Component alignment in simultaneous bilateral or unilateral total knee arthroplasty

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Abstract A bilateral total knee prosthesis procedure can be performed simultaneously in patients with bilateral gonarthrosis. The purpose of this study was to evaluate the differences in component alignment between the simultaneous bilateral TKA and unilateral TKA. A total of 20 patients out of 40 underwent simultaneous bilateral TKA, whereas 20 patients had unilateral TKA. The component alignments were compared radiographically. There was no statistically significant difference in the component alignment between the simultaneous bilateral TKA group and the unilateral TKA group. In conclusion, component alignment of the patients with simultaneous bilateral TKA is similar to that of unilateral TKA.

Introduction

Most cases of gonarthrosis are bilateral [1]. Simultaneous bilateral TKA can provide a better lower extremity function in these patients. Total knee arthroplasty is a good option for pain relief and improved function in patients with advanced gonarthrosis. Simultaneous bilateral TKA procedures have increased in patients with bilateral involvement

in recent years [2–6]. This provides the patient an early return to daily activities [7].

The general condition of a patient must be good for a simultaneous TKA procedure [8]. Other important requisites for the simultaneous procedure are the surgical equipment and the conditions of the surgical centre.

Simultaneous bilateral TKA procedures can take a long time. The surgeon can get tired and make mistakes in these long surgical sessions [9]. Component malalignment is one of the common errors in TKA [10–12]. Therefore, there is a need to search for a difference in component alignment between simultaneous bilateral TKA and unilateral TKA cases.

The hypothesis of our study is that there is no difference in component alignment between bilateral simultaneous and unilateral TKA procedures.

Materials and methods

During the two-year study period, a total of 127 patients with bilateral gonarthrosis were selected as the target group for the study. The inclusion criteria were; bilateral varus gonarthrosis, an indication for simultaneous bilateral TKA, those who signed informed consent for the study and a health status permitting the bilateral simultaneous procedure (American Society of Anesthesiologists [ASA] 1 or 2; ASA-1 refers to a normal healthy patient. ASA-2 refers to a patient with mild systemic disease). The exclusion criteria were; rheumatoid disease, a valgus gonarthrosis, a unilateral instead of simultaneous bilateral TKA because of the worsening health conditions during the surgical procedure, structural defects necessitating wedge or cement filling, and patellar component usage.

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A total of 40 patients were enrolled in both groups. Simultaneous bilateral TKA was performed in 20 patients (group A, the first operated knee; group B, the second operated knee), and unilateral TKA was performed in 20 patients (group C). The selection for uni- or bilateral TKA was done randomly. Randomisation was done with sealed envelopes. Three patients were male and 37 were female. The mean age was 70 years (range 64–77).

All patients had standing anteroposterior (AP) and lateral standard X-rays using same X-ray machine from one metre distance before surgery on both knees. All operations were performed by the same surgeon in the same centre as the first case of the day in that operating room. All patients were operated upon under general anaesthesia. The right knee was operated first in patients with bilateral surgery (group A). A mid-patellar longitudinal incision with medial parapatellar retinacular approach to evert the patella to the lateral side was used. Surgery was done under tourniquet. The Genesis II (Smith and Nephew) cemented total knee prosthesis was used in all patients. An intramedullary femoral guide with a five degree angle was used for the femoral cut. An extramedullary tibial guide with a perpendicular cut to the tibial anatomical axis was used for the tibial cut. Patellar osteophytes were excised and patellar denervation was performed.

All patients had X-rays of the operated knees in full extension, an AP with patella centring the femoral condyles, a lateral with femoral condyles superposing each other and a true lateral proximal tibia to evaluate the tibial components on the first postoperative day. To superpose the femoral condyles on each other, the medial and lateral femoral epicondyle should be perpendicular to the radiological cassette. For the true lateral proximal tibia, the tibial tubercle should be anterior and the fibular head should be palpated at the back of the tibial plateau. For the acceptable femoral lateral view, the two femoral component pegs should be superposed; and for the acceptable proximal tibial view the tibial component pegs and the grooves of the pegs should be true lateral.

Interpretation of the radiographs

All preoperative and postoperative radiographs were evaluated by the same method. The patient X-rays were evaluated as simultaneous bilateral TKA to the right knee (group A), simultaneous bilateral TKA to the left knee (group B) and unilateral TKA (group C). The preoperative assessment was done according to Kellegren-Lawrence and Ahlback classifications for gonarthrosis. The anatomical femoral axes and anatomical tibial axes were drawn in preoperative standing AP radiographs to define the varus angle. The same evaluator drew the alpha, beta, gamma and delta angles of the components in postoperative full length

radiographs. Accordingly, alpha angle (α) is the medial angle between a line drawn parallel with the femoral component condyles and the anatomical axis of the femur (Fig. 1a). Beta angle (β) is the medial angle between a line drawn parallel to the tibial component on the AP X-ray and the anatomical axis of the tibia (Fig. 1a). Sagittal femoral gamma angle (γ) is the proximal angle between a line drawn perpendicular to the distal cement interface of the femoral component and the femoral anatomical axis in the lateral X-ray (Fig. 1b). Sagittal tibial delta angle (δ) is the posterior angle between a line drawn parallel to the tibial component and the anatomical tibial axis in the lateral X-ray (Fig. 1a). The Kellegren-Lawrence and Ahlback gonarthrosis classifications, preoperative anatomical varus angles, postoperative alpha, beta, gamma and delta angles of the groups (groups A, B and C) were all compared statistically.

Statistical method

The statistical analyses were done using NCSS 2007 (NCSS Statistical Software, UT, USA) software package. Descriptive statistical methods (mean, standard deviation)

Fig. 1 Measurement of alpha, beta and delta angles (a) and measurement of gamma angle (b)

were used for data evaluation. The Kruskal–Wallis test was used for the comparison of Kellegren-Lawrence and Ahlback gonarthrosis classifications and preoperative anatomical varus angles, postoperative alpha, beta, gamma and delta angles of the three groups (groups A, B and C).

Results

The mean preoperative anatomical varus angle, Kellegren-Lawrence and Ahlback gonarthrosis classifications are given in Table 1. There were no statistically significant differences between the preoperative anatomical varus angle, Kellegren-Lawrence and Ahlback gonarthrosis classifications ($p=0.457$; $p=0.68$; $p=0.948$, respectively) (Table 1).

The mean postoperative measured alpha, beta, gamma and delta angles of the three groups (groups A, B and C) are given in Table 1. There were no statistically significant differences between the postoperative measured alpha, beta, gamma and delta angles of the three groups (groups A, B and C) ($p=0.209$; $p=0.112$; $p=0.73$; $p=0.999$, respectively) (Table 1).

Discussion

Simultaneous bilateral TKA is important for a comfortable life in patients with bilateral gonarthrosis [2–6]. There may be angular differences in component placements in longer surgical procedures, but according to the results of our study there were no differences in component alignment between simultaneous bilateral TKA and unilateral TKA.

Our study has some limitations. First of all, the study size with 40 patients is rather small, but it is difficult to find suitable patients for this study design. The rheumatoid patients and patients with a valgus deformity were excluded

in order to overcome heterogeneity and data evaluation errors.

The preoperative gonarthrosis scores were evaluated according to Kellegren-Lawrence and Ahlback gonarthrosis classifications [13, 14]. The resemblance of gonarthrosis in simultaneous bilateral or unilateral knees is important for the results of the study. Advanced stage gonarthrosis may lead to less successful total knee arthroplasty outcomes [15, 16]. Therefore, having a similar stage of preoperative gonarthrosis is important for our study groups.

Varus component malposition may be encountered in varus knees [10]. Similarity in varus angles of the knees recruited for the study was important. This helped to ensure that the potential difficulties related to surgery were similar in all knees. We excluded patients with defects from the study because they were small in number and surgeons generally avoid performing simultaneous bilateral procedures on these types of knees. Repair of the defect is also time consuming, which has an adverse effect on surgical time and outcomes.

There are several advantages to simultaneous bilateral TKA procedures. The hospital stay, rehabilitation and disability times, and hospital costs are less in these procedures [17]. Therefore, it is an advantage to perform a simultaneous bilateral TKA. As with in all TKA procedures, the component alignment is an advantage in prosthesis survival [18]. The alignment angles of all prostheses in our study were similar. This indicates that simultaneous bilateral TKA and unilateral TKA component alignment are both the same.

Conclusion

In conclusion, the angular alignment of simultaneous bilateral TKA and unilateral TKA procedures are similar. Simultaneous bilateral TKA does not cause component malalignment.

Table 1 Statistical comparisons of the mean preoperative varus angle, Kellegren-Lawrence and Ahlback classifications, and postoperative alpha, beta, gamma, and delta angles between the groups (groups A, B and C)

Parameter measured	Group A	Group B	Group C	Kruskal-Wallis test	<i>p</i>
Preoperative varus angles	5±3.36	5.7±3.08	4.6±3.56	1.56	0.457
Preoperative Kellegren-Lawrence classifications	3.75±0.44	3.85±0.37	3.75±0.44	0.77	0.680
Preoperative Ahlback classifications	3±1.49	2.95±1.47	2.85±1.42	0.11	0.948
Postoperative alpha angles	96.15±3.08	95.55±2.61	96.65±2.93	1.43	0.490
Postoperative beta angles	88.05±2.98	87.4±2.37	87.15±3	1.08	0.583
Postoperative gamma angles	6.45±2.65	6.6±2.33	6.6±2.46	0.28	0.869
Postoperative delta angles	84.55±3.76	84.7±3.37	84.8±3.27	0.12	0.940

Data given as value ± standard deviation for groups A, B and C

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