



Clinical Outcomes of Total Hip Arthroplasty With the Anterolateral Modified Watson-Jones Approach for Displaced Femoral Neck Fractures

Geriatric Orthopaedic Surgery
& Rehabilitation
Volume 13: 1–8
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DOI: 10.1177/21514593221134800
journals.sagepub.com/home/gos


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Abstract

Objective: In recent years, many studies have reported good results with total hip arthroplasty (THA) for displaced femoral neck fractures (FNFs). However, no study has reported the clinical outcomes of the anterolateral modified Watson–Jones THA (MWJ-THA) for displaced FNFs. This study aimed to investigate the clinical results of THA for displaced FNFs at our hospital and to discuss the advantages of MWJ-THA over THA with other approaches for displaced FNFs. **Methods:** Forty-three patients who underwent MWJ-THA for displaced FNFs were included in this study. Patient characteristics, preinjury walking ability, activities of daily living, implants used, walking ability (at 1, 3, and 6 months after surgery), cup placement angle, clinical hip score, surgical complications, revision surgery, and death within 1 year after surgery were investigated. **Results:** The mean age of the 43 patients was 63.3 years, and the mean body mass index (kg/m²) was 21.1. Regarding the heads used, 28-mm heads were used in 4 patients, 32-mm heads were used in 32 patients, and 36-mm heads were used in 7 patients. The cups were placed in the Lewinnek safety zone (93.0%). Four patients had stem sinkage of a few millimeters. 6 months postoperatively, 38 patients walked unaided, and 4 patients walked with a cane. The Harris Hip Score averaged over 90 points at all time points. No postoperative dislocation was observed. Two patients died within 1 year postoperatively. **Conclusion:** In this study, MWJ-THA was performed for displaced FNFs and resulted in no postoperative dislocations. Furthermore, more than 90% of the patients regained their preinjury walking ability at 6 months postoperatively. MWJ-THA has great dislocation control and is effective in treating displaced FNFs.

Keywords

clinical outcome, dislocation, femoral neck fracture, modified watson jones approach, total hip arthroplasty

Introduction

The number of femoral neck fractures (FNFs) in the elderly has been increasing in recent years and is expected to continue to increase.¹ Surgical intervention, such as osteosynthesis, hemiarthroplasty (HA), and total hip arthroplasty (THA), is recommended as the treatment method. When arthroplasty is chosen, hip hemiarthroplasty is recommended for those with low physical activity due to debate over unipolar vs bipolar hemiarthroplasty. However,

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THA has better long-term results than HA and is often performed in highly active patients, particularly because of less cartilage damage on the postoperative acetabular side.²

In recent years, the use of THA for FNFs has been increasing because of the increase in healthy life expectancy and the number of highly active elderly patients.³ However, high postoperative dislocation rates have become a problem. The early postoperative dislocation rate of THA for FNFs was 3.4%,⁴ which is 2 to 4 times higher than that of THA for osteoarthritis.^{4,5} In particular, the posterior approach has been reported to have a dislocation rate of 3%–8%.^{5,6} Several studies that compared the postoperative dislocation rates of THA and HA reported dislocation rates of 4%–6% for THA and 0%–2.5% for HA.^{7–9}

In our hospital, we chose HA for displaced FNFs in elderly patients with low activity and THA for displaced FNFs in elderly patients with high activity, patients with rheumatoid arthritis, and patients with developmental dysplasia of the hip (DDH). In most cases, we used the anterolateral modified Watson–Jones (MWJ) approach, which is a musculotendon-sparing approach described by Röttinger et al.¹⁰

In recent years, many studies have reported good results with THA for displaced FNFs, but no study has reported the clinical results of MWJ-THA for displaced FNFs. This study aimed to investigate the clinical results of THA for displaced FNFs at our hospital and to discuss the advantages of MWJ-THA over THA with other approaches for displaced FNFs.

Subjects and Methods

This was a retrospective analysis of 59 patients who were admitted to a single institution between April 2008 and

March 2021, diagnosed with displaced FNFs, and underwent THA. Two patients underwent THA via a posterior approach were excluded from this study. 57 patients underwent THA via MWJ-THA. The exclusion criteria were having less than 12 months of follow-up ($n = 5$) and the use of dual mobility cups (DMCs) for comparison with previous studies which used fixed-bearing cups for displaced FNFs ($n = 9$). Ultimately, 43 patients were included in the study (Figure 1). The investigative protocol was approved by the Institutional Ethics Committee. All patients provided informed consent in accordance with the requirements of this review.

Evaluation and Outcomes

We assessed patient characteristics such as age, sex, body mass index (BMI), comorbidities (other trauma, mental disorders, neuromuscular disorders, rheumatoid arthritis, and history of steroid use), pre-injury walking ability, activities of daily living (ADLs), and surgical risks determined by the anesthesiologist according to the American Society of Anesthesiologists (ASA) classification.¹¹ Surgical information, such as the waiting period for surgery, surgical time, blood loss, use of tranexamic acid, perioperative blood transfusion, and discharge destination, was investigated. Finally, implant information was evaluated.

For the cup placement angle, the following method was used to evaluate the cups: 1 week after surgery, anteroposterior (AP) radiographs of the pelvis were obtained by focusing on the superior border of the pubic symphysis and were used to evaluate the cup alignment. One examiner (NT) measured cup alignment using Lewinnek's method.¹² Whether the cup was

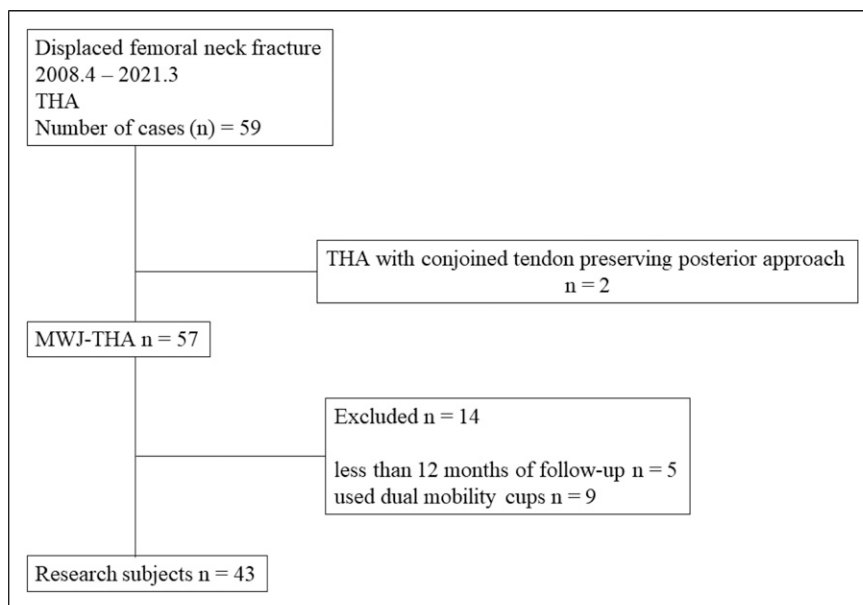


Figure 1. Patient's selection study flow chart.

tilted anteriorly or posteriorly was determined using lateral radiographs of the cross table. To measure cup alignment, the method of Lewinnek et al¹² (anteversion: 5°–25°; inclination: 30°–50°) was used as a safety zone.

Walking ability was assessed 1, 3, 6, and 12 months postoperatively. Walking ability was stratified into the following 5 categories: (1) use of a wheelchair or no walking, (2) use of a walker, (3) use of crutches, (4) use of a 1 stick, and (5) independent gait. The clinical hip score (Harris Hip Score [HHS]) was assessed at 3 months, 6 months, 12 months, and at the last follow-up after 12 months postoperatively. Complications from surgery (dislocation, nerve injury, intraoperative fracture, and postoperative fracture), revision surgery, and death within 1 year postoperatively were investigated. The cup placement angle and stem sinking/loosening were investigated using imaging evaluations.

Operative Procedure

MWJ-THA is a lateral supine anterolateral musculotendon-sparing procedure that was reported by Röttinger et al.¹⁰ A unique feature of this surgical entry technique is intermuscular entry, which is performed from the anterolateral side between the gluteus medius and tensor fasciae latae. Although not described in the original technique, the incised capsular ligament was preserved and repaired. The cups were set with reference to the alignment guide (operative anteversion, 20°; operative inclination, 40°). The surgery was performed or supervised by an experienced hip surgeon.

Results

Patient Characteristics, Operative Information, and Implant Information. A total of 43 patients met the inclusion criteria. Tables 1 and 2 show patient characteristics and operative information. The mean age was 63.3 years, and the mean BMI was 21.1 (kg/m²). Regarding comorbidities, 2 patients had other injuries, 4 patients had developmental hip dysplasia, and 5 patients had rheumatoid arthritis. The preinjury walking ability of most patients was unaided and their ADLs were all independent without assistance. Four patients (9.3%) were ASA class 3. The mean follow-up period was 3.1 years (minimum, 1 year; maximum, 11 years).

The mean operative time was 91 min, and the mean blood loss was 266 mL. Tranexamic acid was administered during surgery starting in September 2013, and no patient required a blood transfusion after the administration of tranexamic acid. Postoperatively, all patients were allowed to walk with full load from the day after surgery, except for 1 patient who had multiple lower extremity injuries. All patients were rehabilitated beginning from the day after surgery without any limitation of the range of motion.

Table 1. Patient Characteristics.

Number of Patients	43	
Age mean ± standard deviation	63.3	±9.0
Sex (male/female)	15/28	
BMI (kg/m ²) mean ± standard deviation	21.1	±3.4
Comorbidities		
other Trauma (%)	2	(4.7)
DDH (%)	4	(9.3)
mental Disorders (%)	3	(7.0)
neuromuscular Disorders (%)	2	(4.7)
rheumatoid Arthritis (%)	5	(11.6)
history of steroid use (%)	1	(2.3)
Pre-injury walking ability		
use of a wheelchair or no walking (%)	0	
use of a walker (%)	0	
use of crutches (%)	0	
use of a 1 stick (%)	1	(2.3)
independent Gait (%)	42	(97.7)
Pre-injury activities of daily living		
no Assistance	43	(100)
need Assistance	0	
American Society of Anesthesiologists classification		
Class 1 (%)	4	(9.3)
Class 2 (%)	35	(81.4)
Class 3 (%)	4	(9.3)
Mean follow-up period (min/max) (year)	3.1	(1/11)

Table 2. Operative Information.

Number of Patients	43	
Surgical time (minutes)	93	±40
Blood loss (ml)	240	±218
Use of Tranexamic Acid		
Yes (%)	34	(79.1)
No (%)	9	(20.9)
Perioperative blood transfusion		
Yes (%)	2	(4.7)
No (%)	41	(95.3)
Postoperative load restriction		
Yes (%)	1	(2.3)
No (%)	42	(97.7)

Data, mean ± standard deviation.

Table 3 summarizes the implant information. We used basically 28 mm heads in the early days. After reports of good results with highly cross-linked polyethylene liners,¹³ we changed our selection a 36-mm head for a cup outer diameter (O.D.) of 54 mm or more, and a 32-mm head for a cup O.D. of 52 mm or less. As a result, we used 28-mm heads in 4 patients (7.7%), 32-mm heads in 32 patients (61.5%), and 36-mm heads in 7 patients

(13.5%). Cementless stems were used in >95% of the cases.

Outcomes

Table 4 shows walking ability at 1, 3, 6, and 12 months postoperatively by category. At 1 month post-surgery, 32 patients were able to walk unaided, and 10 were able to walk with a cane. At 6 months post-surgery, 38 patients were able to walk unaided and four were able to walk with a cane. At 6 months post-surgery, 3 patients (7.0%) had a decrease of 1 step in walking ability category compared with their conditions before the injury. Table 5 shows the HHS at 3 months, 6 months, 12 months, and at the last follow-up after 12 months postoperatively. The HHS was averaged over 90 points at all time points. This was considered a good clinical score. Postoperatively, all patients were rehabilitated without limitation of the range of motion. Table 6 shows complications related to surgery. There were no cases of intraoperative nerve injury. No postoperative dislocation was observed. There was 1 intraoperative fracture of the greater trochanter, but no additional treatment was performed. Periprosthetic fractures due to falls were observed in 2 patients after surgery: 1 occurred at 3 weeks post-surgery, and the other occurred at 5 months post-surgery. One patient underwent stem replacement and the other underwent osteosynthesis. Table 7 shows details of patients who died within 1 year after surgery. Two patients (4.7%) died within 1 year of surgery, and both had no obvious comorbidities at the time of surgery. Both deaths were due to medical illnesses and not causally related to the surgery. With regard to the cup placement angle, the average radiographic anteversion was $13.98^\circ \pm 4.99^\circ$ (range: 5.42° – 26.76°), and the average radiographic inclination was $42.00^\circ \pm 5.65^\circ$ (range: 31.23° – 58.39°). Table 8 lists the frequency distributions for all the angles in this study. Among the 43 patients, 40 (93.0%) were in the Lewinnek safety zone (Figure 2). There were 4 cases of stem sinking, all of which sank by a few millimeters. The patients had no awareness or complaints of leg length differences. No cases of stem loosening were observed.

Table 3. Implant Information.

Number of Patients	43	
Heads		
28 (%)	4	(7.7)
32 (%)	32	(61.5)
36 (%)	7	(13.5)
Stems		
Cement	1	(2.3)
Cementless	42	(97.7)

Discussion

We studied the clinical outcomes of 43 patients who underwent MWJ-THA with fixed-bearing cups for displaced FNFs. There were no postoperative dislocations, and the mean HHS score was more than 90 points at 3 months postoperatively. In terms of walking ability, 90.5% of patients were able to walk independently at 6 months postoperatively, and 92.9% of patients regained their preinjury walking ability.

THA for FNFs is known to have a higher postoperative dislocation rate than THA for osteoarthritis^{4,5} and is associated with higher dislocation rates than HAs.^{7-9,14} There are several reasons for this finding. First, the soft tissues

Table 4. Walking Ability.

Number of Patients	43	
1 month after surgery		
use of a wheelchair or no walking (%)	0	
use of a walker (%)	0	
use of crutches (%)	1	(2.3)
use of a l stick (%)	10	(23.3)
independent Gait (%)	32	(74.4)
3 months after surgery		
use of a wheelchair or no walking (%)	0	
use of a walker (%)	0	
use of crutches (%)	0	
use of a l stick (%)	5	(11.6)
independent Gait (%)	38	(88.4)
6 months after surgery		
use of a wheelchair or no walking (%)	0	
use of a walker (%)	0	
use of crutches (%)	0	
use of a l stick (%)	4	(9.3)
independent Gait (%)	38	(88.4)
Deaths (%)	1	(2.3)
12 months after surgery		
use of a wheelchair or no walking (%)	0	
use of a walker (%)	0	
use of crutches (%)	0	
use of a l stick (%)	4	(9.3)
independent Gait (%)	37	(86.0)
Deaths (%)	2	(4.7)
Decreased walking ability by 1 or more steps	3	(7.0)

Table 5. Clinical hip score (Harris Hip Score).

Harris Hip Score	Average	Median
After 3 months	91	93
After 6 months	91	96
After 1 year	94	96
Final follow-up after 1 years	91	96

and muscles around the hip play an important role in joint stability; however, displaced fractures of the femoral neck are considered acute trauma, and damage to this area can lead to postoperative instability.¹⁵⁻¹⁷ Second, a good preoperative range of motion was maintained postoperatively with THA.^{7-9,14} Third, THA is more prone to dislocations than HA because the former uses a smaller head than the latter.^{7-9,14}

Dislocation rates differ depending on the surgical approach used. The anterior approach has been reported to have a lower dislocation rate than the posterior approach.¹⁸ Noticewala et al¹⁹ studied 66 patients who underwent THA with a posterior approach for FNFs. Four cases (6.1%) of dislocations occurred within 6 months postoperatively. The head size was similar to that of the current study.¹⁹ Patient age and BMI were higher than those in the current study, but previous large-scale studies have shown that age and BMI are not risk factors for dislocation.^{20,21}

Table 6. Complications related to surgery.

Number of Patients	5
Dislocation	0
Nerve injury	0
Intraoperative fracture	1 (2.3)
Postoperative periprosthetic femoral fracture	2 (4.7)
Reoperation	2 (4.7)

Table 7. Deaths within 1 year after surgery.

Number of Patients	2	
Age at the time of surgery	Cause of death	Time of death after surgery
67	Heart failure	11 months postoperative
71	Electrolyte disturbance	4 months postoperative

Table 8. Cup placement angle.

Angle Ranges	Number of Patients (n = 43)	Percentage of Total
Inclination (°)		
25-30	0	0
30-35	6	14.0
35-40	10	23.2
40-45	18	41.8
45-50	6	14.0
>50	3	7.0
Anteversión (°)		
0-5	0	0
5-10	11	25.6
10-15	13	30.2
15-20	15	34.9
20-25	3	7.0
25-30	1	2.3

Compared to previous reports of THA with fixed-bearing cups for FNFs, the current study had the lowest dislocation rate.^{19,22-25} Furthermore, the mortality rate within 1 year in our study was 4.7%, which is lower than that in the control study (Table 9). As there were no cases of THA via the posterior approach during the observation period of this study, we compared MWJ-THA and HA via the posterior approach for displaced FNFs at our hospital. So far, 295 cases of HA have been performed using the posterior approach. Of these, there were 8 cases of postoperative dislocation, with a dislocation rate of 2.7%.²⁶ Although THA for FNF is known to have a higher dislocation rate than HA,^{7-9,14} the dislocation rate in our study was lower than that in our HA via the posterior approach.

MWJ-THA has the potential to solve these problems. We believe that it offers good protection against posterior dislocation because it preserves the posterior muscle groups, and impingement in the extended position can be checked intraoperatively because the surgery is performed in the lateral supine position.

In addition, proper cup placement is essential to prevent dislocation. In this study, it was placed in 93.0% accuracy within the Lewinnek safety zone.¹² Cup placement with an alignment guide in the lateral supine position is inferior to that in the supine position. However, in our previous report, the accuracy of freehand cup placement in the MWJ approach was 92.8% in the Lewinnek safe zone and 74% in

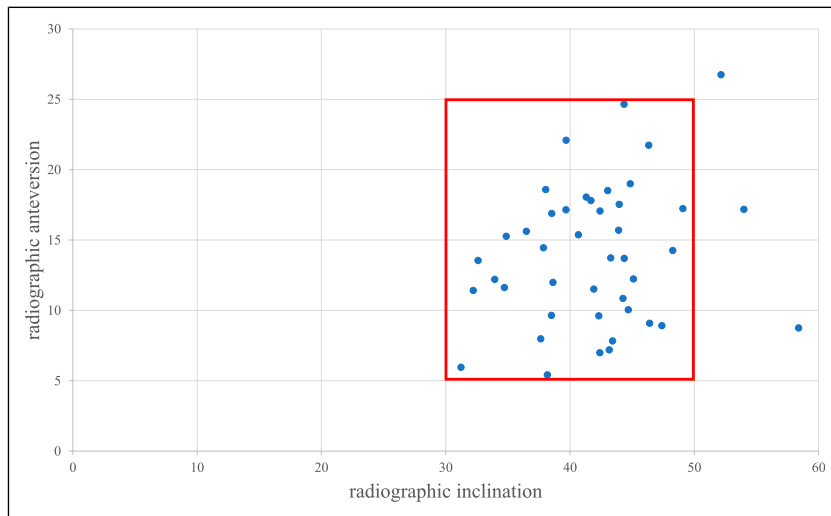


Figure 2. Scatter diagram of cup orientation. The y-axis shows radiographic inclination and the x-axis shows radiographic anteversion. The red box shows the Lewinnek safe zone.

Table 9. Summary of the Literature on the Mortality and Dislocation Rates in Different Approaches.

Studies	Year	Approach	Age	BMI (kg/m ²)	Head (mm)	Dislocation Rate (%)	12-mo Mortality Rate (%)
Present study		MWJ	63.3	21.1	28,32,36	0	4.7
Baker et al ²¹	2006	Lateral	74.2	N/A	28	7.5	N/A
Tarasevicius et al ²²	2010	Posterior	74	N/A	28,32	6.9	19.0
Lim et al ²³	2016	Anterolateral/ posterior	70	25.1	N/A	7.0	6.0
Thurig et al ²⁴	2016	DAA	75	N/A	28,32	2.3	16.7
Noticewala et al ²⁰	2018	Posterior	73.3	25.1	22,28,32,36	6.7	N/A

BMI, Body Mass Index; MWJ, Modified Watson–Jones approach; DAA, Direct Anterior Approach

the Callanan safe zone. This indicates that our cup installation was sufficiently accurate.²⁷ A similar result was observed in the present study. Also, through this approach there were no cups placed in retroversion, which is likely approach-related and contributes to the lack of dislocations.

The HHS in this study averaged >90 points at all time points. In a study comparing the anterior approach with other approaches, no significant differences were found; however, the median HHS score was higher in the anterior approach (94 points). The length of hospital stay was significantly shorter with the anterior approach than with the posterior approach, and better results were attributed to earlier ambulation and rehabilitation.²⁸

In this study, periprosthetic fractures due to falls were observed in 2 patients after surgery: 1 occurred at 3 weeks post-surgery, and the other occurred at 5 months post-surgery. These patients required reoperation. Patients with proximal femoral fractures have a higher risk of falling within the first month after surgery²⁹ and that a second fracture at the same site is more likely to occur within 48 months after injury.³⁰ Patients who sustain proximal

femoral fractures should be cautious about postoperative falls and fractures.

This study had several limitations. First, this was a retrospective cohort study, and it is possible that some information was incomplete. However, because patient data were recorded and available in the electronic medical records used in our hospital, there were no significant differences and the overall outcome was not affected. Second, this study did not include a control group that received other treatments. Considering that the posterior approach has been reported to have a high dislocation rate, we could not use such a technique in the control group because of ethical issues. Therefore, we compared MWJ THA and HA using the posterior approach performed at our hospital. Third, the follow-up period in this study was relatively short. However, given that most complications in trauma patients occur in the early postoperative period, the present results may have been sufficient to examine the clinical outcomes of MWJ-THA for FNFs. Fourth, we cannot rule out the possibility of patient selection bias. At our institution, THA for displaced FNFs is limited to highly

active patients and those with rheumatoid arthritis and DDH. The mean and median patient ages in our study were 63.3 and 65 years, respectively, which are lower than those reported in other studies. The relatively low age may have affected the results because older patients tend to have more comorbidities and higher mortality rates than younger patients.

Conclusion

We investigated the clinical outcomes of MWJ-THA for displaced FNFs at our institution. There were no cases of postoperative dislocation. Furthermore, more than 80% of the patients regained their preinjury walking ability and had good clinical scores. We will continue to follow-up patients and compare their results with those of other approaches and implants.

Acknowledgments

We thank to Department of General Affairs in Toyama Prefectural Central Hospital for data organization.

Authors contribution

All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors. All authors are in agreement with the manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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