

## Original Article

# The impact of unified discharge standards on the clinical efficacy and prognosis of hemiarthroplasty in elderly patients with hip fractures

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**Abstract:** Objectives: The aim of this study was to investigate the impact of unified discharge standards on the clinical efficacy and prognosis of hemiarthroplasty in elderly patients with hip fractures. Methods: Retrospective study of 158 elderly patients with hip fractures who underwent artificial femoral head replacement in our hospital from March 2016 to July 2019 were enrolled. According to the unified discharge standards, patients were divided into the observation (65 cases who met discharge criteria) and control group (93 cases who failed to meet all discharge criteria). Histopathological feature, operation status, postoperative Harris Hip score, therapeutic outcome, postoperative complications, readmission and mortality rate were compared between the two groups. Results: Surgery duration and intraoperative blood loss exhibited no difference between the two groups, while transfusion volume and length of hospital stay were significantly increased in the observation group. There was no significant difference in the Harris Hip score between the two groups 12 months postoperatively. The incidence of postoperative complications during the follow-up period was notably lower in the observation group. In addition, the three-month readmission rate and one-year mortality rate were significantly lower in the observation group. Conclusions: For elderly patients with hip fractures undergoing artificial femoral head replacement, the incidence of postoperative complications and postoperative readmission/mortality rate could be reduced through the establishment of unified discharge standards, which should be used in future clinical practice.

**Keywords:** Unified discharge standards, hip fractures, elderly, artificial femoral head replacement, clinical efficacy, prognosis

## Introduction

Most hip fractures occur in elderly patients, and the incidence increases with age [1, 2]. At present, patients with hip fractures could receive surgical or nonsurgical treatments [1, 2]. However, most elderly patients treated non-operatively experience common complications including pressure ulcer, urinary tract infection and deep vein thrombosis, which could be life-threatening [3, 4]. Recently, artificial femoral head replacement is widely used for the treatment of hip fractures [5, 6]. It is characterized by shorter operation time, less intraoperative bleeding, better therapeutic outcome, fewer complications and lower risk, which could improve the postoperative life quality of the patients [5, 6].

However, due to the lack of unified discharge standards, some patients are discharged early after the surgery when they don't meet the discharge criteria. As a result, some patients experience postoperative delirium and complications. Consequently, the readmission and mortality rate could be remarkably increased. In addition, malnutrition and anemia may lead to poor therapeutic outcomes and increase the incidence of postoperative complications [7-10]. Furthermore, the prognosis of hemiarthroplasty in elderly patients with coronary heart disease, diabetes and cerebrovascular disease is poor [7-10]. More, postoperative wound care could affect the clinical efficacy and prognosis of hip replacement, and preoperative weight-bearing exercise may also prevent post-surgical complications [7-10].

## Unified discharge standards in hemiarthroplasty in the elderly

**Table 1.** Characteristics of patients in the observation and control group [n (%)]

Characteristics		Observation group (n = 65)	Control group (n = 93)	t/ $\chi^2$	P
Age		84.56±4.32	84.64±4.25	0.116	0.908
Gender	Male	11 (16.9)	16 (17.2)	0.002	0.963
	Female	54 (83.1)	77 (82.8)		
Location	Left	32 (49.2)	46 (49.5)	<0.001	0.977
	Right	33 (50.8)	47 (50.5)		
Severity	II	21 (32.3)	30 (32.3)	<0.001	0.997
	III	22 (33.8)	31 (33.3)		
	IV	22 (33.8)	32 (34.4)		
Cause	Traffic accidents	10 (15.4)	14 (15.0)	0.157	0.924
	Falls	53 (81.5)	75 (80.7)		
	Others	2 (3.1)	4 (4.3)		
Other medical conditions	Diabetes	21 (32.3)	29 (31.2)	0.208	0.976
	Hypertension	18 (27.7)	27 (29.0)		
	Coronary heart disease	17 (26.2)	26 (28.0)		
	Liver damage	9 (13.8)	11 (11.8)		

Therefore, unified discharge standards of hip replacement surgery in elderly patients were established in this study. Parameters including operation status, postoperative Harris Hip score, therapeutic outcome, occurrence of complications and readmission/mortality rate were compared between the observation and control group. The aim was to highlight the importance of unified discharge standards in elderly patients underwent artificial femoral head replacement, and our findings could provide guidance to future clinical practice.

### Materials and methods

#### Patients

Retrospective study of 158 elderly patients with hip fractures who underwent artificial femoral head replacement in our hospital from March 2016 to July 2019 were recruited. The inclusion criteria were as follows: (I) aged  $\geq 80$  years; (II) diagnosed with femoral neck or intertrochanteric hip fracture; (III) with stabilized condition and eligible for artificial femoral head replacement. The exclusion criteria were as follows: (I) medical history of mental illness; (II) serious medical conditions including liver damage, kidney disorder and hematopoietic system disease.

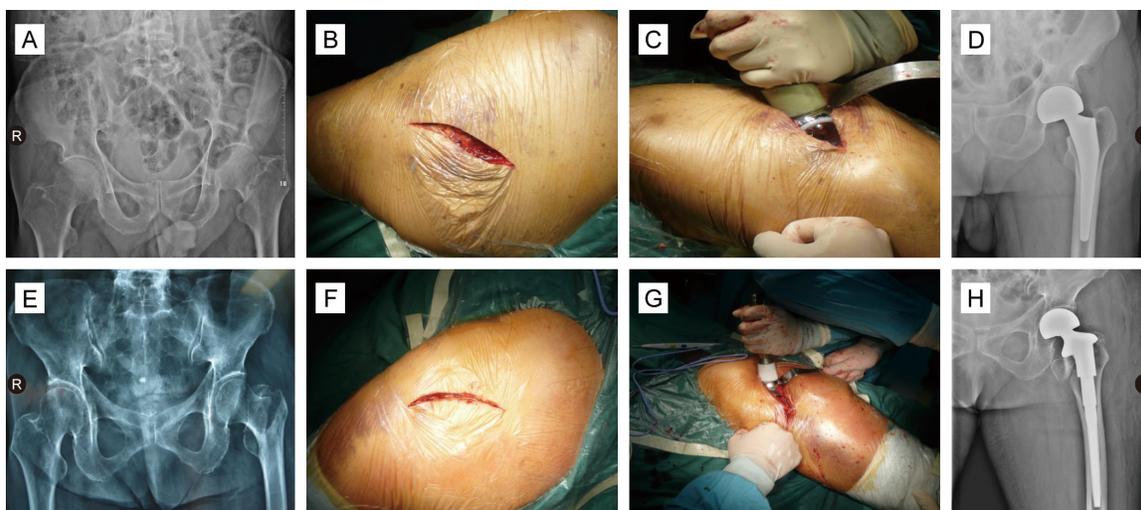
Unified discharge standards were established: (I) with stable conditions and without hypoalbuminemia; (II) hemoglobin  $\geq 90$  g/L for four days after surgery; (III) no wound leakage from the incision and urinary catheter disconnected; (IV) other medical conditions were well controlled; (V) eligible for postoperative physiotherapy; (VI) patients with good preoperative functional capacity ( $\geq 4$  Metabolic equivalents, METs) were capable of upright walking with assistance, and those with poor capacity ( $< 4$  METs) were able to stand using a walking aid. Based on the unified discharge standards, 158 elderly patients with hip fractures were sorted into the observation (65 cases who met discharge criteria) and control group (93 cases who failed to meet all discharge criteria). Characteristics of patients including age, gender, fracture location, severity/cause of fracture and other medical conditions were presented in **Table 1**.

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#### Methods

##### Preoperative preparation

All patients were subjected to preoperative assessment including liver and kidney function, blood pressure and pulse test, as well as Electrocardiograph (ECG) and chest computed tomography (CT) scan. Patients with deep vein thrombosis were also excluded using a CT scan with contrast. Adjustments were made to ensure that all patients have stabilized condition and are eligible for artificial femoral head replacement.



**Figure 1.** Artificial femoral head replacement were performed on elderly patients with hip fractures. A. X-rays of the patients with femoral neck fracture before the surgery. B. The surgical incision of the patients with femoral neck fracture. C. Artificial joint implantation in the patients with femoral neck fracture. D. X-rays of the patients with femoral neck fracture after surgery. E. X-rays of the patients with intertrochanteric hip fracture before the surgery. F. The surgical incision of the patients with intertrochanteric hip fracture. G. Artificial joint implantation in the patients with intertrochanteric hip fracture. H. X-rays of the patients with intertrochanteric hip fracture after surgery.

#### *Treatment plan*

All patients underwent artificial femoral head replacement and were performed by the same doctor. For patients with femoral neck fracture, an incision was made on the side of the thigh, and encountered layers including subcutaneous fat, bursa and gluteus medius were incised, then the joint was exposed.

Subsequently, the femoral head and part of the femoral neck was removed from the acetabulum, and the size of femoral head was measured. The inside of the femur was hollowed out and a metal stem was placed inside the femur. Then the artificial femoral head, that was attached to another headline with polyethylene, was placed on the stem securely. This was called a bipolar prosthesis. The incision was closed and bandaged (**Figure 1A-D**). For patients with intertrochanteric hip fracture, the operational procedure was similar. Intramedullary nailing was performed on all patients, distal locking was performed with one locking bolt (**Figure 1E-H**).

#### *Postoperative management*

Patients were treated with anti-inflammatory (COX-2 inhibitors), anticoagulant (rivaroxaban,

10 mg once daily for five weeks after surgery) and anti-infective (second-generation cephalosporins for two days after surgery) agents post-operatively, and low dose of the opioids was used if necessary. Patients were trained with weight-bearing exercise with proper instruction and supervision two days after surgery.

#### *Operation status*

For all patients, surgery duration, transfusion volume, intraoperative blood loss and the length of hospital stay were recorded. One year after surgery, the function of the hip joint was evaluated based on the degree of pain, functional capacity, malformation and range of movement. The maximum score was 100 points, and higher score indicated better recovery in the patients. During the one-year follow-up period, the occurrence of complications including postoperative infection, dislocation, anemia, hypoalbuminemia, heterotopic ossification and deep vein thrombosis were monitored.

#### *Therapeutic outcomes*

The prognosis of patients was evaluated according to Harris Hip score based on pain scale, functional capacity, malformations and range of movement. Therapeutic outcome was scored

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**Table 2.** Operation status of patients in the observation and control group ( $\bar{x} \pm s$ )

	Observation group (n = 65)	Control group (n = 93)	t	P
Surgery duration (min)	25.85±17.95	24.21±18.67	0.552	0.582
Transfusion volume (ml)	156.92±10.12	64.51±10.31	55.86	<0.001
Intraoperative blood loss (ml)	80.34±15.16	79.72±14.92	0.255	0.080
Length of hospital stay (d)	10.5±1.5	6.0±1.0	22.63	<0.001

**Table 3.** Comparison of Harris Hip score between the two groups ( $\bar{x} \pm s$ )

	Observation group (n = 65)	Control group (n = 93)	t	P
Pain scale	41.4±4.3	41.8±3.8	0.62	0.53
Functional capacity	4.4±0.6	4.3±0.4	1.26	0.21
Malformations	4.5±0.7	4.4±0.6	0.96	0.34
Range of movement	41.1±3.4	40.5±2.9	1.19	0.24
Total score	91.4±6.4	90.0±5.3	1.50	0.13

**Table 4.** Occurrence of complications in the observation and control group [n (%)]

	Observation group (n = 65)	Control group (n = 93)	$\chi^2$	P
Postoperative infection	0 (0)	1 (1.1)		
Dislocation	1 (1.5)	3 (3.2)		
Anemia	0 (0)	2 (1.1)		
Hypoalbuminemia	0 (0)	2 (1.1)		
Heterotopic ossification	0 (0)	2 (1.1)		
Deep vein thrombosis	8 (12.3)	16 (17.2)		
Total incidence (%)	9 (13.8)	23 (21.5)	4.418	0.035

as follows: 90-100% = Excellent, 80-89% = Good, 70-79% = Fair, 0-69% = Poor. Excellent rate = Number of patients rated excellent or good/total number of patients  $\times 100\%$ . Prognostic Index: readmission rate = The number of three-month readmissions/total number of patients  $\times 100\%$ ; mortality rate = Number of patients died within one year/total number of patients  $\times 100\%$ .

### Statistical analysis

All data were presented as means  $\pm$  standard error and analysed using SPSS software (version 22.0; SPSS, Inc., Chicago, IL, USA). Difference in distribution of the two groups was evaluated using the  $\chi^2$  test. Comparisons of difference were conducted using Student's t-test. The Kaplan-Meier method was used to analyze survival data, and the significance was exam-

ined using the log-rank test.  $P < 0.05$  was considered to indicate a statistically significant difference.

### Results

#### Comparison of operation status between the two groups

The influences of unified discharge standards on operation status in patients underwent hemiarthroplasty were investigated. As presented in **Table 2**, surgery duration and intraoperative blood loss exhibited no difference between the two groups ( $P > 0.05$ ), whereas transfusion volume and length of hospital stay were significantly increased in the observation group ( $P < 0.05$ ).

#### The effects of unified discharge standards on postoperative Harris Hip score

The prognosis of patients was evaluated according to Harris Hip score based on pain scale, functional capacity, malformations and range of movement. No significant difference in the Harris Hip score was observed between the groups 12 months postoperatively ( $P > 0.05$ ; **Table 3**).

#### Comparison of postoperative complications between the two groups

During the one-year follow-up period, the occurrence of complications including postoperative infection, dislocation, anemia, hypoalbuminemia, heterotopic ossification and deep vein thrombosis were compared between the observation and control groups. As presented in **Table 4**, the incidence of postoperative complications was remarkably reduced in the observation group ( $P < 0.05$ ).

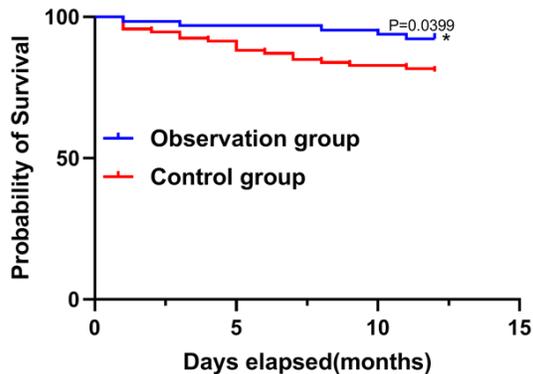
## Unified discharge standards in hemiarthroplasty in the elderly

**Table 5.** Comparison of therapeutic outcome between the two groups [n (%)]

	Observation group (n = 65)	Control group (n = 93)	$\chi^2$	P
Excellent	32 (49.2)	46 (49.5)		
Good	30 (46.2)	44 (47.3)		
Fair	2 (3.1)	4 (4.3)		
Poor	1 (1.5)	1(1.1)		
Excellent rate	62 (95.4)	90 (95.7)	0.009	0.92

**Table 6.** Readmission and mortality rate in the observation and control group [n (%)]

	Observation group (n = 65)	Control group (n = 93)	$\chi^2$	P
Three-month readmission rate	4 (6.2)	16 (17.2)	4.226	0.039
One-year mortality rate	5 (7.7)	18 (19.4)	4.184	0.041



**Figure 2.** Survival rate in the observation and control group after surgery. \*,  $P < 0.05$ .

### *The effects of unified discharge standards on therapeutic outcome*

Prognosis of patients in the two groups were compared according to postoperative Harris Hip Score. Therapeutic outcome was scored as excellent, good, fair and poor. No significant difference in the excellent rate was observed between the two groups 12 months postoperatively ( $P > 0.05$ ; **Table 5**).

### *Comparison of readmission and mortality rate between the two groups*

Furthermore, the prognostic index such as readmission and mortality rate were compared in the observation and control group. As presented in **Table 6**, the three-month readmission rate and one-year mortality rate were sig-

nificantly reduced in the observation group ( $P < 0.05$ ). Meanwhile, the 1-year survival rate in the observation group was significantly higher than that in the control group (**Figure 2**).

### **Discussion**

Due to age-related bone mass loss and muscle dysfunction, femoral neck or intertrochanteric hip fracture is commonly seen in the elderly [11]. Hip fracture may cause multiple complications, which could be life-threatening [12, 13]. As hip fracture keeps patients im-

mobile for long time, most elderly patients treated nonoperatively experience common complications including pressure ulcer, urinary tract infection and deep vein thrombosis [14, 15]. As a result, cardio-pulmonary function could be impaired, which affected patients' quality of life and could be life-threatening. Recently, artificial femoral head replacement is widely used for the treatment of hip fractures [16, 17]. There are many advantages of hip replacement in the treatment of elderly patients with hip fracture, and patients could have a long-lasting and well-functioning artificial hip joint after surgery [18].

The clinical efficacy and prognosis of hemiarthroplasty in elderly patients with hip fractures could be affected by the discharge standards [19]. However, due to the lack of unified discharge standards, some patients are discharged early when they don't meet the discharge criteria. Premature discharge in patients with pre-existing conditions, malnutrition and delirium could induce post-surgical complications and increase the risk of readmission/mortality.

In the present study, unified discharge standards of hip replacement surgery in elderly patients were established, based on postoperative wound healing, pre-existing conditions, nutrition and weight-bearing exercise. Therefore, 158 elderly patients with hip fractures were sorted into the observation (65 cases who met discharge criteria) and control group

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(93 cases who failed to meet all discharge criteria). Parameters including operation status, postoperative Harris Hip score, therapeutic outcome, occurrence of complications and prognostic index were compared between the two groups. Our data suggested that surgery duration and intraoperative blood loss exhibited no difference between the observation and control group. Moreover, transfusion volume and length of hospital stay were remarkably elevated in the observation group.

In addition, there was no significant difference in the Harris Hip score between the two groups 12 months after surgery. Furthermore, the incidence of postoperative complications was significantly reduced in the observation group. These findings suggested that postoperative recovery could be improved and complications could be prevented by the establishment of unified discharge standards. The impact of pre-existing conditions on the treatment in elderly patients undergoing hemiarthroplasty has been previously elucidated [20]. The results have indicated that the severity of pre-existing conditions is closely correlated with the therapeutic outcome. Therefore, pre-existing health conditions could increase the risk of poor prognosis and postoperative complications in patients. Furthermore, a previous study suggested that malnutrition and anemia could induce postoperative complications such as infection and dislocation after hemiarthroplasty [21]. Adequate nutrition and haemoglobin level are essential during postoperative recovery, which should be considered when unified discharge standards are established. In addition, appropriate weight-bearing exercises in elderly patients could also prevent postoperative complications [22, 23].

Additionally, the three-month readmission rate and one-year mortality rate were significantly lower in the observation group. In consistence with our findings, a previous study has revealed that some elderly patients experience postoperative delirium, which significantly affects the prognosis and could be life-threatening [24]. Interventions based on weight-bearing exercises and mental health in patients should be considered during the establishment of unified discharge standards, which could influence the therapeutic outcome and readmission/mortality rate in clinical practice.

Unified discharge standards should be established base on effectiveness, unity and operability. On the other hand, prolonging the length of hospitalization time may also has certain benefits for elderly patients. It is also a direction of prospective research to establish family-oriented wards for elderly patients, provide some strategic support during perioperative period and moderately extend hospital stay. Taken all together, in elderly patients undergoing artificial femoral head replacement, the occurrence of postoperative complications and readmission/mortality rate were reduced by unified discharge standards, which could provide guidance to future clinical practice. However, the prospective and multi-center study needs to be further improved. This study highlighted the importance of unified discharge standards in elderly patients underwent artificial femoral head replacement, and our findings shed lights on future clinical research.

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Our protocol was approved by the Ethics Committee of Xijing Hospital, The Air Force Military Medical University (KY20222154-C-1). Written informed consents were signed by all patients.

### Disclosure of conflict of interest

None.

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### References

- [1] Ramponi DR, Kaufmann J and Drahnak G. Hip fractures. *Adv Emerg Nurs J* 2018; 4: 8-15.
- [2] Ochs M. Surgical management of the hip in the elderly patient. *Clin Geriatr Med* 1990; 6: 571-587.
- [3] Alexiou KI, Roushias A, Varitimidis SE and Malizos KN. Quality of life and psychological consequences in elderly patients after a hip fracture: a review. *Clin Interv Aging* 2018; 13: 143-150.

## Unified discharge standards in hemiarthroplasty in the elderly

- [4] Wijnen HH, Schmitz PP, Es-Safraouy H, Roovers LA, Taekema DG and Van Susante JLC. Non-operative management of hip fractures in very frail elderly patients may lead to a predictable short survival as part of advance care planning. *Acta Orthop* 2021; 92: 728-732.
- [5] Hu C and Yoon T. Recent updates for biomaterials used in total hip arthroplasty. *Biomater Res* 2018; 22: 33.
- [6] Abdelkhalik M, Abdelwahab M and Ali A. Bipolar versus fixed-head hip arthroplasty for femoral neck fractures in elderly patients. *Strategies Trauma Limb Reconstr* 2011; 6: 1-6.
- [7] Chen C, Yin Y, Liu J and Chen G. The direct anterior approach for simultaneous bilateral total hip arthroplasty: a short-term efficacy analysis. *Arthroplasty* 2020; 2: 21.
- [8] Walker J. Care of patients undergoing joint replacement. *Nurs Older People* 2012; 24: 14-20.
- [9] Huo MH, Salvati EA, Sharrock NE, Brien WW, Sculco TP, Pellicci PM, Mineo R and Go G. Intraoperative heparin thromboembolic prophylaxis in primary total hip arthroplasty. A prospective, randomized, controlled, clinical trial. *Clin Orthop Relat Res* 1992; 274: 35-46.
- [10] Mula V, Parikh S, Suresh S, Bottle A, Loeffler M and Alam M. Venous thromboembolism rates after hip and knee arthroplasty and hip fractures. *BMC Musculoskelet Disord* 2020; 21: 95.
- [11] Zhang LZ, Gao J, Zhang ZC, Wang XW, Zhang JZ and Sun TS. Comparison of clinical effects of total artificial hip replacement and cannulated screw fixation for the treatment of displaced femoral neck fractures in elderly patients. *Zhongguo Gu Shang* 2018; 31: 103-110.
- [12] Lin X, Xu T, Wu B, Hu B and Qin M. Correlation of GSTM1 gene deletion in joint synovial fluid with the recovery of patients undergoing artificial hip replacement. *Exp Ther Med* 2018; 16: 3821-3826.
- [13] Du Z, Tang S, Yang R, Tang X, Ji T and Guo W. Use of an artificial ligament decreases hip dislocation and improves limb function after total femoral prosthetic replacement following femoral tumor resection. *J Arthroplasty* 2018; 33: 1507-1514.
- [14] Borjali A, Chen AF, Muratoglu OK, Morid MA and Varadarajan KM. Detecting total hip replacement prosthesis design on plain radiographs using deep convolutional neural network. *J Orthop Res* 2020; 38: 1465-1471.
- [15] Crego-Vita D, Sanchez-Perez C, Gomez-Rico JA and de Arriba CC. Intracapsular hip fractures in the elderly. Do we know what is important? *Injury* 2017; 48: 695-700.
- [16] Shoenfeld N, Stuchin S, Pearl R and Haveson S. The management of vascular injuries associated with total hip arthroplasty. *J Vasc Surg* 1990; 11: 549-555.
- [17] Maillot C, Auvinet E, Harman C, Cobb J and Rivière C. Hip resurfacing generates a more physiological gait than total hip replacement: a case-control study. *Orthop Traumatol Surg Res* 2020; 106: 527-534.
- [18] Merola M and Affatato S. Materials for hip prostheses: a review of wear and loading considerations. *Materials (Basel)* 2019; 12: 495.
- [19] Krastanova M, Ilieva E and Vacheva D. Rehabilitation of patients with hip joint arthroplasty. *Folia Med (Plovdiv)* 2017; 59: 217-221.
- [20] Amarilla-Donoso FJ, López-Espuela F, Roncero-Martín R, Leal-Hernandez O, Puerto-Parejo LM, Aliaga-Vera I, Toribio-Felipe R and Lavado-García JM. Quality of life in elderly people after a hip fracture: a prospective study. *Health Qual Life Outcomes* 2020; 18: 71.
- [21] Burgess L, Phillips S and Wainwright T. What is the role of nutritional supplements in support of total hip replacement and total knee replacement surgeries? A systematic review. *Nutrients* 2018; 10: 820.
- [22] Monticone M, Ambrosini E, Rocca B, Lorenzon C, Ferrante S and Zatti G. Task-oriented exercises and early full weight-bearing contribute to improving disability after total hip replacement: a randomized controlled trial. *Clin Rehabil* 2014; 28: 658-68.
- [23] Minns Lowe CJ, Barker KL, Dewey ME and Sackley CM. Effectiveness of physiotherapy exercise following hip arthroplasty for osteoarthritis: a systematic review of clinical trials. *BMC Musculoskelet Disord* 2009; 10: 98.
- [24] Zeng H, Li Z, He J and Fu W. Dexmedetomidine for the prevention of postoperative delirium in elderly patients undergoing noncardiac surgery: a meta-analysis of randomized controlled trials. *PLoS One* 2019; 14: e0218088.