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Requester information:
Name: Brockwell, Jason
RANK: Medical Director
Hospital: Asia Medical Specialists
Phone no: 25216830
Email: jasonbrockwell@mac.com
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Running Activity After Hip Resurfacing Arthroplasty

A Prospective Study

Nicolas Fouilleron,* MD, Guillaume Wavreille,* MD, Nima Endjah,† MD, and Julien Girard,*†‡ MD, PhD
Investigation performed at the Department of Sport Medicine, University of Lille, Lille Cedex, France

Background: The ability to return to sports activities (especially running) after hip resurfacing arthroplasty seems to be very important for young and active patients who have developed osteoarthritis.

Purpose: To assess the quality of return to sports after hip resurfacing arthroplasty by examining the time spent running, weekly mileage, and the possibility of returning to competition in a series of patients.

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

Methods: A prospective, consecutive series of 202 patients (215 hip resurfacings) was assessed to evaluate the possible resumption of running activity (time spent, weekly mileage, return to competition). Of this initial cohort, 40 patients (43 resurfacings, 21%) practiced running preoperatively. Mean age at hip resurfacing arthroplasty was 50.7 years (range, 31-61 years). No patients underwent revision surgery. A questionnaire was administered to assess the number, type, and level of sports activities. Among patients who practiced running, we determined, preoperatively and at last follow-up, their weekly mileage and whether they were competitors.

Results: At last follow-up, 33 of 40 patients (36/43 hips) still practiced running ($P = .74$), with 91.6% of them resuming running. Mean average recovery time before running at a level assessed as good by patients was 16.4 weeks (range, 5-36 weeks). The number of patients running more than 4 hours per week increased from 18 to 23. Similarly, the time devoted to running at last follow-up remained high (mean, 3.1 hours per week) with no statistically significant difference from the preoperative period ($P = .54$). Moreover, patients were still engaged in competition without statistical difference between the 2 periods ($P = .82$).

Conclusion: Running is possible after hip resurfacing, and runners can even return to some level of competition, but this short follow-up series of hip resurfacing in athletes should be interpreted with caution regarding implant survival.

Keywords: running; sport; hip arthroplasty; resurfacing; wear; bearing

Currently, running is an extremely widespread physical activity. While running is not directly associated with cartilage degradation, other sports activities involving weight-bearing may be accompanied by early osteoarthritis.[7,37]

On the other hand, the ability to return to sporting activities after hip arthroplasty seems to be very important to some patients, and they feel dissatisfied if such expectations are not met.[43] Hip resurfacing arthroplasty (HRA) seems to be an attractive choice of surgical procedure for young patients and athletes afflicted by hip osteoarthritis. In fact, with quality friction torque,[11] considerable stability, the very low dislocation rate, restoration of gait parameters, and the proprioception that this implant type provides, HRA allows a return to sports with a higher level of activity than does a 28-mm head diameter arthroplasty.[42] On the other hand, because component wear of prosthetic metal-polyethylene bearings is directly related to the level of patient activity,[34] it is logical to advise total hip arthroplasty (THA) patients against long-term participation in activities with repeated movements.

Several series have already demonstrated the possibility of resuming physical activity after hip replacement[§] or, more specifically, after HRA,[3,25,28] but none has

‡Address correspondence to Julien Girard, MD, PhD, Orthopaedic and Sport Medicine Department, Lille University Hospital, 2 avenue Oscar Lambret, 59037 Lille Cedex, France (e-mail: j_girard_lille@yahoo.fr).

*Department of Orthopedic Surgery, Roger Salengro Hospital, Lille, France.

†Department of Sport Medicine, University of Lille, Lille Cedex, France.

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TABLE 1
Hip Disease Diagnosis of the Current Prospective Series

Diagnosis	No. of Hips (%) (N = 43)
Primary osteoarthritis	18 (41.8)
Femoroacetabular impingement	18 (41.8)
Dysplasia	3 (6.9)
Posttraumatic arthritis	1 (2.6)
Avascular osteonecrosis	3 (6.9)

currently described the quality of running resumed after hip resurfacing. We reviewed a prospective, consecutive series of 202 patients who underwent 215 hip resurfacing operations. Of the initial cohort, 40 patients (43 HRAs) practiced running before the hip surgery and the onset of pain. In this group, we assessed the quality of their return to sports after surgery by examining the time spent running, their weekly mileage, and the possibility of returning to competition.

MATERIALS AND METHODS

Patients

Between October 2007 and October 2008, 215 HRAs (202 patients) were performed by a single trained surgeon. Male patients older than 65 years of age and female patients over 55 years with proven osteoporosis or severe anatomic deformities were excluded from HRA implantation. Other exclusion criteria were avascular femoral head necrosis with large femoral defects (more than one third of the femoral head).

A questionnaire was administered to assess the number, type, and level of sports activities that were divided according to their level of impact (light, medium, or high), as described by Clifford and Mallon[6] (see the Appendix, available with the online article and at http://ajs.sagepub.com/supplemental/). Patients were asked how much time per week they devoted to each sport (<1 hour, 1-2 hours, 2-4 hours, or >4 hours) and if they felt pain or stiffness, or lacked strength. Among patients who practiced running, we determined, preoperatively and at last follow-up, their weekly mileage and whether they were competitors. The preoperative mileage was established during the pain-free period before the onset of osteoarthritis hip pain.

In this consecutive, prospective series of 202 patients (215 HRAs), 40 (43 HRAs, 21%) practiced running during the preoperative period. Of these 40 patients, none was lost to follow-up. In this group, 4 patients were women and 36 were men, and 22 were right sided and 21 left sided. Mean age at HRA was 50.7 years (range, 31-61 years), and mean body mass index[18] was 24.8 (range, 21.7-33.6). Table 1 summarizes the preoperative diagnoses.

Surgical Technique

We used alternatively 2 resurfacing devices with the same femoral instrumentation (Durom, Zimmer, Warsaw, Indiana), which allowed the best head-to-neck ratio optimization. The Durom hip resurfacing system (Zimmer) was implanted in 11 patients (11 hips), and 29 patients (32 hips) underwent ConservePlus Hip Resurfacing (Wright Medical Technology, Arlington, Tennessee). All procedures were undertaken under general anesthesia via a gluteus maximus muscle–splitting posterior approach with patients in the lateral position. The short external rotators were released, and a posterior capsulotomy was performed. Femoral instrumentation served to align and position the guide rod for femoral head preparation. The femoral head was then dislocated anteriorly and the acetabulum reamed sequentially. Peripheral acetabular osteophytes were excised to prevent a cam effect. The definitive cup component was impacted. The femoral implant was positioned and secured with low viscosity cement. The hip was then reduced and the short external rotators and gluteus maximus tendon repaired.

Immediate full weightbearing was allowed with 2 crutches during the first week. A standardized rehabilitation program was started on the first day after the surgery. The patient should have been able to climb up and down one floor before going home. Because of this, the mean length of hospital stay was 6.1 days (range, 4-8 days). No restriction was applied to hip mobility, and rehabilitation was supervised by a physical therapist 3 times per week. Sports activities without any restriction were allowed postoperatively after the 6 weeks of clinical control.

Outcome Evaluation

Patients were reviewed at 6 weeks, 6 months, 1 year, and annually thereafter. Outcome measures were the Oxford hip score[8] (OHS), Harris hip score[14] (HHS), Devane activity score,[9] University of California, Los Angeles (UCLA) activity scale,[2] and the hop test. Running activity level was assessed with a specific questionnaire described below.

Anteroposterior radiographs of the pelvis were taken with the legs positioned at 15° of internal rotation. They were rejected if the coccyx was not centered on the pubic symphysis and was not located within 2 to 4 cm proximal to it. This ensured proper positioning of the pelvis in both the frontal and sagittal planes.[38] Implant positioning was evaluated and the presence of heterotopic bone formation identified by complementary Dunn incidence, as described by Brooker et al.[4]

Statistical Analysis

Paired samples and ordinal variables were analyzed by the Wilcoxon Z test, paired samples and binary variables by the Cochran Q test, and paired samples and continuous variables by the Student t test. The significance level accepted was $P < .05$ for all statistical analyses with SPSS 15.0 software (SPSS Inc, Chicago, Illinois).

RESULTS

Mean follow-up was 33.3 months (range, 26-41 months). There were no dislocations, superficial or deep wound

TABLE 2
Functional and Clinical Scores of the Entire Group of Patients and Subgroup of Patients Younger or Older Than 50 Years[a]

	All Patients			<50 Years Old			≥50 Years Old		
Clinical Data	Before	After	*P* Value	Before	After	*P* Value	Before	After	*P* Value
Harris hip score	44.7	97.6	<.001	45.0	98.5	.012	44.6	95.8	<.001
Oxford hip score	40.1	13.4	<.001	40.6	13.1	.001	39.7	13.5	<.001
Devane score	3.7	4.6	<.001	3.6	5.2	.043	3.8	4.6	<.001
UCLA activity score	6.9	9.1	<.001	6.8	8.9	.022	6.9	9.4	<.001
Hop test	3.5	8.6	<.001	3.2	8.8	.002	3.8	8.5	<.001

[a]UCLA, University of California, Los Angeles.

infections, and thromboembolic complications among the 43 HRAs. No patients underwent revision surgery.

Table 2 reports the main functional scores of the 40 study patients (43 HRAs). The mean preoperative HHS of 44.7 (range, 23-66) increased to 97.6 (range, 72-100) ($P < .001$) at final postoperative review. The UCLA activity score improved from a mean of 6.9 (range, 5-10) preoperatively to 9.1 (range, 4-10) postoperatively ($P < .001$). Mean OHS was 40.1 (range, 33-50) preoperatively and 13.4 (range, 12-24) ($P < .001$) at final postoperative review. Mean Devane score increased from 3.7 (range, 3-5) to 4.6 (range, 2-5) with statistically significant change ($P < .001$). If we individualized a subgroup of patients according to their age (younger or older than 50 years old), we did not notice any statistical difference in UCLA, Devane, HHS, OHS, and hop test scores ($P > .05$).

All patients had given up running before surgery because of pain. Preoperatively, they practiced an average of 4.2 sports disciplines and were still engaged at last follow-up in an average of 3.8 sports disciplines ($P = .196$). At last follow-up, 33 of 40 patients (36/43 hips) still practiced running ($P = .74$), with 91.6% (who ran preoperatively) returning to running at last follow-up.

The time spent running, mileage, and level of competition are reported in Figures 1, 2, and 3. Three patients dropped out of marathon training and changed mileage class from more than 50 km to 25 to 50 km. Thus, mean weekly postoperative mileage was significantly less than preoperatively (38.9 km and 28.4 km, respectively; $P = .009$) (Figure 1). While some patients had decreased the time they spent running in the postoperative period, the number of patients practicing running more than 4 hours per week increased from 18 to 23 (Figure 2). Similarly, the time devoted to running at last follow-up remained high (mean, 3.1 hours per week) with no statistical difference from the preoperative period ($P = .54$). Moreover, patients were still engaged in competition without statistical difference between the 2 periods ($P = .82$).

In the group of patients younger than 50 years of age (Table 3), the time spent running did not decline significantly postoperatively ($P = .32$) as it did in patients older than 50 years ($P = .1$). However, if weekly mileage decreased significantly throughout the series, it occurred in those older than 50 years ($P = .009$), while mileage reduction was not significant in the group aged younger

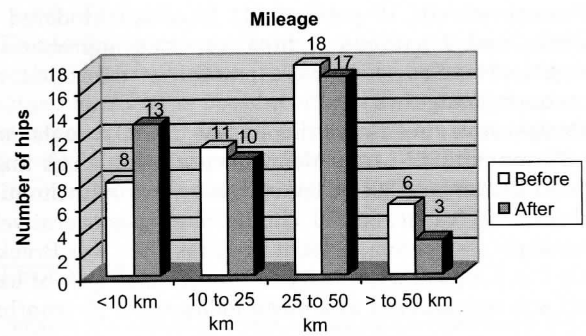

Figure 1. Mean mileage run per week according to the number of kilometers before and after hip resurfacing arthroplasty.

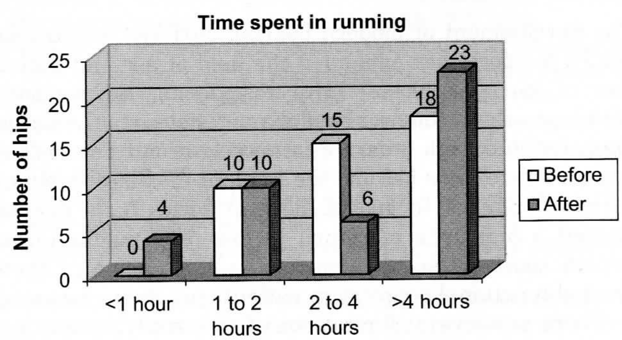

Figure 2. Mean time spent running per week according to the number of hours before and after hip resurfacing arthroplasty.

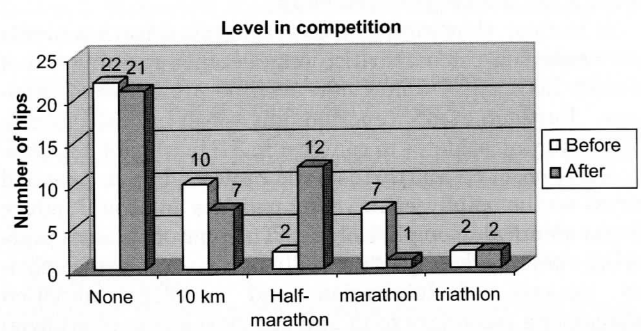

Figure 3. Level of competition before and after hip resurfacing arthroplasty.

TABLE 3
Mean Time Spent Running and Mean Mileage Run (by All Patients and According to Age)

	All Patients			<50 Years Old			≥50 Years Old		
	Before	After	*P* Value	Before	After	*P* Value	Before	After	*P* Value
Time, h	3.2	3.1	.536	3.2	3.1	.317	3.1	3.1	.1
Mileage, km	38.9	28.4	.009	40.7	32.1	.25	38.1	26.5	.009

than 50 years ($P = .25$). Mean average time before resumption of running at a level assessed as good by patients was 16.4 weeks (range, 5-36 weeks).

Postoperatively, 10 patients (11 hips) felt hindered by stiffness, and 7 patients (7 hips) reported apprehension during sports. Four hips were painful on effort but did not require analgesics.

Preoperative head-neck-diaphyseal (HND) angle was 134.2° (range, 125°-144°). Mean femoral stem-shaft angle was 141.3° (range, 130°-154°), with a mean cup inclination angle of 43.9° (range, 35°-50°) immediately postoperatively. Heterotopic ossification, present in 4 hips (7%), was Brooker grade 1 in 3 hips and grade 2 in 1 hip. No osteolysis or loosening was encountered at a mean follow-up of 29 months.

DISCUSSION

The development of modern bearing surfaces suitable for return to sports has expanded the field of use and indication of hip prosthesis.[21] Hip resurfacing arthroplasty, with a prosthetic femoral head diameter close to the native diameter and high wear resistance (without the risk of head fracture), has become the implant of choice in young patients engaged in sports. Several series have demonstrated a high rate of return to low- and medium-level impact sports after hip resurfacing.[3,25,28] None of them studied functional recovery in patients practicing running.

There are several limitations of this study. It was not a prospective, randomized controlled trial designed to demonstrate the superiority of resurfacing compared with conventional arthroplasty. Follow-up was short, but the return to sports (especially running) appeared to be very rapid after the surgical procedure.

It is clear that injury or use in atypical environments can cause hip osteoarthritis; long-distance running is not a risky activity[29,30] and could even be protective of cartilage.[7] Puranen et al[32] reported only 4% of hip osteoarthritis in running athletes in contrast to 8% in control patients.

Early-onset osteoarthritis could be secondary to repeated stress on the epiphyses in young patients and could induce strain identical to epiphysiolysis.[7] The hips of patients practicing running could paradoxically be saved by osteoarthritis because of lubrication and cartilage nutrition phenomena secondary to in and out movements of synovial fluid during races.[7] Osteoarthritis in our population of runners appears to be related to other at-risk sports that create cartilaginous alterations. Physiological hip functioning during running seems compatible with HRA. Moreover, the adaptive response to stress is an increase in water and proteoglycan content in joint fluid film while periarticular ligaments and muscles undergo supporting adaptive hypertrophy.[19] Hip resurfacing arthroplasty in standard conditions, whether for jogging or running at a competitive level, therefore appears to be possible and safe.

Two studies recorded a decline in sports with postoperative hip joint replacement. Ritter and Meding[33] and Dubs et al[10] noted 77% to 56% and 78% to 56% reductions, respectively, in return to sports between the preoperative and postoperative periods. With 91.6% returning to running, our results agree with more recent series showing that patients remain very active after hip surgery. In 216 arthroplasties, Chatterji et al[5] reported postoperative sports activity in 83% of patients versus 80% preoperatively. The number of sports decreased from 1.9 preoperatively to 1.7 postoperatively. In 112 patients with a mean age of 53 years reviewed at 2 years' follow-up, Naal et al[25] discerned that only 2 patients did not resume their activity, and the number of activities performed did not decrease significantly. According to Banerjee et al,[3] in a series of 152 HRAs, the percentage of active patients remained the same (98%), and the number of activities performed decreased significantly (3.6 preoperatively and 3.2 postoperatively). In contrast, Narvani et al[28] determined that the percentage of participation increased from 65% to 92% postoperatively.

In our study, we found that the time spent running after surgery remained similar postoperatively regardless of age, but mileage decreased significantly in patients over 50 years of age while it was unchanged in patients under 50 years. These age-related differences have been described in the literature.[17,35] Decreases in sports activities in aged patients are the rule after hip or knee arthroplasty. More recently, Naal et al[25] reported that older patients (mean age, 60.2 years) who underwent HRA participated in many different disciplines with a higher weekly frequency and longer session length than did younger patients (mean age, 46.4 years).

A significant decrease in postoperative practice of high-impact activities seems to be the rule after joint replacement.[3,5,25] Unlike our series, Narvani et al[28] showed that all high-impact sports were still practiced, except for rugby in only 1 patient. Mont et al[23] described the rate of return to a high-impact sport (tennis) after total hip replacement. Fifty-eight patients who played tennis after arthroplasty were surveyed through sports associations in 3 American states. Patients were all former competitors, and the average recovery time of 6.7 months allowed them 3 workouts per week with significant improvement in quality of play.

The consensus guidelines of Klein et al[20] offer a resumption of sporting activities within a minimum of 3 months. In the series of Banerjee et al,[3] 90% of patients returned to their activities within 3 months and 98% before 6 months. Naal et al[25] established that 50% of patients took 3 months and 90% took up to 6 months before resuming their activities. These data are consistent with ours: the most determined patients returned to sports before 3 months without weightbearing (cycling and swimming) and to high-impact sports activities between 3 and 6 months. This difficulty could be secondary to apprehension related to muscle weakness and proprioception.

The long-term effects of intense physical activity on the fixation of osseointegrated (cup) or cemented (femoral component) implants and bone quality seem difficult to assess. It is, therefore, possible that HRA patients are exposed to a greater risk of implant loosening compared to conventional THA.[21] However, despite the high level of activity observed after HRA, a study on the release of metal ions did not find correlations between the UCLA score and chromium and cobalt ions in blood at 1 year in HRA patients.[40] Therefore, several investigations revealed good results at midterm follow-up of HRA in active and young people.[1,39] Moreover, the relatively recent opportunity to use cementless femoral hip resurfacing components would provide superior long-term fixation. To date, for young and active patients, the bone in-growth into the femoral resurfacing component may be an alternative method of fixation.

Mont et al[24] performed gait analysis of HRA patients and reported that their characteristics were fully comparable with those of normal nonosteoarthritic hips. In contrast, THA patients had severely altered kinematics. This study suggests a mechanism of action for higher level function and better reproduction of natural biomechanics.[24] According to Lavigne et al,[22,26] THA patients presented lower hip abductor muscle strength compared with HRA patients. There were statistical differences between the 2 patient groups in biomechanical hip reconstruction. Another gait analysis showed that in the sagittal plane of motion, HRA returned a normal gait pattern while THA evoked an adaptive strategy that could enhance center of mass control and increase energy generation during the push-off period.[27] Moreover, previous gait studies have reported significantly lower walking speed in THA patients than in normal patients 6 months to 2 years after surgery.[24,31]

The excellent hip function found in resurfacing patients may be because of the conservative nature of the resurfacing procedure on the femoral head that conserves bone stock as well as mechanoreceptors and allows closer approximation to the normal proximal femoral anatomy.[36,41] Precise biomechanical reconstruction after HRA led to the preservation of abductor and extensor moment arm distances, which might account for the lack of weakening of abductor and extensor muscles.[21] In fact, on the femoral side, more precise restoration of anatomy was noted with HRA in a prospective, randomized study comparing THA versus HRA. Leg length was restored to within ±4 mm in 33 (60%) of THA and 42 (86%) of HRA patients. Femoral offset was restored to within ±4 mm in 14 (25%) of THA and 29 (59%) of HRA cases.[12]

CONCLUSION

Running is currently a very popular physical activity. Accessibility, social, and sports dimensions motivate more and more people to become competitors. When osteoarthritis affects patients, the practice of running quickly becomes painful and impossible. Hip resurfacing arthroplasty provides an opportunity for patients to resume their sports activities at the intensity they desire and whatever the level of impact.[3,25]

This is the first series to describe the results of running after hip arthroplasty with 91.6% of return to running practice. Running is possible after HRA, and runners can even recover some degree of competition, but the short follow-up of this series of resurfacing in athletes should be interpreted with caution regarding implant survival.

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