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Comparison between mobile-bearing and fixed-bearing knees in bilateral total knee replacements

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Abstract The purpose of this study was to compare mid-term results of mobile-bearing and fixed-bearing in bilateral total knee arthroplasty (TKA). Twenty-two patients underwent bilateral TKA with a mobile-bearing prosthesis (Rotaglide, Corin, UK) on one side and a fixed-bearing prosthesis (NexGen-CR, Zimmer, USA) on the other. There were 21 female patients, and in 18 patients, the diagnosis was rheumatoid arthritis. The average age was 59.6 (35–78) years. In all procedures, the posterior cruciate ligament was retained and patella re-surfaced. The average follow-up in the mobile-bearing group was 98 (79–107) months and 96 (79–107) months in the fixed-bearing group. At the final follow-up, the knee score was 91.8 points and 91.1 points, respectively, and the function score 65.5 points. The range of motion was similar in the two groups (1.1–106.9°; 0.4–106.9°). Five patients favoured the fixed-bearing prosthesis, but 16 found no difference. In patients with bilateral TKA, there was no difference in the short-term result between mobile-bearing and fixed-bearing prostheses.

Résumé Le but de cette étude était de comparer les résultats à moyen terme des plateaux fixes et des plateaux mobiles dans l'arthroplastie totale du genou bilatérale (TKA). Vingt-deux malades ont eu une arthroplastie bilatérale avec une prothèse à plateau mobile (Rotaglide, Corin, ROYAUME-UNI) d'un côté et une prothèse à plateau fixe (NexGen-CR, Zimmer, USA) de l'autre. Il y avait 21 femmes et, pour 18 malades le diagnostic était polyarthrite rhumatoïde. L'âge moyen était 59.6 (35–78) ans. Dans tous les cas, le ligament croisé postérieur a été conservé et la rotule resurfacée. Le suivi moyen dans le groupe plateau mobile était 98 (79–107) mois et 96 (79–107) mois dans le groupe plateau fixe. Au dernier recul le score du genou était 91,8 points et 91,1 points respectivement et le score fonctionnel de 65,5 points. L'amplitude de mouvement était semblable dans les deux groupes (1.1–106.9° resp. 0.4–106.9°). Cinq malades préfèraient la prothèse à plateau fixe mais 16 n'ont trouvé aucune différence. Chez les malades avec une arthroplastie bilatérale du genou il n'y avait aucune différence dans les résultat à court terme entre les prothèses à plateau fixe et celles à plateau mobile.

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Introduction

The mobile-bearing knee is designed to allow antero-posterior (AP) and rotational movement of the knee during flexion while keeping the loaded articular contact area to the maximum; other design goals include reducing wear on the polyethylene insert and improving the long-term performance of the implant. It is not yet clear, however, whether the mobile-bearing knee provides better results than the fixed-bearing knee (Fig. 1). For cases requiring bilateral total knee arthroplasty (TKA), we used a mobile-bearing implant for one knee and a fixed-bearing for the other and compared the short-term results between them under the same conditions of gender, age, body weight, diagnosis, bony quality and activity. In addition, we issued questionnaires to the patients to determine their subjective evaluation of both knee implant types.

Patients and methods

Of the 23 bilateral TKA cases treated from February 1996 to June 1998 for which we used a mobile-bearing implant for one knee and a fixed-bearing implant for the other, we

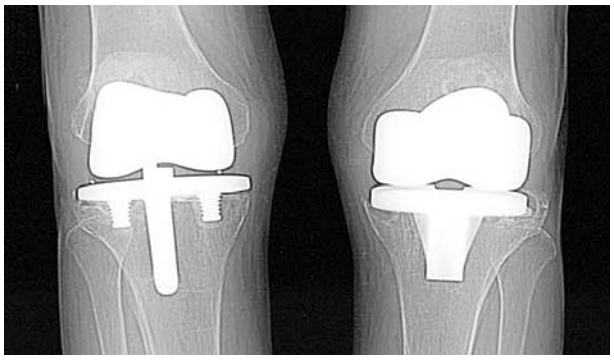

Fig. 1 Radiograph of bilateral total knee prostheses with a Rotaglide mobile-bearing implant in the right knee and a NexGen CR fixed-bearing implant in the left knee.

examined 44 knees of 22 cases (21 women and one man). One patient died. Average patient age at the time of operation was 59.6 (range 35–78) years. Diagnosis was rheumatoid arthritis (RA) in 18 patients (36 knees) and osteoarthritis (OA) in four patients (eight knees). For mobile-bearing knees, we used 22 Rotaglide prostheses (Corin, UK). The polyethylene-bearing insert of the Rotaglide allows 5 mm of AP translation and 25° of axial rotation on a polished metallic tibial tray. For the fixed-bearing knee, we used 22 NexGen CR prostheses (Zimmer, Warsaw, IN, USA). We performed a medial para-patellar approach, retained the posterior cruciate ligament and re-surfaced the patella in all knees. No cases required lateral patellar retinaculum release. The implant was fixed with cement in 40 knees of 20 cases, and we used a hybrid TKA (tibial and patellar fixation with cement and femoral fixation without cement) in four knees of two cases. In four cases, both knees were treated simultaneously and in 18 cases, they were operated on separately. The implant type was randomly selected for each knee.

For evaluation, we determined the American Knee Society knee scores, pain and function scores [4], range of motion (ROM), and joint line displacement pre-operatively and at final follow-up [3]. We also examined the femoro-tibial angle (FTA) pre-operatively and at the final follow-up. The angle of components, occurrence of radiolucent lines (RLL) [2], and complications at the final follow-up were recorded. Furthermore, we investigated the differences in subjective symptoms between the two knee groups based on the questionnaires. We used Mann–Whitney's *U* test for statistical verification.

Results

The average duration of follow-up was 98.6 (range 79–107) months for the Rotaglide group and 96.2 (range 79–107) months for the NexGen group. The average knee scores for the Rotaglide group were 26.1 (range 0–70) points pre-operatively and 91.8 (range 72–100) points at the final follow-up. For the NexGen group, average scores were 28.2 (range 3–70) points pre-operatively and 91.1 (range 72–99) points at the final follow-up. The average pain scores of the Rotaglide group were 5.5 (range 0–30) points pre-operatively and 49.7 (range 45–50) points at the final follow-up. For the NexGen group, average scores were 7.3 (range 0–30) points pre-operatively and 50.0 (range 50–50) points at the follow-up. Average function scores were 15.2 (range 0–55) points pre-operatively and 65.5 (range 0–100) points at the follow-up. For two cases the final function score was 0 points due to polyarthritis caused by RA in one and paralysis as an after effect of cerebral infarction in the other.

Pre-operatively, the average ROM of the Rotaglide group was from 10.5° (range 0–35° fixed flexion) to 113.2° (range 60–140°); that of the NexGen group was from 12.8° (range 0–30° fixed flexion) to 107.8° (range 45–140°). At the final follow-up, the average ROM of the Rotaglide group was from 1.1° (range 0–15°) to 106.9° (range 85–125°); that of the NexGen group was from 0.4° (range 0–5°) to 106.9° (range 85–120°) (Table 1).

Table 1 Summary of results. (*FTA*=Femoro-tibial angle)

		Rotaglide	Range	NexGen CR	Range	*p* value
Pre-operative knee score	Points	26.1	0–70	28.2	3–70	0.30
Pre-operative pain score	Points	5.5	0–30	7.3	0–30	0.74
Pre-operative flexion contracture	Degrees	10.5	0–35	12.8	0–30	0.91
Pre-operative flexion angle	Degrees	113.2	60–140	107.8	45–140	0.64
Pre-operative FTA	Degrees	175.6	156–195	176.6	165–195	0.79
Follow-up period	Month	98.6	79–107	96.2	79–107	0.58
Post-operative knee score	Points	91.8	72–100	91.1	72–99	0.82
Post-operative pain score	Points	49.7	45–50	50.0	50–50	1.00
Post-operative flexion contracture	Degrees	1.1	0–15	0.4	0–5	0.96
Post-operative flexion angle	Degrees	106.9	85–125	106.9	85–120	0.79
Post-operative FTA	Degrees	173.2	165–178	172.5	164–180	0.36
α angle	Degrees	96.8	92–102	97.0	93–105	0.60
β angle	Degrees	89.3	83–94	89.8	84–94	0.73
γ angle	Degrees	6.7	0–15	6.3	1–15	0.60
δ angle	Degrees	82.5	75–89	83.6	80–90	0.47
Change of joint line	Millimeters	4.9	0–8	6.3	2–15	0.57

The average post-operative change of joint line was 4.9 (range 0–8) mm higher for the Rotaglide group and 6.3 (range 2–15) mm for the NexGen group. Pre-operatively, the average FTA was 175.6° (range 156–195°) in the Rotaglide group and 176.6° (range 165–195°) in the NexGen group. At the final follow-up, the average FTA was 173.2° (range 165–178°) in the Rotaglide group and 172.5° (range 164–180°) in the NexGen group (Table 1). Average angles of components determined in the final follow-up were α=96.8° (range 92–102°), β=89.3° (range 83–94°), γ=6.7° (range 0–15°), and δ=82.5° (range 75–89°) for the Rotaglide group and α=97.0° (range 93–105°), β=89.8° (range 84–94°), γ=6.3° (range 1–15°), and δ=83.6° (range 80–90°) for the NexGen group (Table 1). At the final follow-up, a 1 mm or larger RLL was seen in six Rotoglide knees and three NexGen knees. For the Rotaglide group, the distribution of the lines was five in zone 1 of the frontal view of the tibia, one in zone 2, three in zone 3, and one in zone 2 of the lateral view of tibia; and for the NexGen group, the distribution was two in zone 1 of the frontal view of the tibia, two in zone 2, and two in zone 4. During the follow-up, we found no statistically significant difference (p>0.05) between the Rotaglide and NexGen groups with regard to, the knee score, pain score, ROM, and FTA before and after operation. Change of joint line, the angle of components and RLL were similar in both groups. Nor did we recognize any post-operative complication such as infection, wear, instability, dislocation, or patellar disorder.

In the questionnaire, 16/22 patients answered that they did not notice any difference between their two knees. Of the remainder, five claimed that their NexGen knee was better than the other, and one that the Rotaglide was better. Subjective symptoms reported for the Rotaglide knee but not for the NexGen included swelling for three knees, less flexion angle than contra-lateral side for three knees, knocking sound for two knees, minor pain for one knee, sense of discomfort for one knee, and clicking for one knee. Subjective symptoms reported for the NexGen knee but not for the Rotaglide included swelling for one knee and instability for one knee.

Discussion

The mobile-bearing knee was developed to disperse the stress on tibial components and reduce both polyethylene wear and loosening of fixation, but the effects of a mobile insert on the dynamic state inside a living organism, such as the ROM and stability, are unknown. Several reports, compare a mobile-bearing prosthesis for one knee and fixed-bearing one for the other in bilateral TKA cases, under the same conditions of gender, age, body weight, bony quality, and activity of the subjects [1, 5–7]. Kim et al. [5] reported the clinical outcome after more than 6 years of follow-up after simultaneous bilateral posterior-cruciate-retaining TKA cases using LCS (DePuy, Warsaw, IN, USA) meniscal-bearing prosthesis and AMK (DePuy) fixed-bearing prosthesis. Chiu et al. [1] reported short-term results of bilateral TKA cases using LCS (DePuy) rotating-platform prosthesis and AMK (DePuy) posterior-stabilized, fixed-bearing prosthesis. Ranawat et al. [7] reported short-term results of bilateral TKA using PFC Sigma (DePuy) posterior-stabilized rotating-platform and posterior-stabilized fixed-bearing prostheses with the same femoral components. These studies reported that there was no difference between the mobile-bearing and fixed-bearing groups for clinical scores and ROM. Price et al. [6] reported clinical results at 1-year follow-up of bilateral posterior-cruciate-retaining TKA cases using TMK (Biomet, UK) mobile-bearing prosthesis and AGC (Biomet) fixed-bearing prosthesis. This study reported that clinical scores and pain scores for the mobile-bearing group were slightly better than those for the fixed-bearing group but there was no difference in ROM. Our results indicated no difference between the mobile-bearing and fixed-bearing groups for knee scores, ROM, and the occurrence of RLLs.

The questionnaires completed by the patients, however, tended to indicate more subjective symptoms for the mobile-bearing knee. In particular, such symptoms as reduced flexion, knocking sounds, feelings of discomfort, and clicking seemed to be related to the mobile bearing insert mechanism. For the mobile-bearing TKA, more importance is attached to balancing the soft tissue. We assumed that these subjective symptoms occurred as a result of incomplete soft-tissue balancing. The follow up period was not sufficient to evaluate the reduction in wear of inserts and/or loosening of implants, which constitutes a design concept of the mobile-bearing knee. A longer-term observation of the two groups used in this study is necessary to fully evaluate the usefulness of the mobile-bearing knee. We found no statistically significant differences between the mobile bearing and fixed-bearing implants in midterm performance evaluations of bilateral TKA cases. However, the patients tended to notice more subjective symptoms with the mobile-bearing group.

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