Original Article

Total Knee Arthroplasty after Previous Ipsilateral Hip Arthroplasty Showed Lower Clinical Outcomes and Higher Leg Length Discrepancy Perception

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J Knee Surg

Abstract

The purpose of this study is to compare perception of leg length discrepancy (LLD) and clinical results of total knee arthroplasties (TKA) in patients with or without previous ipsilateral hip arthroplasty. Between 2008 and 2015, navigation-assisted TKA was performed in 43 patients with previous hip arthroplasty after hip fracture. After 1:3 propensity score matching was performed, 108 patients of primary navigation-assisted TKA (group 1) and 36 patients with hip arthroplasty (group 2) were included. Knee Society (KS) scores, Western Ontario and McMaster Universities Index (WOMAC) scores, and patients' satisfaction including perception of LLD were evaluated. Radiographic evaluation included mechanical axis, component position, and LLD. Logistic regression analysis was performed to find the factors that affect the clinical outcomes. No significant differences in radiologic and clinical evaluations, except for KS function score, patient's satisfaction and LLD ($p < 0.001$), were detected between the groups. LLD and its perception were significantly higher in group 2 (1.8 ± 3.4 mm in group 1 and 9.7 ± 4.1 mm in group 2, $p = 0.000$). Risk factors for the low KS function score were found as LLD (odds ratio [OR]: 1.403, $p = 0.008$) and previous hip arthroplasty itself (OR: 15.755, $p = 0.002$), but much higher OR was found in previous hip arthroplasty. Although the outcomes of TKA in patients with ipsilateral hip arthroplasty are comparable to those of primary TKA, LLD was high and patient's satisfaction and functional outcomes were low in patients with previous ipsilateral hip arthroplasty. Care should be taken when considering TKA in patients with previous hip arthroplasty. This is a Level III, case control study.

Keywords
- total knee arthroplasty
- hip arthroplasty
- ipsilateral
- clinical outcomes
- leg length discrepancy

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received
December 13, 2019
accepted
June 25, 2020

DOI https://doi.org/10.1055/s-0040-1715447.
ISSN 1538-8506.

The success of total knee arthroplasty (TKA) depends on the optimal component position, proper axial alignment, and balanced flexion–extension gaps.[1] The leg length discrepancy (LLD) after TKA may be another meaningful measure of success[2–5]; however, few studies have examined clinical effects and significance of LLD following primary TKA.[2–6] Total hip arthroplasty (THA) or hemiarthroplasty is considered as treatment options for the hip fractures in elderly patients.[7–9] LLD following hip arthroplasty is a well-known cause of patient dissatisfaction and worse clinical outcomes.[10,11] However, unlike THA, LLD has not been regarded as a significant issue after TKA. This is likely due to differences in surgical techniques, as the bone that is removed during TKA is replaced with prosthetic components with the same thickness within just a few millimeters of resected bone, or due to the compensation provided by the other joint, such as the hip.[6,12]

Successful TKA in patients with previous ipsilateral hip arthroplasty remains challenging because of the altered lower limb mechanical axis, already existing LLD, or decreased functional status.[10,11,13] To our best knowledge, little previous research was performed on the TKA in patients with previous ipsilateral hip arthroplasty, including addressing the issue of LLD and patients' satisfaction.

The purpose of this study was to compare the clinical and radiological outcomes including LLD of primary TKA in patients with or without a previous ipsilateral hip arthroplasty. It was hypothesized that primary TKA in patients with previous ipsilateral hip arthroplasty would yield unfavorable clinical and radiological outcomes compared with primary TKA, and LLD would affect the clinical outcomes.

Materials and Methods

This retrospective, matched-pairs, case–control study included patients who underwent primary TKA for varus deformity with severe knee osteoarthritis between October 2008 and February 2015, minimum 4 years follow-up. The overall average follow-up is 64.4 ± 9.5 months (range, 48–110 months). A total of 397 patients with 453 knees had undergone navigation-assisted TKA using the OrthoPilot navigation system (Columbus, Aesculap, Tuttlingen, Germany). Of them, 43 patients (35 women and 8 men) had a previous history of ipsilateral hip arthroplasty after hip fracture only. THA was performed to the relatively active, younger patients with a relatively long life expectancy, and hemiarthroplasty was performed to the others.[7–9] Exclusion criteria for primary TKA group were as follows: bone graft or screw fixation due to bone defect, revision surgery, severe flexion contracture over 20 degrees, body mass index over 30 kg/m^2, severe spine deformity with neurologic symptoms, patients treated with open reduction, and internal fixation using hip screws or hip arthroplasty other than fracture. After applying the exclusion criteria, the primary navigation-assisted TKA group included 304 knees (284 patients). Navigation-assisted TKA was performed in 43 patients (43 knees) with a history of ipsilateral hip arthroplasty using the same prosthesis and navigation system: THA was performed in 5 patients and bipolar hemiarthroplasty was performed in 38 patients (►**Fig. 1**). Then, 1:3 propensity score matching was performed. Finally, 108 knees were included in the primary navigation-assisted TKA group (group 1) and 36 knees were included in primary navigation-assisted TKA group with a history of ipsilateral hip arthroplasty group (group 2). Seven patients with bipolar hemiarthroplasty were excluded further in group 2 because of severe spine deformity (5 patients) and the absence of matching cases (2 patients). Patient demographics were similar between the two groups (►**Table 1**).

Patients were evaluated preoperatively, postoperatively at 6 weeks, 6 months, and 1 year, and annually thereafter. At every visit, one independent experienced research assistant obtained scores for all patients using the Knee Society (KS) scoring system, Western Ontario, and McMaster Universities Index (WOMAC) score, and postoperative range of motion. Patients' perception of LLD was evaluated during an interview at the last follow-up visit, with a three-point scale of perception of LLD that included the following response options: discomfort, perception without discomfort, and no perception.[5] Patients were also asked to indicate in a questionnaire if they were fully satisfied, satisfied, barely satisfied, dissatisfied, or very dissatisfied with the surgical outcome based on the 5-point Likert scale.[5,14] The postoperative complications were also evaluated during the follow-up period. This study has been approved by the appropriate ethics committee of our hospital.

Radiological Evaluation

Full-length standing anteroposterior radiographs were used for the radiological evaluation. The standing patient was positioned with both feet in symmetric internal rotation to bring both patellae into the forward-facing position. The pre- and postoperative leg length measurement was defined as the length from the tip of the femoral head to the center of the tibial plafond (►**Fig. 2**).[5,15,16]

The following component positions were evaluated in the coronal and sagittal planes: coronal femoral component angle (α), coronal tibial component angle (β), sagittal femoral component angle (γ), and sagittal tibial component angle (δ) (►**Fig. 3**).[17] The mechanical femorotibial angle was also used. The joint line level was defined as the distance from the distal femoral condyle to the tibial tuberosity on the lateral radiographs.[5,18] The Insall–Salvati and Blackburne–Peel ratios were evaluated to assess the patellar height. All measurements were performed on a picture archiving and communications system(General Electric, Chicago, IL) monitor using a mouse point cursor and automated computer calculation and the values were rounded off to two decimal places.

Surgical Technique and Rehabilitation

The senior author performed all TKA procedures using a standard mid-vastus approach with patellar subluxation to establish a transmitter for navigation system.[5,18] A minimum medial release was performed to correct the varus deformity, guided by real-time feedback from the navigation system. The posterior cruciate ligaments were sacrificed in all patients. The coronal alignment was accepted within 0 to

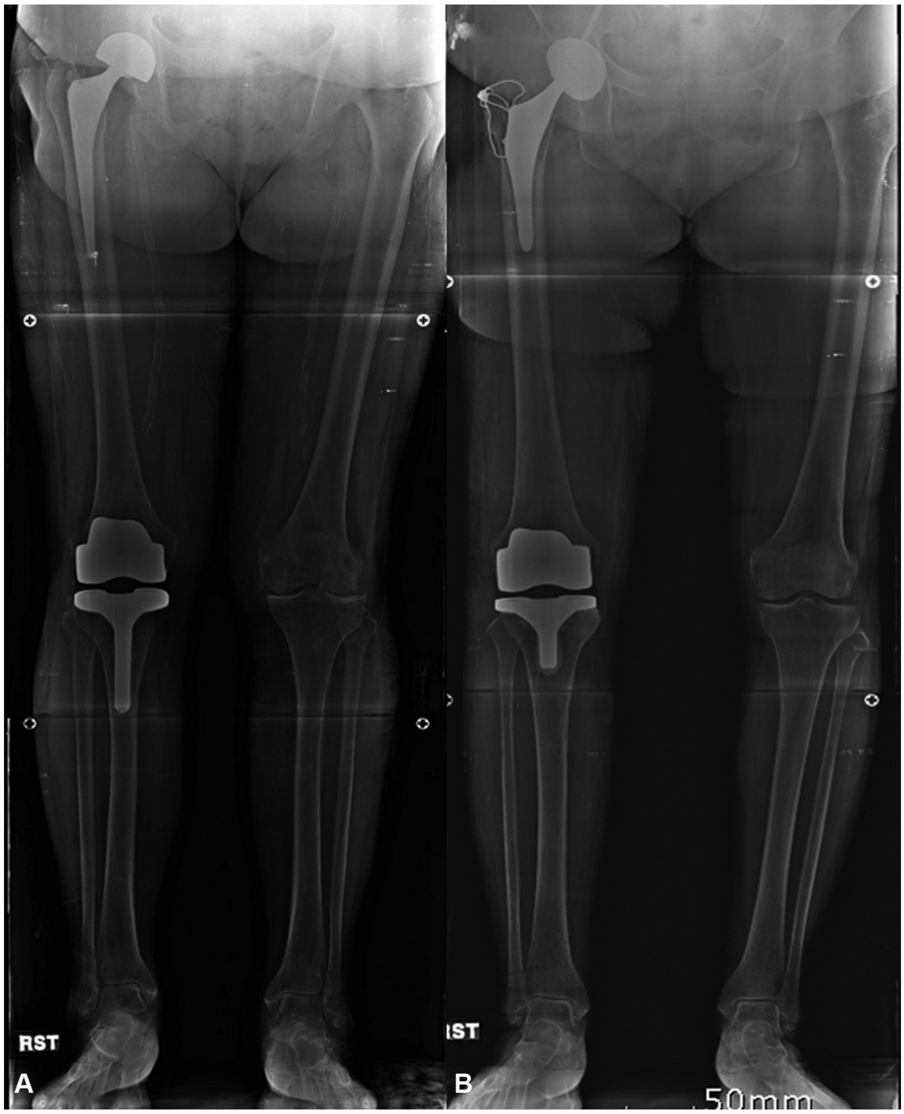

Fig. 1 Navigation-assisted total knee arthroplasty in a patient with ipsilateral hip surgery. (A) Bipolar hemiarthroplasty; (B) total hip arthroplasty.

2 degrees of varus after soft tissue release. All prostheses were fixed with cement.

A similar postoperative rehabilitation program was used in all patients. Briefly, a closed suction drain was used for 24 to 48 hours, and ankle pump exercises were started immediately after surgery. On the second postoperative day, a continuous passive motion machine was applied, and quadriceps exercises and ambulation were encouraged, but using a crutch for up to 1 week was advised for patients from group 2 to avoid fall down.

Statistical Analysis

All statistical analyses were performed using SPSS software (SPSS Inc., Chicago, IL) and "matchit" and "optmatch" R-packages (ver. 3.5.1; R Foundation, Vienna, Austria). Patients who underwent primary TKA without hip arthroplasty and those who underwent TKA after hip arthroplasty were propensity score matched to adjust for differences in baseline variables associated with outcome. The propensity score with a greedy matching algorithm with a 3:1 ratio was calculated by binary logistic regression using R-packages with the covariates specified in ►**Table 1**. The standardized difference was used as a balance diagnostic, and a less than 10% difference in mean or prevalence of covariates between groups was considered acceptable.[19–21]

The primary outcome measurement was mean Knee Society Function Score (KSFS) at the final follow-up. The post hoc power analysis showed a power of 0.9999673 with a two-sided α error of 5% and 1.1534150 of effect size with 3:1 ratio allocation. The secondary outcome measurement was mean LLD at the final follow-up. The post hoc power analysis showed a power of 1.0 with a two-sided α error of 5% and 2.0975505 of effect size.

To compare the mean values, the data were analyzed using Mann–Whitney U-test, independent *t*-test, paired t-test, chi-squared test, or Wilcoxon signed-rank test according to the results of the Shapiro–Wilk test used to test the normality of their distribution. Pearson's correlation coefficient was used to assess the relationship between clinical scores and radiologic and demographic evaluations. Logistic regression analysis was used to evaluate the risk factors for the worse outcome of overall KSFS scores in a subgroup analysis (<80 points).

Table 1 Patients' demographic data before and after propensity matching

	Unmatched group		*p*-Value	Standardized difference	Propensity-matched groups		*p*-Value	Standardized difference
	Primary TKA	TKA with hip surgery			Group 1	Group 2		
Number of cases	453	43	–	–	108	36	–	–
Age (years)	66.5 ± 8.4	72.5 ± 5.3	0.000	0.733	68.8 ± 4.4	69.3 ± 4.5	0.558	0.113
Body mass index (kg/m^2)	26.2 ± 6.5	22.7 ± 3.2	0.0006	−0.557	23.8 ± 3.4	23.7 ± 3.7	0.881	−0.029
Sex (male: female)	82: 371	8: 35	0.9004	0.019	16: 92	5: 31	0.892	−0.042
Flexion contracture (degree)	12.6 ± 5.9	15.1 ± 3.9	0.007	0.434	14.5 ± 3.3	14.7 ± 3.4	0.755	0.06
Further flexion (degree)	118.5 ± 15.5	116.2 ± 8.4	0.338	-0.153	116.3 ± 8.2	115.8 ± 7.8	0.749	−0.062
KSS scores								
KS knee score	44.8 ± 17.2	45.2 ± 10.5	0.881	0.024	47.1 ± 9.6	46.8 ± 10.3	0.874	−0.031
KS function score	55.1 ± 22.2	43.4 ± 8.6	0.0007	−0.547	45.0 ± 8.9	44.4 ± 7.8	0.719	−0.069
WOMAC scores								
Total	48.3 ± 15.6	58.1 ± 12.6	0.0001	0.638	52.0 ± 10.8	52.4 ± 10.4	0.846	0.037
Pain	9.2 ± 4.2	9.4 ± 3.5	0.763	0.048	9.4 ± 3.1	9.5 ± 3.0	0.866	0.033
Stiffness	4.1 ± 2.1	4.5 ± 1.5	0.223	0.195	4.4 ± 1.6	4.5 ± 1.4	0.738	0.06
Function	35.5 ± 17.9	44.8 ± 16.8	0.001	0.522	37.5 ± 11.3	38.1 ± 14.3	0.797	0.049
Mechanical tibiofemoral angle (deg)	Varus 12.8 ± 12.3	Varus 14.7 ± 4.1	0.315	0.474	Varus 13.8 ± 6.6	Varus 14.0 ± 3.5	0.862	0.033
Insall–Salvati ratio	0.94 ± 0.6	0.87 ± 0.6	0.487	−0.117	0.91 ± 0.7	0.88 ± 0.5	0.8003	−0.046
Blackburne–Peel ratio	0.63 ± 0.7	0.58 ± 0.6	0.676	−0.072	0.6 ± 0.7	0.59 ± 0.5	0.647	−0.015
Demographic data not included in propensity score matching								
Follow-up (months)	64.6 ± 8.4	63.2 ± 5.5	0.284	–	65.2 ± 7.6	63.7 ± 3.1	0.252	–
Preoperative LLD[a]	−3.5 ± 7.6	7.2 ± 5.2	0.000	–	−3.1 ± 6.3.	6.5 ± 5.6	0.000	–

Abbreviations: KSS, Knee Society Score; LLD, leg length discrepancy; TKA, total knee arthroplasty; WOMAC, Western Ontario and McMaster Universities index.
[a]Negative value in LLD denotes shorter limb length of affected knee compared with that of unaffected knee.
Note: Data are presented as mean ± standard deviation.

Two orthopaedic surgeons independently evaluated pre- and postoperative radiographs two times, with an interval of 2 weeks between measurements. The inter- and intraobserver reliability was evaluated by the intraclass correlation coefficient (ICC) for consistency. The significance level was set at 0.05.

Results

Clinical Analysis

The clinical outcomes of both groups at the final follow-up are summarized in ►**Table 2**. The KSFS scores were statistically different between the two groups. Regarding the specific questions in KSFS, the scores for the ability to go up and down the stairs and to walk on the floor were lower in group 2. Moreover, KSFS scores were also reduced in some patients from group 2 due to the use of cane when walking. For the WOMAC scores, the groups' scores for difficulty in ascending or descending stairs were statistically different, similarly to the KSFS scores. As for the satisfaction questionnaire, the proportion of satisfied patients was significantly higher in group 1. (88.0% in group 1 vs. 61.1% in group 2, $p = 0.005$). Moreover, a statistically significant difference was also detected between the two groups in the perception of the LLD ($p = 0.000$, ►**Table 2**). Furthermore, 3 cases of perception with discomfort, 7 cases of perception without discomfort, and 26 cases of absent LLD perception were present in group 2 preoperatively; postoperative incidence of discomfort perception was significantly different from preoperative incidence of discomfort perception. ($p = 0.032$, chi-squared test).

The postoperative overall mean KSFS scores, combined the results of two groups, were negatively correlated with postoperative LLD (KSFS: $r = –0.358$, $p < 0.000$) and ipsilateral hip arthroplasty ($r = –0.511$, $p < 0.001$). No patient in either group experienced complications, such as infection, symptomatic deep vein thrombosis (DVT), implant loosening, or patellofemoral maltracking, except one patient with asymptomatic DVT (distal DVT) in group 2.

Fig. 2 Assessment of leg length by measuring the length from the tip of the femoral head to the center of the tibial plafond. (**A**) Preoperative measurement; (**B**) postoperative measurement.

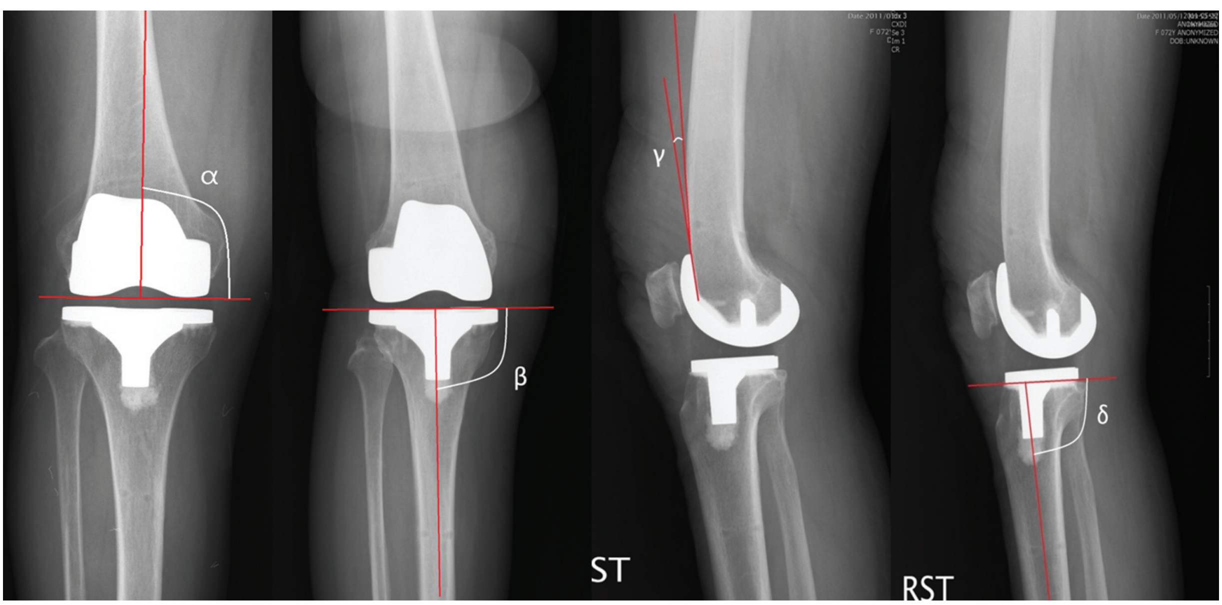

Fig. 3 Assessment of prosthesis alignment. Coronal femoral component angle (α) and tibial component angle (β), and sagittal femoral component angle (γ) and tibial component angle (δ).

Radiologic Analysis

The overall radiological results of both groups are summarized in ►**Table 3**. The mean postoperative LLD significantly differed between the groups. The whole leg lengths were increased in both groups (increased length, 4.6 mm ± 3.3 [range, 0.2–9.4mm] in group 1, 3.5 ± 3.1 mm [range, 0.2–8.6mm] in group 2, $p = 0.091$) In group 1, the shorter limb length of affected knee was found longer than that of contralateral limb after TKA. In

Table 2 Comparison of clinical outcomes at final follow-up

	Group 1	Group 2	*p*-Value
Flexion contracture (degree)	2.8 ± 3.1	3.5 ± 4.1	0.283
ROM (degree)	126.5 ± 8.0	125.2 ± 7.1	0.387
KSS scores			
KS knee score	91.0 ± 15.7	90.1 ± 19.2	0.779
KS function score	89.3 ± 7.2	80.4 ± 8.2	0.000
Ability to walk up or down the stairs	44.1 ± 4.1	41.5 ± 5.2	0.003
Ability to walk on the floor	46.7 ± 5.2	42.4 ± 3.1	0.000
WOMAC scores			
Total	12.1 ± 6.9	13.2 ± 7.6	0.421
Pain	2.8 ± 3.6	2.9 ± 3.5	0.885
Stiffness	0.9 ± 1.0	1.0 ± 1.2	0.622
Function	8.7 ± 6.4	9.5 ± 5.6	0.505
Pain when walking up or down the stairs	0.51 ± 0.8	0.68 ± 0.7	0.257
Difficulty with ascending stairs	0.91 ± 1.3	2.01 ± 1.4	0.000
Difficulty with descending stairs	1.01 ± 1.2	1.93 ± 1.6	0.000
Difficulty with rising from sitting	0.87 ± 1.5	1.54 ± 1.2	0.016
Patient satisfaction questionnaire			0.005
Highly satisfied	45 (41.7%)	10 (27.8%)	
Satisfied	50 (46.3%)	12 (33.3%)	
Barely satisfied	11 (10.2%)	13 (36.1%)	
Dissatisfied	2 (1.8%)	1 (2.8%)	
Highly dissatisfied	0 (0%)	0 (0%)	
Patient perception of LLD questionnaire			0.000
Perception with discomfort	0 (0%)	7 (19.4%)	
Perception without discomfort	3 (2.8%)	14 (38.9%)	
No perception	105 (97.2%)	15 (41.7%)	

Abbreviations: KSS, Knee Society Score; LLD, leg length discrepancy; ROM, range of motion; WOMAC, Western Ontario and McMaster Universities Index.
Note: Data are presented as mean ± standard deviation.

Table 3 Comparison of radiological outcomes at the final follow-up

	Group 1	Group 2	*p*-Value
LLD (mm)	1.8 ± 3.4	9.7 ± 4.1	0.000
MAD (degree)	1.4 ± 1.6	1.9 ± 2.1	0.137
α (degree)	89.6 ± 1.9	89.1 ± 2.7	0.224
β (degree)	89.4 ± 1.7	89.5 ± 1.5	0.754
γ (degree)	3.1 ± 1.7	3.4 ± 1.8	0.368
δ (degree)	83.7 ± 2.3	84.1 ± 2.1	0.358
Outliers over 3 degree of MAD	3 (2.8%)	4 (11.1%)	0.117
Change in joint line position (mm)	1.5 ± 4.2	1.9 ± 4.9	0.636
Thickness of polyethylene (mm)	10.8 ± 1.3	11.0 ± 2.1	0.499
Insall–Salvati ratio	0.89 ± 0.9	0.93 ± 0.8	0.82
Blackburne–Peel ratio	0.61 ± 0.7	0.59 ± 0.8	0.879
Patellar tilt angle (degree)	2.5 ± 2.5	1.7 ± 3.2	0.124

Abbreviations: LLD, leg length discrepancy; MAD, mechanical femorotibial angle.
Note: Data are presented as mean ± standard deviation.

Table 4 Results of logistic regression analysis of significant risk factors for low function

Factor	Odds ratio	*β*-Value	95% Confidence interval	*p*-Value
The risk of worse postoperative KSFS scores less than 80				
Ipsilateral hip arthroplasty	15.755	2.76 ± 0.903	2.683–92.531	0.002
Postoperative LLD	1.403	0.338 ± 0.127	1.094–1.799	0.008
Constant	–	−7.754 ± 1.62	–	0.000

Abbreviations: KSFS, Knee Society Function Score; LLD, leg length discrepancy.

group 2, the whole leg length after TKA was longer than that before TKA, although not significant (leg length after TKA vs. length before TKA: 796.7 ± 11.3 mm [range, 780.3–817.8 mm] vs. 793.3 ± 15.6 mm[range, 778.6–814.6mm]$p = 0.293$). In brief, the absolute mean postoperative LLD decreased in group 1 (preoperative vs. postoperative, −3.1 ± 6.3 mm [range, −5.6–2.3mm] vs. 1.8 ± 3.4 mm [range, −1.3–5.3mm], $p = 0.000$), but increased in group 2 (preoperative vs. postoperative, 6.5 ± 5.6 mm [range, 1.3–13.3mm] vs. 9.7 ± 4.1 [range, 3.7–18.3mm], $p = 0.007$]. However, other radiologic measurements were not significantly different (►**Table 3**).

The results of the logistic regression analysis for worse overall KSFS scores in all radiological measurements and demographic data are summarized in ►**Table 4**. The odds ratio (OR) for the risk of worse KSFS scores (< 80) increased with increasing postoperative LLD and with the presence of a history of ipsilateral hip arthroplasty; however, OR of ipsilateral hip arthroplasty was much higher than that of postoperative LLD. Other variables did not show statistically significant differences.

The overall ICC was > 0.91 (range, 0.83–0.92), indicating that all radiographic measurements had good inter- and intraobserver reliability.

Discussion

The most important finding of this study was that clinical and radiologic outcomes of primary TKA in patients with a history of ipsilateral hip arthroplasty were comparable to those of the primary TKA, but worse functional improvement was still found significantly even with the successful restoration of alignments. In addition, the LLD perception was high and satisfaction was low in patients with a history of ipsilateral hip arthroplasty. The ipsilateral previous hip arthroplasty and postoperative LLD were associated with worse functional outcomes.

To the best of our knowledge, little study compared clinical and radiological outcomes between navigation-assisted TKA in patients with a history of ipsilateral hip arthroplasty and those with primary navigation-assisted TKA, especially including the LLD factor. The results of this study showed that the clinical and radiologic outcomes of primary TKA after ipsilateral hip arthroplasty could be comparable to those of the primary TKA, but patients with a history of ipsilateral hip arthroplasty still have functional deficit and worse satisfaction along with the increased perception of LLD. Furthermore, a history of ipsilateral hip arthroplasty itself was a significant risk factor of worse functional outcomes (►**Table 4**), in spite of successful restoration of all radiologic parameters, except for pre-existing LLD (►**Table 3**). The pre- and postoperative LLD was higher in group 2, and affected the functional outcomes and perception of LLD after primary TKA. (►**Table 2**)

LLD is a relatively common diagnosis in patients with spine and lower-extremity disorders, and is also a common complication after primary THA. Patients can often perceive even minor changes in leg length, which may result in limping, pain, general dissatisfaction, and poorer clinical outcomes.[10,22–24] The uneven load distribution due to LLD is also likely to lead to premature fatigue in standing position, which can explain the poorer outcomes.[25,26] Meanwhile, Lang et al[15] reported that 83% of patients in their study showed an increase in leg length after TKA. In their study, leg lengthening occurred frequently after TKA along with the correction of coronal deformities. In the laboratory study of Ohmori et al,[27] authors reported that correction of coronal alignment and flexion contracture could induce leg lengthening after TKA. This study suggested that leg length increases after TKA denote restoration of the coronal limb alignment and flexion contracture. However, there are still controversies whether LLD could affect the clinical outcomes of TKA or not.[3,5,6,28] Chinnappa et al[3] found an increase in leg length in 77% of patients, but no large radiologic LLD and no associations between the functional outcomes and radiologic LLD, although some patients who perceived the LLD showed lower functional outcome. Goldstein et al[6] reported that preoperative LLD perception was resolved after primary TKA, because of the correction of lower extremity malalignment during TKA. On the other hand, Kim et al[5] and Vaidya et al[28] reported worse functional outcomes in patients with persistent postoperative LLD. The preoperative LLD and unilateral TKA for patients with knee osteoarthritis would be risk factors for postoperative LLD, because of correction of varus deformity or flexion contracture during TKA.[5] In our study, the increase in leg length was also found in both groups, although larger LLD was found in group 2. The postoperative LLD as an absolute value in group 1 was decreased due to correction of alignment and restoration of joint line, because the shorter affected knee preoperatively was elongated after TKA. The overall KSFS score showed a statistically significant negative correlation with LLD, but a weak correlation, which was similar to the results of previous studies.[5,28] Moreover, patients' satisfaction in group 2 was significantly different from that in group 1, and the incidence of perception of LLD was higher and significantly increased after TKA in group 2 (►**Table 2**). However, the functional outcomes were more affected by the history of ipsilateral hip arthroplasty itself than by postoperative LLD (►**Table 4**). Because of the difference of inclusion criteria, such as inclusion of unilateral or bilateral TKA, degree of osteoarthritis in the contralateral knee, preoperative LLD status, and definition of LLD, the results of this study and those of previous studies are conflicting with each other in terms of the effect of postoperative LLD on clinical outcomes, and thus cannot be compared with this study directly. Briefly, the preoperative LLD of patients with a history of ipsilateral hip arthroplasty persisted after primary TKA, even if some changes were related to the increase in leg length. The postoperative LLD was affected and was correlated to the worse postoperative functional outcomes, but its effect was limited. However, because increased postoperative LLD, increased incidence of its perception, and worse satisfaction in group 2 were found, care should be taken when the TKA was performed to the patient with ipsilateral hip arthroplasty.

This study had several limitations. First, it was retrospective in nature and had a mid-term follow-up period. Longer follow-up with survival analysis would be needed to evaluate whether the history of ipsilateral hip arthroplasty could affect the survival of TKA. Second, it remains unclear how the history of ipsilateral hip arthroplasty affected the functional outcomes. There could be many reasons, such as decreased power of quadriceps, difficult compensation by hip joint, unbalance due to hip surgery, general weakness that was not assessed, and pre- or postoperative LLD. However, the low correlation value between clinical outcomes and postoperative LLD could have originated from other factors than LLD that were not included in this study. Moreover, uneven load distribution during gait with LLD can affect the load distribution of polyethylene in TKA,[25,26] and a long-term follow-up would be needed. Third, preoperative LLD itself, which is not included in regression analysis of this study, also could be a factor that affects the clinical outcomes, although postoperative LLD was found as a significant factor with low correlations in this study. Although surgeons tried to perform hip arthroplasty with no LLD before and after surgeries, increased neck length and offset to prevent from dislocation due to posterior approach could result in the increase leg length. There is possibility that preoperative LLD itself could affect the clinical outcomes, because the history of ipsilateral hip arthroplasty is a major factor of low functional outcome in this study. However, the propensity score matching was performed to reduce bias of this study; the results of this study may have worthy. Finally, we could not analyze patients with ipsilateral hip arthroplasty by the type of previous surgery (THA vs. hemiarthroplasty) because of small number of cases in each surgery subgroup. There could be differences among patients with THA and hemiarthroplasty. Moreover, the unilateral or bilateral TKA might affect the postoperative LLD. Further study would be needed to compare these patients.

Overall, the functional outcomes of primary TKA in patients with a history of ipsilateral hip arthroplasty were worse than those of primary TKA even after propensity score matching; the worse outcomes were associated with LLD and a history of hip arthroplasty itself mainly. Although the clinical and radiological outcomes of primary TKA in patients with ipsilateral hip arthroplasty were comparable to those in patients who underwent primary TKA, surgeons should inform patients that the functional outcomes would be worse than those of primary TKA, regardless of the presence of LLD. Furthermore, incidence of perception of LLD could be increased and satisfaction could be worse after TKA in patients with ipsilateral hip arthroplasty; surgeons should also inform patients. Care should be taken for the correction of postoperative LLD during the TKA procedures, which could affect the functional outcomes.

Conclusion

The LLD increased after TKA and was significantly high in patients with previous ipsilateral hip arthroplasty. In addition, the functional outcomes are still found low in patients with previous ipsilateral hip arthroplasty. Care and council regarding these points should be taken when considering TKA in patients with previous ipsilateral hip arthroplasty.

Ethical Approval

The study was approved by the Institutional Review Boards of Chung-Ang University Hospital (No.:1601--009–255) and was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

Funding

This research was supported by the Chung-Ang University Research Grants in 2019.

Conflict of Interest

None declared.

Acknowledgments

The authors would like to acknowledge the support provided by the Chung-Ang University Research Grants in 2019.

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