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ORIGINAL ARTICLE

Function and quality of life following medial unicompartmental knee arthroplasty in patients 60 years of age or younger

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KEYWORDS

Unicompartmental knee arthroplasty;
Function;
Quality of life;
Sports

Summary

Introduction: UKA is an appropriate bone-sparing solution for focal advanced knee osteoarthritis in young patients. As the expectations of patients younger than 60 years of age are different from those in an older population, we aimed to evaluate quality of life and the quality of sports activity after UKA in this population.

Patients and methods: Sixty-five UKAs in 62 patients younger than 60 (mean age: 54.7 years; mean BMI: 28 kg/m²) performed between 1989 and 2006 were included. At last follow-up (minimum 2 years), before the objective evaluation, patients were asked to fill in a KOOS questionnaire and a specific sports questionnaire including the UCLA score and questions from the Mohtadi score.

Results: With a mean follow-up of 11.2 ± 5 years (range, 2–19 years), the KOOS score was higher than 75 points in 90% of the patients for the quality-of-life categories but also for the score's four other categories: 83.4% of the patients had resumed their sports activities and the mean UCLA score was 6.8 (range, 4–9); 90% of the patients reported no or slight limitation during sports activities. The function KSS improved from 52 ± 4 to 95 ± 3 points postoperatively and the Knee KSS from 50 ± 4 to 94 ± 4 points. With three patients undergoing revision for an isolated insert exchange, one for septic loosening and three for osteoarthritis in the external compartment, the 12-year Kaplan-Meier survivorship was 94%.

Discussion and conclusion: These results confirmed that UKA can provide good patient-rated outcomes, which is very important in this demanding population. As for TKA, wear remains a problem in this active population.

Level of evidence: Therapeutic study, level IV.

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Introduction

Management of osteoarthritis of the medial femorotibial compartment in the young subject is controversial [1]. In cases of medical treatment failure, surgery can be required to relieve pain and restore function [1]. The surgical possibilities available include conservative surgical treatments including limited arthroscopic debridement or valgus high tibial osteotomy (HTO), which is effective in certain precise indications [1–4]. When conservative treatments no longer suffice, prosthetic treatment must be called upon: medial unicompartmental knee arthroplasty (medial UKA) or total knee arthroplasty (TKA) [1–4]. The population of subjects aged less than 60 years comprises active patients whose management must take particular needs into consideration: functional recuperation, resumption of sports activities, and the lifespan of the implants are three of the specific problems added to arresting extension of osteoarthritis to the neighboring compartments [1,3]. Over the past decade, progress in the ancillary instrumentation used to implant these unicompartment prostheses associated with better patient selection have accelerated functional recuperation, increased the satisfactory clinical results based on the classical scores and satisfactory implant survival, even if the wear rates seems higher in this age group [2,5,6]. However, the study of implant survival has thus far been insufficient to demonstrate the value of an intervention, particularly in a population that is still young and active, whose quality of life can be strongly related to the condition of the knee [7,8]. We have hypothesized that medial UKA could restore satisfactory quality of life in patients less than 60 years of age over the long-term. The objectives of this study were (1) to evaluate knee function using objective and subjective scores and by analyzing the patient's physical activities and (2) to analyze the specific complications in this group as well as implant survival.

Patients and methods

We conducted a retrospective study on 62 consecutive patients (65 knees) aged less than 60 years, who presented isolated medial femorotibial osteoarthritis treated with medial UKA between December 1989 and December 2006 by two senior surgeons (J.-N.A., J.-M.A.) in our department. The study included clinical and radiological assessment based on the International Knee Society scores [9], the Knee Osteoarthritis Outcome Score (KOOS: <http://koos.nu/>) [7,8], the activity subscore of the UCLA score [10], and certain items of the Mohtadi score [11] at a follow-up time ranging from 2 to 19 years postoperative. The surgical indications included osteoarthritis with Ahlback-stage narrowing of the joint space greater than or equal to 2 [12], limited to the medial femorotibial compartment. The inclusion criteria were age under 60 years, known unicompartmental Ahlback-stage osteoarthritis [12] evaluated at 2 or above, preoperative knee mobility greater than or equal to 100°, complete extension, knee stable in all planes, absence of patellofemoral involvement on the 30°, 60°, and 90° flexion skyline views, and normal cartilage thickness in the lateral compartment with total correction of the deformity on the stress X-rays (Fig. 1). In cases of doubt as to

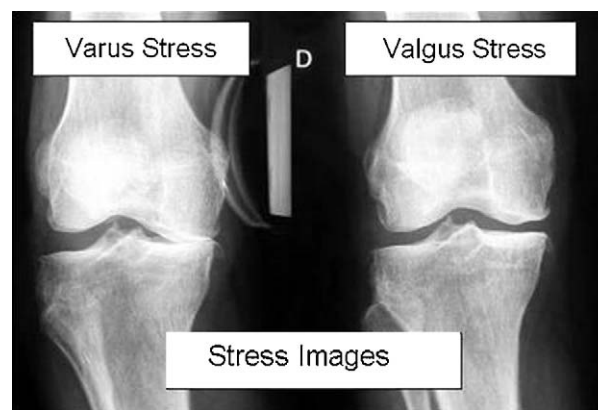


Figure 1 Preoperatively, the stress images are very important in evaluating wear and confirming reducibility of the deformity and the facing compartment.

the integrity of the anterior cruciate ligament (ACL), magnetic resonance imaging (MRI) was done. In this series, a pathological ACL was a contraindication for UKA surgery.

Thirty-three females and 29 males were included in the series. Three patients (two males and one female) were operated on both sides, for a total of 65 knees. The mean age at surgery was 54.7 ± 5 years (range, 32–60 years). The mean body mass index (BMI) was 28 ± 4 kg/m². According to the Ahlback classification, six knees (9%) were classified stage 2 and 59 knees stage 3 (91%). No stage 4 knees for the medial compartment were included in the study, because none met the other inclusion criteria, in particular the requirement for healthy patellofemoral and lateral compartments. The etiologies were primary osteoarthritis in 47 cases (72%), post-traumatic osteoarthritis in 13 cases (20%), and aseptic osteonecrosis in five cases (8%). Fifty-one patients were working or regularly participated in a sport.

All surgeries were performed by two operators using modular prostheses with a cemented metallic tibial tray (Miller-Galante, Zimmer™, Warsaw, IN, USA). These implants included a femoral component in chrome-cobalt alloy, a tibial tray in titanium alloy, and a fixed noncongruent gamma-sterilized cross-linked polyethylene insert. The tibial joint surface in polyethylene is smooth and unstressed. The femoral and tibial fixation consists of two cemented studs [13]. Before 2000 (41 knees, 63%), the unicompartmental implants were placed via a standard parapatellar approach and the visible osteophytes in the patellofemoral and femorotibial joints and at the intercondylar notch were resected. After 2000 (24 knees, 37%), a minimally invasive approach allowed us not to dislocate the patella (Fig. 2) [13]. For all patients, this was a first-line surgery. There was no ligament release. The polyethylene insert thickness varied from 8 to 12 mm. A rehabilitation protocol with full weight-bearing was recommended in all cases. All the patients received low-molecular-weight heparin at a preventive dose for 3 weeks following surgery.

One patient had died at the last follow-up. For the analysis, the status of his knee evaluated at 10 years postoperative, 1 year before his death, was used. No patient was lost to follow-up.

At the last follow-up (mean, 11.2 years; range, 2–19 years), the clinical evaluation was made by an



Figure 2 Minimally invasive medial parapatellar approach with no dislocation of the patella.

independent observer (E.F.). Every patient had a clinical examination (joint range of motion and International Knee Society score) and responded to a written questionnaire evaluating quality of life (KOOS) and return to sports or recreational activities (UCLA and Mohtadi scores) [7–11]. A four-level satisfaction questionnaire (enthusiastic, satisfied, no change, disappointed) was also used.

The radiological assessment was carried out by an independent observer (E.F.) on long leg full weight bearing X rays, AP and lateral views (Fig. 3) and on skyline patellar views. The mechanical axes of the lower limbs were measured pre- and postoperatively using the Kennedy and Wright classification [14], in which lower limb alignment is considered correct with the overall mechanical axis of the lower limb is in zone 2 or C (zone C, center of the knee; zone 2, pointing slightly inward). Positioning of the implants was assessed on plain AP and lateral images as well as the presence or the progression of radiotransparent zones at the femur or tibia according to the IKS score [9]. In addition, osteoarthritis progression was assessed at the other compartments using the four-stage Berger scale [15] on skyline views. According to this scale, stage 1 is defined not as a loss of cartilage thickness but by the presence of radiographic modifications such as osteophyte formation [15]. Stage 2 represents a 25% loss of cartilage thickness, stage 3 as 50%, stage 4 as more than 50% [15].

The statistical analysis was performed using SPSS software (version 12; Chicago, IL, USA). The characteristics of



Figure 3 Postoperative AP and lateral views of a unicompartmental prosthesis at 10 years of follow-up.

the series were described as means and standard deviations for the continuous variables and in percentages for the categorical variables. The clinical evaluation described by the IKS knee and function, KOOS, UCLA Activity, and Mohtadi scores was analyzed using the Student *t*-test. The radiographic evaluation in terms of restoring lower-limb alignment and stability over time was then evaluated. Finally, a survival analyzing using the Kaplan-Meier method with 95% confidence intervals was carried out, considering surgical revision with TKA or radiographic loosening as failure [16]. The significance level was defined as $\alpha = 0.05$.

Results

Functional results

A significant improvement in the IKS knee and function scores was demonstrated at the final follow-up of 11.2 ± 5 years (Table 1). All the patients except two were able to return to their presymptomatic level of activity. At the last follow-up, 42 patients (67%) were enthusiastic, 18 (27%) satisfied, one (3%) unchanged, and one (3%) disappointed.

The mean KOOS score at the end of the study (Fig. 4) was 86 out of 100 (range, 21–100) for the pain items, 83 out of 100 (range, 27–100) for the symptom items, 80 out of 100 (range, 21–100) for the daily life items, 66 of 100 (range, 0–100) for the sports items, and 78 out of 100 (range, 30–100) for the quality-of-life items. The responses to the sports and quality-of-life items are reported in Table 2.

Fifty-four patients (83%) were able to resume the activities that they had had to give up and the mean time between

Table 1 Mobility and IKS score.

	Preoperative mean	Postoperative mean	Significance (P)
Flexion (degrees)	110 ± 7	132 ± 6	< 0.001
IKS knee score (out of 100)	52 ± 9	93 ± 3	< 0.001
IKS function score (out of 100)	50 ± 4	94 ± 4	< 0.001

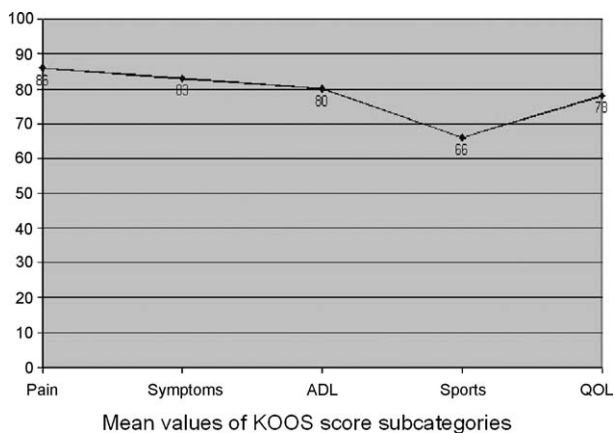


Figure 4 Postoperative Koos score.

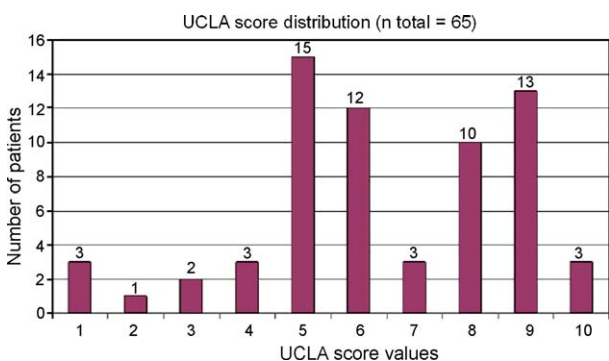


Figure 5 Postoperative UCLA score.

surgery and return to the presymptomatic activities was 4 months. Twenty-six patients (40%) in the series had a UCLA score equal to or higher than 8 (Fig. 5), corresponding to physical activities such as cycling, golf, dancing, or sports with repeated impacts on the knee (tennis and running)

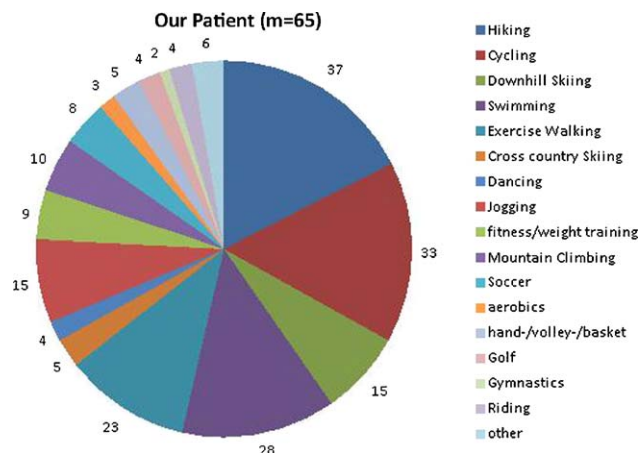


Figure 6 Sports activities.

(Fig. 6). For 90% of the patients, their knee no longer limited their physical or recreational activities.

Radiographic results

The mean preoperative hip-knee-ankle (HKA) axis was $172 \pm 3^\circ$ (range, $170\text{--}180^\circ$) and the mean postoperative alignment was $4 \pm 2^\circ$ (range, $0\text{--}7^\circ$) varus. Restoration of the appropriate mechanical axis (Kennedy zone 2 or C) was found in 58 (90%) of the 65 knees. Five knees (7.6%) presented a mechanical axis that progressed to zone 1 and two (2.4%) to zone 3. The mean angle between the diaphysis and the tibial component was $88 \pm 3^\circ$ (range, $85\text{--}90^\circ$) and the mean tibial slope was $4 \pm 3.8^\circ$ (range, $0\text{--}8^\circ$). The mean femoral component axis was $89 \pm 4^\circ$ (range, $82\text{--}92^\circ$). On the lateral compartment at the last follow-up, progression of the osteoarthritis to stage 1 in 11 cases (17%), stage 2 in five cases (8%), and stage 3 in two cases (3%) was

Table 2 Quality of life and sports activities.

Patients's sports aptitude	Type of patient response (n = 65 total)				
	Extreme discomfort	Strong discomfort	Moderate discomfort	Slight discomfort	No discomfort
Squatting	15 (23%)	7 (11%)	13 (20%)	19 (29%)	11 (17%)
Running	7 (11%)	7 (11%)	23 (36%)	8 (12%)	20 (30%)
Hopping	7 (11%)	15 (23%)	18 (27%)	11 (17%)	14 (22%)
Pivoting on one leg	26 (40%)	13 (20%)	20 (30%)	3 (5%)	3 (5%)
Kneeling	10 (15%)	5 (8%)	13 (20%)	16 (25%)	21 (32%)

Quality of life items	Type of patient response (n = 65 total)				
	All the time	Once a day	Once a week	Once a month	Never
Do you think about your knee?	26 (40%)	7 (11%)	7 (11%)	12 (18%)	13 (20%)
	Totally	A lot	A little	Moderately	Not at all
Have you changed your way of life?	14 (22%)	18 (27%)	11 (17%)	14 (22%)	8 (12%)
Does lack of trust in your knee bother you?	24 (37%)	12 (18%)	13 (21%)	8 (12%)	8 (12%)
Are you bothered by your knee?	15 (23%)	16 (25%)	13 (20%)	11 (17%)	10 (15%)

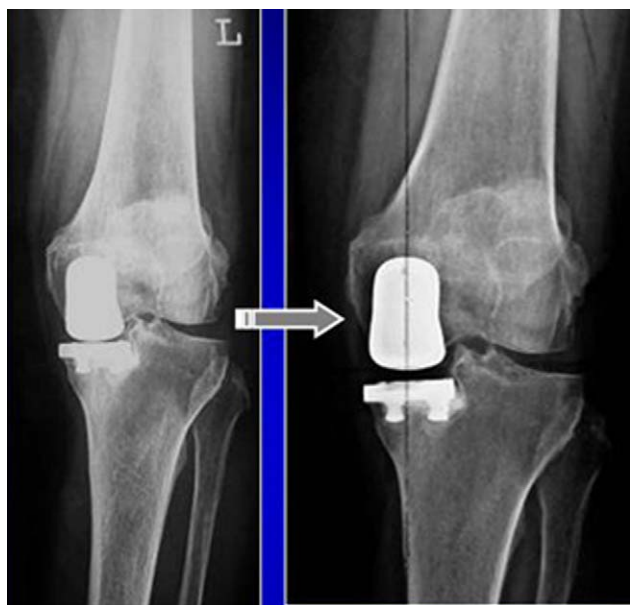


Figure 7 Wear of polyethylene unicompartmental knee implant at 130 months. B. Isolated change in polyethylene insert with no radiolucent lines or signs of osteolysis.

observed. For the patellofemoral joint, we noted progression of osteoarthritis at stage 1 in nine cases (14%), stage 2 in three cases (4%), and stage 3 in three cases (4%). Seven knees (10.7%) presented combined arthritic progression of the lateral and patellofemoral compartments. Three (9%) presented radiolucent lines (< 1 mm) at the bone–cement interface of the tibial component, with no signs of progression at a minimum follow-up of 5 years. None of the femoral implants presented evolving radiolucent lines. None of the implants presented radiological signs of loosening.

Implant survival

The Kaplan-Meier survival analysis showed a 94% 12-year survival rate (95% CI, 0.87–0.96).

Seven knees required surgical revision. Three knees were revised for polyethylene wear at 99, 130, and 145 months with no mechanical axis abnormality or overweight found that could explain the excessive wear (Fig. 7). The polyethylene was changed via a minimally invasive medial parapatellar approach. These three knees continued to be evaluated within the study. The IKS scores for these patients were 95 at 99 months, 95 at 120 months, and 94 at 140 months, respectively, after the index surgery, and 92 at the last follow-up. One knee was revised for septic loosening at 36 months with implant removal, placement of a cement spacer with antibiotics and implantation of a cemented posterior-stabilized prosthesis with a mobile tray at 43 months (7 months of antibiotic therapy). Three knees required surgical revision with TKA for symptomatic progression of osteoarthritis in the other compartments. Each of these surgical revisions leading to TKA was considered the final point in the implant survival and the functional evaluation of these knees was not pursued, but the functional and radiological results before the prosthesis change were included.

Discussion

Osteoarthritis in active subjects under the age of 60 has become increasingly frequent. It poses a therapeutic problem in these patients who often engage in sports and have a high functional demand [17]. The osteoarthritis can involve one or several compartments of the knee and may or may not associate lower-limb axis abnormalities [17]. When this osteoarthritis is unicompartmental and advanced and when the lower-limb deformity is moderate (up to 10° varus), the unicompartmental prosthesis can be a choice option [1,2,13,18,19]. In the last decade, progress in ancillary instrumentation for implanting these prostheses associated with better patient selection has accelerated functional recuperation, with satisfactory clinical results according to the classical scores and satisfactory implant survival, even if the wear rates seem higher in this age group [1,2,5,6,13,18,19]. However, the survival study is insufficient to demonstrate the value of an intervention, particularly in a population that is still young and active and whose quality of life can be strongly related to the knee status [7,20].

Our results, confirming our working hypothesis, suggest that the unicompartmental implant reliably, long-lastingly, and reproducibly improves the knee function and quality of life of these patients, allowing them to resume their former activities of daily life and sports activities. The main cause of revision altering the survival curve is polyethylene wear, without our being able to demonstrate a particular risk factor for this wear. The use in this study of a tibial implant with a cemented metallic tray made it possible to simply replace the insert in cases with no progression of osteoarthritis or loosening, with functional results after the change comparable to the rest of the study's population.

One of the limits of this study was its being retrospective and the absence of a direct comparison between matched UKA series in older subjects. However, this type of comparison is made difficult by confounding factors such as co-morbidities in the older group of subjects, which can affect the final results. We did not compare the results of HTO and UKA within the same population because the indications were distinct [2,4,13,18,21]. Although they both concerned medial unicompartmental osteoarthritis, these two interventions cannot be directly compared (HTO for Ahlback grade osteoarthritis strictly below 2, UKA for Ahlback grade 2 or higher) [2,4,13,18,21]. For the same reasons, we did not make a comparison with an identical group of patients treated with UKA. Nevertheless, earlier series report good functional results as well as long follow-up periods in TKA in young subjects and total knee replacement can be an alternative. Gioe et al. [22] recently compared the different treatment modalities of knee osteoarthritis (cemented or cementless TKA and UKA) in young subjects (under 55 years) and showed that patients with total knee prostheses had a lower revision rate. According to Pagnano et al. [17], the total knee prosthesis should be proposed with caution in the young subject because of the possible need for revision despite the good clinical results demonstrated in various studies. Moreover, the results in terms of survival in our series, 94% at 12 years, are comparable to TKA survival in the same population [17,23–25].

Our experience shows that knee function can be completely restored after a unicompartmental implant in the patient less than 60 years of age with rapid return to activity and notable improvement in quality of life. This point is vital in a young population [8,10,20]. It is interesting to note that for 90% of the patients, the knee was not a limiting factor in their activities. In a recent publication, Naal et al. [26] showed that 90% of the patients who had undergone unicompartmental knee arthroplasty judged that the surgery had allowed them to maintain or improve their ability to participate in sports or recreational activities, with a mean 4 months between surgery and return to activity. These figures, both in terms of improvement of skills and mean time to recuperation, are similar to those in our study. However, the absence of follow-up in their study makes it impossible to assess the problems related to wear in this active population. Similarly, in a 2006 study, Fisher et al. [27] concluded that 93% of the patients of all ages returned to their sports activities after surgery. However, after having concluded on their patients' high level of activity, they judged it necessary to assess long-term survival of the implants in this active population. In 2008, Dahm et al. [10] studied return to sports activities in an all-age population after total knee arthroplasty. In their series, 91% of the patients were satisfied with the activities they were able to perform (94% in our series) and 47% felt no limitation due to the operated knee (90% in our series). In 2003, Pennington et al. [5] evaluated 46 unicompartmental arthroplasties using the same implant as in the present study, with a mean follow-up of 11 years. Evaluation was radiological (mechanical axis, progression of osteoarthritis, and signs of loosening) and clinical (UCLA activity score, Hospital for Special Surgery knee evaluation score). In this study, the evaluation of activity using the UCLA score gave comparable results to ours with a nearly identical survival rate (92% at 11 years). They also encountered polyethylene wear problems in two patients with similar management strategies (PE change with or without tibial implant change) and the results converged toward the rest of the series after this change. The activities undertaken by the patients postoperatively are entirely comparable in our series and the series reported by Naal et al. with sports such as hiking, cycling, swimming, power walking, and running. On the other hand, the evaluation methods and particularly the follow-up periods in the above-cited studies make it difficult to compare their results with ours. In the present study, certain patients operated on more than 15 years ago presented functional results that were difficult to compare with those of patients who had just undergone surgery and who are therefore necessarily younger. Nevertheless, the time between surgery and return to recreational activities found in our study can be compared to those reported in the literature (around 4 months).

Polyethylene wear remains the main problem in these active patients. In our study, we observed three cases of polyethylene wear with no predictive factor that could be individualized. The insert was changed with no problem via a minimally invasive parapatellar approach. The functional results of these patients were comparable to the results obtained for patients who were not reoperated at follow-up. According to the results of this and earlier studies, the reduction in wear is the main factor improving survival of unicompartmental implants. Wear depends on the load

applied, the number of cycles, and the material's mechanical properties [28]. An isolated insert change is possible only if there are no signs of osteolysis or loosening [18]. A congruent mobile polyethylene insert is an alternative and reduces the risk of wear; however, the risk of intraprosthetic dislocation is high, notably in a more active population [18].

Conclusion

UKA is a solution that is adapted to the treatment of unicompartmental osteoarthritis in the young subject less than 60 years of age. This intervention provides the patient with excellent quality of life and satisfaction in more than 90% of the cases. For these relatively young patients with a high life expectancy, saving bone stock and the need to retain solutions for the future support the choice of unicompartmental knee arthroplasty in cases of isolated medial osteoarthritis. Polyethylene wear remains problematic and research should continue seeking to limit its onset. The use of modern ancillary instrumentation makes surgery more reliable with reproducible results, and minimally invasive approaches contribute more rapid functional recuperation.

Conflict of interest statement

J.-N.A.: occasional consultancies, expert reports for Zimmer (Warsaw, IN, USA).

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