

# Total Hip Replacement vs. Internal Fixation in the Treatment of Femoral Neck Fractures in the Elderly

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## Research article

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# Abstract

**Background:** To evaluate the effects of total hip replacement and internal fixation on the outcome of femoral neck fractures in the elderly.

**Methods:** A retrospective study was conducted in a total of 79 individuals diagnosed with Garden I or Garden II femoral neck fractures aged from 56-71 years old from October 2012 to May 2019. Patients treated with total hip replacement were grouped into group 1, while those treated with internal fixation were grouped into group 2. Baseline characteristics were compared between the two groups to eliminate extra factors. Postoperative activity time, blood loss, length of hospital stay, and length of surgical incision were compared between the two groups. Besides, postoperative complications and hip function (Harris score) were detected to evaluate the final effects in the two groups.

**Results:** Baseline characteristics were similar between the groups, but the mean duration of surgery was more in group 1 than that in group 2 ( $p < 0.0001$ ). Blood loss and length of surgical incision were both larger in group 1. However, the incidence of such postoperative complications as lung infection, urinary tract infection and thrombosis of lower limb was lower in group 1 compared with those in group 2. Moreover, the hip function (Harris score) was also better after total hip replacement compared with that after internal fixation.

**Conclusions:** Total hip replacement provides satisfactory clinical outcomes, but with longer operation time and increased blood loss compared with internal fixation.

## Background

The femoral neck fracture is of high frequency in the elderly clinically [1–3]. With the global aging of population, the proportion of the elderly has been increasing, and the incidence of femoral neck fractures is also rising as expected [4–6]. It is estimated that the number of patients with hip fractures will be up to approximately 6 million in the world by 2050 [7]. With the improvement of medical technology, the development of built-in materials and the progress in surgical techniques, the surgical treatment for femoral neck fractures has been widely recognized. The common surgical treatment includes the open or closed hollow screw internal fixation, muscle bone flap, and artificial hemi/total hip replacement. It has been found in studies that reduction internal fixation can be performed for patients aged below 60 years old, while hip replacement can be conducted for patients aged above 80 years old [8]. However, the initial surgical methods for patients with femoral neck fractures aged 60–80 years old are still controversial [8, 9]. Due to the influences of life expectancy, preoperative living ability, mental state, postoperative functional recovery and quality of life, the risk of avascular necrosis and nonunion of the femoral head is higher in patients undergoing internal fixation, with a higher possibility of reoperation, so it is difficult to be accepted by patients [10, 11]. However, there are also such problems as short durable years and prosthesis dislocation in total hip replacement [12]. Previous studies indicated that the optimal treatment factors for femoral neck fractures include fracture displacement, patient's age, risk status, functional

requirements, cognitive function and physical ability [13–16]. In addition, with the extension of human life expectancy and the diversity and complexity of diseases, the expected life span of patients increases or decreases, making it difficult for clinicians to perform joint replacement [17]. Surgical treatment should be adopted for Garden I and II impacted fractures without displacement, unless there are surgical contraindications. This prospective randomized study was conducted to reveal different outcomes of total hip replacement and internal fixation in patients with Garden I or Garden II femoral neck fractures.

## Methods

After Ethics Committee of Affiliated Dongtai Hospital of Nantong University approved the study, this retrospective study was performed in Affiliated Dongtai Hospital of Nantong University from January 2015 to September 2018. Inclusion criteria: patients aged 60–80 years old, with the time from injury to admission <one week, and Garden I or II femoral neck fracture, and those receiving total hip arthroplasty or internal fixation with closed reduction and hollow compression screw. Exclusion criteria: patients aged <60 or >80 years old, those with open comminuted fractures or multiple fractures at any site at low extremities, or a previous history of surgery on lower limbs. According to surgical methods, the patients were divided into total hip replacement group (group 1, n = 40) and internal fixation group (group 2, n = 39). In group 1 (mean age =  $63.75 \pm 4.07$ , male/female ratio = 11:29), patients received total hip replacement by using hip prosthesis, acetabulum screw, Ceramic ball head (Dragonbio, Wuhan, China) and BENCOX Delta Head. In group 2 (mean age =  $63.36 \pm 3.93$ , female / male ratio = 27:12), 3.3 mm locking compression plate (MEDIOX, Eger, Hungary) was employed to fix fractures. The mechanism of injury and fracture type were similar in both groups (Table I). The same team conducted all the surgery.

## Surgical technique

In group 1, the operation was performed under a lateral position through the modified Hardinge approach [18] after general anesthesia or continuous epidural anesthesia. The skin was cut open layer by layer along the greater trochanter of femur to expose the hip joint, the femoral head was excised, the circumferential cartilage and round ligament were removed, and the acetabulum cartilage was honed from small to large using the file at the abduction of 40–45° and anteversion of 15–25°. Then according to the size of file, the appropriate acetabular cup with lining was placed, followed by femoral medullary over-reaming at the anteversion of 10–15°. According to the size of medullary file, the appropriate femoral prosthesis was placed for reduction, as well as flexion and extension, adduction, internal and external rotation of hip joint. After there was no dislocation trend, the femoral head prosthesis was officially installed for the reduction of hip joint, and the stability of hip joint was checked again. After there was no dislocation trend, the wound was washed, the negative pressure drainage tube was placed, and the skin was sutured layer by layer, followed by pressure dressing (Figure 1).

In group 2, the C arm-assisted closed replacement was performed under a horizontal position after general anesthesia or continuous epidural anesthesia. After anatomical reduction, routine disinfection

and draping, a guide pin was percutaneously drilled in parallel to the femoral neck at 3–4 cm below the greater tuberosity of femur, which was also parallel to the axis of the femoral neck and the anteversion angle. After the position was confirmed, three guide pins were drilled in a parallel and triangular manner. After the angle and position were confirmed again, a small incision (about 1 cm long) was percutaneously made along the guide pin, and the drill hole was expanded using the hollow drill under the protection of the sleeve. After depth detection, the appropriate hollow screw was screwed into the bone, with the screw tip at about 0.5–1 cm below the articular surface without penetrating the articular surface. The other two screws were also screwed along the other two guide pins in the same way, and the guide pins were pulled out after the satisfactory position, angle and depth were confirmed, followed by routine suture of wound (Figure 2).

## Statistical analysis

All data were analyzed by statistical software Statistical Product and Service Solutions (SPSS) 19.0 (SPSS Inc., Chicago, IL, USA), and quantitative data were shown as mean  $\pm$  standard. Unpaired *t*-test was used for quantitative data in single-factor test. Rank sum test was used for data not meeting normal distribution. Quantitative data were shown as rate or percentage, and  $\chi^2$  test was performed.  $p < 0.05$  demonstrated that the difference was statistically significant.

## Results

The baseline characteristics were similar in the two groups. The time from onset to surgery was (4.68 $\pm$ 1.56) days in group 1 and (4.90 $\pm$ 1.55) days in group 2. In addition, Comparison of hypertension, diabetes, rheumatoid arthritis and coronary heart disease between the two groups suggested no statistically significant differences ( $p > 0.05$ ) (Table I).

As shown in Table II, the mean time of surgery was less in group 2 than that in group 1 [(120.06 $\pm$ 20.52) minutes *vs.* (53.96 $\pm$ 9.58) minutes,  $p < 0.0001$ ]. Blood loss during surgery also significantly differed between the two groups [(316.21 $\pm$ 30.82) mL in group 1 *vs.* (28.36 $\pm$ 9.75) mL in group 2,  $p < 0.0001$ ]. Moreover, the average length of surgical incision was markedly shorter in group 2 than that in group 1 [(12.81 $\pm$ 2.62) cm *vs.* (3.05 $\pm$ 1.03) cm,  $p < 0.0001$ ], while there was no remarkable significance between the two groups in the time of hospital stay [(16.64 $\pm$ 5.36) days *vs.* (14.71 $\pm$ 4.14) days,  $p = 0.08$ ]. On the contrary, the activity time was longer after internal fixation compared with total hip replacement.

Postoperative complications were also used to compare two groups (Table III). It was found that lung infection occurred in one individual in group 1 and eight patients in group 2 ( $p = 0.01$ ). One individual was diagnosed with urinary tract infection after total hip replacement and seven patients after internal fixation ( $p = 0.02$ ). There were 4 cases of thrombosis of lower limb after total hip replacement and no case after internal fixation ( $p = 0.03$ ). None of the patients had bone nonunion or osteonecrosis of the femoral head

in group 1, whereas two patients had bone nonunion and three patients had osteonecrosis of the femoral head in group 2.

According to the comparison of hip function after surgery (Harris score) (Figure 1), the Harris score was significantly increased with time. Group 1 had higher scores than group 2 at the three time points. At 3 months after surgery, the hip function was better after total hip replacement than that after internal fixation [(81.96±1.21) points vs. (65.63±1.26) points,  $p<0.0001$ ]. The Harris score at 6 months after surgery was also higher in group 1 than that in group 2 [(86.66±1.09) points vs. (72.15±2.01) points,  $p<0.0001$ ]. At the end of follow-up, the Harris score in group 1 was close to that in group 2, but still lower than that in group 2 [(90.65±2.69) points vs. (81.06±3.09) points,  $p<0.0001$ ] (Table IV). Moreover, the Harris score was markedly increased in both group 1 and group 2 from 3 months to 6 months or 6 months to 12 months after surgery (Figure 3).

## Discussion

With the development of aging society, femoral neck fractures have gradually become a clinical disease [19, 20]. The main causes of femoral neck fractures for the middle-aged and elderly people are as follows: (1) The bone mineral density declines inevitably in the middle-aged and elderly people, leading to osteoporosis and weak femoral neck structure [21]. (2) The elderly are slow in reaction due to the degradation of muscle group around the hip, and they have no rapid defense against foreign damage, so the risk of femoral neck fractures increases under the influence of external violence [22]. Moreover, there are complications in multiple systems and organs in the middle-aged and elderly people, mainly the cardiovascular diseases, followed by respiratory diseases, cerebrovascular diseases, diabetes and kidney diseases [23]. Therefore, the approach to treat femoral neck fractures with conservative traction will result in nonunion and femoral head necrosis easily, and the immobilization may cause such severe complications as lower limb vein thrombosis, osteoporosis, pressure sores, pneumonia, cardiovascular and cerebrovascular accidents and organ failure, threatening the lives of patients. Besides, the nonunion rate is high, and ischemic necrosis of femoral head occurs easily. Therefore, the rapid, simple and effective surgical treatment should be actively adopted for middle-aged and elderly patients with femoral neck fractures.

Femoral neck fractures are mainly clinically treated with internal fixation and total hip replacement, among which the open reduction and internal fixation has a positive effect on reducing wound and complications, but the patients are prone to postoperative nonunion and femoral head necrosis [24]. The patients undergoing total hip replacement have short bedridden time, and they can obtain normal living ability in a short period of time. Moreover, the total hip replacement can effectively reduce the risk of lung infection and urinary system infection in the middle-aged and elderly patients with poor physical function and many complications, and the length of hospital stays is short. The research results in this paper showed that total hip replacement and open reduction and internal fixation have their own advantages and disadvantages in the treatment of femoral neck fractures in the elderly. After total hip replacement, the time of off-bed activity is early, and the complications can be effectively prevented. Therefore, hip

replacement is suitable for the elderly patient active in postoperative activities, but the operation time is longer and the amount of intraoperative bleeding is large, so it is not suitable for patients who have poor general conditions and cannot endure the major surgery. Besides, open reduction and internal fixation is characterized by short operation time and small amount of bleeding, but the time of postoperative off-bed activity is late, and the immobilization will easily lead to postoperative complications in the elderly patient.

## **Conclusions**

Total hip replacement has longer operation time and larger trauma, which requires better physical conditions of patients compared with internal fixation. However, it can enable the patients to go to ground activity earlier, conduct limb partial weight bearing and functional exercise in shorter time, and realize better postoperative hip function recovery. The internal fixation has relatively short operation time and small trauma, but the patients are not able to conduct weight bearing and corresponding functional exercise for a long time. In clinic, the patients' age, fracture type and body shape should be considered comprehensively to choose the most appropriate surgery.

## **Declarations**

## **Ethics approval and consent to participate**

The study was approved by the Ethics Committee of Affiliated Dongtai Hospital of Nantong University.

## **Consent for publication**

Not applicable.

## **Availability of data and materials**

The datasets in the study are available from the corresponding author on reasonable request.

## **Competing interests**

The authors declared that they have no conflict of interest.

## **Funding**

None.

# Authors' contributions

YX and WZ conducted the data, image collecting and statistical analysis. JZ, DJ and XL participated in the study design and surgery. XL wrote the manuscript. All authors approved the final manuscript.

# Acknowledgements

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## Tables

Table 1. Comparison of the spinopelvic parameters between AS patients and normal controls

	AS group(n=94)	Control group(n=30)	P
Sex,M/F	91/3	27/3	0.130
Age(yr)	36.8±9.6	34.4±8.3	0.225
PI (°)	47.4±7.5	43.2±4.6	<0.001*
PT (°)	38.6±11.7	7.8±3.2	<0.001*
SS (°)	8.8±10.2	35.4±3.7	<0.001*
TK (°)	53.9±18.1	32.3±6.2	<0.001*
TLK (°)	33.3±12.7	6.6±5.0	<0.001*
LL (°)	-5.4±14.2	-46.3±6.4	<0.001*
SVA(mm)	166.1±58.1	0.6±15.1	<0.001*
SPA(°)	120.5±15.2	173.5±1.1	<0.001*
SSA(°)	77.8±13.3	126.9±4.1	<0.001*
TPA (°)	47.1±12.5	4.0±1.0	<0.001*

AS, ankylosing spondylitis; M, male; F, Female; PI, Pelvic incidence; PT, Pelvic tilt; SS, Sacral slope; TK, Thoracic kyphosis; TLK, Thoracolumbar kyphosis; LL, Lumbar lordosis; SVA, Sagittal vertical axis; GK, Global kyphosis; SPA, spinopelvic angle; SSA, spinosacral angle; TPA, T1 pelvic angle

\*Statistically significant (P<0.05).

Table 2. Correlation coefficient(r) between PI and other sagittal parameters in AS patients and controls

Correlation coefficient(r)	PI			
	AS group	P value	Control group	P value
PT	0.506	<0.001*	0.601	<0.001*
SS	0.159	0.127	0.722	<0.001*
TK	0.171	0.100	0.090	0.637
TLK	-0.67	0.522	-0.292	0.117
LL	-0.135	0.194	-0.540	0.002*
SVA	0.090	0.389	-0.163	0.389
SPA	-0.504	<0.001*	-0.296	0.112
SSA	-0.11	0.919	0.803	<0.001*
TPA	0.533	<0.001*	0.265	0.157

AS, ankylosing spondylitis; PI, Pelvic incidence; PT, Pelvic tilt; SS, Sacral slope; TK, Thoracic kyphosis; TLK, Thoracolumbar kyphosis; LL, Lumbar lordosis; SVA, Sagittal vertical axis; GK, Global kyphosis; SPA, spinopelvic angle; SSA, spinosacral angle; TPA, T1 pelvic angle

\*Statistically significant (P<0.05).

Table 3. Linear regression model for PI with TPA and SPA in AS patients

	Unstandardized coefficients	Standardized coefficients	R <sup>2</sup> of model	P
TPA	0.323	0.533	0.284	<0.001*
SPA	-0.251	-0.504	0.254	<0.001*

AS, ankylosing spondylitis; PI, Pelvic incidence; SPA, spinopelvic angle; TPA, T1 pelvic angle

\*Statistically significant (P<0.05).

Table IV. Comparison of postoperative hip function (Harris score)

Follow-up data	Group 1 (n=40)	Group 2 (n=40)	p-value
3 months	81.96±1.21	65.63±1.26	<0.0001
6 months	86.66±1.09	72.15±2.01	<0.0001
12 months	90.65±2.69	81.06±3.09	<0.0001

## Figures

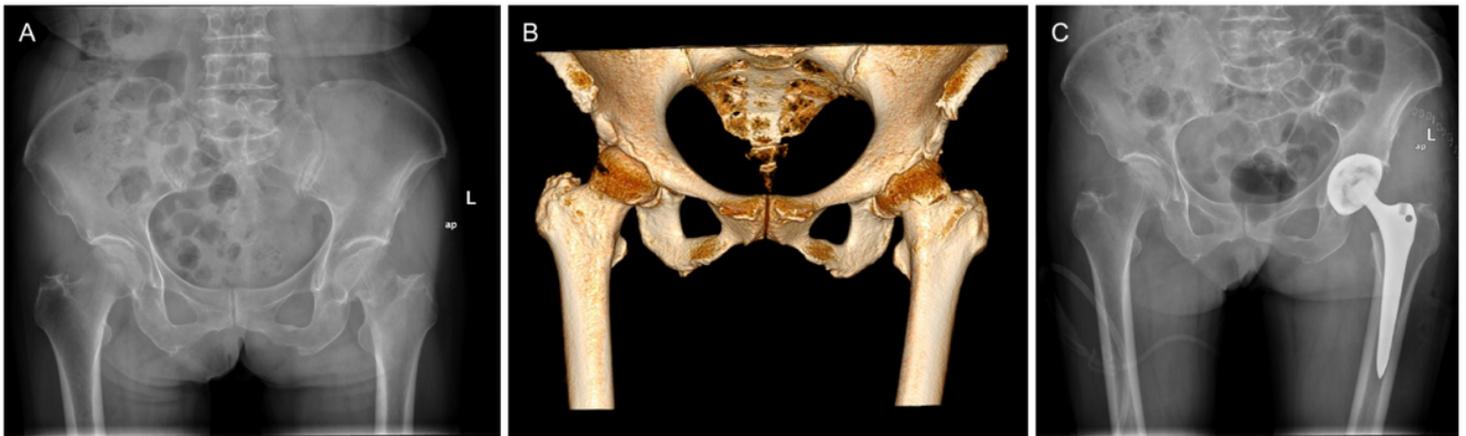


Figure 1

Group1: Pre-operative plain x-ray (A), 3D computed tomography view (B), post-operative plain x-ray of a patient who received total hip replacement after left femoral neck fracture (C).

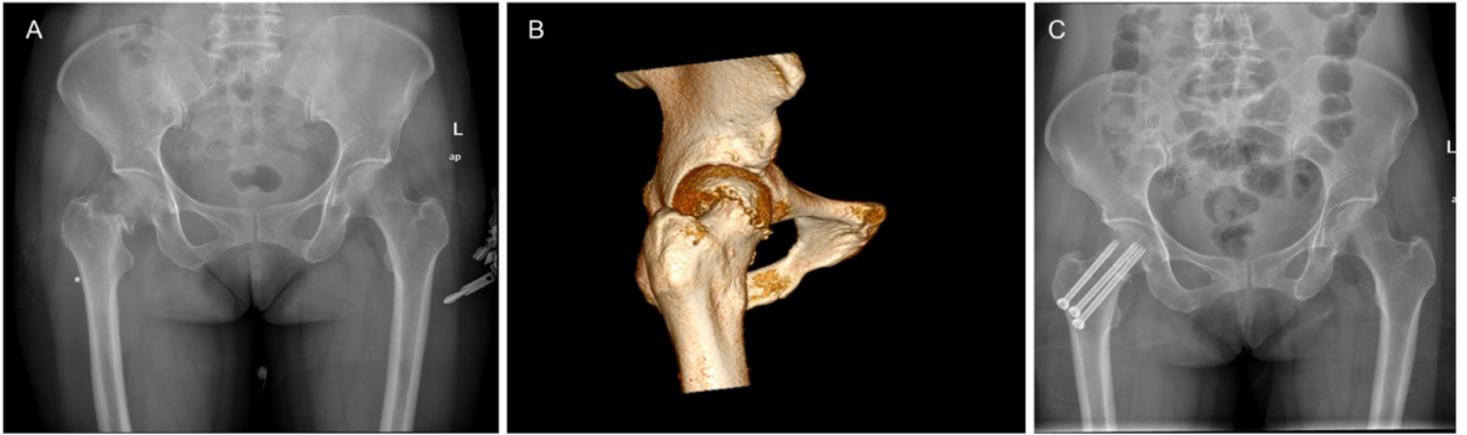


Figure 2

Group2: Pre-operative plain x-ray (A), 3D computed tomography view (B), post-operative plain x-ray of a patient who underwent internal fixation following left femoral neck fracture (C).

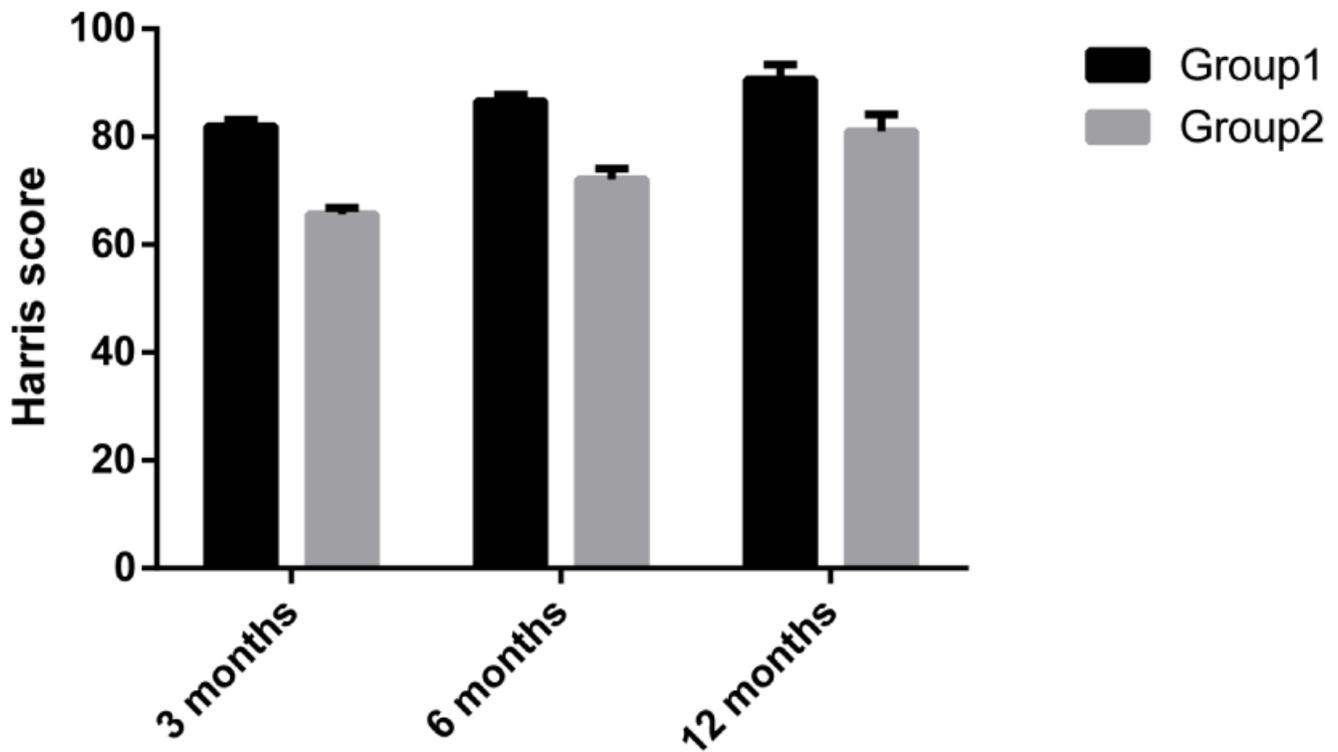


Figure 3

Harris score was markedly increased in two groups at the point of 3 months, 6 months and 12 months after surgery. The score in group 1 was more than that of group 2 at three different times.