Association between the femoral and tibial component positions and intraoperative knee kinematics in posterior-stabilized total knee arthroplasty

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I have no financial conflicts to disclose.

Background

✓ 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

Nishio Y et al. J Arthroplasty 2014

✓ No clinical reports have described the relationship between **the medial pivot motion** of the knee in TKA and **the femoral component position**

Purpose

To examine the relationship between **intraoperative knee kinematics** measured in TKA using a computer-navigation system and **the positions of the femoral and tibial components** calculated with computed tomography data.

Method

✓ Subject

From 2015 to 2018, **44** patients (**48** knees) who underwent primary TKA

Average age of **73.8** years (range 52-88 years)

Posterior-stabilized implants (Triathlon; Stryker Kalamazoo, MI, USA) were used

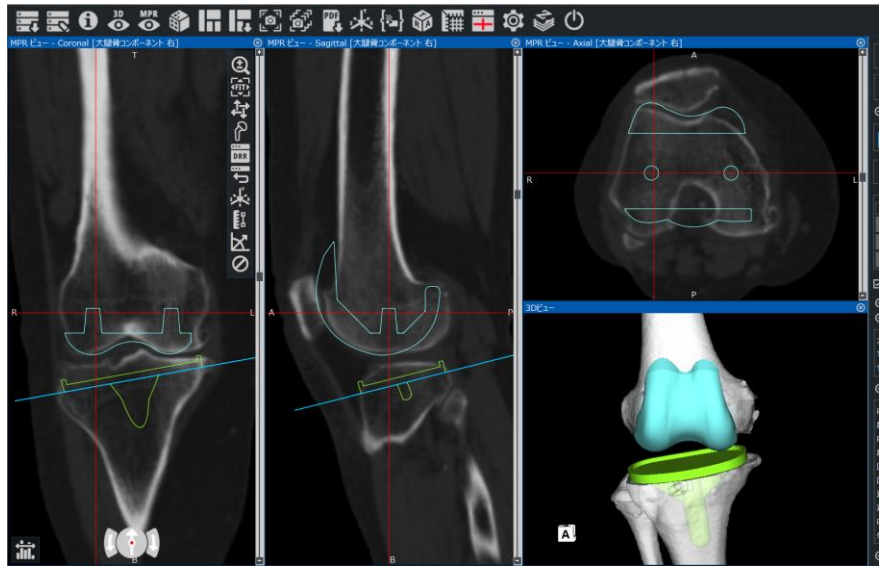
✓ Intraoperative tibial rotation measurements

Intraoperative knee kinematic measurements were examined using **the computed tomography (CT)-free navigation system (Stryker Knee Navigatio System version 4.0; Stryker Leibinger, Freiburg, Germany)** during **passive knee motion from knee extension to flexion**

The navigation system automatically recorded the angle of tibial rotational position

✓ Evaluation of the femoral and tibial component positions

The femoral and tibial component positions were measured from the computed tomography data with three-dimensional evaluation Zedknee software (LEXI, Tokyo, Japan)



We analyzed the relationship between

the component positions and **knee kinematics of the extent of internal tibial rotation**

Result

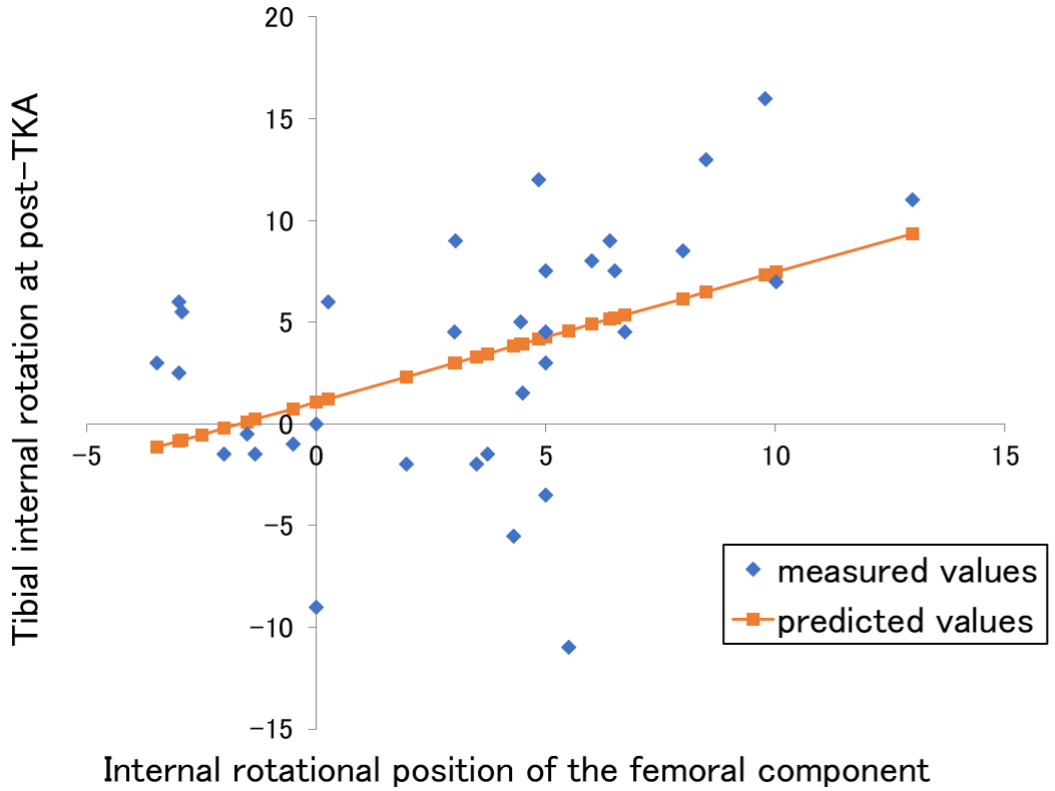
The relationship between **the extent of internal tibial rotation** and **the component positions**

	Average (SD)	The extent of tibial internal rotation			
		knee extension to 90˚ flexion		knee extension to maximum flexion	
		p values	95% CI	p values	95% CI
Femoral component position in coronal plane	+0.49˚ (2.70)	0.60	-0.762 – 0.451	0.41	-0.999 – 0.423
Femoral component position in sagittal plane	+1.13˚ (3.08)	0.078	-0.0728 – 1.315	0.096	-0.127 – 1.500
Femoral component position in axial plane	+2.80˚ (4.55)	0.00074 *	0.357 – 1.247	0.000044 *	0.655 – 1.699
Tibial component position in coronal plane	+1.22˚ (2.50)	0.35	-0.492 – 1.354	0.27	-0.487 – 1.677
Tibial component position in sagittal plane	+4.57˚ (2.87)	0.68	-0.621 – 0.932	0.53	-0.627 – 1.193
Tibial component position in axial plane	+2.96˚ (6.31)	0.27	-0.526 – 0.154	0.77	-0.455 – 0.342

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**.

*: $p<0.05$ (multiple regression analysis)
SD, standard deviation; CI, confidence interval

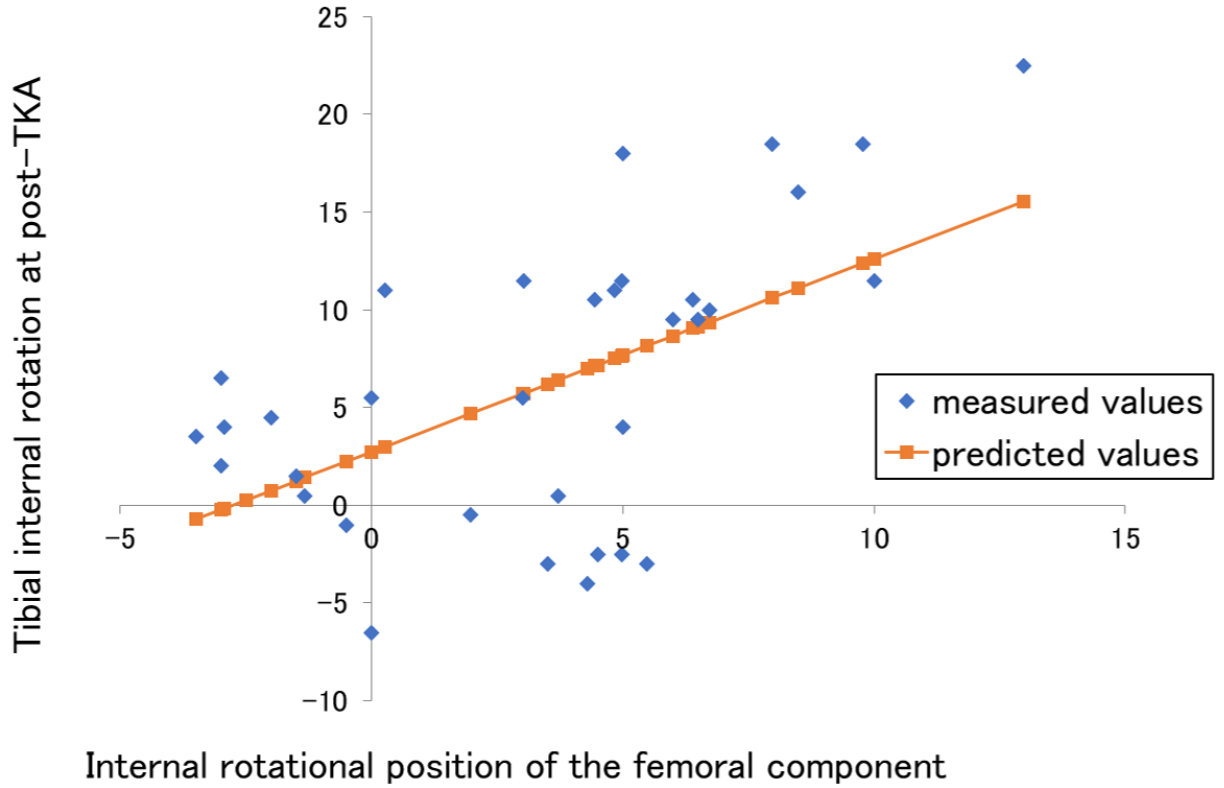
The correlation between **the internal rotational position of the femoral component** and **the tibial internal rotation from knee extension to 90° flexion**



Significantly positive correlation

(*correlation coefficient, 0.409; p = 0.0035*)

The correlation between **the internal rotational position of the femoral component** and **the tibial internal rotation from knee extension to maximum flexion**



Significantly positive correlation

(*correlation coefficient, 0.531; p = 0.000083*)

The extent of internal tibial rotation
due to **rotation of the femoral component**
from knee extension to 90° or maximum flexion

	Group IN (n=22)	**Group EX** (n=26)	*p* values
The extent of tibial internal rotation **from knee extension to 90° flexion**	4.9 (6.9)	-1.0 (4.6)	0.010 *
The extent of tibial internal rotation **from knee extension to maximum flexion**	9.5 (8.4)	0.64 (4.4)	0.001 *

IN : internal rotational position of the femoral component
EX : external rotational position.
*: significant difference between the groups

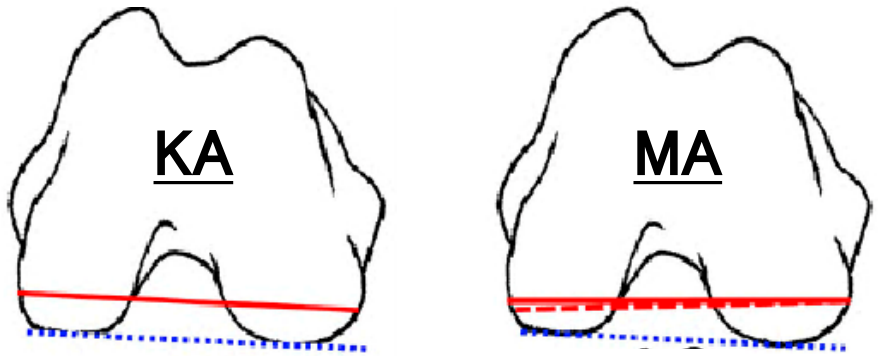
Discussion

kinematically alignment (KA) procedure

Howell S et al. Orthopedic Knowledge Online. 2012

Park A et al. Knee 2014

- ✓ **Near-normal knee kinematics**
- ✓ The femoral component was placed in valgus and **internal rotational positions**, compared to a mechanical alignment (MA) procedure



The internal rotational position of the femoral components causes patellofemoral joint complications

Barrack RL et al. Clin Orthop Relat Res 2001

Li PL et al. J Bone Joint Surg Br 1999

- Anterior knee pain
- Patellar subluxation
- The necessity of performing lateral release after TKA

✓ Several reports showed **better clinical results** of **KA-TKA**

Brander Va et al. Clin Orthop Relat Res 2003

Dossett HG et al. Bone Joint J 2014

The knee kinematics of **kinematically aligned TKAs** with a computer simulation model

Ishikawa M et al. Knee 2015

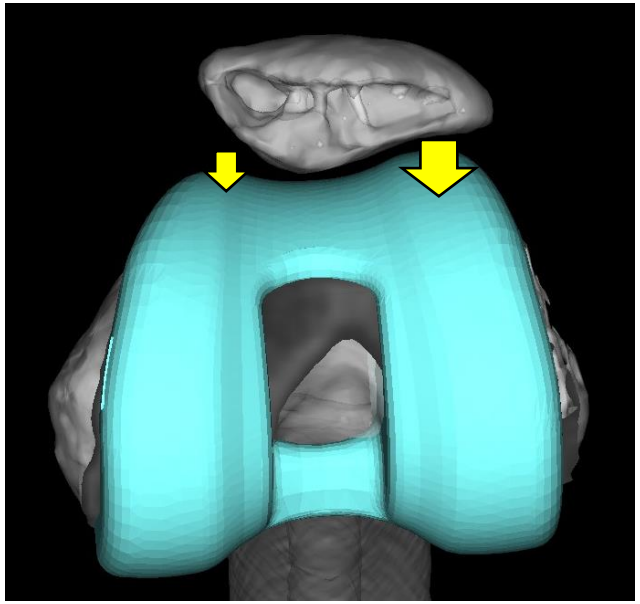
✓ Patella shifted laterally

✓ Contact pressure between the patellar and the femoral components was higher on the lateral side than on the medial side at all knee flexion positions

① The patella exerts a greater force on the lateral side of the femoral component and pushes to the posterior side

② External femoral rotation occurs

③ In addition, the larger lateral compartment clearance due to the internal position of the femoral component is advantageous for **medial pivot motion**



Conculusion

- ✓ The extent of internal tibial rotation from knee extension to flexion was positively correlated with the internal rotational position of the femoral component

- ✓ The internal rotation position of the femoral component positively affects knee kinematics