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ORIGINAL ARTICLE

Total hip arthroplasty for vascular necrosis of the femoral head in patients with systemic lupus erythematosus: a midterm follow-up study of 28 hips in 24 patients

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Abstract
Objective Avascular necrosis of the femoral head is one of the most frequently reported complications in patients with systemic lupus erythematosus (SLE) and often requires total hip arthroplasty (THA). Our objective was to analyze the perioperative management, technical problems, clinical outcomes, and complications associated with THA in patients with SLE.
Methods A total of 28 total hip arthroplasties performed for 24 patients with SLE, including 19 women and 5 men with a mean age of 38.8 years performed from 1998 to 2011 were retrospectively reviewed. SLE disease activity index and ASA class were evaluated preoperatively. WOMAC, HHS, and SF-36 scores were also evaluated in all cases pre- and post-operatively for functional recovery of the hip and health-related quality of life (HRQOL).
Results The average SLE disease activity index was 3.5 points. Three patients were in ASA class I, 12 class II, and 9 were class III (37.5%). The average duration of follow-up was 67.5 months. None of the patients required a revision, and 3 patients died during the follow-up period. A statistically significant improvement in all scores was found comparing pre- and post-operative conditions ($P < 0.001$). The complication rate was 11.1% with 2 wound infections and 1 urinary tract infection.
Conclusion THA is an acceptable method for achieving functional recovery and increasing HRQOL in patients with SLE and ANFH who receive proper perioperative management.

Keywords Arthroplasty · Hip · Systemic lupus erythematosus · Avascular necrosis of the femoral head

Introduction

Systemic lupus erythematosus (SLE) is an autoimmune disease characterized by the production of antinuclear autoantibodies and the inflammatory infiltration of multiple organ systems and cardiovascular, urinary, musculoskeletal, and central nervous system involvement [1]. The overall prevalence of SLE is estimated to be about 1/1,000 in the general population; however, there are ethnic and gender differences, and women are 10 times as likely as men to be affected, especially women who are in the childbearing years [2–5].

Musculoskeletal discomfort is commonly the initial symptom for the patients with SLE. Though arthritis associated with SLE is not typically erosive or destructive of bone, a small but important group of patients manifest arthralgias and malfunction in the affected joint. Avascular osteonecrosis of the femoral head (ANFH) is one of the most frequently reported complications of SLE affecting the musculoskeletal system [6–8]. Symptomatic avascular osteonecrosis has been reported to occur in 4–40%

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of patients with SLE [8–11], with an overall average of 10% [12]. ANFH may result in pathological fracture and disabling hip pain with progressive collapse of the femoral head, resulting in a significant decrease in quality of life (QoL). Hence, prosthetic arthroplasty is often necessary.

It is well known that total hip arthroplasty (THA) is the first and the best choice for the treatment of end-stage ANFH, and high success rates have been reported [13–15]. However, SLE, other systemic diseases, osteoporosis, and long-term steroid use increase the surgical risk. In patients with SLE, disease activity and infection are the two main causes of death post-operatively. Takahashi et al. [16] analyzed 63 major operations in 52 SLE patients and reported that 16% of the patients had post-operative complications, and the mortality rate was 6%, both of which are higher than that of routine surgeries. There are only a few, relatively small reports of THA in patients with SLE [1, 17–21]. The purpose of this study was retrospectively review THAs performed in SLE patients at our institute to evaluate the clinical outcomes, technical problems, and complications associated with the procedure to determine whether it is a reasonable option for the treatment of ANFH in SLE patients.

Materials and methods

Patient characteristics

From April 1998 to June 2011, 29 THAs were performed in 25 SLE patients with ANFH. One patient (1 hip) was lost to follow-up and excluded from the study. The remaining 28 hips in 24 patients, including 19 women (21 hips) and 5 men (7 hips) with a mean age of 38.8 years (range, 21–70 years), were available for retrospective clinical and radiographic review. Approval for the study was obtained from the Review Board on Ethics in Medical Research of the First Affiliated Hospital of Sun Yat-sen University, Guangzhou, China. All patients met the American Rheumatic Association criteria for the classification of SLE revised in 1997 [22] and accepted regular corticosteroid therapy. SLE disease activity index (SLEDAI) was evaluated in all patients preoperatively [23]. All patients had Ficat III or IV necrosis of the femoral head, that is, radiographs, computed tomography (CT), or magnetic resonance imaging showed sclerosis and cystic or configuration changes of the femoral head associated with or without hip pain [24]. All patients were classified by the American Society of Anesthesiologists (ASA) rating to evaluate the operation risk [25]. Patients with an ASA rating of IV or V should not receive THA until their general condition improves (Table 2).

Perioperative treatment

Osteoporosis treatment was performed immediately after admission, and the Rheumatology department in our hospital developed a corticosteroid protocol as follows: prednisone 5–10 mg/day orally until surgery, 40 mg intravenous prednisone intraoperatively, followed by the same dose of prednisone intravenously the first 3 days post-operatively, then reduce the dose by 50% every 3 days until 10 mg/day, and then prednisone 5–10 mg/day for 2 weeks. Patients were administered broad-spectrum antibiotics (e.g., ceftriaxone) the day prior to surgery at a conventional dosage, the 30 min before surgery at twice the conventional dosage, and post-operatively for 5–7 days at the conventional dosage. Infections were treated with a prolonged duration and/or multiple antibiotics. Post-operatively, all patients received low-molecular-weight heparin anticoagulation therapy. None of the patients received immunosuppression in the perioperative period.

Surgical methods

All operations were performed with combined spinal epidural anesthesia (CSEA), and all procedures were performed by the 2 senior authors (Dr. Wei-ming Liao and Dr. Pu-yi Sheng). Procedures were performed with the patient in the lateral decubitus position using the lateral direct approach [26]. The mean surgical time was 112.2 ± 50.2 min (range, 60–300 min). The choice of the implant (uncemented or cemented) was made by the treating surgeon according to factors including the patients' age, bone quality, and degree of osteoporosis. If the patient was old or had severe osteoporosis, cement was typically used; otherwise, uncemented was preferred. Before cement filling, the bone marrow cavity should be expend and fully flushed. During cement filling and bone marrow expanding vital signs should be careful monitored. All procedures should be performed as gently as possible to avoid any iatrogenic fractures. The average blood loss during surgery was 443.1 ml (range, 100–1,500 ml). Eleven of the 24 patients (45.83%) required a blood transfusion with a mean volume of 4.2 units (range, 1–10 units [1 unit = 100 ml]). Both average blood loss and blood transfusion in operation were exceeding the average level at our institute (268.55 ml and 3.02 units, respectively) (Table 1).

Follow-up

All patients were followed up after the surgery at 1, 3, 6, and 12 months post-operatively, and then yearly. Patients were contacted by both telephone and mailed a questionnaire in a prepaid return envelope. Clinical status at the time of the last follow-up was evaluated by assessing pain,

Table 1 Patients' demographics characteristics

Characteristics	Mean ± SD or %
Gender ($N = 24$)	
Female	19 (79.2%)
Male	5 (20.8%)
Age (years, $N = 24$)	38.8 ± 13.9
Body mass index (kg/m^2, $N = 24$)	22.1 ± 2.2
Operated hips ($N = 28$)	
Left hip	16 (57.1%)
Right hip	12 (42.9%)
Duration between onset and operation (years) ($N = 28$)	8.5 ± 4.6
Operation time (minutes, $N = 27$)	112.2 ± 50.2
Blood loss (ml, $N = 27$)	443.1 ± 359.3
Blood transfusion (units, 1 unit = 100 ml, $N = 11$)	4.2 ± 2.8
Hospital stay (days, $N = 27$)	19.4 ± 6.3
Follow-up (months, $N = 28$)	67.5 ± 39.6
Complication ($N = 27$)	11.1%

Table 2 Patients' clinical characteristics

Characteristics	Mean ± SD or %
ASA ($N = 24$)	
I	12.5%
II	50.0%
III	37.5%
SLEDAI ($N = 24$)	3.5 ± 2.0
Ficat stage ($N = 28$)	
III	16.7%
IV	83.3%
Prothesis supplier ($N = 28$)	
Zimmer	35.7%
Depuy	42.9%
Smith and Nephew	21.4%

ambulatory status, and general situation. Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index [27, 28] and Harris hip score (HHS) [29] were also evaluated in all cases pre- and post-operatively to assess functional recovery of the hip. For the WOMAC Osteoarthritis Index, responses were recorded on a visual analog scale with terminal descriptors. Scores were added for each category and standardized to a score of 0–100 with higher scores indicating more pain, more stiffness, or more dysfunction. The HHS is a hip-directed test to evaluate hip in pain (six stages) and functional (four items) aspects. The higher the score, the better the joint recovery. Health-related quality of life (HRQOL) pre- and post-operatively was assessed by the 36-item short-form health survey (SF-36) [30], which provides 2 general indices referring to the physical component summary (PCS) and the mental component summary (MCS) scores. Items from each concept are summed and rescaled with a standard range of 0 to 100, where 100 represents the best HRQOL. Post-operative radiographs were collected to evaluate the position, fixation, and loosening of the cemented and uncemented components, radiolucent lines, and osteolysis. SPSS 13.0 (SPSS Inc, Chicago, IL, USA) was used for data analysis, and a value of $P < 0.05$ was considered to indicate statistical significance.

Results

The average duration between onset of SLE and surgery was 8.5 years (range, 2–20 years). The average SLEDAI was 3.5 points (range, 0–7 points). Four hips were Ficat III, and 24 were Ficat IV. Three patients were ASA class I, 12 class II, and 9 class III (37.5%) (Table 2). All femoral components were uncemented prostheses. Acetabular components were uncemented in 24 hips and cemented in 4 hips. Twelve implants were supplied by Depuy-Johnson & Johnson (New Brunswick, NJ, USA), 10 were from Zimmer Inc. (Warsaw, IN, USA), and 6 were from Smith & Nephew Medical Limited (London, England) (Table 2). Four patients received bilateral replacements, only one of which was completed in a single procedure because the patient was young and ASA class I (Fig. 1). In one case, because of an extremely thin acetabulum and severe osteoporosis, the acetabulum was reconstructed with Titanium mesh (Zimmer Inc) and morcellized impacted cancellous autograft, and a cemented component implanted (Fig. 2).

The average duration of follow-up was 67.5 months (range, 12–156 months), with death and revision as the endpoint (Table 3). None of the patients required a revision arthroplasty. Three patients died during the follow-up period. The first was a 65-year-old woman with hypertension, Sjogren's syndrome, overlap syndrome, and prior left nephrectomy who died from intracranial bleeding 18 months post-operatively. Her HHS was 92 at the last follow-up of 12 months. She was able to care herself well and had no pain in her hip. The second was a 70-year-old woman with hypertension and osteoporosis who died from pneumonitis and acute heart failure 24 months after THA. Her HHS was 89 at 12 months post-operatively, and she had no hip pain. The third was a 67-year-old man with hypertension who died of a myocardial infarction 60 months after the surgery. His HHS was 91 at 48 months post-operatively.

The mean hospital stay was 19 days (range, 14–38 days); the same time required for the routine primary

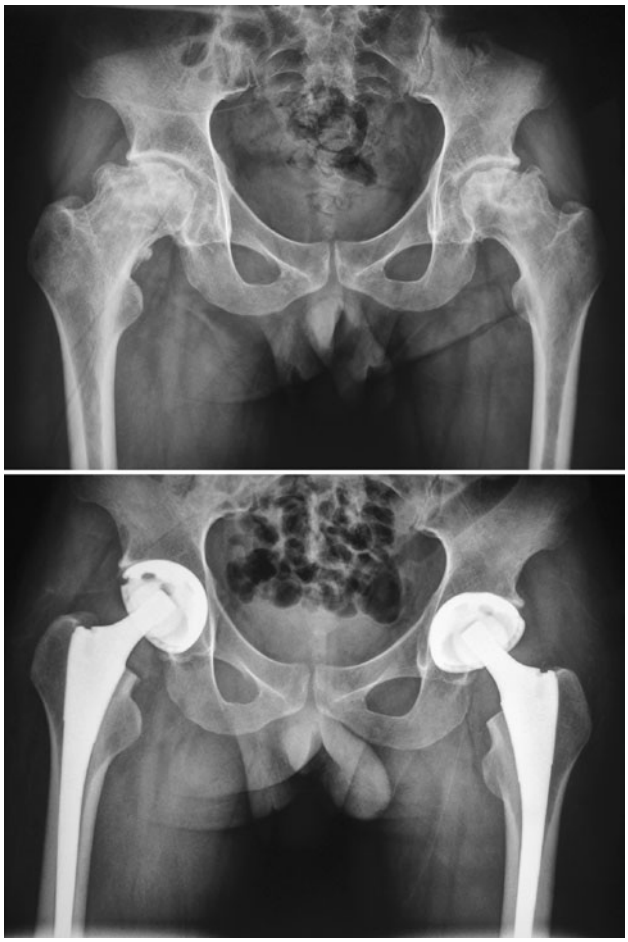

Fig. 1 Pre- and post-operative anteroposterior X-ray of a SLE patient (Male, 26 years, avascular necrosis of bilateral hips, Ficat IV, ASA I) with cementless total hip arthroplasties

THA at our institute. Redness, swelling, and drainage of the surgical wound were noted in 2 patients post-operatively. One was a 57-year-old man in whom the wound was culture negative, which healed well after antibiotic therapy. Radiograph did not indicate any evidence of infection of the hip. The other was a 38-year-old woman with a Staphylococcus infection confirmed by bacterial culture that healed well after enhanced antibiotic therapy. A 28-year-old woman with a history of renal transplantation developed a urinary tract infection 5 days after surgery that resolved with antibiotics. The complication rate in this series was thus 11.1%. There was no nerve palsy or other significant complications related to the surgery such as dislocation, fracture, or pulmonary embolism, and no perioperative systemic complications in any patient (Table 1).

Before surgery, all patients had moderate or severe pain in their hips and were unable to walk or had minimal walking ability with crutches. The mean WOMAC score was 86.2 ± 4.1 (range, 77.1–90.6) preoperatively and 39.5 ± 5.6 (range, 29.2–47.9) at the last follow-up. The mean HHS was 33.0 ± 4.7 (range, 25–44) preoperatively and 84.3 ± 5.2 (range, 75–92) at the last follow-up. In 6 of 28 (21.4%) cases, the post-operative HHS was between 90 and 100, in 17 of 28 (60.7%) between 80 and 89, and in 5 of 28 (17.9%) between 70 and 79. The mean post-operative SF-36 PCS and MCS scores were greater than the preoperative scores. A statistically significant improvement in all scores was found post-operatively as compared to preoperative values (all, $P < 0.001$) (Table 4 and Fig. 3).

Radiographs of at least 12 months post-operatively were available for all patients. Component malpositioning, dislocations, aseptic loosening, radiolucent lines, or osteolysis were not detected in any cases.

Discussion

Although the precise pathological mechanisms of femoral head necrosis are still not fully understood, recent study has indicated that it may highly be related to the long-term use of glucocorticoids, vasculitis, and microvascular thrombosis [5].

Though SLE still carries a risk of mortality 5.92 times higher than that of persons without SLE and long-term morbidity, the survival of patients with SLE has greatly improved through advances in the treatment over the last few decades [16]. Doria et al. [31] reported survival rates 5, 10, and 15 years after diagnosis of 96, 93, and 76%, respectively. Hence, hip arthroplasty is of great significance to patients with SLE with respect to improving their HRQOL. In our series, three patients who were elderly with systemic diseases died of cardio-cerebral vascular accidents at least 1 year post-operatively; however, there was not evidence that their deaths were related to the THA. There is disagreement as to whether or not patients with SLE should undergo THA, and it is important to weight the risks and the benefits of surgery as well to improve management to decrease the surgical complication rate and morbidity and mortality.

To the best of our knowledge, there are only a few published studies regarding THA in patients with SLE. Zanggeret al. [1] compared the results of 26 THAs performed on 19 SLE patients with those of 29 routine THAs performed on 19 patients. An increased incidence of complications (6/19 patients) was noted in the SLE group. No radiological evidence of implant loosening was noted in the routine THA group, but one asymptomatic cup migration occurred in the SLE group, and HHS and SF-36 scores were similar between the two groups. Prupas [19] reported on 6 SLE patients who underwent arthroplasty for the treatment of avascular necrosis of the hip; no serious complications were occurred, and all patients had good or excellent results. Hanssen [20] reported on 31 SLE patients (43 hips) who had either conventional THA (29 hips) or bipolar

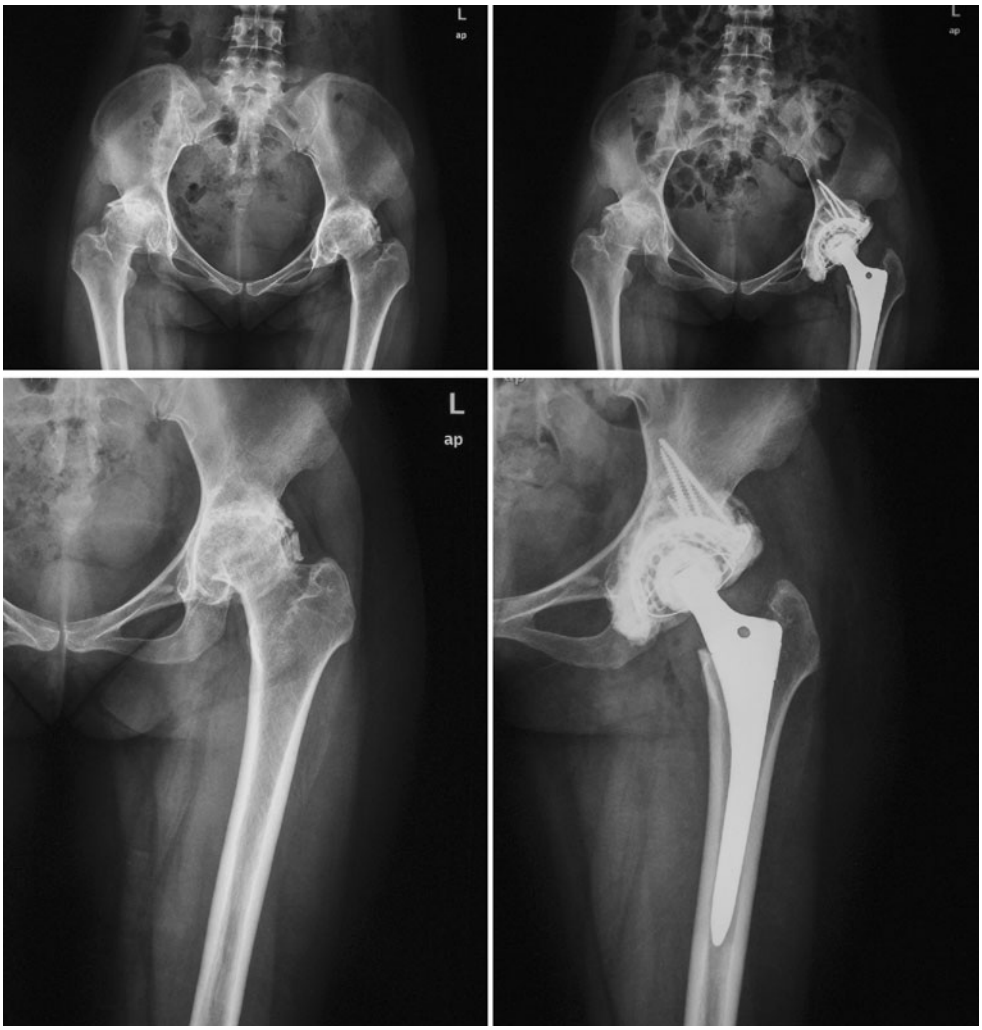

Fig. 2 Pre- and post-operative anteroposterior X-ray of a SLE patient (woman, 37 years, avascular necrosis of bilateral hips, Ficat IV, the symptoms of the *left hip* was more serious than the right one, ASAII) with mixed total arthroplasty of the *left hip*. The *right hip* was not treated because of economical dilemma

endoprosthetic replacements (14 hips) for the broken hips, and 93.02% had good or excellent results. Approximately, 15% had delayed wound healing and approximately 10% superficial wound infections that were not related to the intake of steroids.

In our study, patients generally had dramatic improvement in HHS, WOMAC, and SF-36 scores, which are consistent with the limited published results mentioned above, all of which mean good or excellent clinical results. Although the mean preoperative and last-followed HHS in SLE patients were lower than the average level of routine primary THA at our institute (46 ± 6.7 and 94.8 ± 4.9, for preoperatively and the last followed, respectively), the SLE obtained similar improvement in HHS. There were no significantly difference found in the mean preoperative and last-followed WOMAC and SF-36 between SLE and general patients. We experienced 3 cases of post-operative complications, an incidence of 11.1%, which is significantly higher than the average complication rate for routine primary THA at our institute (3.11%), warning us to pay great attention in preventing complications in SLE patients. Fortunately, all of these were early complications, similar to the results of Hanssen et al. [20]. In addition, massive blood loss and transfusion during operation was noted in the SLE group. These may resulted from SLE-associated complications, like vasculitis, anemia, coagulation disorder and secondary osteoporosis, or overexposure of the operative site.

As mentioned above, disease activity and infection are the two main variables that affect the outcome of the surgery. In our study, the SLE activity score was <10 (mean, 3.5; range, 0–7) in all patients, which indicates resting stage SLE. In addition, the ASA class of all patients was <IV, thus they were all in generally good physical condition. Moreover, the use of prophylactic antibiotics was more aggressive that for routine THA. The strict selection of

Table 3 The first follow-up time, duration of follow-up, and the last radiographic follow-up time of each patient

Number	The first follow-up time ($N = 28$)	Duration of follow-up (months, $N = 28$)	The last follow-up time ($N = 28$)
1	08-Aug-1998	156	14-Jun-2011
2	28-Apr-2000	134	09-May-2011
3[a]	27-Feb-2001	24	27-Feb-2003
4	24-Jan-2001	122	26-Feb-2011
5	22-Sep-2001	116	07-Apr-2011
6	28-Feb-2002	109	11-Feb-2011
7	21-Mar-2002	112	04-Jun-2011
8	19-Apr-2002	106	16-Jan-2011
9[a]	24-Feb-2003	60	08-Feb-2008
10	12-Apr-2003	96	14-Mar-2011
11	13-May-2003	97	02-May-2011
12	07-May-2004	84	17-Apr-2011
13	31-Jul-2005	70	16-May-2011
14	01-Aug-2005	67	28-Feb-2011
15	30-Aug-2005	69	14-May-2011
16	26-Feb-2006	62	06-Apr-2011
17	25-Jun-2006	57	21-Mar-2011
18	23-Dec-2006	52	13-Apr-2011
19	22-May-2007	44	01-Jan-2011
20	22-Jun-2007	48	01-Jun-2011
21	18-Nov-2007	38	01-Jan-2011
22[a]	08-Feb-2008	18	01-Aug-2009
23	14-Jul-2008	32	01-Mar-2011
24	13-Oct-2008	30	01-Apr-2011
25	14-Oct-2008	28	01-Feb-2011
26	12-Mar-2009	22	01-Jan-2011
27	12-Apr-2009	26	01-Jun-2011
28	06-Jun-2010	12	01-Jun-2011

[a] These patients were died during the follow-up period

Table 4 Mean WOMAC, Harris hip scores, and SF-36 scores of SLE patients pre- and post-operatively

Index	Preoperation ($N = 28$)	Post-operation ($N = 28$)	P-value
WOMAC[a]	86.2 ± 4.1	39.5 ± 5.6	<0.001
HHS[b]	33.0 ± 4.7	84.3 ± 5.2	<0.001
SF-36[b]			
PCS	26.9 ± 5.4	42.2 ± 8.9	<0.001
MCS	43.2 ± 10.7	49.5 ± 11.1	<0.001

All scores were showed by mean ± standard deviation. Significance was tested with the t-test

WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; *HHS,* Harris hip score; *SF-36,* short form 36; *PCS,* physical component summary scale score; and *MCS,* mental component summary scale score

[a] Range from 0 to 100 with lower scores representing better quality of life

[b] Higher scores representing better function or quality of life

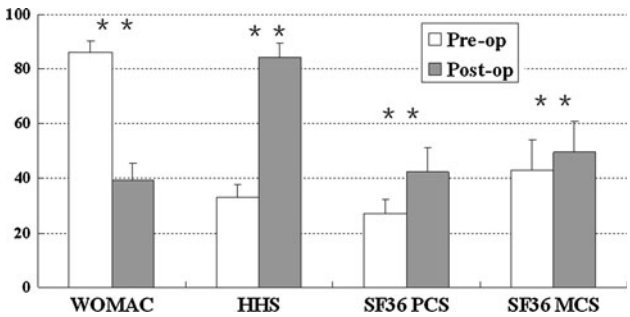

Fig. 3 Comparison of pre- and post-operative WOMAC, Harris hip score, and SF-36 (PCS and MCS) in SLE patients who received THA because of avascular necrosis. Statistics were showed in Table 4. WOMAC ranges from 0 to 100 with lower scores representing better quality of life, while higher HHS or SF-36 scores representing better function or quality of life. *Bar labeled* with *two asterisks* (**) indicates a significant difference from its preoperative score ($P < 0.001$)

patients and the aggressive use of antibiotics can effectively lower the complication rate in SLE patients receiving THA.

The SLE patients who received THA were younger, usually had osteoporosis, required a longer surgical time, and had more post-operative complications. In our study, all femoral components were uncemented for the sake of simplifying possible revisions in future. Because of osteoporosis, gentle manipulation is necessary to prevent intraoperative femoral fractures during canal preparation. In our series, we had no femoral fractures during preparation of the femoral canal. Decisions about acetabular resurfacing were based on the surgeon's assessment of the quality of the remaining cartilage and on their preference. In our series, 24 uncemented acetabular components were implanted. However, because of critical bone loss and damage to the acetabulum, cement should be used in some cases. Other than cement, the acetabulum was constructed with titanium mesh and morcellized impacted cancellous autograft in one case. Despite the technical challenges, there were surprisingly few serious orthopedic complications in our series, and the clinical outcomes were acceptable.

Although THA in SLE patients is challenging due to disease activity, osteoporosis, and long-term steroid use, our study offers objective evidence to support the theory that THA can be performed in SLE patients with satisfactory outcomes despite the prevailing attitude that SLE patients are generally in poor operative risks [16].

The strength of this study includes the fact that all procedures were performed with the same approach. The weakness of this study includes that the 28 THAs were performed by two senior surgeons, and three different implants were used, both of which can affect the results.

In summary, on the basis of this study, THA is an acceptable method for achieving functional recovery and increasing HRQOL in patients with SLE and ANFH who receive proper perioperative management.

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Conflict of interest No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

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