)	2.3°±2.9° (CI; -1.3 to -0.5)	0.108
Outliers (>3°)	15 of 160 knees (9%)	24 of 160 knees (15%)	0.110
Coronal tibial mechanical axis (deviation from mechanical axis)	1.8°±1.1° (CI; -0.9 to -0.1)	2.3°±1.7° (CI; -0.7 to -0.2)	0.631
Outliers (>3°)	8 of 160 knees (5%)	15 of 160 knees (9%)	0.321
Femoral angle (sagittal plane)	3.2°±2.1° flexion (CI; -1.5 to -0.6)	3.6°±2.8° flexion (CI; -1.4 to -0.5)	0.514
Tibial angle (coronal plane)	86° to 92° (mean deviation, 5°±3.1°) (CI; 88.9 to 89.8)	85° to 94° (mean deviation, 8°±4°) (CI; 87.5 to 88.9)	0.123
Outliers (>3°)	9 of 160 knees (6%)	24 of 160 knees (15%)	0.178
Deviation from preoperatively planned tibial slope	2.2°±1.5° (CI; -1.1 to -0.3)	3.8°±3.2° (CI; -1.2 to -0.1)	0.413
Outliers	15 of 160 knees (9%)	27 of 160 knees (17%)	0.089
Rotational deviation of femoral component	9° internal rotation to >3.2° external rotation (mean deviation, 0.5°±1.2°) (CI; -2.6 to -0.4)	4.2° internal rotation to 5.42° external rotation (mean deviation, 0.9°±1.3°) (CI; -1.5 to -0.3)	0.831
Outliers (>3°)	19 of 160 knees (12%)	21 of 160 knees (13%)	0.879
Rotational deviation of tibial component	9.8° internal rotation to 9.0° external rotation (mean deviation, 3.9°±2.8°) (CI; -2.8 to -0.8)	9.2° internal rotation to 10.4° external rotation (mean deviation, 2.7°±3.1°) (CI; -2.3 to -0.7)	0.791
Outliers (>3°)	34 of 160 knees (21%)	38 of 160 knees (24%)	0.416

CI = confidence interval.