



Factors affecting the result of a conservative treatment in post-collapse osteonecrosis of the femoral head

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Abstract

Osteonecrosis of the femoral head (ONFH) affects patients' quality of life. In our institute, some patients in the post-collapse state denied having an operation and considered continuing conservative treatment. Hence, the purpose of this study was to compare patient characteristics between patients who had total hip arthroplasty and those still on conservative treatment. We collected the data of seventy patients who had osteonecrosis of the femoral head with femoral head collapse from the hospital electronic database. All patients underwent the same approach in consideration of THA. We advised patients to shift to a THA treatment plan from a conservative one if the pain did not decrease by conservative treatment or improvement did not meet the patient's lifestyle and daily living requirements. We recorded the patient's demographic data, physical examination and hip radiographic. Twentynine patients (40 hips) had THA, while 31 patients (45 hips) were still undergoing conservative treatment. There were no differences in the patients' base demographic data. However, patients with THA had a lower rate of history of previous core decompression before head collapse than patients still undergoing conservative treatment (90.3% and 37.9%, respectively, $p < 0.01$). In the conservative treatment group, most cases had femoral head collapse at the superolateral head, while patients in the THA group had an increased number of patients with collapse at the superomedial part of the femoral head. This study revealed that patients considering the continuation of conservative treatment had a higher rate of history of core decompression and a lower rate of superomedial femoral head collapse. Thus, these factors might be considered in the discussions with patients concerning the prognosis of the disease.

Keywords: osteonecrosis, hip, conservative treatment, total hip arthroplasty

1. Introduction

Osteonecrosis of the femoral head (ONFH) is a common hip condition affecting the quality of life in adult patients worldwide. In the early 2000s, the incidence in the general population in the United States was estimated to be between 300.000 and 600.000 cases (1). The disease has been divided into two major groups: traumatic and non-traumatic ONFH. In the non-traumatic ONFH group, risk factors were studied and shown to be: alcohol intake (2), hypercoagulation disorder (3), and high-dose corticosteroids (4). However, 30% of non-traumatic ONFH were idiopathic (5).

The natural history of the disease begins at the non-collapsed femoral head, with or without pain, then the disease progresses to the post-collapsed femoral head in some patients, with arthritis change of acetabulum at the end-stage (6). Ficat and Arlet et al. classified the disease into four states by clinical and radiographic appearance (7). Besides, this ONFH has been categorized into pre-collapsed and post-collapsed stages. In the pre-collapse stage, the primary treatment is hip preservation, consisting of conservative treatment or core decompression, whereas in a post-collapse state, the standard treatment is total hip arthroplasty (THA)

(8). Mohammad et al. reported that THA improved quality of life in patients with post-collapse non-traumatic ONFH (9).

However, in our institute, some patients in the post-collapse state denied having an operation and considered continuing conservative treatment. Hence, the purpose of this study was to compare patient characteristics between patients who had total hip arthroplasty and those still on conservative treatment.

2. Material and Methods

This study was retrospective. We collected the data from the hospital electronic database (database 2011-2019) and included patients who had osteonecrosis of the femoral head with femoral head collapse. The inclusion criteria were being diagnosed with post-collapse stage ONFH and followed up in our center for at least six months. All patients underwent the same approach in consideration of THA. We advised patients to shift to a THA treatment plan from a conservative one if the pain did not decrease by conservative treatment or improvement did not meet the patient's lifestyle and daily living requirements. All patients considered the choice themselves at each follow-up visit. Patients who chose

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conservative treatment would be treated with non-steroidal anti-inflammatory drugs, activity modification, weight reduction (if overweight), and hip strengthening exercises.

We recorded the demographic data, occupation, working level, underlying diseases, history of hip core decompression, range of motion on physical examination, hip radiographic data, and THA requirement. We classified occupation and working levels according to the International Standard of Occupations (10,11) and measured basic radiographic parameters of both hips in anteroposterior (AP) and frog-leg view to evaluate the location of femoral head collapse. The local Ethics Committee and Institutional Review Board approved this report.

We performed statistical analysis using R-program version 3.2.1 software (R Foundation for statistical computing, Vienna, Austria). We used the independent sample t-test to compare age, height, weight, body mass index (BMI), and the total motion range between the groups. We compared the difference in the motion range in each direction with the Wilcoxon rank-sum test. We analyzed gender, occupation, working level, site, history of previous core decompression, underlying diseases, risk etiology of osteonecrosis, and femoral head collapse data location with Pearson's chi-square to compare the groups. We defined statistical significance as $p < 0.05$.

3. Results

We included 70 patients in the post-collapsed ONFH group. Twenty nine patients (40 hips) had THA, while 31 patients (45 hips) were still undergoing conservative treatment. There were no differences in the patients' base demographic data between the two groups regarding age, gender, body mass index (BMI), occupation and working level. (Table 1)

The data relating to osteonecrosis found that unilateral or bilateral inflammatory joint disease (RA, SLE) and risk etiology of osteonecrosis was not different between the groups. (Table 2) However, patients with THA had a lower rate of history of previous core decompression before head collapse than patients still undergoing conservative treatment.

The physical examination and radiographic data found that patients in the conservative treatment group had a higher range of motion in all directions compared with the THA group. (Table 3) Additionally, the location of femoral head collapse had different patterns in both groups. In the conservative treatment group, most cases had femoral head collapse at the superolateral head, while patients in the THA group had an increased number of patients with collapse at the superomedial part of the femoral head.

Table 1. Demographic data

Characteristic	Conservative group (n = 31)	THA group (n = 29)	p-Value
Age (years)	48.4 ± 12.8a	47 ± 13.1a	0.68
Gender			0.80
Male	16 (51.6%)	13 (44.8%)	
Female	15 (48.4%)	16 (51.7%)	
Weight (kg)	60.6 ± 12.3a	63.4 ± 13.6a	0.40
Height (cm)	162.2 ± 8.0a	160.2 ± 8.2a	0.36
BMI (kg/m ²)	22.9 ± 3.6a	24.7 ± 4.8a	0.10
Occupation			0.60
Manager	6 (19.4%)	6 (20.7%)	
Technician	8 (25.8%)	5 (17.2%)	
Service	5 (16.1%)	6 (20.7%)	
Farmer	7 (22.6%)	10 (34.5%)	
Craft worker	0 (0%)	1 (3.4%)	
Operator	2 (6.5%)	0 (0%)	
Housewife	3 (9.7%)	1 (3.4%)	
Working level			0.71
Sedentary	21 (67.7%)	17 (58.6%)	
Light	5 (16.1%)	7 (24.1%)	
Medium	5 (16.1%)	5 (17.2%)	

THA: Total Hip Arthroplasty; BMI: Body Mass Index.
aMean values with standard deviations.

Table 2. Medical history data

Characteristic	Conservative group	Characteristic	Conservative group
Affected side			0.76
Bilateral	14 (45.2%)	11 (37.9%)	
Unilateral	17 (54.8%)	18 (62.1%)	
Contralateral hip problem			0.70
Yes	3 (9.7%)	4 (13.8%)	
No	28 (90.3%)	25 (86.2%)	
Previous core decompression			<0.01
Yes	28 (90.3%)	11 (37.9%)	
No	3 (9.7%)	18 (62.1%)	
Underlying disease			0.97
No	9 (29%)	8 (27.6%)	
RA	0 (0%)	1 (3.4%)	
SLE	13 (41.9%)	11 (37.9%)	
Other	9 (29%)	9 (31%)	
Risk etiology of osteonecrosis			0.27
Undetectable risk	3 (9.7%)	7 (24.1%)	
Corticosteroid	20 (64.5%)	17 (58.6%)	
Alcohol	6 (19.4%)	2 (6.9%)	
Hemoglobinopathy	0 (0%)	1 (3.4%)	
Irradiation	0 (0%)	1 (3.4%)	
Other	2 (6.5%)		

THA: Total Hip Arthroplasty; BMI: Body Mass Index; SLE: Systemic Lupus Erythematosus; RA: Rheumatoid Arthritis

Table 3. Physical examination and radiographic data

Characteristic	Conservative group	Characteristic	Conservative group
Total ROM	255.4 ± 33.9a	178.8 ± 43.5a	<0.01
Flexion	110 (110,120)b	90 (78.8,100)b	<0.01
Adduction	30 (30,30)b	15 (10,21.2)b	<0.01
Abduction	45 (30,45)b	30 (27.5,30)b	<0.01
External rotation	46.7 (12.7)b	36.1 (15.8)b	<0.01
Internal rotation	15 (15,30)b	10 (0,15)b	<0.01
Location of femoral head collapse			< 0.01
Superomedial	0 (0%)	5 (12.5%)	
Superolateral	44 (97.8%)	23 (57.5%)	
Both	1 (2.2%)	12 (30%)	

4. Discussion

Total hip replacement is one of the standard treatments for post-collapse osteonecrosis of the femoral head (10). However, some patients consider undergoing conservative treatment instead of surgery. Our study aimed to evaluate the difference in patient characteristics between patients with post-collapse osteonecrosis of the femoral head who had THA and those who considered continuing conservative treatment. This study found that the group of patients who considered continuing conservative treatment had a higher rate of history of core decompression, a higher range of motion, and a lower rate of patients who had a collapse in the superomedial part of the femoral head.

Core compression is the treatment for pre-stage collapse and is accomplished by reducing intraosseous pressure to reduce pain and delay the progression of the disease (11-13). This study found that patients who considered continuing conservative treatment had a higher rate of history of core decompression in pre-stage collapse. We hypothesized that patients who had previous core decompression might have lower intraosseous pain than those who did not. Hence, the primary source of pain in such patients might stem from articular pain following the femoral head collapse, while patients who did not have core decompression had combined pain of intraosseous and articular pain.

The location of the femoral head collapse was one factor that may predict the requirement for THA. Our study found that the group of patients who underwent THA had a higher rate of patients with femoral head collapse at the superomedial part. A previous study by Sugano et al. reported that osteonecrosis lesions that involved more than the medial one-third of the weight-bearing surface from anteroposterior radiographic had a poor prognosis for massive collapse (14). We hypothesized that patients suffering from the superomedial part of femoral head collapse might have higher

pain and more limited function because the superomedial part of the head has a higher contact surface with the acetabulum throughout the whole range of motion.

There were some limitations in this study. First, the limited number of patients could not demonstrate any significant differences for some characteristics, and due to the mixing of categories, some biases may have occurred. Second, there was no data on the duration of the disease nor treatment after the femoral head had collapsed in each group, which is a factor affecting the treatment results. Finally, this study used only plain radiographic to evaluate hip lesions, which are not as accurate as magnetic resonance imaging (MRI). Therefore, further prospective studies should address this limitation.

In conclusion, this study revealed that patients considering the continuation of conservative treatment had a higher rate of history of core decompression, a higher range of motion, and a lower rate of superomedial femoral head collapse. Thus, these factors might be considered in the discussions with patients for the prognosis of the disease and might be used as evidence for the choice of treatment.

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References

- Lieberman JR, Berry DJ, Mont MA, Aaron RK, Callaghan JJ, Rajadhyaksha AD, Urbaniak JR. Osteonecrosis of the hip: management in the 21st century. *Instr Course Lect.* 2003;52:337-55. PMID: 12690862.
- Yoon BH, Kim TY, Shin IS, Lee HY, Lee YJ, Koo KH. Alcohol intake and the risk of osteonecrosis of the femoral head in Japanese populations: a dose-response meta-analysis of case-control studies. *Clin Rheumatol.* 2017 Nov;36(11):2517-2524. doi: 10.1007/s10067-017-3740-4. Epub 2017 Jul 6. PMID: 28685377.
- Atsumi T, Kuroki Y. Role of impairment of blood supply of the femoral head in the pathogenesis of idiopathic osteonecrosis. *Clin Orthop Relat Res.* 1992 Apr;(277):22-30. PMID: 1372850.
- Mont MA, Pivec R, Banerjee S, Issa K, Elmallah RK, Jones LC. High-Dose Corticosteroid Use and Risk of Hip Osteonecrosis: Meta-Analysis and Systematic Literature Review. *J Arthroplasty.* 2015 Sep;30(9):1506-1512.e5. doi: 10.1016/j.arth.2015.03.036. Epub 2015 Apr 8. PMID: 25900167; PMCID: PMC7127809.
- Tsai SW, Wu PK, Chen CF, Chiang CC, Huang CK, Chen TH, Liu CL, Chen WM. Etiologies and outcome of osteonecrosis of the femoral head: Etiology and outcome study in a Taiwan population. *J Chin Med Assoc.* 2016 Jan;79(1):39-45. doi: 10.1016/j.jcma.2015.07.010. Epub 2015 Sep 19. PMID: 26387635.
- Mont MA, Zywiell MG, Marker DR, McGrath MS, Delanois RE. The natural history of untreated asymptomatic osteonecrosis of the femoral head: a systematic literature review. *J Bone Joint Surg Am.* 2010 Sep 15;92(12):2165-70. doi: 10.2106/JBJS.I.00575. PMID: 20844158.
- Arlet J, Ficat C. Ischemic necrosis of the femoral head. Treatment by core decompression. *J Bone Joint Surg Am.* 1990

- Jan;72(1):151-2. PMID: 2295665.
8. Petek D, Hannouche D, Suva D. Osteonecrosis of the femoral head: pathophysiology and current concepts of treatment. *EFORT Open Rev.* 2019 Mar 15;4(3):85-97. doi: 10.1302/2058-5241.4.180036. PMID: 30993010; PMCID: PMC6440301.
 9. Abbas-Zadeh MR, Azizi A, Abbas-Zadeh L, Amirian F. Effect of surgical treatment on the quality of life in patients with non-traumatic avascular necrosis of the femoral head. *Rev Bras Ortop.* 2018 Feb 3;53(6):773-777. doi: 10.1016/j.rboe.2017.08.021. PMID: 30377614; PMCID: PMC6205024.
 10. Massin P. Treatments of avascular osteonecrosis of the hip: Current treatments. *Morphologie.* 2021 Jun;105(349):120-126. doi: 10.1016/j.morpho.2020.06.003. Epub 2020 Jul 8. PMID: 32653168.
 11. Migliorini F, Maffulli N, Eschweiler J, Tingart M, Baroncini A. Core decompression isolated or combined with bone marrow-derived cell therapies for femoral head osteonecrosis. *Expert Opin Biol Ther.* 2021 Mar;21(3):423-430. doi: 10.1080/14712598.2021.1862790. Epub 2020 Dec 30. PMID: 33297783.
 12. Hockett SA, Sherrill JT, Self M, Mears SC, Barnes CL, Mannen EM. Augmentation of core decompression with synthetic bone graft does not improve mechanical properties of the proximal femur. *J Mech Behav Biomed Mater.* 2021 Mar;115:104263. doi: 10.1016/j.jmbbm.2020.104263. Epub 2020 Dec 11. PMID: 33385950.
 13. Bednarek A, Atras A, Gaęała J, Kozak Ł. Operative technique and results of core decompression and filling with bone grafts in the treatment of osteonecrosis of femoral head. *Ortop Traumatol Rehabil.* 2010 Nov-Dec;12(6):511-8. English, Polish. PMID: 21273647.
 14. Sugano N, Takaoka K, Ohzono K, Matsui M, Masuhara K, Ono K. Prognostication of nontraumatic avascular necrosis of the femoral head. Significance of location and size of the necrotic lesion. *Clin Orthop Relat Res.* 1994 Jun;(303):155-64. PMID: 8194226.