Mid-long term results of total knee arthroplasty followed by ipsilateral total hip arthroplasty versus total hip arthroplasty subsequent to ipsilateral total knee arthroplasty: A retrospective cohort study

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Research article

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Abstract

Background

Total hip arthroplasty (THA) altered the mechanical axis and loading distribution of the lower extremity. The effect of a prior THA on clinical outcomes of a subsequent ipsilateral total knee arthroplasty (TKA) remains unknown.

Methods

We reviewed 83 patients who underwent ipsilateral THA and TKA for rheumatoid arthritis or osteoarthritis between January 2008 and April 2014. Forty-seven patients were classified as TKA followed by ipsilateral THA (THA-TKA group) and 36 as THA subsequent to ipsilateral TKA (TKA-THA group). Twenty-eight patients (30 hips and knees) were selected for each group after the propensity score was matched with preoperative demographics and hip-knee-ankle angle (HKA). Clinical measurements, radiographic evaluations, and complication data were compared between 2 groups.

Results

Both groups had a significant improvement in modified Harris Hip Scores (HHS), Knee Society Score (KSS), and Short Form-12 at final follow-up compared to baseline ($p < .001$). The clinical parameters were actually lower in THA-TKA group. However, those differences were not significant ($p > .05$). Meanwhile, there was no significant difference in postoperative radiographic axial alignment and implant survivorship (90.0% vs 96.7%, $p = .305$). The rate of complication was also similar in both groups.

Conclusions

A prior THA does not appear to influence clinical outcome of a subsequent ipsilateral TKA. Patients with different sequence of ipsilateral THA and TKA have similar mid-long term clinical outcomes and implant survivorship.

Trial registration:

The trial was registered in the Chinese Clinical Trial Registry (ChiCTR2000035147) dated 2nd August 2020.

Background
Although the utilization of disease modifying medications has improved the quality of life for patients with symptomatic arthritis, the number of people affected with multiple lower extremity joints remain still high [1, 2]. Subsequently, it may increase the possibility of performing total joint arthroplasty (TJA) on ipsilateral hip and knee in the same patient. Previous studies [3–5] demonstrated that lateral patellar tilt increased and external knee adduction moment decreased after ipsilateral total hip arthroplasty (THA) which resulted in abnormal knee loading and ipsilateral knee pain. Yet, to our knowledge, there is no study evaluating the influence of a prior THA on the functional results and implant survivorship of a subsequent ipsilateral total knee arthroplasty (TKA).

Because the concept of proximal joint function influencing the loading and biomechanics alignment of distal joint is widely accepted, surgeons always perform THA before TKA when both ipsilateral hip and knee simultaneously meet the indication for TJA. During a subsequent TKA, proper positioning of femoral component is required to avoid overloading of the implant bearing, which has been reported as a risk factor for early loosening, osteolysis, and polyethylene wear [6, 7]. Thus, accurate estimate and restoring a neutral femoral and tibial mechanical axis is important. However, center rotation of the hip and femoral offset is altered after THA which inevitably lead to modifications in mechanical axis. We then estimate distal femoral resection depend on the altered femoral mechanical axis during a subsequent TKA. Further, prior studies reported that biomechanics loads during gait on the ipsilateral or contralateral knee also was altered after unilateral THA [5, 8]. Additionally, due to a prior femoral prosthesis, it is difficult to thorough insert the femoral intramedullary guide into the femoral canal in certain cases during ipsilateral TKA which has a chance of malalignment [9].

Therefore, the objective of this study was to assess the influence of a prior THA on a subsequent TKA by comparing the mid-long term results of TKA followed by ipsilateral THA and THA subsequent to ipsilateral TKA. We hypothesized that the altered mechanical axis, loading redistribution of lower extremity, and extra surgical difficulties recreated by a prior THA might give rise to poor outcomes and limited survival.

**Methods**

**Patients**

This retrospective study was approved by Institutional Review Board of West China Hospital (ID: 2012 – 268) and was reported in accordance with the STROCSS criteria [10]. Inclusion criteria were patients with severe pain and/or considerable difficulty in performing daily activities refractory to non-operative management who underwent ipsilateral THA and TKA for rheumatoid arthritis (RA) or osteoarthritis (OA). The exclusion criteria were hip dysplasia, acetabulum or femoral fracture, ankylosing spondylitis, prior lower extremity fracture, posttraumatic arthritis, revision THA or TKA, and incomplete clinical or radiographic records. Additionally, to avoid bias in related to prior TJA, patients with interval time between ipsilateral THA and TKA shorter than 6 months and patients who underwent prior TJA with a functional score at the time of subsequent surgery less than 70 points were also excluded. We identified 88 patients
(97 hips and 97 knees) who underwent ipsilateral THA and TKA at our institution between January 2008 and April 2014. Of these, two patients (2 hips and 2 knees) were lost follow-up and could not be contacted via telephone, while three patients (4 hips and 4 knees) died for diseases unrelated to the surgeries. According to different sequence of ipsilateral THA and TKA, the remaining 83 patients (91 hips and 91 knees) were classified into 2 groups. To minimum possible confounding factors, the two groups were statistically matched for age, gender, body mass index, the cause for TJA, and preoperative hip-knee-ankle angle (HKA). Ultimately, there were 28 patients (30 hips and knees) who underwent TKA followed by ipsilateral THA and 28 patients (30 hips and knees) who underwent THA subsequent to ipsilateral TKA were included in the final analysis.

**Surgical Techniques**

All THA procedures were performed using a posterolateral approach under general anesthesia. The cementless porous-coat acetabular fixations (Pinnacle implants, DePuy Orthopaedics) were routinely press-fitted into the acetabulum at 15 ± 10° of anteversion, 40 ± 10° of inclination. If necessary, supplemental screws were used to achieve implant stability. Yet, four types of cementless femoral stems, including Corial (41 hips, 68.3%), Summit (12 hips, 20.0%), Trilogy (5 hips, 8.3%), and S-ROM (2 hips, 3.3%), were inserted in hips (Table 2). Of these, the ceramic-on-ceramic articulations were utilized in 43 hips (71.7%) and the ceramic-on-polyethylene were used in 17 hips (28.3%).

For ipsilateral TKA, we measured the femoral anatomic angle, which was the angle between the altered femoral mechanical axis and mid-medullary axis of the distal diaphysis of the femur passing through the center of the femoral intercondylar notch. During the procedure of TKA, the knee was exposed by a standard medial parapatellar approach, and osteophytes, worn meniscus, posterior cruciate ligament of the knee were resected. After determining the entry point, we inserted a femoral intramedullary alignment rod in the center of the femoral intercondylar notch with the distal femoral cutting guide set for individual degrees measured before surgery. A total of 6 knees in THA-TKA group underwent shorter intramedullary guides due to abutment of the distal end of the prior hip prostheses. Of note, three knees in THA-TKA group and 4 knees in TKA-THA group have a preoperative anatomic valgus of >10° that we released the iliotibial band (ITB) using the “pie-crusting” technique [11]. If the lateral tension on extension and flexion was still tight, the posterolateral capsule was also released, avoiding the collateral ligament (LCL) and popliteus tendon (POP). After assessing the extension gap and balancing flexion gap, we performed cemented, posterior-stabilized TKAs on all subjects with fixed-bearing or rotating-platform total knee implants which included Johnson & Johnson/DePuy (27 hips, 45.0%), Stryker (30 hips, 50.0%), TC3 (3 hips, 15%). All patients received intraoperative and postoperative prophylactic broad-spectrum antibiotics and tranexamic acid antithrombosis therapy. Postoperatively, active flexion-extension ankle motion and quadriceps strengthening exercises were encouraged. Partial weight-bearing with crutches as tolerated on the second postoperative day and full weight-bearing were allowed from the third day. For patients with THA, simultaneous flexion and internal rotation were avoided after surgery.
Clinical Evaluations And Radiographic Assessments

Clinical follow-up was conducted routinely at 3 weeks, 3 months and 6 months after the procedures and annually thereafter until the final follow-up. Clinical evaluation protocol included the Harris Hip Score (HHS) [12], Knee Society Score (KSS) [13], and Short Form-12 scale (SF-12) [14]. Radiographs (serial standardized anteroposterior and lateral radiographs of hip and knee, and lower-extremity weight-bearing anteroposterior films) were taken for patients preoperatively and reviewed at each follow-up. For minimizing the variability of interobserver, all radiographic measurements were performed independently and averaged by 2 trained investigators in the index surgery. To describe the coronal extremity axis, the HKA was defined as the angle between the femoral and tibial mechanical axes. The femoral knee angle (FKA) was defined as the angle between the femoral and tibial anatomic axes. The femoral offset (FO) was defined as the perpendicular distance from the center line of the proximal part of the femoral shaft to the center of the femoral head. Inclination angle was defined as the angle formed by the inter-teardrop line and the long axis of cup opening ellipse. Limb length discrepancy (LLD) was calculated by comparing the vertical distance from the prominent points of lesser trochanter to teardrop line. If the deformation of lesser trochanter was severe, we used the tip of the greater trochanter as the reference. The correction in LLD was defined as the height difference in the preoperative and postoperative LLD [15].

The serial radiographs were also evaluated for the evidence of postoperative periprosthetic fracture (PFF), dislocation, subsidence, and femoral component stability. Subsidence of the femoral component was defined as the changes in the distance from the center of the femoral head to the lesser trochanter by the method of Heekin et al [16]. The femoral component stability was evaluated and graded as bone stable, fibrous stable, or unstable, according to the criteria described by Engh et al [17]. Complications including periprosthetic infection, deep venous thrombosis, and neurologic injury. Kaplan-Meier survivorship analysis was performed on all THAs and TKAs using standard case scenario where all arthroplasties were considered to be successful at the final follow-up. Prosthesis failure was defined as any reason for aseptic revisions.

Statistical analysis

Statistical analysis was performed by the SPSS statistical software, version 25.0 (IBM Corp., Armonk, NY). The Figures were performed by GraphPad Prism 8.0. Groups of THA-TKA and TKA-THA were matched one-to-one using propensity scores generated by logistic regression. The paired t-test was used to analyze continues variables between two groups. Pearson's Chi-square test or Fisher's exact test if necessary was used for discontinues variables between two groups. THA or TKA survivorship was analyzed by the Kaplan-Meier curve with revision for any reason other than infection as the endpoint. Survival rate between 2 groups was compared by the log-rank test. $\alpha = .05$, $P < .05$ indicated statistically significant.

Results
Comparisons of demographic characteristics are summarized in Table 1. Mean age was 55.7 years in THA-TKA group and 59.5 years in TKA-THA group with mean body mass index of 22.2 and 22.5, respectively. Females comprised 89.3% and RA comprised 60.7% of all patients in each group. The minimum follow-up was 80 months. No significant difference was detected in preoperative clinical parameters, including HHS, KSS, and SF-12. There was also no significant difference in pre-operative radiographic measurement between 2 groups, including HKA, TFA, FO, and LLD. However, Preoperative mean HKA and TFA indicated valgus alignment in both groups (184.0° vs 183.7°, 184.5° vs 182.1°, \(p > .05\)).

The postoperative clinical and radiographic results were summarized in Table 3. In both groups, the parameters of HHS, KSS, and SF-12 improved significantly after surgery (\(p < .001\)). At the final clinical evaluation, the postoperative parameters, including HHS, KSS-knee score and function score, physical component summary (PCS) and mental component summary (MCS) of SF-12, were actually lower in the THA-TKA group. However, those differences were not significant (\(p > .05\)). The comparisons of lower extremity alignment parameters were based on the measured data of the lower-extremity weight-bearing radiographs. Relative to preoperative values, HKA and TFA, were corrected to neutral after surgeries (\(p < .001\)). The postoperative FO, LLD, cup inclination did not differ between 2 groups (\(p = .916, .159, .398\)).

No periprosthetic infection and deep venous thrombosis were identified during the follow-up in each group (Table 4). There was 1 sciatic nerve palsy patient in TKA-THA group after THA who recovered spontaneously within 9 months without residual symptoms. Intraoperative fracture occurred in 4 hips (1 in distal and 3 in proximal femur) and 1 knee without displace cracks or perforation; all the fractures were treated with immediate cerclage wire fixation. Two patients (2 hips) experienced postoperative dislocation in THA-TKA group who were treated closed manipulative reduction and confined to bed for 4 weeks. Two patients in THA-TKA group and 1 patient in TKA-THA group had an over 5 mm subsidence of femoral stem which performed stem revisions with subsequent stabilization and evidence of a fibrous stable in the final follow-up. Of the patients with aseptic revisions, in THA-TKA group, two femoral revisions were performed for stem subsidence, one acetabular revision for recurrent dislocation. For ipsilateral TKA, two knee revisions for tibial aseptic loosening and 1 for instability. In contrast, in the TKA-THA group, one femoral stem revision was performed for subsidence, one modular liner was changed because of dissociation of highly cross-linked polyethylene insert from outer shell, and one knee revision for tibial implant loosening. There was no difference between THA-TKA group and TKA-THA group with respect to complications rate and overall revisions (\(p > .05\)).

Including all cases of ipsilateral THA and TKA, Kaplan-Meier survivorship with aseptic revision for any reason as end point was 93.3 % (95% confidence interval 92.9%-93.73%) at 8 years. In contrast, the TKA survival rate of THA-TKA group (92.4%) (95% confidence interval 89.8%-95.0%) has no significant difference to that of TKA-THA group (95.5%) (95% confidence interval 93.3%-97.7%).

**Discussion**
Previous studies demonstrated that the changes in axial alignment and abnormal loading distribution after THA may result in ipsilateral knee pain and a greater disease progression of knee [3–5]. However, the effect of a prior THA on the outcome of a subsequent ipsilateral TKA was unclear. The main finding of the present study was that a prior THA does not appear to influence the clinical and implant survivorship of a subsequent ipsilateral TKA.

There was only one literature [18] has assessed the influence of a prior THA on axial alignment and the clinical outcome of a subsequent ipsilateral TKA. However, it measured the lower extremity alignment without long-limb weight-bearing radiographs which could not evaluate alteration in the mechanical axis and the control group of the study matched patients underwent only TKA. Compared with this most comparable study of Asensio-Pascual et al [16], the clinical scores of our results were lower than those where postoperative HHS, KSS-knee score, KSS-function score averaged 86.4, 87.6, 88.3, respectively in THA-TKA group. A possible interpretation was the disease of our study included RA which involved in multiple joint sites, including metatarsal phalangeal joints and ankle, might be present even after the TJAs. Although RA is a rare indication for TJA compared to OA, it has been the most common cause of widespread involvement of the multiple lower extremity joints [19–21]. The immobility of other lower limb joints could lead to the difficult in ambulation or ascending stairs in spite of evident improvements in hip and knee function. Further, several prior studies involving RA patients primarily for multiple joint arthroplasties documented that between 46.2% and 62.5% patients required walking aids and the ability of walking was limited [19, 22, 23]. However, due to lower preoperative baseline expectation compared to OA patients, RA patients had no difference in satisfaction after TKA [24].

In consistent with the finding of the present study, Foucher et al [25] reported that no increase in biomechanics loading during gait on the ipsilateral knee after THA. Likewise, other studies demonstrated that the changes in the axial alignment of the lower extremity after THA could result in an increased overload on the contralateral knee rather than ipsilateral knee which was characterized by compensation to minimize the loading of affected limb [4]. Thus, patients who underwent THA may have higher risks of developing OA in contralateral knee than in the ipsilateral knee [26].

Patients received ipsilateral hip and knee surgeries presented preoperative valgus deformity in current study, especially in THA-TKA group. Preoperative valgus knee deformity was associated with advanced RA, which was in agreement with the previous study [27]. Although knees with preoperative valgus were corrected to neutral and no significant differences were detected between the 2 groups in axial alignment at the final follow-up, the overall implant survivorship of TKA in present study was lower than the results of Asensio-Pascual et al [18] with 96.6% survivorship at 7.2 years. Preoperative valgus deformity means that the procedure of TKA is much more technical challenging, including obtaining a proper component rotational alignment and balancing soft tissue in both flexion and extension with the least constraint. Sorrells et al [28] showed that knees preoperative valgus alignment were more likely to fail compared to preoperative neutral alignment. Ritter et al [29] noted that preoperative anatomical alignment of valgus failed at a higher rate than preoperatively neutral knees even when corrected to neutral postoperative alignment. Similar results were reported by Mazzotti et al [30] in a retrospective study of 2327 TKAs.
In clinical practice, if both THA and TKA are indicated, most surgeons would perform THA before TKA. Because active flexion and extension of knee depend largely on free hip function and the pain of knee is always associated with dysfunction of ipsilateral hip. However, certain affected multiple joint diseases, such as RA, normally erode knees first that lead to compulsory TKA. Then the disease severity of ipsilateral hip gradually developed a degree where met the indication for THA. We agreed with the idea that the sequence of arthroplasties should depend on the severity of symptoms and the most symptomatic joint of hip or knee should be replaced first [5, 31].

The special surgical difficulties during the procedure of TKA after prior ipsilateral THA was the femoral intramedullary guide cannot be thorough inserted into femoral canal in certain cases. In present study, a total of 6 knees in THA-TKA group underwent shorter intramedullary guides due to abutment of the distal end of the prior hip prosthesis. Bradley et al [9] reported that the alterations in the axial alignment of the extremity by a prior THA could result in greater difficulty for the alignment of the knee during TKA and the postoperative tibial-femoral limb alignment of THA-TKA patients using shorter femoral intramedullary guide was significant different from the control group who were treated only TKA, although the differences could not alter the mechanical axis alignment between the center of third of the knee. Here, we summarized some key aspects concerning the surgical technique of TKA subsequent to ipsilateral THA. First, accurate femoral cutting guarantees the restoration of the mechanical alignment according to the preoperative individual femoral anatomic angle. Second, patients with multiple joint arthroplasties have higher possibility of preoperative valgus deformity. During the procedure of TKA with severe valgus deformity, we only released ITB and posterolateral capsule, using the “pie-crusting” technique. In our experience, POP and LCL are two vital supporting structures for stability of knee which are easily released excessively. Finally, it is necessary to evaluate the length of the prior femoral prosthesis and the width of distal femoral intramedullary canal. We should prepare shorter axial assistant before TKA in case of the femoral intramedullary guide cannot be thorough inserted into femoral canal.

To date, this is the first study compared the mid-long term results of TKA followed by ipsilateral THA and THA subsequent to ipsilateral TKA. The strengths of this study include completeness of clinical and radiographic data, uncemented hip prosthesis, and homogeneity of surgical technique. However, we note there are several limitations in the present study. First, the retrospective data and a relatively small sample population for each group decreased the level of evidence. Second, we did not exclude patients with bilateral THA and TKA which might influence the function or biomechanics of the lower limb joints. When unilateral both hip and knee met the indication for TJA, the disease severity of contralateral hip or knee may not as normal as ordinary people. We matched bilateral THA and TKA patients between 2 groups to reduce the possible confounding factors. Third, only the coronal alignment was evaluated in present study, although the rotational alignment and patellar tilt are also important for the success of TKA. Yet, this study focused on the modification in the mechanical axis, which mainly present in coronal alignment. Future research with three-dimensional CT would be useful in studying the modifications in rotational alignment.
Conclusion

In summary, our findings demonstrate that a prior THA does not appear to influence clinical function of a subsequent ipsilateral TKA. Patients with different sequence of ipsilateral THA and TKA could achieve good clinical outcomes, including considerable improvement in clinical function, normal radiographic alignment, and low incidence of complications.

List Of Abbreviations

TJA, total joint arthroplasty; THA, total hip arthroplasty; TKA, total knee arthroplasty; RA, rheumatoid arthritis; OA, osteoarthritis; HKA, hip-knee-angle; ITB, iliotibial band; LCL, collateral ligament; POP, popliteus tendon; HHS, Harris Hip Score; KSS, Knee Society Score; SF-12, Short Form-12 Score; FKA; femoral knee angle; FO, femoral offset; LLD, limb length discrepancy; PFF, periprosthetic fracture; PCS, physical component summary; MCS, mental component summary.

Declarations

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Availability of data and materials

The datasets used or analyzed in the current study are available from the corresponding author on reasonable request.

Author contributions

Zunhan Liu, Wei-Nan Zeng, and Zongke Zhou participated in the design and coordination of the study, collected the data, analysed the data, and wrote the manuscript. Zhenyu Luo, Enze Zhao, and Hao Li collected assisted in collecting the data and writing up. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Ethics Committee and Institutional Review Board of West China Hospital, Sichuan University (2012-268). Informed consent was obtained from each patient.
Consent for publication

All patients provided consent to participate in current study, per our institution's standard for research consent forms, this consent specified that the research information obtained may be used for publication.

Competing interests

The corresponding author Dr. Zongke Zhou is a member of the editorial board of BMC Musculoskeletal Disorders, the rest of authors declare they have no competing interests.

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Additional information

The authors declare that they have no competing financial interests.

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Tables

Table 1 Baseline characteristics of the 2 matched groups.

| Parameters                        | THA-TKA group | TKA-THA group | p value |
|-----------------------------------|---------------|---------------|---------|
| Gender (male/female).             | 3/25          | 3/25          | 1.000   |
| Age (yr)                          | 55.7 ± 1.7    | 59.5 ± 10.7   | 0.198   |
| Body mass index (kg/m²)           | 22.2 ± 2.5    | 22.5 ± 3.9    | 0.718   |
| No. of diseases (RA/OA)           | 17/11         | 17/11         | 1.000   |
| Affected side (unilateral/bilateral) | 26/2       | 26/2          | 1.000   |
| Preoperative Harris Hip Score     | 34.1 ± 4.3    | 34.7 ± 5.9    | 0.653   |
| Preoperative KSS                  |               |               |         |
| Knee score                        | 32.0 ± 6.5    | 32.6 ± 8.4    | 0.746   |
| Function score                    | 37.8 ± 6.0    | 37.2 ± 5.8    | 0.663   |
| Preoperative SF-12                |               |               |         |
| PCS                               | 10.4 ± 2.4    | 10.7 ± 2.6    | 0.570   |
| MCS                               | 13.1 ± 2.5    | 13.6 ± 2.8    | 0.502   |
| Preoperative HKA (°)              | 184.0 ± 5.3   | 183.7 ± 5.5   | 0.810   |
| Preoperative TFA (°)              | 184.5 ± 7.6   | 182.1 ± 8.0   | 0.221   |
| Preoperative FO                   | 39.1 ± 8.8    | 42.7 ± 7.6    | 0.097   |
| Preoperative LLD                  | 36.9 ± 11.8   | 41.2 ± 8.1    | 0.101   |
| Interval between surgery (mo)     | 12 (6 to 87)  | 20 (6 to 61)  | 0.164   |
| Follow-up (mo)                    | 101 (80 to 142)| 106 (80 to 149)| 0.054 |
KSS, knee society score; PCS, physical component summary; MCS, mental component summary; HKA, hip knee ankle angle; TFA, femoral knee angle; FO, femoral offset; LLD, limb length discrepancy.

The values are present as the mean ± SD or n (%).

### Table 2 Implant informations.

| Characteristics               | THA-TKA group | TKA-THA group | p value |
|-------------------------------|---------------|---------------|---------|
| Femoral stem                 |               |               |         |
| Corial                        | 21            | 20            | 0.783   |
| Summit                        | 5             | 7             | 0.522   |
| Tri-Lock                      | 3             | 2             | 0.643   |
| S-ROM                         | 1             | 1             | 1.000   |
| Ceramic-on-ceramic            | 22            | 21            | 0.776   |
| Ceramic-on-polyethylene       | 8             | 9             | 0.776   |
| Total knee implants           |               |               |         |
| Johnson & Johnson/Depuy       | 13            | 14            | 0.797   |
| Stryker                       | 15            | 15            | 1.000   |
| TC3                           | 2             | 1             | 0.557   |

The Corail, Summit, Tri-Lock, and S-ROM prostheses are manufactured by Depuy (DePuy, Warsaw, IN).

### Table 3 Postoperative Clinical outcomes.

| Parameters                        | THA-TKA group | TKA-THA group | p value |
|-----------------------------------|---------------|---------------|---------|
| Postoperative Harris Hip Score    |               |               |         |
| Knee score                        | 85.7 ± 6.5    | 86.6 ± 8.3    | 0.616   |
| Function score                    | 84.8 ± 4.6    | 86.5 ± 5.3    | 0.199   |
| Postoperative SF-12               |               |               |         |
| PCS                               | 20.7 ± 2.2    | 21.2 ± 2.2    | 0.409   |
| MCS                               | 22.7 ± 1.8    | 23.2 ± 1.8    | 0.298   |
| Postoperative HKA (°)             | 179.7 ± 3.2   | 179.5 ± 2.3   | 0.779   |
| Postoperative TFA (°)             | 176.7 ± 4.5   | 176.9 ± 3.4   | 0.906   |
| Postoperative FO                  | 40.2 ± 6.4    | 40.4 ± 9.2    | 0.916   |
| Postoperative LLD                 | 42.6 ± 8.1    | 45.8 ± 9.2    | 0.159   |
| Cup inclination (°)               | 41.6 ± 5.9    | 40.2 ± 6.0    | 0.398   |

The values are present as the mean ± SD or n (%).

### Table 4 Complications and Revisions

| Complications                          | THA-TKA group | TKA-THA group | p value |
|----------------------------------------|---------------|---------------|---------|
| Periprosthetic infection               | 0             | 0             | 1.000   |
| Deep venous thrombosis                 | 0             | 0             | 1.000   |
| Sciatic nerve palsy                    | 0             | 1             | 0.317   |
| Postoperative PFF                      | 4             | 2             | 0.393   |
| Early postoperative dislocation        | 2             | 0             | 0.154   |
| Femoral component stability            |               |               |         |
| Bony stable                            | 24            | 28            | 0.132   |
| Fibrous stable                         | 5             | 2             | 0.232   |
| Unstable                               | 1             | 0             | 0.317   |
| Femoral stem subsidence                | 2             | 1             | 0.557   |
| Revision                               |               |               |         |
| Total hip revision                     | 3             | 2             | 0.643   |
| Total knee revision                    | 3             | 1             | 0.305   |

PFF, postoperative periprosthetic fracture.
A 43-year-old female with rheumatoid arthritis receiving TKA subsequent to ipsilateral THA. X-ray radiography at preoperative (A), postoperative image of THA (B), and 3-month follow-up (C). 7 months after THA, the patient received ipsilateral TKA. The postoperative radiograph of lower extremity (D) and a 15-day postoperative radiograph (E) showed stable implants fixation. Postoperative radiographic view (F) at 7-year follow-up demonstrated the acetabular, femoral, and tibial components were considered to be stable.
Figure 2

Radiographs (A-F) of a 27-y-old woman with underwent THA subsequent to ipsilateral TKA for rheumatoid arthritis. (A) Preoperative lower extremity image. (B) Postoperative radiograph of the patient receiving unilateral TKA. (C) Postoperative radiographic view at 6-months follow-up. (D) 1 year after prior THA, the patient received ipsilateral THA. The anteroposterior postoperative image of lower extremity. (E) A 6-month radiograph after subsequent THA. (F) Postoperative radiographic view of acetabular, femoral, and tibial components showed stable implants fixation.
Figure 3

Kaplan-Meier survivorship curve with radiographic loosening or revision of TKA for any reason