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Long-term outcomes of conventional core decompression for osteonecrosis of the femoral head in systemic lupus erythematosus: a single-center retrospective study

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Abstract. – OBJECTIVE: Although the therapeutic efficacy of conventional core decompression (CD) for the early-stage osteonecrosis (ON) has been widely investigated in the literature, no study to date has specifically focused on its therapeutic effect on the long-term outcome of ON of the femoral head (ONFH) in systemic lupus erythematosus (SLE). This study aimed to provide a long-term survival analysis of all hips that underwent conventional CD for the management of ONFH in a consecutive case series of patients with SLE.

PATIENTS AND METHODS: Sixteen hips of 10 consecutive SLE patients that underwent conventional CD for the management of ONFH in a single tertiary referral center were retrospectively identified and included in the study. After a retrospective chart review, several clinical and radiological data were recorded.

RESULTS: All the hips treated with CD were stage I or IIA sclerotic and/or cystic based on the classification system of Ficat. Only the 2 hips of 1 patient (12.5%) survived both clinically and radiographically. The median overall survival for all hips after CD was 80 months (95% CI, 60-100). The 5-, 10-, and 15- year survival rates of hip joints following CD were 63%, 31%, and 12.5%, respectively (CI 95% 63.567 to 133.058 months).

CONCLUSIONS: Conventional CD may not be effective in preventing the progression of pre-collapse ONFH to collapse and eventually end-stage osteoarthritis requiring arthroplasty in patients with SLE.

Key Words:
Osteonecrosis, Osteonecrosis of the femoral head, Systemic lupus erythematosus, Core decompression, Survival rate, Survivorship analysis.

Introduction

Osteonecrosis (ON), also called avascular necrosis, is a clinical entity characterized by the death of bone tissue that results in a collapse of bony architecture, destruction of articular cartilage, pain, and functional impairment[1]. Although the exact etiology remains unclear, the accepted mechanism of ON development is the compromised vascular supply and progressive ischemia to the subchondral bone. This can be secondary to traumatic events or non-traumatic conditions such as idiopathic, corticosteroid use, and rheumatic disorders, especially systemic lupus erythematosus (SLE)[1,2].

ON constitutes a serious comorbidity in patients with SLE, with the prevalence of symptomatic cases ranging between 4% and 15%[3,4]. The condition most commonly involves the femoral head. ON of the femoral head (ONFH) may progress to end-stage osteoarthritis requiring joint replacement surgery with functional impairment and reduced quality of life[1,5]. To prevent this progression, different non-surgical and surgical treatment options with variable success have been used in the management of ONFH[1,6]. The decision for the treatment modality is primarily based on the stage of the lesion[1,6-8].

Conventional core decompression (CD) and its variations combined with bone graft or bone marrow mononuclear cells have been described[9-11] for the treatment of early-stage ONFH (Ficat stage I and II). Today, conventional CD aims to diminish intraosseous pressure in the femoral head, improving vascular supply, and relieving pain. It

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is still a popular joint-preserving procedure[12,13]. Although the therapeutic efficacy of conventional CD for the early-stage, ON has been widely investigated in the literature[14-16], no study has specifically focused on its therapeutic effect on the long-term outcome of ONFH in patients with SLE.

The aim of this study was to provide a long-term survival analysis of all hips that underwent conventional CD for the management of ONFH, in a consecutive case series of patients with SLE, from a single tertiary referral center. We hypothesized that core decompression would prevent the progression of pre-collapse ONFH to collapse and eventually end-stage osteoarthritis requiring arthroplasty in patients with SLE.

Patients and Methods

Study Population

After that the approval of the Institutional Review Board was obtained, a total of 12 patients with the diagnosis of SLE who underwent conventional CD for the treatment of ONFH at a single tertiary referral center from 2001 to 2012 were retrospectively identified based on the hospital database. Based on the eligibility criteria (Table I), after excluding two patients (one was lost to follow-up; one had incomplete radiographic images), the remaining 16 hips of 10 consecutive patients meeting the inclusion criteria were included in the current study. All 10 patients included in the study were contacted and were still alive.

Patients were followed-up at the Department of Rheumatology using a standardized protocol, including clinical examination and laboratory assessment with varying intervals of 1 to 6 months a year depending on the severity of the disease. The diagnosis of ONFH was established based on the clinical assessment and radiological findings (X-ray and magnetic resonance imaging) by a multidisciplinary committee including rheumatologists, orthopedic surgeons, and physiatrists.

Clinical Data

Clinical and demographic data were collected from the hospital electronic database and the patient medical records, including patients' age at the time of SLE diagnosis, patients' age at the time of the diagnosis of ONFH, interval between diagnosis of SLE and diagnosis of ONFH for each hip, gender, involved side, follow-up from diagnosis of SLE to final visit for each hip, interval between diagnosis of ONFH and core decompression surgery for each hip, and survival time of the hips with ONFH. Development of end-stage osteoarthritis, for which joint replacement surgery was indicated or performed, was defined as the outcome event, and survival time was defined as the duration from the core decompression date to the date when end-stage osteoarthritis was diagnosed.

Functional status was assessed with Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score at the final follow-up in patients who did not have joint replacement surgery.

Radiological Data

At the time of ON diagnosis, ONFH was staged based on the Ficat classification (stage 0 to IV)[17], using X-rays of antero-posterior, lateral, and frog-leg lateral views of bilateral hips in all patients.

Surgical Procedure

The main indication for CD was the diagnosis of ONFH without radiographical evidence of collapse (Ficat stage I and IIA). The indication was established by the multidisciplinary team during weekly regular meetings. All procedures were carried out by an experienced orthopedic surgeon at the Department of Orthopedics and Traumatology.

Table I. Eligibility criteria for inclusion and exclusion of the study participants.

Inclusion criteria	Exclusion criteria
• A diagnosis of SLE • Radiologically confirmed ONFH • Being treated by conventional core decompression • Complete medical and radiographic records • Being willing to participate the study	• Lost to follow-up • Inadequate medical and radiographic records • Being unwilling to participate the study

SLE = Systemic lupus erythematosus; ONFH = Osteonecrosis of the femoral head.

CD was performed with the patient in supine position under spinal or general anesthesia; a direct lateral approach was carried out through a midline longitudinal incision distal to the greater trochanter. The lateral aspect of the proximal femoral metaphysis was exposed by splitting the fascia lata and vastus lateralis longitudinally. With the aid of an image intensifier, one, if necessary two or three guide wires were inserted into the center of necrotic area over the lateral cortex of the femur just below the trochanteric ridge. Then, an 8-mm trephine over the guide wire(s) was directed into the ON segment of the femoral head and introduced up to 5 mm of the subchondral area.

Postoperative Rehabilitation

Postoperative rehabilitation consisted of non-weight bearing for a minimum of 6 weeks after surgery in patients with unilateral involvement. This was extended to three months in patients with bilateral involvement. After the period of non-weight bearing, progressive weight bearing was allowed.

Statistical Analysis

SPSS 25.0 (IBM Corp., Armonk, NY, USA) was used for calculations. Statistical significance was set at p-value < 0.05. Descriptive statistics were used to describe patients' characteristics. Descriptive data are given as means and ranges (minimum and maximum). The Kaplan-Meier's method was used to calculate 5- and 10-year rates of hips treated with CD. For the survival analysis, the clinical endpoint was defined as the diagnosis of end-stage osteoarthritis, for which joint replacement surgery was indicated or performed.

Results

Baseline Characteristics

Among 10 patients (16 hips; 7 right side and 9 left side), 2 were male (3 hips) and 8 were female (13 hips). The mean age of the patients at the time of SLE diagnosis was 25 (range = 17-43) years. The mean age of the patients at the diagnosis of ONFH was 32 (range = 21-48) years. The mean interval between diagnoses of SLE and ONFH for all hips was 67 (range = 2-192) months. The mean interval between diagnosis of ONFH and core decompression surgery was 17 months (range = 1-48) for all hips. The mean follow-up from diagnosis of SLE to final visit for all hips was 232 months (range = 131-317). The mean survival time of the hips following core decompression was 114 (range = 11-238) months (Table I).

All the hips treated with CD were stage I or IIA sclerotic and/or cystic based on Ficat. Overall, both hips of one patient (12.5%) survived both clinically and radiographically. This patient's WOMAC score was 94.2 at the final follow-up (Table II and III).

The remaining 14 hips (9 patients) progressed to end-stage osteoarthritis during follow-up, for which total hip arthroplasty was performed in 9 hips and scheduled in 5 hips. In patients scheduled for total hip arthroplasty, the mean WOMAC score was 49.2 (range = 35.9-65.6) (Table II and III).

Survival Analysis

According to the Kaplan-Meier's analysis, the median overall survival for all hips after core decompression was 80 months (95% CI, 60-100). The 5-, 10-, and 15- year survival rates of hip joints following CD were 63%, 31%, and 12.5%, respectively (CI 95% 63.567-133.058 months) (Figure 1).

Table II. Demographic characteristics of all the study participants.

Number of patients	10
Gender (Female/Male)	8/2
Number of hips with ONFH	16
Unilateral/bilateral involvement	4/6
Right/Left Side	7/9
Mean age of the patients at the time of SLE diagnosis (year), mean (min to max)	25 (17-43)
Mean age of the patients at the diagnosis of ONFH (year), mean (min to max)	32 (21-48)
Mean interval between diagnoses of SLE and ONFH for all hips (month), mean (min to max)	67 (2-192)
Mean interval between diagnosis of ONFH and CD surgery for all hips (month), mean (min to max)	17 (1-48)
Mean follow-up from diagnosis of SLE to final visit for all hips (month), mean (min to max)	232 (131-317)
Mean survival time of the hips following CD (month), mean (min to max)	114 (11-238)

ONFH = osteonecrosis of the femoral head; SLE = systemic lupus erythematosus; CD = core decompression.

Table III. Demographic, clinical, and radiographical data of the study participants.

Patient No.	Gender	Age at SLE diagnosis (year)	Age at ONFH diagnosis (year)	Involvement	Side	Interval between SLE and ONFH diagnoses (month)	Interval from ONFH diagnosis to CD surgery (month)	Follow-up from SLE diagnosis to final assessment (month)	Progress to end-stage osteoarthritis	Survival time of the hip (month)	WOMAC score
1	M	19	29	Unilateral	L	125	1	317	+	11	
2	M	25	30	Unilateral	L	62	2	288	+	99	
3	F	43	45	Unilateral	R	26	1	232	+	154	
4	M	25	27	Unilateral	L	17	4	201	+	49	
5	F	18	21	Bilateral	R L	26 26	12 15	264 264	- -	238 238	94.2
6	M	28	29	Bilateral	R L	16 9	8 11	131 131	+ +	95 91	
7	F	36	48	Bilateral	R L	141 141	3 3	192 192	+ +	21 48	
8	F	23	38	Bilateral	R L	168 168	12 36	291 291	+ +	60 108	35.9
9	M	20	26	Bilateral	R L	2 2	33 33	144 144	+ +	120 36	59.4
10	M	17	22	Bilateral	R L	60 60	48 48	312 312	+ +	226 222	65.6

ONFH = osteonecrosis of the femoral head; SLE = systemic lupus erythematosus; CD = core decompression; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

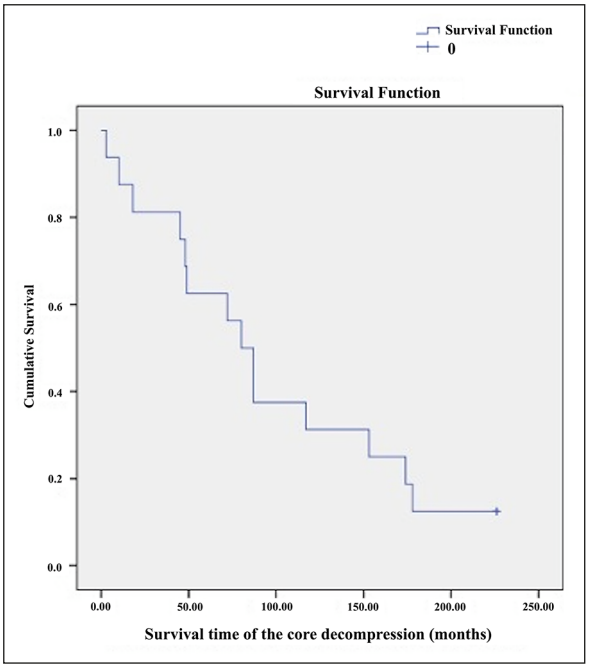

Figure 1. The Kaplan-Meier curve illustrating the survival of the hip joints with osteonecrosis of the femoral head.

Discussion

Non-traumatic ONFH represents a major cause of morbidity in young patients and can progress with femoral head collapse to the end-stage osteoarthritis requiring joint replacement surgery[14,18]. To reduce the risk of progression for non-collapsed stages and save the femoral head, core decompression and its variations have been described[9,10] and used for the treatment of early-stage ONFH. Today, conventional CD remains a popular joint-preserving procedure because of its simplicity and ease of operation technique[12]. Although there is a controversy about the efficacy of CD in literature, recent quantitative meta-analyses and systematic reviews[15,16,19,20] have shown that this conventional technique is effective and can change the natural course of ONFH when performed in the early pre-collapse stages. Even though ONFH has been cited[7,21] as a serious comorbidity for patients with SLE, little information exists on the efficiency of CD for this particular patient population. Unlike previously reported in literature, this study only included SLE patients and analyzed the long-term survival rates of hips with ONFH treated with CD in a consecutive case series.

We have consecutively performed conventional CD using 8 mm-wide cannula trephines for the treatment of early stage ONFH (Ficat stage I and IIA) in 16 hips of 10 patients with SLE. Our study population consisted of younger patients with a mean age of 25 years. Our hypothesis was that CD prevents the progression of pre-collapse ONFH and the development of end-stage osteoarthritis requiring arthroplasty in this young patient population. Of 16 hips analyzed in the study, while 6 hips progressed to end-stage osteoarthritis in the early postoperative period (range = 11-60 months), 7 hips developed osteoarthritis requiring arthroplasty at the mid-to long-term follow-up (range = 91-238 months). Eventually, in all but two hips, joint replacement surgery was indicated or performed. Therefore, contrary to our expectations, these findings strongly refute our hypothesis.

In literature, a small number of studies[7,21] had investigated the efficiency of conventional CD for the management of ONFH in SLE. In one of those studies, Hungerford and Zizic[21] compared the short-term outcomes of medical treatments *vs.* CD in SLE related ON of the proximal or distal femur. The authors observed no radiographic progression in 11 of 12 patients with early pre-collapsed disease (stage I and II as per the Ficat and Arlet classification[22]) between 4 and 45 months of follow-up. Moreover, they obtained acceptable symptomatic levels without the clinical requirement for arthroplasty even in most ON sites with stage III advanced disease (18/20) with a mean follow-up of 28 months. However, in our opinion, their short follow-up period is not enough to make a definitive judgment on hip survival. In another study, Mont et al[7] retrospectively analyzed the results of CD in SLE patients with stage I to III ONFH. The authors found that among 31 hips, 21 (68%) were converted to arthroplasty at a mean follow-up of 51 months. While none of the 4 stage I hips displayed radiographic progression following core decompression, 5 of 11 (45%) stage II hips required arthroplasty. In contrast, all the 16 stage III hips progressed to end-stage osteoarthritis at a mean follow-up of 14 months.

Considering that CD can prevent the progression of the ONFH to end-stage osteoarthritis if applied before the development of the collapse, we typically performed this procedure only for early-stage non-collapsed disease. Unfavorable results from the previous two studies[7,21] above support our notion that advanced stage collapsed ONFH is not a suitable candidate for CD. Nevertheless, compared to those studies, we found a relatively lower hip survival following core de-

compression as the 15-year survival rate of 12.5% according to the Kaplan-Meier analysis. This inconsistent result can be probably explained by the longer follow-up period of the current study.

Limitations

When interpreting the findings of the present study, some limitations should be considered. The major limitations of the study are its retrospective design, relatively small sample size as well as the absence of a control group. Despite these limitations, the present study is one of the few to examine the efficiency of conventional CD for the management of ONFH in a consecutive case series of patients with SLE.

Conclusions

The results of this study have suggested that conventional CD may not be effective in preventing the progression of pre-collapse ONFH to collapse and eventually end-stage osteoarthritis requiring arthroplasty in patients with SLE.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Availability of Data and Materials

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Informed Consent

Informed consent was waived from all patients due to the retrospective nature of the study.

Ethics Approval

This study was approved by the Istanbul University Medical School Ethics Committee [Approval No. (28.01.2021)53473].

Authors' Contribution

Each author listed above contributed significantly to, and is willing to take public responsibility for, one or more aspects of the study. All authors participated in the study design, analysis and interpretation of the data. All authors were actively involved in drafting and in the critical revision of the manuscript and have given the approval of the final version to be submitted.

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