CASE REPORT

Full marathon after bilateral total hip arthroplasty: case report with magnetic resonance imaging findings

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Abstract

Long-distance running is not a recommended form of exercise after total hip arthroplasty (THA). However, younger and more active patients often wish to return to sport after THA. We present the case of a 38-year-old man who underwent bilateral THA for osteonecrosis. Three months after surgery and rehabilitation, the patient returned to his normal life. He returned to sport one year after surgery when he engaged in long-distance running and documented his daily exercise status. In the fourth year after surgery, he completed a full marathon race with a total length of 42.2km. Magnetic resonance imaging of the bilateral hip joints performed within 48 hours after the marathon revealed no oedema in the greater trochanteric region and a small amount of fluid accumulation in the hip joints. Bilateral THA achieved excellent clinical and radiographic results based on clinical manifestations and magnetic resonance imaging.

Keywords: Total hip arthroplasty; Magnetic resonance imaging; Long-distance running; Return to sport.

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Introduction

Total hip arthroplasty (THA) is a highly successful operation that improves pain, quality of life, and functional abilities. Although THA has traditionally been reserved for older patients with severely limiting disease, an increasing number of adults are undergoing THA at younger ages. Many younger and more active patients who are involved in athletic activities wish to return to sport (RTS) after surgery. Most patients can return to pre-operative levels of low-impact (e.g. walking) and moderate-impact (e.g. hiking) sports between seven and 12 months after THA.[1] However, some types of exercises are unsuitable for patients who have undergone THA.

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Marathon running is a popular long-distance competitive race event worldwide, covering a total distance of 42.2km (26 miles and 385 yards). This sport is not recommended after THA mainly due to potential component wear and the need for more frequent revision procedures because of increased polyethylene wear associated with high-impact activities.[2] Marathon running is not considered a risk factor for short-term implant failure, but long-term analysis is needed.[3] We report the case of a patient who underwent bilateral THA and subsequently ran a full marathon. Local hip conditions were evaluated after the marathon using magnetic resonance imaging (MRI).

Case Report

A 38-year-old man presented to Peking University Third Hospital, Beijing, in April 2018, due to bilateral hip pain. The patient had developed bilateral femoral head aseptic vascular necrosis after large doses of corticosteroids were administered to treat ankylosing spondylitis. His symptoms were pain and limited mobility in both the hips for the past 10 years. The bilateral femoral heads were classified as Ficat stage IV4 before the surgery (Figure 1a). The patient was 164cm (5.4 feet) tall, weighed 64kg, and had a body mass index of 23.8kg/m^2.

In April 2018, the patient underwent right THA via the modified Hardinge approach under general anaesthesia in the right lateral position. He recovered satisfactorily and then underwent left THA using the same surgical approach in September 2018. Both THA procedures used a trabecular metal modular acetabular cup with a longevity highly cross-linked polyethylene liner and a femoral stem with a 32-mm cobalt chromium head (Smith & Nephew, Memphis, Tennessee, USA). Initial follow-up radiographs demonstrated that the components were appropriately aligned (Figure 1b).

The post-operative rehabilitation process was uneventful. The patient was allowed to walk with the help of a walker on the first day after surgery and returned to normal activities three months later. The patient started long-distance running in September 2019, i.e. one year after the right THA. During the first 1–1.5 years after surgery, the patient performed 19 long-distance runs. Starting from 1.5 years after surgery, the patient's long-distance running frequency, average running distance, stride

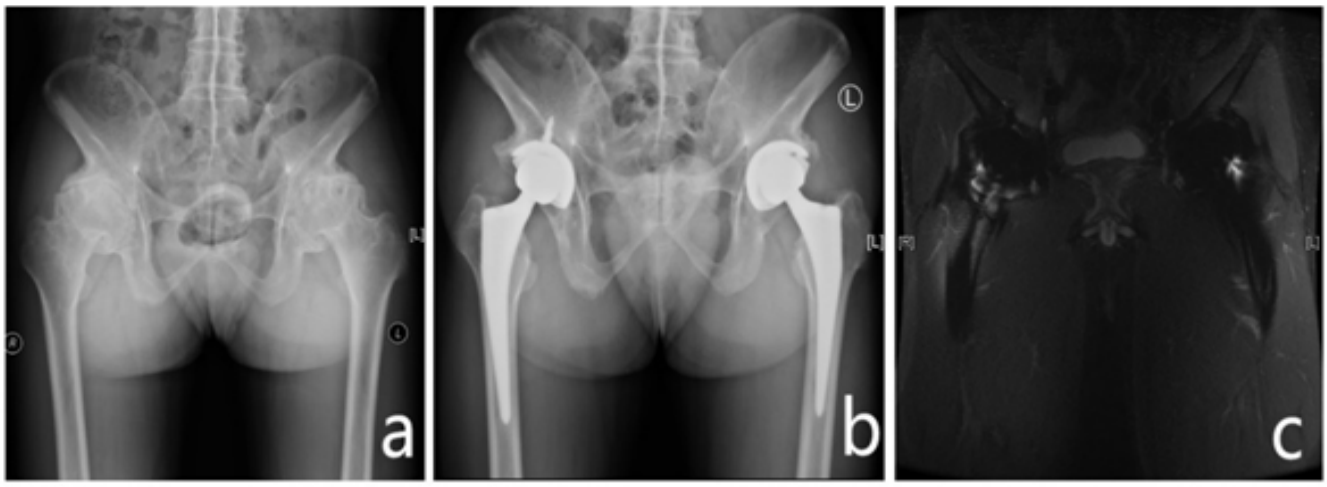

Figure-1: Pre-operative and post-operative images of the hips. a) pre-operative radiograph showing bilateral Ficat stage IV hips; b) radiograph of bilateral hips immediately after left THA; c) MRI at 48 hours after the full marathon showing no obvious oedema signal.
THA: total hip arthroplasty; MRI: magnetic resonance imaging.

Table-1: Exercise status after bilateral THA.

Postoperative Time	Exercise frequency	Distance (Km)	Pace (min/Km)	Step number	Step frequency	Stride length (cm)
1~1.5 year	19	4.97	7:10	6385	169	78.9
1.5~2 year	79	7.26	6:51	8934	183	81.6
2~2.5 year	74	9.52	7:02	11167	183	85.0
2.5~3 year	91	8.96	6:42	10360	184	86.1
3~3.5 year	93	10.19	6:37	11794	182	86.8
3.5~4 year	67	7.88	8:40	9391	178	84.5
4~4.5 year	81	10.49	6:24	12300	183	87.0

frequency, and stride length improved substantially, and he was running every 2.5 days on average. Although the COVID-19 pandemic, that occurred 2 years after the patient's surgery, led to a decrease in his exercise frequency and ability, he maintained a good and stable exercise intensity level (Table 1). As of March 2023, the patient had run a total of 4,513.0km after surgery.

On November 6, 2022, the patient participated in a full marathon (total length 42.2km). His race time was 07:03, with a total of 53,776 steps, stride frequency of 176 steps per minute, and stride length of 78.5cm. The patient underwent hip MRI 48 hours after the marathon, and no obvious oedema signal was observed (Figure 1c). Complete MRI content can be seen in the original file attached. This indicated that the patient's bilateral hip function was good and there was no inflammatory reaction due to competitive long-distance running.

Discussion

THA improves the function of the hip joint and restores the gait.[5] In the present case, the patient began to recover normal walking function three months after bilateral THA. He then resumed long-distance running one year after surgery and gradually increased the amount of exercise. Despite running a total of 4,513.0km and participating in a full marathon race, he maintained excellent clinical and radiographic results five years post-operatively.

Resumption of sports activities after total hip replacement is crucial for some patients, especially for younger patients and those with good pre-operative functional status. Running is a common sport, but whether long-distance running can accelerate the wear of the prosthesis remains controversial. In the past, the attitude toward high-impact sports after hip replacement surgery has mainly been negative.

Accelerated polyethylene wear in association with increased patient activity scores rather than in association with the number of steps taken. McGrory et al.[6] suggested that although patients with THA can complete long-distance running activities, such as a marathon, there is still a potential increased risk of prosthesis wear. The peak hip contact force during jogging has been reported to be 5.5 times the body weight and 1.6 times the peak hip contact force during walking.[5] Therefore, long-distance running is an achievable but not a recommended form of

exercise after THA. Healy et al. reported that jogging is classified as a high-impact or ''not recommended'' sport, as are contact sports such as baseball, soccer, and basketball.[7]Despite the above reports, other studies have shown that although running can help to restore patients' functional abilities, this activity does not increase the revision rate. Hirobito et al.[7] showed that none of their patients who engaged in jogging complained of pain or showed serum cobalt and chromium ion elevations greater than 7ppb. None of the hips showed loosening, abnormal component migration, or excessive wear at a mean five-year follow-up. A prospective study on hip resurfacing arthroplasty by Nicolas et al.[8] demonstrated that running was possible after hip resurfacing, and runners could even return to some level of competition; however, this short follow-up series of hip resurfacing in athletes should be interpreted with caution in terms of implant survival.

In a systematic review by Colin et al. 89 of 121 (73.6%) pre-operative runners returned to running post-operatively. Although no early failures were observed, increased linear wear and increased mid-term THA revisions were noted.[9]

In the present case, the modified Hardinge approach was used for staged bilateral THA. The patient achieved RTS one year after surgery and returned to a stable state of exercise 1.5 years after surgery. The highly cross-linked polymer liners used in the THAs showed no obvious signs of wear on post-operative MRI. THA is increasingly performed in younger and more active patients; thus, RTS has become an urgent post-operative need in this population. A previous study showed that 40.0% (95% confidence interval [CI], 32.5–47.9) of patients achieved RTS between two and three months after THA, 76.9% (95% CI, 71.5–82.0) by six months after THA, and 93.9% (95% CI, 82.7–99.5) achieved RTS between six and 12 months after THA.[10]

The effects of the surgical approach may influence the post-THA gait biomechanics. Yoo et al.[11] reported that the gait speed and peak hip flexion within three months after THA are significantly higher after THA via the direct anterior approach versus the anterolateral approach. However, Moyer et al.[12] reported minimal early or late post-operative differences in gait biomechanics between surgical approaches. Although there are some important differences among surgical approaches, it remains unclear whether the reported post-operative differences in gait values are clinically meaningful.[12]

The post-operative gait is also affected by whether the patient undergoes unilateral or bilateral THA. Temporiti et al.[13] suggested that patients undergoing bilateral THA achieve a gait variable pelvic tilt score that is closer to the normative value, a longer stance, and shorter swing phase compared with patients undergoing unilateral THA. Moreover, patients with bilateral THA have a higher numeric rating scale score for pain during walking than patients with unilateral THA.[13]

MRI has been avoided in the routine evaluation of metal implants after THA because artefacts create in-plane and through-plane distortions and signal intensity voids. However, MRI can identify THA prosthesis loosening, which manifests as a thin linear gap of signal abnormality along the bone–metal, bone–cement, or cement–metal junctions as well as marrow oedema related to the superimposed stress reaction, subsidence, angulation, and frank displacement.[14]

The present study has some limitations. It is a case report, and although the patient demonstrated good functional outcomes in the short term after surgery and provided accurate data on daily activities, long-term results are lacking. The findings in this case may not be generalizable to encompass a recommendation for running after total hip replacement.

The present case report describes the patient's RTS after bilateral THA. Despite regularly running long distances (over 4,000km in total) and successfully participating in a full marathon race, his bilateral hip joints showed excellent clinical and radiographic results. Furthermore, MRI showed no local oedema after the marathon. However, given the risk of accelerated implant wear resulting from high-intensity repetitive activity, this type of activity is not recommended after THA.

Conclusion

Bilateral THA can achieve excellent clinical and radiographic results based on the clinical manifestations and MRI.

Consent: The patient provided written informed consent for the publication of his case details. The attached table contains the exercise parameters provided by the patient.

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RZ: Data management, analysis and writing.
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HC: Data management and project development.
YL: Project development and editing.