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ORIGINAL ARTICLE

Bicompartmental (uni plus patellofemoral) versus total knee arthroplasty: a match-paired study

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Abstract

Background Osteoarthritis (OA) of the knee, whether primary or post-traumatic, does not always involve all three compartments (tibiofemoral medial and lateral and the patellofemoral ones). Bicompartmental knee arthroplasty (BKA) was proposed as a good alternative to total knee arthroplasty when two of the three knee compartments were affected.

Materials and methods We performed a retrospective comparative study collecting all BKAs performed between March 2010 and January 2016. During this period, we treated 27 patients with BKA for medial or lateral and patellofemoral OA. Seven of them were lost to follow-up and were not included in the study. Group A (BKA group) was compared to a homogeneous group of 20 patients who underwent TKA during the same period (group B).

Results Patients treated with TKA were younger than those treated with BKA (mean age 65 vs. 67.2; $p=0.2149$). BKA resulted in longer mean operating time (87 vs. 82.4 min; $p=0.2983$), less blood loss (413 vs. 458 ml; $p=0.0052$) but higher blood transfusion rate (12 vs. 10%). Medium follow-up was 34 months for BKA group and 38 months for TKA group. No statistically significant differences were found in KSS score between the two groups (KSS score 92.3 for BKA, 94.5 for TKA; $p=0.5221$; KSS function was 87.2 for BKA and 89.2 for TKA; $p=0.4985$).

Conclusion The most important finding of the present study was that although BKA seemed to be theoretically more favorable in terms of functional recovery and blood loss, patients of group A had lower KSS score and higher transfusion rate than those of group B. Our data confirm that BKA could be proposed as an alternative to TKA, especially in young and high-demanding patients.

Keywords Unicompartmental knee arthroplasty · Bicompartmental knee arthroplasty · Patellofemoral arthroplasty · Match-paired study

Introduction

Osteoarthritic changes of the knee, whether primary or post-traumatic, do not always involve all three compartments (tibiofemoral medial and lateral and the patellofemoral ones). Nowadays, total knee arthroplasty (TKA) is still the most common way to treat knee osteoarthritis (OA), even when only one of the compartments is affected [1]. TKA is widely reported in the literature as giving reliable and long-lasting results in 85–95% of cases [1]. However, patient satisfaction does not always meet expectations. During TKA, healthy portions of the knee are sacrificed as are, even more importantly, one or both cruciates eliminating normal knee kinematics and proprioception. Then, surgical alternatives to TKA must be taken into consideration for uni- or bicompartmental knee OA [1].

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Bicompartmental knee arthroplasty (BKA) has been proposed to bridge the gap between unicompartmental knee arthroplasty (UKA) and TKA when two of the three knee compartments are affected. BKA is a type of resurfacing surgery where two of the three compartments of the knee (medial tibiofemoral, lateral tibiofemoral and patellofemoral) joint are replaced with preservation of the third [2]. The commonest form of bicompartmental osteoarthritis affects both the medial tibiofemoral and the patellofemoral compartment and can be called medio-patellofemoral osteoarthritis [3]. Consequently, the commonest form of BKA is the combination of medial UKA and patellofemoral joint arthroplasty (PFJA). Less frequently, both medial and lateral compartments (bi-uni) can be performed, followed by lateral UKA plus PFJA.

Advocates of BKA cited less blood loss, shorter hospital stay, tissue sparing, better functional results and easier revision surgery, especially in younger patients. These goals are obtained by replacing only the damaged compartment, while preserving the others as well as the ligaments and the capsule [4]. But opponents stated that these advantages do not persist after 1 year postoperatively and that they are minimal when adjusted for age, sex, body max index (BMI) and baseline status [5].

The aim of this study is to compare the results of BKA versus TKA in patients with medial or lateral tibiofemoral and patellofemoral OA.

Materials and methods

From March 2010 and January 2016, 27 patients underwent BKA for medial or lateral and patellofemoral OA (Figs. 1, 2). Seven of them were not available for follow-up and were not included in the study. Group A (BKA group) was compared to a homogeneous group of 20 patients who underwent TKA during the same period (group B). The groups did not show statistical differences in terms of age, sex and BMI (Tables 1, 2).

Inclusion criteria for BKA were as follow: unicompartmental disease (medial or lateral) associated with patellofemoral OA with evident clinical symptoms; flexion contracture $< 10°$; ROM (range of motion) $> 90°$; varus/valgus deformity $< 15°$. Exclusion criteria for BKA were as follow: inflammatory OA, such as rheumatoid arthritis; tibial lateral thrust; flexion contracture $> 10°$; varus/valgus deformity $> 15°$; ROM $< 90°$; anterior cruciate ligament deficiency in young patients. Age and BMI were not contraindications. When three of the compartments were affected or when two compartments with ACL where affected in a young and high-demanding patient, TKA was performed.

The clinical data were analyzed using the Knee Society Score (KSS). Radiological analysis comprised standard anteroposterior, lateral view and axial view of the patella.

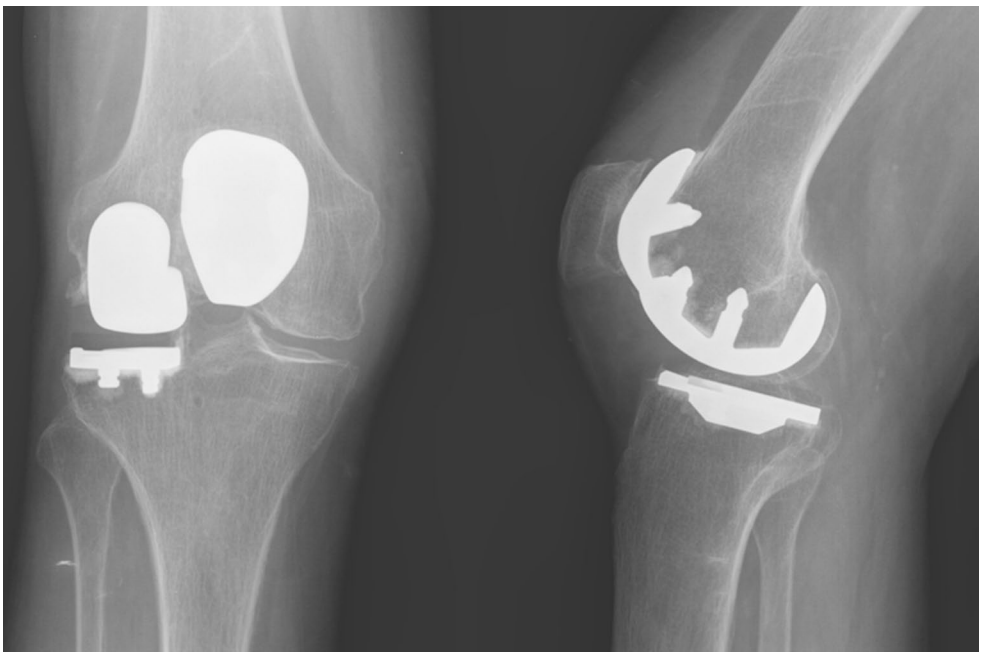

Fig. 1 Lateral UKA plus patellofemoral arthroplasty

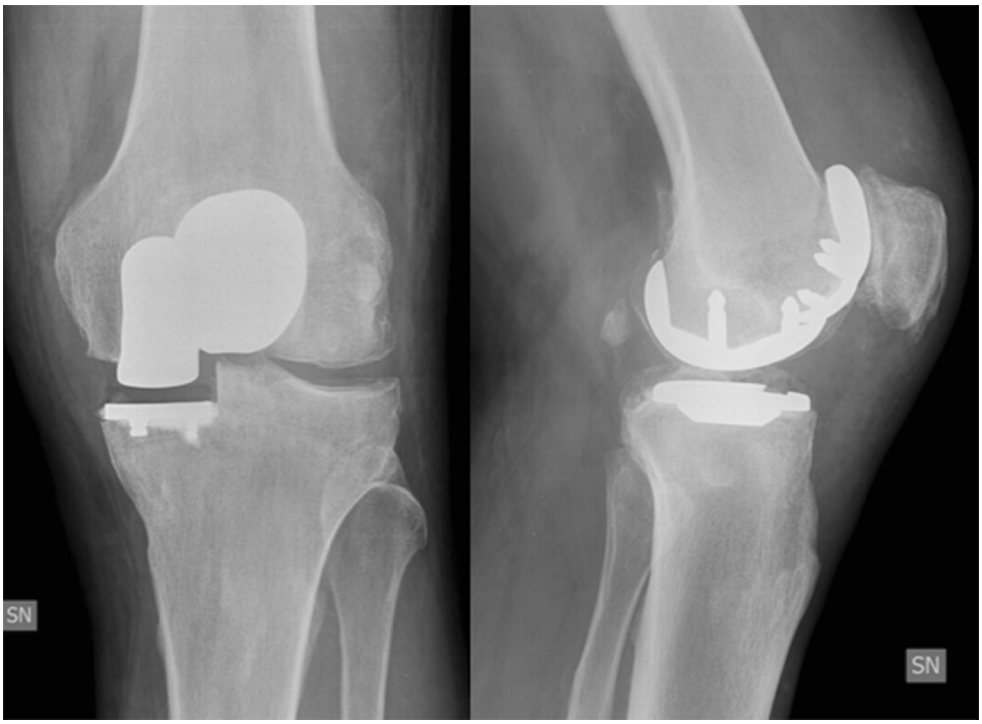

Fig. 2 Medial UKA plus patellofemoral arthroplasty

Table 1 Demographic characteristics of BKA group of patients

Patient	Sex	BMI	Age	Medial–lateral	CAS
1	F	25	52	Lateral	Yes
2	M	27.28	68	Medial	Yes
3	F	27	74	Medial	Yes
4	F	25.95	79	Lateral	Yes
5	F	28.3	76	Medial	Yes
6	F	28	69	Medial	Yes
7	F	29	69	Medial	Yes
8	F	21.3	76	Medial	Yes
9	M	26	64	Lateral	Yes
10	M	28	44	Lateral	No
11	M	28.81	49	Medial	Yes
12	F	30.47	70	Medial	Yes
13	F	30.08	60	Lateral	Yes
14	F	29.73	71	Lateral	Yes
15	F	25.48	69	Lateral	Yes
16	M	33.03	56	Medial	Yes
17	F	28.44	73	Medial	Yes
18	F	25	78	Medial	Yes
19	F	25.82	71	Lateral	Yes
20	M	30	76	Medial	Yes

CAS computer-assisted surgery

Table 2 Demographic characteristics of TKA group of patients

Patient	Sex	BMI	Age	CAS
1	F	30.1	62	Yes
2	F	29.8	69	Yes
3	F	27.3	70	Yes
4	F	26.5	72	Yes
5	F	25	65	No
6	F	28.3	60	No
7	F	31	33	Yes
8	F	27.8	68	No
9	F	25.18	74	Yes
10	M	31.4	66	Yes
11	F	28	54	Yes
12	M	27.3	47	Yes
13	F	29	66	Yes
14	F	27.8	69	Yes
15	F	26.2	87	No
16	M	28.1	63	Yes
17	F	26.6	69	Yes
18	F	28.3	70	Yes
19	F	29.7	70	Yes
20	F	28.54	67	Yes

CAS computer-assisted surgery

Statistical analysis

Statistical analysis of the data was performed with the statistical software STATA. The Mann–Whitney test was used to compare averages of continuous variables of the two groups. In particular, the *t* test can be used to determine if two sets of data were significantly different from each other (for example to determine whether there was a significant difference in operating time or BMI or age between the two groups). The level of significance chosen was 95%. The test is significant if the p value < 0.05.

Results

Demographics

There were 20 patients in group A (6 males and 14 females, mean age 67.2, mean BMI 27.6). The UKA implant was medial in 12 patients and lateral in 8. Nine cases involved the right knee and 11 the left. The diagnosis was primary OA in 19 cases and secondary OA in 1 case. The implants we used were Sigma Partial Knee (DePuy) in association with PFJ (DePuy) in 17 cases, Accuris with Journey PFJ (Smith and Nephew) in 2 cases and ZUK with PFJ (Zimmer, Warsaw) in 1 case. We never performed patella arthroplasty. The BKA was computer-assisted in 19 cases.

Group B had 20 patients (3 males, 17 females, mean age 65, mean BMI 29.7). Sixteen cases involved the right knee and 4 the left. The diagnosis was primary OA in 18 cases and secondary OA in 2 cases. The implant was posterior stabilized in 3 cases, cruciate retaining in 17 cases. The implants we used were Columbus BBraun in 14 cases, Journey (Smith and Nephew) in 3 cases and GMK (Medacta) in 3 cases. We never performed patella arthroplasty. The TKA was computer-assisted in 16 patients.

Complications

Medium follow-up was 34 months for BKA group and 38 months for TKA group. There were no general complications such as cardiac/cerebrovascular events, urinary tract infections and deep vein thrombosis. In group A we reported 2 manipulations under anesthesia for knee stiffness, 1 patella resurfacing, 1 scar dehiscence treated with VAC-therapy and 1 failure (aseptic loosening) treated with TKA in other hospital. In group B, we had 1 superficial infection treated with surgical debridement and 1 revision due to knee laxity (in this case we changed only thickness of polyethylene).

Clinical outcomes

Patients treated with TKA were younger than those treated with BKA (mean age 65 vs. 67.2; $p = 0.2149$). BKA resulted in longer mean operating time (87 vs. 82.4 min; $p = 0.2983$), less blood loss (413 vs. 458 ml; $p = 0.0052$) but higher blood transfusion rate (12% for BKA and 10% for TKA). The mean KSS score in the 2 groups did not show statistical significant difference (KSS score 92.3 for BKA, 94.5 for TKA; $p = 0.5221$; KSS function was 87.2 for BKA and 89.2 for TKA; $p = 0.4985$). Respectively, in patients treated with BKA and TKA, KSS score was excellent (80–100) in 13 and 14 patients, good (70–79) in 4 and 3 patients, fair (60–69) in 3 and 3 patients.

Discussion

The most important finding of the present study was that although BKA seemed to be theoretically more favorable in terms of functional recovery and blood loss, patients of group A had lower KSS score and higher transfusion rate than those of group B. However, these differences were not statistically significant.

BKA has been done with two philosophically different femoral component designs, either with modular unlinked components which are what was done in this study or with a single monolithic design with linked between the patello- and tibiofemoral components [6]. The monolithic implant for BKA has the challenge for the appropriate in sizing and implant alignment due to variability in coronal alignment and morphology of the distal femur [7]. Modular femoral implant for BKA allows independent sizing and orientation of the individual components in each compartment. In their study, Palumbo et al. concluded that the implantation of the monolithic bicompartmental prosthesis (Journey-Deuce) was an unreliable method to treat degenerated medial and patellofemoral compartments. They observed persistent knee pain and reduced function with a high incidence of conversion to TKA [8]. Morrison et al. [5] had a revision rate of 14% of their 21 Journey-Deuce BKA to TKA for persistent pain after 1 year postoperatively with a trend for increased revision rate at 2 years of follow-up.

Outcomes reported for modular BKA are more favorable, and enthusiasm is spreading in orthopedic community for this custom-made solution, especially for younger patients. Heyse et al. [9] presented data on a small series of 9 patients and reported 100% survival at 12 years, with very good functional outcomes. The 71 patients study published by Parratte and Argenson [10], however, reported a much lower survival rate (54%) at 17 years and a good level of satisfaction. The authors of this second study underlined the issues related to implant design, the need for accurate patient selection

and the problem of crude or absent instrumentation at the time of investigation, and the consequent risk of component malalignment. The authors of both studies concluded that this intervention is technically demanding and requires experience in both UKA and PFJA.

Our results are similar to those reported in the literature. Tamam et al. [11] reported good to excellent results in 83% of 29 BKA with CAS technique. Tan et al. [12] performed a match-paired study comparing BKA and TKA in a short-term follow-up: they had similar functional scores, longer mean operative time and less blood loss for BKA group. Chung et al. [13] compared knee muscle strength and physical performance between a group of BKA and TKA: they concluded that although BKA seemed to be theoretically more favorable in knee kinematics by preservation of more bone stocks and cruciate ligaments, it was not superior in recovery of the knee muscle strength as well as physical performance at 1 year compared to TKA. Sabatini et al. [14] retrospectively reviewed 9 cases of BKA, reporting good functional results but with a short-term follow-up. Benazzo et al. [1] retrospectively reviewed 30 BKA performed between 2007 and 2012: they reported excellent functional results but also 3 cases of revisions (10%), 2 for patella resurfacing and 1 for aseptic loosening in all-poly tibial baseplate (treated with conversion to TKA). More recently, Romagnoli and Marullo reported the outcomes of BKAs in a retrospective study of 105 PFJAs: they divided patients in two groups, one with isolated PFJAs (64 implants) and one with combination of medial UKA and PFJA (41 implants). Both groups showed improvement in knee ROM and KSS. At a medium follow-up of 6 years, only 2 implants were revised, due to aseptic loosening and unexpected pain [15].

One of the primary aims of BKA is to restore knee alignment and a more normal knee kinematics and function by preserving the bone and the ligaments of the patient [16–21]. In fact, this bone and ligament-sparing technique can be considered minimally invasive surgery (MIS), not only for the skin and the muscular tissue, but also for the structures inside the knee. One of the disadvantages of MIS is the reduction of sight during operation: computer navigation systems has been introduced to reduce outliers in TKA and UKA and can be considered a valid tool in assisting surgeon even in BKA [22]. So, we used CAS in 19 of our patients during positioning of unicompartmental component.

Limitations of our study are the use of different implants, in both BKA group and TKA group and the use of CAS only in some cases. Our data and that in the literature confirm that BKA could be proposed as an alternative to TKA, especially in young and high-demanding patients. Although BKA was not superior in terms of functional results, we still consider that BKA is advantageous in bone preservation which allows greater chances of easier conversion to TKA if necessary in the future. BKA still can be considered as an alternative treatment for bicompartmental OA in mid-aged patients who are too young to consider TKA.

Compliance with ethical standards

Conflict of interest None.

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