Return to Sports and Recreational Activity After Single-Stage Bilateral Short-Stem Total Hip Arthroplasty

5-Year Results of a Prospective Observational Study

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Background: Single-stage bilateral total hip arthroplasty (THA) is an alternative to staged unilateral THA in patients suffering from bilateral hip arthritis; however, there is still broad concern regarding the safety and reliability of this procedure. Short-stem THA has emerged in recent years. To date, no data are available on sports and recreational activity levels after single-stage bilateral short-stem THA in the general patient population.

Hypothesis: Patients who have undergone single-stage bilateral short-stem THA return to a satisfying level of sports and recreational activity at midterm follow-up.

Study Design: Case series; Level of evidence, 4.

Methods: A total of 54 consecutive patients (108 hips) were prospectively included. Midterm follow-up was performed in 51 patients (94.4%). The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score and the Harris Hip Score (HHS) were assessed clinically after a mean of 5.2 years. After a mean of 4.9 years, activity levels were assessed using the University of California, Los Angeles (UCLA) activity scale via a questionnaire. Additionally, a detailed evaluation of sports behavior was conducted using an additional questionnaire. Pain and satisfaction with sporting ability were assessed using a visual analog scale (VAS). Complications and revisions were documented.

Results: Patients had a mean WOMAC score of 98.0 (range, 60.0-100.0) and HHS score of 97.8 (range, 65.0-100.0) at final follow-up. The mean UCLA activity score was 4.7 (range, 2.0-10.0). An increasing number of patients were active in sports at follow-up compared with before surgery (76.5% vs 60.8%, respectively); 2 patients (3.9%) stopped participating in sports on a regular basis, and 10 (19.6%) commenced with sports after surgery. The most popular activities before surgery were cycling (31.4%), hiking (29.4%), swimming (21.6%), and fitness/weight training (15.7%). At follow-up, most patients were engaged in cycling (35.3%) and fitness/weight training (33.3%), followed by swimming (25.5%) and hiking (19.6%). The duration (hours per week) and frequency (times per week) of sporting activities remained stable. The mean VAS pain level during sports was 1.3 (range, 0.0-7.0). No revision surgery had to be performed.

Conclusion: After single-stage bilateral short-stem THA, the study patients returned to satisfying levels of activity at midterm follow-up. Postoperatively, few patients were engaged in high-impact sports; however, more patients commenced with lower impact activities. Satisfaction with sporting abilities was high, and the complication rate in total was low.

Keywords: sports activity; single-stage bilateral; total hip arthroplasty; short stem; optimys

Excellent results in terms of quality of life and survival obtained with total hip arthroplasty (THA) has led to the extension of this procedure to younger and more active patients, who increasingly often have high expectations.[4] These patients request THA not only for pain relief but also to maintain a high level of activity to participate in social and sporting events.[12]

Given this development, an increase in enthusiasm for minimally invasive surgery and the desire to preserve proximal bone stock has evolved, leading to a further evolution and a distinct gain in popularity of short and neck-preserving femoral implants in recent years.[3] It is well

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known that young patients face higher risks of implant failure[8]; thus, the preservation of bone becomes more important. Short stems, by preferentially loading the proximal femur, may retain more proximal bone stock over time than distally anchoring stems.[10] However, there is a large variety of short stems, differing in design and function. At present, only a few midterm results have been published, and there are almost no data on the long-term outcomes of short stems.[6,30,32,35]

A recent analysis of the Swedish Hip Arthroplasty Register revealed that 17% of all patients undergoing primary THA suffer from bilateral symptoms of osteoarthritis.[9] Moreover, 10% of patients require contralateral THA within 1 year after their first procedure.[1] One-stage bilateral THA is an alternative to staged unilateral THA; however, there is still broad concern about the safety and reliability of this procedure. One-stage bilateral THA offers various advantages for patients, such as a single hospital stay, a single anesthetic agent, and lower management costs per patient.[27] Postoperative rehabilitation might also be improved by a shorter rehabilitation time.[17] Bilateral treatment, in contrast to a staged unilateral procedure, leads to early reduced pain ambulation without marked residual symptoms of the leftover pathological hip. Thus, encouraging functional outcomes have been reported after bilateral THA.[36] This potentially leads to high satisfaction rates and satisfying activity levels, especially in young and active patients.

Although 1-stage bilateral short-stem THA is increasingly used, there are no data available about postoperative sporting behavior and activity levels. The aim of the present study was to investigate clinical outcomes and participation in sports and recreational activity as well as subjective outcomes in a consecutive cohort of patients after 1-stage bilateral short-stem THA at midterm follow-up.

METHODS

Patients

This study included the first consecutive patients from an ongoing, prospective observational investigation (N = 54 patients and 108 hips) who underwent 1-stage bilateral short-stem THA between December 2010 and June 2012 at our institution. Criteria for undergoing the 1-stage procedure were marked bilateral symptoms and the absence of severe neurological and cardiovascular diseases. Patients older than 80 years were not considered for the 1-stage bilateral procedure. Institutional review board approval for this study was received, and written consent to participate was obtained from all patients before inclusion. All patients included at final follow-up agreed to additionally complete a nonvalidated questionnaire inquiring sporting behavior, activities of daily living, pain levels, and satisfaction with postoperative outcomes.

Figure 1. One-stage bilateral implantation of a calcar-guided short stem (optimys; Mathys).

Implants and Surgical Technique

All surgical procedures were performed in the supine position using a modified minimally invasive anterolateral approach.[18,26] All patients bilaterally received the same cementless, calcar-guided short-stem optimys (Mathys) (Figure 1).

The optimys short stem is a type 2A short stem according to the classification of Khanuja et al.[14] It is made of a titanium alloy with a plasma-sprayed surface and a calcium phosphate coating. The profile of the stem is tapered in 3 planes with a trapezoidal cross section to provide femoral press-fit fixation. The implant was aligned alongside the calcar. Anchoring was based on the fit-and-fill principle as well as on classic 3-point anchoring, depending on the individual stem alignment. The greater trochanter region remained intact. There were 2 different offset options (standard and lateral offset) to optimally reconstruct the individual anatomy.[20] The stems were combined with cementless press-fit cups (RM Pressfit vitamys [Mathys] or Fitmore [Zimmer]) with 28-mm alumina on highly cross-linked polyethylene bearing in all hips. The RM Pressfit vitamys is a titanium particle-coated monoblock cup with vitamin E–stabilized highly cross-linked polyethylene (Figure 1). The Fitmore, being a standard metal-back cup, was chosen in patients with slightly reduced bone quality to achieve sufficient primary fixation. The decision on which cup to use was made based on the surgeon's preference.

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Ethical approval for this study was obtained from the Freiburg Ethics Commission International (FEKI 010/2071).

Full weightbearing using 2 crutches was allowed in all cases immediately after surgery. Recommendations for sports activity levels met the consensus guidelines based on a survey of the Hip Society and the American Association of Hip and Knee Surgeons.[16]

Outcome Tools

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC; Likert scale transformed to 100 = best and 0 = worst) and the Harris Hip Score (HHS; range from 100 = best to 0 = worst) were administered at final follow-up. Furthermore, the University of California, Los Angeles (UCLA) activity scale (10 = highest and 1 = lowest) was administered. The validated German version of this questionnaire was used.[24,33] Intraoperative and postoperative complications and revisions were documented at final follow-up.

Using additional questionnaires, patients were asked in detail about their sporting activity pattern. The ability to return to sports after surgery was assessed. Patients were asked about their preoperative and postoperative participation in 10 different sporting activities, with an option to add further disciplines to the list. The preoperative and postoperative activity frequency (number of times per week) and duration (given in hours) were documented. Satisfaction and pain (in general and during sports) were assessed on a visual analog scale (VAS).

Statistical Analysis

Statistical analyses were performed using SAS Enterprise Guide version 7.11 (SAS Institute). Data are reported either as a percentage or as the mean and range. The Wilcoxon signed-rank test was used to compare preoperative and postoperative clinical outcomes and sports activities. A P value $<.05$ was considered significant.

RESULTS

Demographics

The mean clinical follow-up was performed at 5.2 years (range, 4.8-6.3 years) after surgery. Additional questionnaires were completed postoperatively at a mean of 4.9 years (range, 4.3-5.8 years).

Of the 54 patients included, 51 patients (94.4%) who underwent 102 short-stem THA procedures were analyzed at midterm follow-up. Two patients were known to be deceased from causes unrelated to the operative procedure with implants in situ, and 1 patient was lost to follow-up. Thus, 22 female (43.1%) and 29 male (56.9%) patients were available for evaluation. The mean age was 63.1 years (range, 36.7-76.8 years) at the time of inclusion. The age distribution is shown in Figure 2. The median body mass index was 27.6 kg/m^2 (range, 19.6-41.8 kg/m^2). The indications for implantation were bilateral primary osteoarthritis in 96.1% (n = 49) and bilateral femoral head necrosis in 3.9% (n = 2).

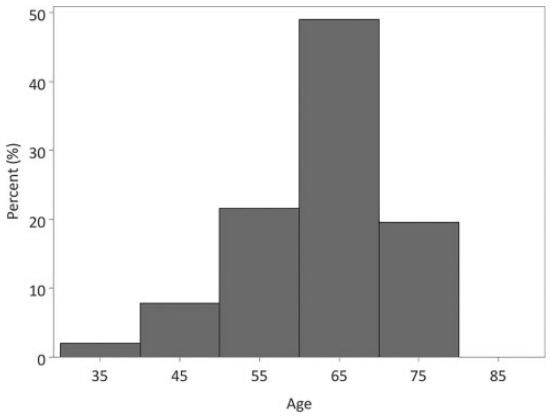

Figure 2. Age distribution at the time of inclusion. Each bar represents the percentage of patients in each decade.

TABLE 1
Clinical Scores and Activity Levels[a]

	n	Mean ± SD	Range	P Value
UCLA activity scale				.0013
Preoperatively	51	3.8 ± 2.0	1.5-10.0	
Follow-up	51	4.7 ± 1.7	2.0-10.0	
Harris Hip Score				<.0001
Preoperatively	51	44.2 ± 15.2	7.0-70.0	
Follow-up	51	97.8 ± 5.3	65.0-100.0	
WOMAC				NA
Follow-up	51	98.0 ± 5.8	60.0-100.0	

[a]NA, not applicable; UCLA, University of California, Los Angeles; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Complications

One patient showed an intraoperative avulsion of the greater trochanter on 1 side without any clinical malfunction. No therapy was required. One case of deep vein thrombosis (DVT) was reported, which was treated successfully. In addition, a prolonged seroma was documented in 3 hips without any further consequences. To date, none of the cases needed a revision procedure.

Outcome Scores and Subjective Outcomes

Scores for the WOMAC, the HHS, and the UCLA activity scale are shown in Table 1. All scores increased significantly, confirming a significant improvement in daily activities.

Patients slightly increased both their hours of daily activities per week, from 3.4 hours (range, 3.0-10.0 hours) preoperatively to 4.2 hours (range, 3.0-14.0 hours) postoperatively. They also increased their sports activity per week, from 3.4 hours (range, 0.0-10.0 hours) preoperatively to 3.7 hours (range, 0.0-16.5 hours) postoperatively; however, these increases were not statistically significant (P = .26 for daily activities and P = .44 for sports) (Table 2).

TABLE 2
Frequency and Hours of Sports per Week

	n	Mean ± SD	Range	*P* Value
Number of times per week				.21
Preoperatively	51	2.8 ± 3.1	0.0-12.0	
Follow-up	51	3.4 ± 2.9	0.0-12.0	
Hours of sports per week				.44
Preoperatively	51	3.4 ± 2.4	0.0-10.0	
Follow-up	51	3.7 ± 4.1	0.0-16.5	

Patients had a mean score of 9.2 (range, 0.9-10.0) on the VAS concerning their satisfaction with the postoperative outcome of their sporting ability. The mean level of general pain on the VAS was reduced significantly, from 7.4 (range, 0.8-10.0) preoperatively to 1.3 (range, 0.0-8.0) postoperatively ($P < .0001$). Pain during sports also decreased significantly, from 7.1 (range, 1.5-10.0) preoperatively to 1.3 (range, 0.0-7.0) postoperatively ($P < .0001$).

Return to Sports

Of the 51 study patients, 31 (60.8%) were regularly active in sports before surgery, and 39 (76.5%) were active at follow-up. There were 29 patients (56.9%) who were active before and after surgery. Two patients (3.9%) stopped participating in regular sports after surgery, and 10 (19.6%) commenced with sports after surgery. Another 10 patients (19.6%) were never engaged in any regular sport.

Sports and Recreational Activity

Patients who were active in sports were engaged in a mean of 2.3 (range, 1.0-6.0) different athletic disciplines before surgery versus 1.8 (range, 1.0-5.0) at follow-up. Preoperatively, the most popular activities were cycling (31.4%), hiking (29.4%), swimming (21.6%), and fitness/weight training (15.7%). Nine patients (17.6%) performed high-impact sports such as soccer, tennis, jogging, and skiing. At follow-up, most patients were engaged in cycling (35.3%) and fitness/weight training (33.3%), followed by swimming (25.5%) and hiking (19.6%) (Figure 3). Postoperatively, only a few patients (9.8%) were engaged in high-impact sports. However, more patients commenced with lower impact activities such as swimming, fitness/weight training, and cycling after surgery.

DISCUSSION

Encouraging results obtained from THA in the past century have led to an increase in patient expectations, with a particular emphasis on returning to sports.[12] While more young and active patients undergo short-stem THA nowadays, increasingly, 1-stage bilateral procedures in cases of bilateral osteoarthritis are also performed.[18,21] Recent studies have mainly addressed the risks and complication rates of 1-stage bilateral THA.[31,34] However, there are no data available on activity levels and the ability to perform sports after 1-stage bilateral THA.

In the present study, 60.8% of the patients were actively participating in sports before surgery, and 76.5% were doing so at follow-up. Of the patients who were active before surgery, 93.5% (29/31) returned to sports. Moreover, 50.0% of patients who had not been involved in sports before surgery commenced with sports after surgery and were active even at midterm follow-up. These numbers are comparable with previously published data on unilateral short-stem THA[29] as well as on unilateral hip resurfacing arthroplasty.[2,23,25] Schmidutz et al,[29] in a study on unilateral THA using the Metha short stem (B. Braun/Aesculap), found a return-to-sport rate of 98% in active patients; 91% of the patients were active in sports before surgery. In the present study, presumably because of severe bilateral symptoms of osteoarthritis, accompanied with pain and limited mobility, the rate of preoperative activities was lower. However, the return-to-sport rate turned out to be similar.

Patients undergoing 1-stage bilateral short-stem THA participated preoperatively in a mean of 2.3 sports disciplines, which then decreased nonsignificantly to 1.8 disciplines after surgery. Previous studies, addressing conventional unilateral THA, reported similar numbers of disciplines.[5,7,28] Chatterji et al[5] found that despite an increase in active patients after THA (80% preoperatively vs 83% postoperatively), the average number of disciplines decreased (1.9 preoperatively vs 1.7 postoperatively). Similarly, Dubs et al[7] reported an average of 2 sports disciplines after conventional THA. Another study reported even fewer (1.4 preoperatively vs 0.9 postoperatively).[28] However, in the study of Schmidutz et al[29] investigating sporting activity after unilateral short-stem THA, patients preoperatively participated in more sports disciplines with an average of 3.9, which then decreased slightly to 3.5 disciplines after surgery. These findings are comparable with those of Banerjee et al[2] and Naal et al[23] (3.6 and 4.8 disciplines preoperatively, respectively, vs 3.2 and 4.6 postoperatively, respectively) on unilateral hip resurfacing arthroplasty. Schmidutz et al also found that neither the frequency nor the duration decreased postoperatively. In summary, the number of preoperative sports disciplines pursued by patients undergoing bilateral short-stem THA was found to be considerably lower than that found in patients undergoing unilateral short-stem THA but was comparable with that in patients undergoing conventional unilateral THA.

Several rationales might account for the advantageous results obtained regarding postoperative sporting ability and activity using short-stem THA as compared with conventional THA. Important reasons are the optimization of implantation techniques and the use of minimally invasive approaches.[18] The implantation technique of modern short stems differs from conventional techniques used with traditional straight-stem designs. These implants, besides their reduced length, provide an anatomic curvature, which has been adapted from the calcar. Using a "round-the-corner" technique of implantation, the greater trochanter and the gluteal muscles can be distinctly protected.[13] Therefore, soft tissue–sparing implantation is facilitated

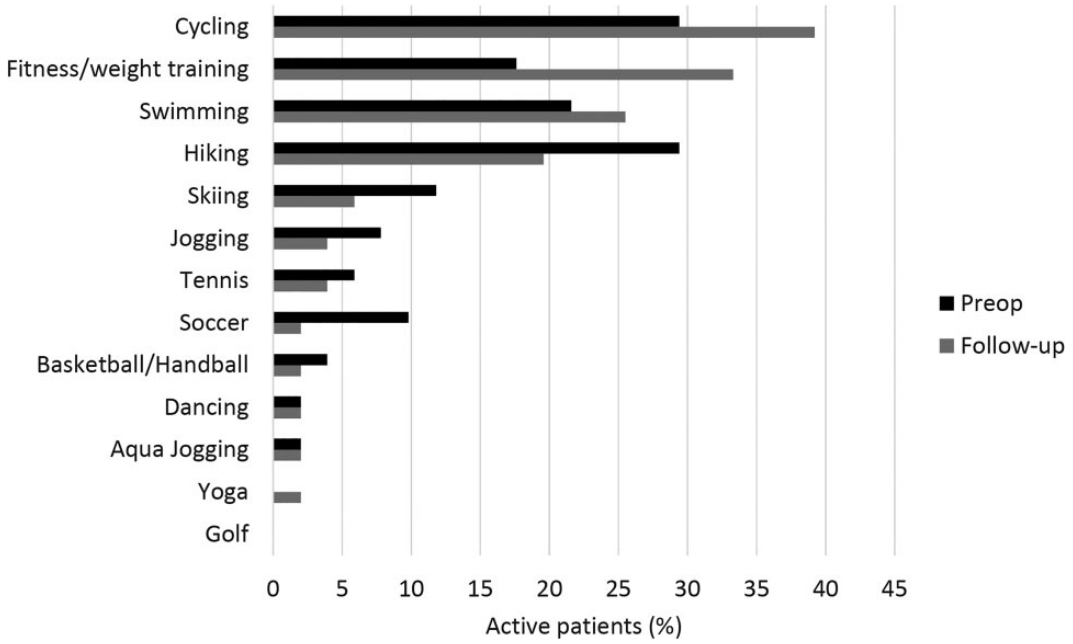

Figure. 3. Types of sports and percentage of active patients preoperatively and 5 years after 1-stage bilateral short-stem total hip arthroplasty.

by the small size and curved design of the implant, possibly leading to favorable early clinical results.[19]

In the present study, although one could assume that pain-free range of motion after THA would further increase the number of times and the total hours of sports per week, no significant differences were found regarding the frequency and duration of sporting activities compared with preoperatively. It remains unknown if, because of the bilateral procedure, patients generally are more cautious regarding frequent and extensive sporting activities.

In recent years, several investigations regarding the clinical outcomes and complications of 1-stage bilateral THA have been published. However, to date, almost no data are available concerning 1-stage bilateral THA using short stems.[18] Trojani et al,[34] in a multicenter study including 112 patients treated with 1-stage bilateral THA using a conventional technique, found a complication rate of 7.1%, the main complications being DVT and pulmonary embolism. Consequently, those authors recommended the procedure in selected patients only. In the present cohort also, 1 case of DVT occurred postoperatively. The overall complication rate was low however, and all complications were treated successfully without further consequences. To date, no revisions have had to be performed.

Trojani et al[34] came to the conclusion that only patients with American Society of Anesthesiologists (ASA) class 1 and class 2 are suitable for 1-stage bilateral THA. Kim et al,[15] in their retrospective study, found no significant difference in complications between patients with ASA classes 1 and 2 compared with ASA classes 3 and 4. However, several patients with ASA class 3 and class 4 were considered unsuitable for 1-stage bilateral THA because of comorbidities. Patients in the present study were mostly classified as ASA class 1 and class 2; however, 7 patients (13.0%) were classified as ASA class 3. No increased rate of complications was observed in this group. Haverkamp et al,[11] performing a meta-analysis, found no difference regarding the rate of major complications comparing 1-stage with 2-stage bilateral THA. Laursen et al[21] examined 41 patients clinically and radiographically at least 5 years postoperatively and found excellent results with regard to patient satisfaction and hip function; these authors concluded that the bilateral procedure may be advantageously carried out in a single session. This can be confirmed by the patients of the current study, who had excellent scores on the WOMAC and the HHS as well as high satisfaction with their postoperative outcome and sporting ability. All patients (100.0%) included at midterm follow-up stated that they would choose to undergo the same procedure again.

Preoperatively, only a few patients were engaged in high-impact sports such as tennis, jogging, and soccer in the present study, we assume because of the presence of distinct bilateral symptoms of hip osteoarthritis. Postoperatively, a further decrease in high-impact sports was observed, most likely being the effect of fear and anxiety, as opposed to pain, on postoperative activities. Engagement in low-impact sports such as swimming, cycling, and fitness/weight training significantly increased after surgery. These findings have been demonstrated previously. Chatterji et al[5] found that tennis, jogging, and skiing exhibited the greatest decreases, while hiking and water aerobics increased after THA. Also in short-stem THA and hip resurfacing arthroplasty, a tendency of reducing high-impact activities could be observed; however, some patients were still capable of continuously performing sports after surgery.[23,29] Recommendations of surgeons concerning sport disciplines and activity levels after THA are

inconsistent and often do not reflect patients' objectives and expectations.[22] Based on our own experience to this point, we do not permit or prohibit specific sports disciplines in general after 1-stage bilateral short-stem THA. However, patients are individually informed of sport-specific risks and the general risks of higher activity and impact levels, such as periprosthetic fractures, possible increased wear, and subsequent earlier implant failure.

The present study is limited by several drawbacks. First, the overall age of the patients included was quite low because patients over 80 years as well as patients with pre-existing severe neurological and cardiovascular diseases were not considered for the 1-stage bilateral procedure. This accounts for a bias and does not allow a transfer of the findings to all patient populations.

Second, the additional questionnaire used is not validated. However, to our knowledge, there are no validated tools available that address the question of sports participation after THA. Patients were asked for activities, durations, and subjective feelings that in many cases dated back several years. This reveals a potential bias. Patients were asked for their preoperative activities; however, the patient's interpretation might be influenced by his or her subjective opinion and by the length of time between the onset of symptoms and survey completion. There is always a bias because of the subjective nature of patient responses.

Clinical data, such as the WOMAC and HHS scores, provide objective outcome measurements. However, these scores demonstrated significant ceiling effects. This suggests that in the future, additional tools with greater sensitivity and high-end range to characterize young active patients undergoing THA are needed.

A final limitation was that the size of the cohort was quite small, given the 51 analyzed patients. However, because 1-stage bilateral treatment with short-stem THA is currently performed rarely, the present sample size can still be considered sufficient. To date, no comparable data are available in the literature.

CONCLUSION

The data from this study show that patients who were treated with 1-stage bilateral short-stem THA were highly satisfied with their sports and recreational activity at midterm follow-up. Postoperatively, only a few patients were engaged in high-impact sports; however, more patients commenced with lower impact activities after surgery. The frequency and duration of activities were comparable with those in recent studies evaluating unilateral procedures. Activity levels and clinical scores were encouraging. The complication rate in total was low, and to date, no stem revision has been required.

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