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A Retrospective Study to Compare the Efficacy and Postoperative Outcome of Total Hip Arthroplasty with Internal Screw Fixation in Patients with Avascular Necrosis of the Femoral Head

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Background: This retrospective study compared the effects of total hip arthroplasty (THA) and traditional surgery using internal screw fixation for the treatment of avascular necrosis (AVN) of the femoral head.

Material/Methods: Two hundred and seventy patients with bilateral AVN of the femoral head were admitted for elective surgery, and 176 patients underwent THA (the THA group), and 94 patients underwent closed reduction screw fixation (the traditional surgery group). The Harris hip score (HHS) was used pre-operatively and to evaluate postoperative outcome.

Results: The mean operation time in the traditional surgery group (82.6±15.6 min) was significantly less compared with the THA group (104.8±14.2 min) (P=0.001). Intraoperative blood loss in the traditional surgery group (219.8±21.6 mL) was significantly less compared with the THA group (339.4±29.4 mL) (P=0.001). After treatment, the mean HHS score of the THA group (76.5±9.2 points) was significantly increased when compared with the traditional surgery group (61.4±10.5 points) (P=0.001). Disease recurrence rate in the THA group was significantly reduced compared with the traditional surgery group (P=0.001). The mean quality of life score of the THA group (85.5±6.4 points) was significantly higher than that of the traditional surgery group (73.4±8.8 points) (P=0.001).

Conclusions: Compared with closed reduction screw fixation, THA for AVN of the femoral head effectively reduced the length of hospital stay, time to recovery, and achieved an improved clinical outcome.

MeSH Keywords: **Diabetes Complications • Pregnancy Complications, Parasitic • Simaroubaceae**

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Background

Avascular necrosis (AVN) of the femoral head is a common condition in orthopedic practice. Long-term reduced blood flow to the femoral head results in AVN, which more commonly affects middle-aged and elderly people [1]. According to Graham et al. [2], worldwide, in 2017, 425,000 patients were newly diagnosed with AVN of the femoral head, and the reported incidence in developed countries was significantly higher than in developing countries. Porubský et al. also reported that the prevalence of AVN of the femoral head was increasing annually with a progressively younger trend [3]. Andriolo et al. predicted that AVN of the femoral head would become a condition affecting people of all ages worldwide by 2040 [4].

The early manifestations of AVN of the femoral head include joint pain and stiffness. These symptoms are often neglected by patients, resulting in delayed treatment. According to Pouya et al. [5], approximately 72.3% of patients with AVN of the femoral head have early clinical symptoms but do not seek timely medical diagnosis and treatment, resulting in clinical deterioration as bone destruction may occur rapidly, and delay in surgery can limit functional improvement.

Before the 20th century, due to the limitations in surgical management, the treatment of AVN of the femoral head was difficult and prolonged, and the prognosis was unsatisfactory, and in advanced cases, amputation surgery was required to prevent further deterioration [6]. With the rapid development of medical technology, total hip arthroplasty (THA) has been widely used and is now recognized as the best treatment for patients with AVN of the femoral head [7]. However, recent studies have mainly focused on the clinical efficacy of THA, while its long-term effects have rarely been studied.

Therefore, the aims of this study were to compare the effects of THA with traditional surgery using internal screw fixation for the treatment of AVN of the femoral head and to compare the long-term results. In this study, the Harris hip score (HHS) and quality of life score were used to evaluate all patients before surgery and to evaluate the postoperative outcome.

Material and Methods

Patients studied

A total of 270 patients with bilateral avascular necrosis (AVN) of the femoral head were admitted to the Affiliated Hospital of Xuzhou Medical University from February 2016 to January 2017 and were studied retrospectively. There were 176 patients who underwent total hip arthroplasty (the THA group); the remaining 94 patients underwent closed reduction screw fixation (the

traditional surgery group). The THA group included 114 male and 62 female patients aged 40–60 years (mean, 49.73±8.64 years). The traditional surgery group included 61 male and 33 female patients aged 40–60 years (mean, 50.27±8.04 years).

Inclusion and exclusion criteria

All patients included in this study were diagnosed with bilateral AVN of the femoral head by X-ray examination at our hospital, according to previously reported guidelines [8]. All patients required surgical treatment and had planned elective surgery. Following surgery, X-ray examination was performed to evaluate the femoral head. The patients in the THA group underwent THA, while those in the traditional surgery group underwent closed reduction screw fixation. All patients had good compliance with the study and had complete medical records.

Exclusion criteria included cardiovascular and cerebrovascular disease, respiratory and gastrointestinal disease, lack of tolerance to surgery, physical disability, pregnancy, a referral from other hospitals, patients who were bedridden, and patients receiving treatment with other drugs or devices. The study design was approved by the local Ethical Committee of the Affiliated Hospital of Xuzhou Medical University (dated 2015.11.12). All patients included in the study provided written informed consent.

Surgical methods

After receiving the diagnosis of AVN of the femoral head, patients in the THA group underwent THA in accordance with current surgical guidelines [9]. Following surgery, the patients received antibiotics for three days. The surgical site drainage tube was removed within 48 hours. Rehabilitation began three days following surgery.

Patients in the traditional surgery group underwent closed reduction and internal fixation with Herbert screws [10]. Surgery was performed by the same surgeon for all patients. Following surgery, the patients received antibiotics for three days. The surgical site drainage tube was removed within 48 hours. Rehabilitation began three days following surgery.

The duration of surgery, the volume of intraoperative blood loss, volume of postoperative drainage, length of hospital stay, inpatient costs from admission to discharge, the occurrence of postoperative venous thrombosis and other postoperative complications in the two groups were recorded and compared.

The Harris hip score (HHS)

The Harris hip score (HHS) (out of 100) was used to assess patients before surgery and was used to evaluate postoperative

Table 1. Harris score.

Classification	Performance	Score
Pain situation	No pain	44
	Feeling weak pain, no effect on normal function	40
	Can be normal activities, activities associated with more obvious pain	30
	Obvious pain, limited activity	20
	Severe pain, unable to move	10
Gait	Normal	11
	A little limp	8
	Medium limp	5
	Severe limp	0
Daily activities	Daily activities	14
	Slow activity	8
	Need help	3
	Unable to move	0
Range of activities	Not limited	11
	5 blocks or more	8
	2~5 blocks	5
	Indoor only	2
	Bed or wheelchair	0
Deformity	Normally available 4 points	4
	Fixed flexion contracture deformity less than 30°-1	
	Fixed adduction deformity less than 10°-1	
	Fixed extension adduction deformity less than 10°-1	
	Short limbs less than 3.2 cm-1	

outcome, and included pain severity (0–44 points), function (0–47 points), range of motion (0–5 points), and absence of deformity (0–4 points). The HHS after one day and seven days of rehabilitation were recorded for the two patient groups (Table 1). Prognosis and quality of life score surveys, including joint status, recurrence, pain, activity, quality of life, and emotional function, were performed for all patients at two years after discharge [11]. The mean HHS scores were calculated, and the differences were analyzed and compared between the two groups.

Statistical analysis

Statistical analysis was performed using SPSS version 22.0 (IBM, Chicago, IL, USA). Clinical information, complications, including venous thrombosis, were presented as the rates. A chi-squared (χ^2) test was used to compare the groups. Duration of surgery, intraoperative blood loss, postoperative drainage volume, length of stay, HHS, and quality of life scores for patients in both groups were presented as the mean \pm standard deviation (SD). The t-test was used to compare the groups. A P-value <0.05 was considered to be statistically significant.

Results

Patient demographics and clinical information

Patient clinical demographic information was compared between the two groups, including age, gender, disease course, residence, smoking habits, type of avascular necrosis (AVN), and clinicopathological changes. No significant difference was found in the demographic and clinical information between the two groups ($P>0.05$), indicating that the two groups were comparable (Table 2).

Short-term outcome

The mean duration of surgery of the traditional surgery group (82.6 ± 15.6 min) was significantly less than that of the THA group (104.8 ± 14.2 min) ($P=0.001$). Intraoperative blood loss in the traditional surgery group (219.8 ± 21.6 mL) was significantly less than that of the THA group (339.4 ± 29.4 mL) ($P=0.001$), indicating that surgical trauma of traditional surgery group was less than that of the THA group. However, the length of hospital stay in the THA group (17.6 ± 4.8 d) was significantly less than that of traditional surgery group (24.2 ± 4.2 d) ($P=0.001$). The mean postoperative drainage volume of the THA group (124.8 ± 18.2 mL) was also significantly less than that of traditional surgery group (154.6 ± 15.7 mL) ($P=0.001$).

In the THA group, venous thrombosis occurred in 1.7% (3/176) of patients, subcutaneous hemorrhage occurred in 1.1% (2/176) of patients, wound infection occurred in 2.3% (4/176) of patients, and gastrointestinal bleeding occurred in 1.1% (2/176) of patients. The complications in the THA group were significantly less severe than those in the traditional surgery group ($P<0.05$). There was no significant intergroup difference between the pre-operative Harris hip score (HHS) (out of 100) ($P>0.05$). Postoperatively, the mean HHS of the THA group (76.5 ± 9.2 points) was significantly higher than that of traditional surgery group (61.4 ± 10.5 points) ($P=0.001$). The hospitalization cost for the THA group was (58842.69 ± 12644.58 yuan), which was significantly higher than that of traditional surgery group (27614.75 ± 8741.68 yuan) ($P<0.001$) (Tables 3, 4).

Table 2. Comparison of clinical information between the two groups of patients [n (%)].

	THA group (n=176)	Traditional group (n=94)	χ^2 (t)/P
Age			0.46/0.643
	49.73±8.64	50.27±8.04	
Gender			0.001/0.984
Male	114 (64.8)	61 (64.9)	
Female	62 (35.2)	33 (35.1)	
Course of disease (years)	5.16±2.17	5.29±1.94	0.49/0.627
Marital status			0.78/0.376
Married	158 (89.8)	81 (86.2)	
Unmarried	18 (10.2)	13 (13.8)	
Residence			0.33/0.568
Downtown	108 (61.4)	61 (64.9)	
Countryside	68 (38.6)	33 (35.1)	
Smoking habits			0.44/0.508
Yes	123 (69.9)	62 (66.0)	
No	53 (30.1)	32 (34.0)	
Necrosis type			0.38/0.829
Alcoholic lesions	64 (36.4)	36 (38.3)	
Hormone lesions	57 (32.4)	32 (34.0)	
Traumatic lesions	55 (31.3)	26 (27.7)	
Pathological staging			0.09/0.761
I~II	42 (23.9)	24 (25.5)	
III~IV	134 (76.1)	70 (74.5)	
Hospitalization cost (RMB)	58842.69±12644.58	27614.75±8741.68	23.36/0.001

Table 3. Comparison of efficacy between the two groups of patients.

	THA group (n=176)	Traditional group (n=94)	χ^2 (t)/P
Operation time (min)	104.8±14.2	82.6±15.6	11.82/0.001
Intraoperative bleeding (ml)	339.4±29.4	219.8±21.6	34.74/0.001
Hospitalization time (d)	17.6±4.8	24.2±4.2	11.00/0.001
Drainage (ml)	124.8±18.2	154.6±15.7	13.43/0.001
Venous thrombosis (%)	1.7	25.5	38.65/0.001
Subcutaneous bleeding (%)	1.1	27.7	46.37/0.001
Wound infection (%)	2.3	17.0	19.43/0.001
Gastrointestinal bleeding (%)	1.1	14.9	15.69/0.001

Table 4. Harris scores in the two groups.

	THA group (n=176)	Traditional group (n=94)	t/P
Before treatment	42.6±5.8	41.7±6.4	1.17/0.243
After treatment	76.5±9.2	61.4±10.5	12.22/0.001

Table 5. Quality of life scores in the two groups.

	THA group (n=168)	Traditional group (n=84)	t (χ ²)/P
Disease recurrence (%)	2.3	20.2	25.31/0.001
Joint status	83.6±8.5	72.2±9.6	18.03/0.001
Recurrence	86.5±5.6	74.1±6.0	16.18/0.001
feeling of pain	82.1±7.1	70.5±8.7	11.32/0.001
Activities	90.1±5.3	79.8±11.5	9.74/0.001
Quality of Life	85.1±5.5	72.6±8.1	14.44/0.001
Mood	85.5±6.4	71.2±8.8	14.69/0.001
The average score	85.5±6.4	73.4±8.8	12.43/0.001

Long-term outcome

Postoperative follow-up was successfully completed for 252 of 270 patients, including 168 in the THA group and 84 in the traditional surgery group. Disease recurrence occurred in 2.3% (4/176) of patients in the THA group and 20.2% (19/94 cases) of patients in the traditional surgery group. The mean quality of life score (85.5±6.4 points) of the THA group was significantly higher than that of traditional surgery group (73.4±8.8 points) (P=0.001). Sub-item scores of the THA group were also significantly higher than those of traditional surgery group (P>0.05). The intergroup difference in the joint status score was most significant between in the THA group (83.6±8.5 points) compared with the traditional surgery group (72.2±9.6 points) (P=0.001) (Table 5).

Discussion

Avascular necrosis (AVN) of the femoral head is a common orthopedic disease in clinical practice. There are several predisposing factors for AVN of the femoral head, including chronic alcoholism, long-term antibiotic use, rheumatic arthritis, and fractures [12,13]. At the onset of AVN of the femoral head, patients may have joint dysfunction. However, if the conditions progress slowly, normal walking, squatting, and other functions may be directly affected. Successful surgical treatment results in rapid functional improvement, allowing patients to mobilize fully, resulting in improved quality of life [14,15].

The clinical treatment of AVN of the femoral head mainly aims to relieve pain. For patients with early AVN of the femoral head, drug treatment may be combined with electroacupuncture, which can achieve good therapeutic outcome [16,17]. However, the symptoms of AVN of the femoral head are often misinterpreted as those of osteoarthritis by patients, resulting in a delay in treatment. Many patients have moderate to advanced AVN of the femoral head at the time of diagnosis when surgical treatment must be adapted to achieve the best outcome [18]. In traditional reduction screw fixation, which has been regarded as the best surgical treatment for AVN of the femoral head, the necrotic part of the femoral head is removed during surgery [19,20]. However, this approach not only creates significant trauma but is also associated with a high incidence of recurrence due to the presence of residual necrotic tissue.

Before the 20th century, there was limited development or availability of materials that could adequately replace human bone, and so joint replacement surgery was a difficult procedure, particularly the avoidance of nerve damage during surgery [21,22]. Recent developments in medical devices and improved surgical techniques for THA have resulted in THA being the surgical treatment of choice for patients with advanced AVN of the femoral head [23]. However, there have been few previously reported clinical studies that have compared traditional reduction screw fixation with THA for the treatment of AVN of the femoral head, and follow-up of the results of long-term postoperative outcome have rarely been compared. Therefore, this study compared the short-term and long-term

results of traditional reduction screw fixation versus THA for the treatment of AVN of the femoral head in a single center to provide information regarding THA in patients with AVN of the femoral head.

In this study, patients with AVN of the femoral head were screened in accordance with the study inclusion and exclusion criteria, and statistical analysis showed comparability between the two patient study groups. The results showed that THA not only significantly shortened the length of hospital stay, but it also reduced the time to recovery of normal activities. The use of the Harris hip score (HHS) and quality of life score, before and after surgery in both study groups, showed that both the short-term and long-term outcome of THA were significantly better than those of traditional reduction screw fixation. THA not only significantly reduced the risk of recurrence, but it also maintained a good quality of life for patients after surgery. These findings were supported by those reported by Yang et al. [24].

An important postoperative complication of the surgical use of THA is postoperative bone collapse. With the development of surgical and anesthesia techniques and the accumulation of surgical experience, the incidence of complications following THA has been significantly reduced. In the present study, only four patients in the THA group developed complications, indicating that the THA technique was effective and safe, and the selection of the surgical method resulted in the intergroup difference in patient prognosis. Although reduction screw fixation was superior to THA in term of reduced duration of surgery and reduced intraoperative blood loss, reduction screw fixation was associated with an increased incidence of recurrence due to incomplete removal of the necrotic tissue. Although THA requires a large incision, its use can completely replace the necrotic tissue in AVN. With the recent rapid development of in the technology of joint replacement prostheses, a good postoperative outcome with good joint stability can be achieved in most cases [25]. THA prevents secondary joint erosion after prosthesis implantation, reduces the risk of repeat surgery, and improves patient outcome. Also, replacement of the necrotic femur in THA effectively resolves joint pain, leading to postoperative improvement in patient mobility and quality of life, which may explain why the mean long-term quality of life score of the THA group was higher than that of the traditional group in the present study.

The findings of the present study also showed that the cost of hospitalization in the traditional surgery group was significantly lower than that in the TAH group, mainly because of the cost of purchasing the TAH joint prosthesis. In this study, imported prosthetic materials were chosen that were of good quality but higher cost. In future clinical practice, it may be possible to choose less costly joint prostheses.

Ravikumar et al. [26] reported that patient outcome following THA was significantly better than traditional surgery to preserve the femoral head in patients with AVN of the femoral head. Compared with this study, Ravikumar et al., who published the results of their study in 2000, had the advantage of accumulating 13 years of case data, with more comprehensive statistical analysis. However, in the present study, not only were the latest and best prosthetic materials used but after about 20 years of technological development, the current THA technology was likely to be significantly improved when compared with that in 2000. Also, in this study, the patients were followed up for two years, which not only compared the short-term efficacy of THA but also reflected the prognostic impact of THA technology.

Further long-term follow-up of the subjects included in this study is planned to obtain further outcome data. This study was limited by the possible bias introduced in study conducted in a single center and the small number of subjects in this study. Further multicentre studies should be undertaken to included increased numbers of subjects for data analysis.

Conclusions

The findings from a retrospective study showed that compared with traditional reduction screw fixation, total hip arthroplasty (THA) effectively reduced the length of hospital stay and time to recovery for patients with avascular necrosis (AVN) of the femoral head, achieved better improvement in postoperative symptoms and quality of life, and resulted in significantly improved long-term outcome. The findings of this study support that THA should be considered in the patient population requiring surgical management of AVN of the femoral head.

Conflict of interest

None.

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