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ORIGINAL STUDY

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The prevalence and risk factors of dislocation after primary total hip arthroplasty

Yujian Ding, Dehong Feng, Yi Liu, Jianrui Gao, Ling Wang, Yaxin Li, Yu Guo, Fenglin Tang

From the Department of Orthopedics, Affiliated Wuxi People's Hospital of Nanjing Medical University, Wuxi, Jiangsu, China

This study aimed to investigate the occurrence of dislocation and risk factors following primary total hip arthroplasty (THA). Retrospective analysis was done on the clinical data of 441patients with primary total hip arthroplasty who were admitted to our hospital between May 2018 and early December 2020. A total of 294 patients without posterior soft tissue repair were included as control group, and a total of 147 patients with repair of the short external rotator muscle and joint capsule were assigned to the repair group. All operated patients were observed to analyze the occurrence and risk of early postoperative dislocation. Within 6 months after hip arthroplasty, the early hip dislocation rate in the repair group was 0.68%, which was significantly lower than that in the control group (4.78%) ($P < 0.05$). The results of multifactorial analysis showed that age ≥75 years, combined limb or mental illness, artificial femoral head diameter <30 mm, posterolateral approach and prosthesis placement outside the safety zone, and improper handling were risk factors for dislocation ($P < 0.05$); The incidence of re-dislocation was lower in the targeted intervention group ($P < 0.05$). The occurrence of dislocation after THA is related to age, gender, and type of orthopedic disease. The risk factors should be explored to develop targeted intervention protocol, decreasing the dislocation rate and improving the prognosis.

Keywords : Primary total hip arthroplasty; postoperative dislocation; risk factors; multifactorial logistic analysis.

INTRODUCTION

Total hip arthroplasty (THA), as a common surgical option in orthopedic department, could significantly improve patients' pain, correct deformities and promote the recovery of hip function *(1,2)*. As a typical postoperative complication, dislocations primarily occur 3 months after surgery, 75% occur within 1 year after surgery, and recurrent dislocations will occur in 16% to 59% of patients *(3,4)*. Some studies found that factors influencing postoperative dislocation after THA include soft tissue dysfunction, improper prosthesis position and infection in the early stage of dislocation, while the incidence of later-stage dislocation has connection with increased range of

■ Yujian Ding,
■ Dehong Feng*,
■ Yi Liu,
■ Jianrui Gao,
■ Ling Wang,
■ Yaxin Li,
■ Yu Guo,
■ Fenglin Tang

Department of Orthopedics, Affiliated Wuxi People's Hospital of Nanjing Medical University, Wuxi, Jiangsu 214000, China.

Correspondence: Dehong Feng. No. 299, Qingyang Road, Wuxi, Jiangsu 214000, China; Phone: +86-15961796168

E-mail: fengdehong66@163.com

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motion of the hip joint and poor prosthesis position *(5)*. The occurrence of postoperative dislocation affects the patient's limb function, prolongs the hospital stay, and may lead to medical disputes *(6,7)*. Therefore, the study analyzed the occurrence and risk factors of dislocation after THA, which can provide clinical guidance for the prevention and treatment of postoperative dislocation. In this study, we retrospectively analyzed the occurrence of early dislocation after THA in 441 cases admitted to our hospital from May 2018 to December 2020, and discussed the risk factors for the occurrence of postoperative dislocation, with the aim of providing clinical reference.

MATERIALS AND METHODS

The baseline data of 441 patients who underwent primary artificial hip arthroplasty in our hospital from May 2018 to December 2019 were retrospectively analyzed. All cases met the following inclusion criteria. (i) patients with fresh femoral neck fractures or primary/secondary osteoarthritis of the hip, and all received the procedure for the first time; (ii) complete clinical data. Exclusion criteria: 1. patients with previous femoral neck fractures; 2. patients with neurological or muscular system diseases. 3. Patients with obvious deviation of artificial prosthesis placement as shown in the X-ray frontal and lateral radiographs of the hip after replacement. The posterior soft tissue repair of the hip joint as determined by the attending surgeon was performed according to the patient's condition. A total of 268 patients without posterior soft tissue repair were included as the control group, and a total of 104 patients with joint capsule and short external rotation muscle repair were included as the repair group. All patients signed informed consent, and patients who did not undergo posterior soft tissue repair voluntarily abandoned the procedures. This study has been approved by the Ethics Committee of Affiliated Wuxi People's Hospital of Nanjing Medical University.

All patients received total hip replacements, and all procedures were performed by the same group of experienced surgeons. All patients were placed in a supine position with elevation of the hip by lumbar support pillow to fully expose the femur and hip joint. After performing cleaning and disinfecting tasks, an incision was made from 3 cm distal and 3cm lateral to the ASIS and extended in a straight line towards the fibula head for 10 cm, separating the fascial layer by layer until the anterior superior iliac spine was reached. The hip capsule was fully exposed and after electrocoagulation of the local artery, a "T"-shaped incision was made in the posterior joint capsule to expose the femoral neck and hip joint, and the lower limb was fully internally rotated. After routine treatment of the femur and acetabulum, the acetabular prosthesis was placed at 45° of abduction and 20° of anterior tilt, while the femoral head prosthesis was placed at 15° of anterior tilt. It was required to maintain stability when the hip joint was rotated 40° externally or flexed 90° and rotated 40° internally. In the repair group, holes were drilled at the femoral rotor, the preserved flap-like joint capsule was repositioned and repaired, and the externally rotating muscles were introduced into the pre-drilled holes of the greater trochanter, stretched and knotted, and the hip joint was in internal rotation at 15°-20° during the suturing process to maintain the length of the joint capsule flap. The rotational mobility of the prosthesis was observed before and after the joint capsule repair, and the incision was closed layer by layer by repairing the incised femoral muscles. In the control group, the posterior joint capsule was resected directly and no repair procedures was performed in the external rotator muscle. All patients started post-replacement rehabilitation training 1 day after replacement, and were given isometric contraction exercises for quadriceps, gluteus and gastrocnemius, and the time to out of bed activities was decided according to the patients' physical fitness and bone quality and condition of the intraoperative prosthesis.

Baseline data such as age, gender, pre-replacement disease [ischemic necrosis of femoral head, hip osteoarthritis, hip fracture] and follow-up period after replacement were collected from the two groups.

The hospitalization time, operation time and intraoperative bleeding, Harris hip function scores (preoperative, 1 month, 3 months, 6 months

postoperative), imaging data (anteversion angle, abduction angle, leg length discrepancy) were compared between two groups.

All patients were followed up by the same group of nurses after discharge, with no lost cases during more than 1 year of follow-up. Dislocation of the joint occurred within 6 months after replacement was defined as early dislocation. Early dislocations were recorded and compared between the two groups.

Analysis of risk factors for the occurrence of dislocation Clinical data were collected from all enrolled patients, including general data and surgical conditions. The general data covers age, gender, whether there was a combination of mental illness, and surgical history. The surgical conditions covers approach, diameter of artificial femoral head, placement of prosthesis, and handling. The differences of the above indicators between the dislocation group and the non-dislocation group were compared, and the risk factors for the occurrence of dislocation were analyzed.

The SPSS23.0 statistical software was applied for data analysis, and the count data were expressed as (%) with chi-square (χ^2) test; the measurement data were expressed as () with t-test, and the rank data were tested with rank sum test. Risk factors were analyzed by unconditional logistic regression equation. The test criterion α=0.05, and P<0.05 was considered a statistically significant difference.

RESULTS

There was no statistically significant difference between the two groups in terms of baseline data such as mean age, gender, pre-replacement condition and post-replacement follow-up period (P > 0.05) (Table I).

Within 6 months after hip replacement, the early hip dislocation rate was 0.68% in the repair group, which was significantly lower than that of 4.78% in the control group (P < 0.05). After 6 months, the control group recovered well after one case of traumatic posterior hip dislocation, which was treated with conventional repositioning; no late dislocation occurred in the repair group after 6 months (Table II).

Comparison of surgical indicators between two groups There was no significant difference between two groups in terms of operative time, hospital stay and intraoperative bleeding (P<0.05) (Figure 1).

Comparison of hip imaging indexes between two groups The differences in the anteversion angle, abduction angle and and bilateral lower limb length of the hip joint between two groups after surgery were not statistically significant (P<0.05) (Figure 2).

Comparison of Harris hip function scores between two groups Compared with the preoperative period, the Harris hip function scores were significantly higher in both groups at 1, 3 and 6 months after

Table I. – Comparison of baseline data

Group	Number of cases	Gender (male/female)	Mean age (years)	Ischemic necrosis of femoral head	Hip osteoarthritis	Hip fracture	Follow-up time (years)
Repair group	147	79/68	65.2±10.8	45	50	62	2.3±1.6
Control group	294	156/138	63.6±10.3	95	83	106	2.5±1.3
χ^2/t	/	0.018	1.513	1.085			1.245
P	/	0.893	0.131	0.581			0.214

Table II. – Comparison of early hip dislocation rate

Group	Dislocation	Normal	Total	Dislocation rate
Repair group	1	146	147	0.68%
Control group	14	280	294	4.76%
χ^2				4.969
P				0.026

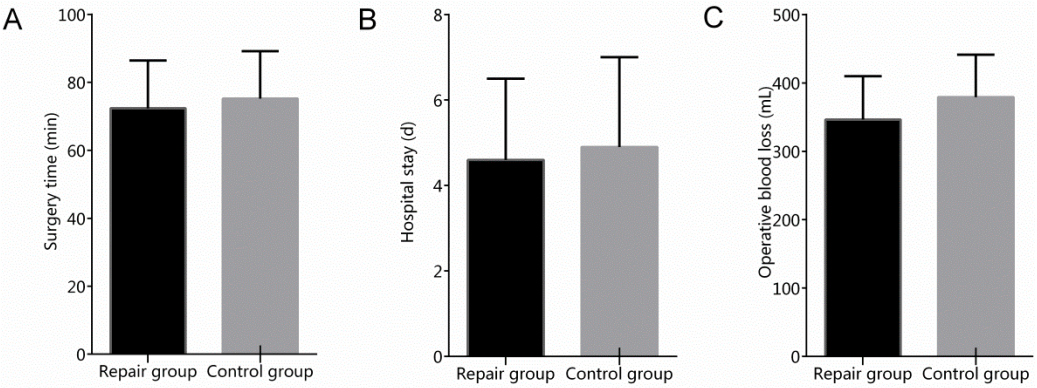

Fig. 1. – Comparison of surgical indicators between the two groups.
Figure 1 shows that the differences in operative time, hospital stay and intraoperative bleeding in the repair group were not significant when compared with the control group.

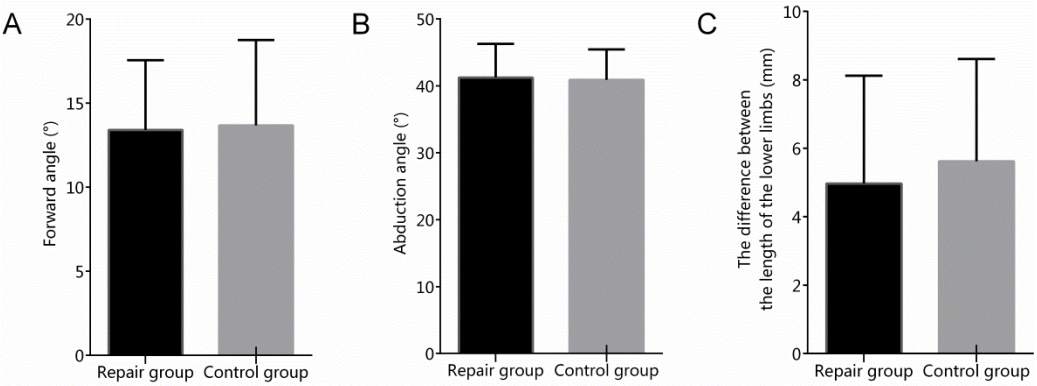

Fig. 2. – Figure 2 Comparison of postoperative hip imaging-related indexes between the two groups
Figure 2 shows the differences in the anteversion angle, abduction angle and and bilateral lower limb length of the repaired hip joints compared with the control group (P>0.05).

surgery (all $P < 0.05$). However, there was no statistically significant difference in the Harris hip function scores between two groups at each time point (all $P > 0.05$) (Table III).

There were no statistically significant differences between the non-dislocated group and the dislocated group in terms of baseline data such as gender composition, proportion of comorbid psychiatric diseases and types of orthopedic diseases ($P > 0.05$), and the mean age of the dislocated group was significantly higher than that of the non-dislocated group ($P < 0.05$) (Table IV).

When comparing the surgical conditions of the two groups, the proportions of femoral head

Table III. – Comparison of Harris scores (score)

Group	Number of cases	Preoperative	1 month after surgery	3 months after surgery	6 months after surgery
Repair group	147	42.72±10.65	76.16±932	87.25±11.38	92.46±11.18
Control group	294	41.09±12.15	78.39±10.33	86.36±10.35	91.47±10.82
χ^2/t	/	1.201	1.919	0.724	0.794
P	/	0.231	0.056	0.470	0.428

Table IV. – Comparison of baseline data

Group	Number of cases	Sex (male/female)	Age (≥75 years)	Comorbid psychiatric disorders	Ischemic necrosis of the femoral head	Osteoarthritis of the hip joint	Hip fracture
Non-dislocation group	426	254/182	97	12	135	129	162
Dislocation group	15	8/7	8	7	5	4	6
χ^2/t	/	0.144	5.872	47.352	0.064		
P	/	0.704	0.015	0.000	0.969		

diameter <30 mm, posterior-lateral approach, prosthesis placement outside the safety zone and improper handling were significantly higher in the dislocation group than in the non-dislocation group (P < 0.05) (Table V).

Multifactor logistic regression analysis was performed with whether dislocation occurred as the dependent variable (yes=1, no=0) and the factors that differed significantly between the two groups (age, pain level, comorbid mental illness, femoral head diameter, approach, prosthesis placement and improper handling; Table VI for the assigned values) as independent variables. The results showed that age, combined mental illness, artificial femoral head diameter < 30 mm, posterior lateral approach and prosthesis placement outside the safety zone, and improper handling were risk factors for dislocation (P < 0.05, Table VII).

DISCUSSION

Hip dislocation as a postoperative complication of replacement surgery, can somewhat increase the level of pain and have an impact on the outcome

Table V. – Univariate analysis of the occurrence of dislocation after primary total hip arthroplasty (cases, %)

Factor		Number of cases	Dislocation group (15 cases)	Non-dislocation group (426 cases)	χ^2	P
Artificial femoral head diameter	<30mm	56	8 (54.2)	48 (11.5)	19.490	0.000
	≥30mm	385	7 (45.8)	378 (88.5)		
Repair	Yes	107	10 (70.8)	97 (23.1)	12.899	0.000
	No	334	5 (29.2)	329 (76.9)		
Prosthesis placement position	Outside the safety zone	30	10 (70.8)	20 (4.8)	78.271	0.000
	Within safety zone	411	5 (33.3)	406 (95.2)		
Improper handling	Yes	50	9 (62.5)	41 (9.6)	31.739	0.000
	No	391	6 (37.5)	385 (90.4)		

Table VI. – Assignment

Factor	Assignment
Age	<75 years = 1, ≥75 years = 2
Pain level	None=1, mild=2, moderate=3, severe=4
Mental illness	None=0, Yes=1
Femoral head diameter	<30mm=1, ≥30mm=2
Repair	Repaired=1, unrepaired=2
Prosthesis placement	Inside the safety zone=1, outside the safety zone=2
Improper handling	No=0, Yes=1

Table VII. – Results of multifactor analysis

Factor	β	S.E.	Waldχ^2	OR value	95% CI	P
Age ≥75 years	2.054	0.521	4.725	7.457	2.940-17.985	0.000
Those with combined physical or mental illness	3.241	0.409	4.895	21.402	8.512-68.412	0.000
Artificial femoral head diameter <30mm	2.310	0.417	4.836	9.312	3.745-19.654	0.000
Posterior soft tissue repair	3.965	0.513	4.752	10.135	3.995-25.415	0.000
Prosthesis placed outside the safety zone	1.498	0.475	4.935	34.210	1.902-10.754	0.000
Improper handling	2.647	0.462	4.872	14.856	6.125-35.641	0.000

of the surgery *(8)*. Norambuena G A *(9)* et al. performed 21490 primary THAs at one hospital, and 189 cases (190 hips) had their first dislocation within 1 year after surgery (0.9%). Therefore, the analysis of risk factors becomes crucial to develop targeted intervention and improve prognosis *(10,11)*. Early dislocation is defined as the occurrence of dislocation within 6 months after the primary THA. Studies have concluded that surgical factors are considered to be one of the crucial factors influencing the incidence of early dislocation. With the large volume of hip replacements and the accumulation of operators' experience, dislocations due to poor prosthesis position have gradually decreased, and soft tissue imbalance has gradually become the main factor of prosthesis dislocation. In this study, during the primary THA via the posterolateral approach, the joint repair of the posterior joint capsule and the short external rotator muscles was used to reduce the incidence of early dislocation after replacement. The results show that for the primary total hip replacement through posterior lateral approach, joint repair of the posterior joint capsule and short external rotator muscles can reduce the early dislocation rate after replacement.

Meanwhile, the risk factors affecting early dislocation were further observed, and the results showed that age ≥75 years, those with combined limb or mental disease, artificial femoral head diameter <30 mm, postero-lateral approach and prosthesis placement outside the safety zone, and improper handling were risk factors for dislocation. The reason may be that 1. the presence of multiple underlying diseases in elderly patients, the relative laxity of the soft tissues near the hip joint as well as reduced muscle strength contribute to the reduction in the stability of their joints and makes them highly susceptible to joint dislocation due to falls *(12,13)*. Meanwhile, lower neurosensitivity and lack of motor coordination in the elderly increases the risk of joint dislocation *(14,15)*. 2. Those with combined limb or mental disorders have weak peripheral muscle tone, which increases the difficulty of early postoperative rehabilitation exercises and increases the risk of joint dislocation *(16,17)*. 3. When the artificial femoral head diameter is <30 mm, its hip joint mobility is low, and it is highly susceptible to severe prosthesis friction and collision, increasing the risk of joint dislocation *(18,19)*. 4. The posterior lateral approach is very likely to produce different degrees of damage to the posterior joint ligament structures and muscles, thus triggering serious consequences such as reduced muscle tone and muscle atrophy, which cannot protect the hip joint and increase the incidence of joint dislocation *(20,21)*. 5. Increased abduction angle and decreased peripheral angle caused by improper prosthesis placement will continue to shift the load at the joint and impede its hip movement, aggravating the risk of postoperative dislocation *(22)*. Zecevic-Lukovic T *(23)* et al. found that higher acetabular inclination angles and heightened radiographs of the greater trochanter were more likely to induce hip dislocation. *(7)* Improper handling can cause inadequate formation of muscle tone, which affects the stability of its joint area and prevents the affected limb from being held in an abducted neutral

position, increasing the incidence of hip dislocation *(24)*. Lu Y et al *(25)* found that joint capsule repair can effectively treat prosthesis dislocation, and its surgical trauma is relatively small, with good surgical results and good tolerance by patients.

Shortcomings of this study: (i) the sample size in this study was small; (ii) there were limitations in the conditional assumptions, and some factors were ignored. Prospects for this type of study: increase number of subjects to improve the comprehensiveness and accuracy of the study results.

CONCLUSION

In conclusion, the occurrence of dislocation after THA is influenced by age, gender, type of orthopedic disease, etc. Targeted intervention programs can be formulated clinically by studying and analyzing their risk factors, thus consistently reducing the rate of postoperative dislocation and improving their prognosis.

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