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Relationship Between The Femoral And Tibial Component Positions And Postoperative Knee Range Of Motion After Posterior-Stabilized Total Knee Arthroplasty

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Background / Objective

- In the total knee arthroplasty (TKA), whether the femoral and tibial component positions directly affect the knee range of motion (ROM) is controversial.

- In this study, we hypothesized that the femoral and tibial component positions affect postoperative knee ROM after TKA. Thus, we aimed to investigate the relationship between postoperative knee ROM and the femoral and tibial component positions.

Patients and Methods

- From 2015 to 2019, consecutive patients who underwent primary TKA for osteoarthritis of the knee with varus deformity, corresponding to the Kellgren–Lawrence classification grade 2 or higher and for osteonecrosis of the femoral and tibial medial condyles, were included.
- Patients with valgus osteoarthritis, extraarticular deformity, and inflammatory arthritis (e.g., infection and rheumatoid arthritis) and those who underwent revision surgery were excluded.
- The study population included 44 patients (48 knees), with an average age of 73.8 years (range, 52-88 years).

Patients and Methods

Surgical procedure

- A computed tomography (CT)-free navigation system (Stryker, Germany) was used in all TKA procedures.
- The femoral and tibial osteotomy were performed with the measured resection technique, and posterior-stabilized implants (Triathlon; Stryker, USA) were used for all TKAs.
- The femoral and tibial component positions were aimed at the mechanical axis in coronal, at 0° to 5° of flexion in sagittal.
- In axial, the femoral and tibial component positions were aimed surgical epicondylar axis and Akagi line, respectively.

Patients and Methods

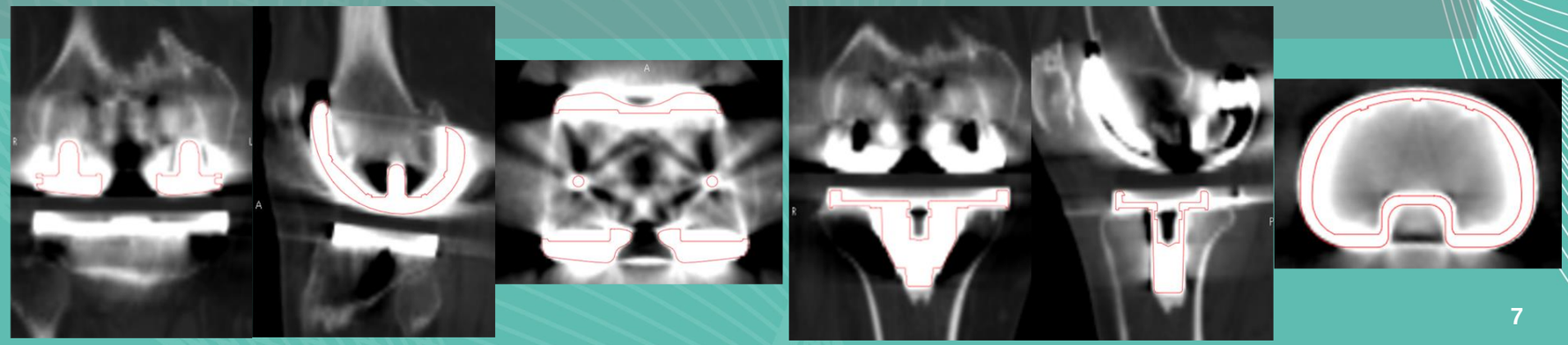
Postoperative procedure and evaluation

- On postoperative day one, the suction drain was removed.
- Patients were allowed to start ROM rehabilitation and ambulation.
- Exercises were performed for approximately 3 weeks during hospitalization.
- After discharge, all patients were followed-up by monthly outpatient visits for a minimum of 2 years postoperatively.
- The knee ROM was examined using a goniometer before surgery and 2 years after TKA by two senior orthopedic surgeons.

Patients and Methods

Evaluation of the femoral and tibial component positions

- CT examinations of the lower limbs including the hip to ankle were performed pre and postoperatively.
- Preoperative CT images were fused to postoperative images automatically by matching the bone surfaces with three-dimensional models using the ZedKnee software (LEXI, Japan).
- Varus in the coronal plane, flexion in the sagittal plane, and internal rotation in the axial plane of the femoral and tibial component positions were represented by positive values.



Patients and Methods

Statistical analysis

- The femoral and tibial component positions and preoperative knee extension restriction angle were compared between the group with an extension restriction angle of 10° or more at 2 years postoperatively and the group with an extension restriction angle of less than 10° using a parametric *t*-test.
- The femoral and tibial component positions, preoperative knee flexion angle and were compared between the group with knee flexion angle of 120° or less at 2 years postoperatively and the group with knee flexion angle more than 120° at 2 years postoperatively using a parametric *t*-test.

Results

Postoperative restriction angle was associated with preoperative knee extension restriction angle and posterior flexion of tibial component

		Postoperative restriction angle of knee extension		
		≥10° (n=9)	<10° (n=39)	*p* values
Preoperative restriction angle of knee extension		16.3 ± 8.8	6.7 ± 6.1	< 0.001 *
Femoral component	Varus(+) – Valgus(-)	16.3 ± 8.8	6.7 ± 6.1	< 0.001 *
	Flexion(+) – Extension(-)	0.42 ± 1.7	-0.19 ± 3.2	0.585
	Internal rotation(+) – External rotation(-)	-0.15 ± 3.0	1.7 ± 2.6	0.087
Tibial component	Varus(+) – valgus(-)	2.2 ± 4.2	3.8 ± 3.8	0.275
	Posterior flexion(+) – Anterior extension(-)	1.5 ± 2.2	1.2 ± 2.3	0.747
	Internal rotation(+) – External rotation(-)	6.2 ± 2.4	3.9 ± 2.4	0.018 *

Table: Comparison of the femoral and tibial component positions and preoperative restriction angle of knee extension

Results

Postoperative restriction angle was associated with preoperative knee flexion angle and internal rotation of the femoral component

		Postoperative knee flexion angle		
		≤120° (n=18)	>120° (n=30)	*p* values
Preoperative knee flexion angle		108.1 ± 19.8	126.5 ± 15.5	0.001 *
Femoral component	Varus(+) – Valgus(-)	0.0022 ± 3.2	−0.088 ± 2.6	0.925
	Flexion(+) – Extension(-)	0.99 ± 2.7	1.5 ± 2.9	0.617
	Internal rotation(+) – External rotation(-)	1.5 ± 3.2	5.2 ± 3.7	0.002 *
Tibial component	Varus(+) – valgus(-)	1.1 ± 1.8	1.4 ± 2.6	0.734
	Posterior flexion(+) – Anterior extension(-)	4.8 ± 2.3	4.2 ± 2.8	0.444
	Internal rotation(+) – External rotation(-)	2.3 ± 6.3	3.7 ± 6.1	0.483

Table: Comparison of the femoral and tibial component positions, preoperative knee flexion angle

Discussion

- The present study showed that Patients with a higher postoperative restriction angle of knee extension had a more posterior flexion position of the tibial component in the sagittal plane, and a more internally rotated position of the femoral component was associated with a greater postoperative knee flexion angle.
- A larger posterior tibial slope in a posterior-stabilized TKA was linked to unintended anterior impingement of the tibial insert post during knee extension [1], and impacted knee extension restriction.
- In the kinematically aligned TKA described by Howell et al. [28,29], the femoral component was placed in valgus and internal rotational positions, compared to a mechanical alignment procedure [2,3,4].
- The knee kinematics of the medial pivot motion, which includes the internal tibial or external femoral rotation, can produce a greater knee ROM after TKA [5,6,7,8].

Conclusion

- Knee extension restriction after posterior-stabilized TKA was related to posterior flexion of the tibial component.
- Postoperative knee flexion angle was associated with the internal rotational position of the femoral component.

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