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Original Article

Noteworthy complication rate following conversion total hip arthroplasty after the fixation of proximal femoral nail antirotation-Asia for intertrochanteric femur fractures

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Abstract: Objective: In recent years, proximal femoral nail antirotation-Asia (PFNA-II) and dynamic hip screw (DHS) have become an increasingly popular treatment for intertrochanteric femur fractures (IFF). Conversion total hip arthroplasty (CTHA) is often used to treat failed internal fixation (DHS or PFNA-II) of IFF. The purpose of this study is to evaluate the complication rates and clinical results of CTHA devices after treatment for IFF with prior DHS or PFNA-II and to determine which device (DHS or PFNA-II) is more suitable for CTHA. Methods: From March 2007 to August 2015, 120 patients with DHS devices and 70 patients with PFNA-II devices converted into CTHAs and evaluated at our institution. There were 190 patients (190 hips). Primary outcome was clinical outcome as defined by the Harris Hip Score (HHS), collected pre- and post-operatively at 2 months, 12 months, 24 months and last follow-up. Secondary outcome was the incidence and distribution of complications. Results: HHS improved from 47.47 ± 2.10 preoperatively to 87.28 ± 1.88 at last follow-up in group DHS and from 46.84 ± 3.13 to 86.97 ± 1.96 in group PFNA-II, with no remarkable difference between the both groups ($P > 0.05$). However, the complication rate in converted PFNA-II patients was significantly higher at 32.9% than that in converted DHS patients (10.8%, $P = 0.000$). Conclusion: Previous fixation with PFNA-II may be associated with significantly higher complication rates during conversion.

Keywords: Intertrochanteric femur fracture, total hip arthroplasty, complications, proximal femoral nail, dynamic hip screws

Introduction

Intertrochanteric femur fractures (IFF) after low-energy trauma is common in the elderly people. Associated with the aging population in China, hip fractures have been dramatically increasing. The incidence of IFF is approximately 50% of hip fractures [1, 2].

Due to the high failure rate and intra- and post-operative complications associated with internal fixation, PFNA-II or DHS has been recommended by most orthopedists as primary treatment for IFF [3]. The incidence of failure of this type of fixation is up to 5%, mostly depending on fracture severity and patient age [4]. Some studies comparing PFNA-II with DHS have been conducted [5, 6]. However, consensus of results has been lacking, and there has yet to be studies that show which one has clinical superiority with regard to fracture union. Some authors concluded that no difference between nonunion rates between Group PFNA-II and Group DHS [7-9]. However, in Group DHS, there were fewer intra- and post-operative fractures, lower technical complications and fewer reoperations. PFNA-II has been shown to have improved surgical outcomes for IFF, but there were no conclusive randomized clinical studies showing this.

Despite nonunion rate of IFF treatment is low, functional outcomes are often poor and approximately half of the patients treated for IFF do not regain their prefracture level of mobility. High reoperation rates have been reported after PFNA-II or DHS fixation [10, 11]. However, it has also shown that CTHA is a more techni-

Table 1. Preoperative patient characteristics in both groups

Variable	DHS (n = 120)	PFNA-II (n = 70)	*P* Value
Age (years)	68.57±10.85	70.07±11.76	0.37
Sex (M:F)	52:68	37:33	0.20
Femoral fixation (number)			0.88
Cemented	56 (46.7%)	34 (48.6%)	
Cementless	64 (53.3%)	36 (51.4%)	
Length of follow-up (months)	30.63 ± 4.37	31.67 ± 5.24	0.16

cally complex procedure than PFNA-II or DHS. Though there have been various reports of successful clinical outcomes after the use of CTHA, clinical outcomes of CTHA can also be associated with a higher rate of intra- and post-operative complications [12, 13]. During CTHA, orthopaedic surgeons may encounter universal problems, including infection, dislocation, poor bone quality, bone defects, fracture, component wear, broken hardware, soft tissue deficiency, etc. Postoperative complications are also common, with reported rates of dislocation of greater than 22.5% [14] and periprosthetic fracture of greater than 30% [15]. As CTHA has become increasingly common, it will be very important to continue monitoring clinical outcomes of CTHA and improving treatment strategies of failed internal fixation (DHS or PFNA-II) of IFF to reduce complications for these patients. Most previous studies evaluating CTHA have examined conversion of DHS to THA [16, 17]. However, reports on conversion of failed PFNA-II patients to THA have been limited.

The purpose of this study is to evaluate the complication rates and clinical results of CTHA devices after treatment for IFF with prior DHS or PFNA-II and to determine which device (DHS or PFNA-II) is more suitable for CTHA.

Materials and methods

This is a retrospective review study. Institutional Review Board approval was obtained for this study. From March 2007 to August 2015, there were 190 patients (190 hips) who underwent CTHAs following treatment of IFF with DHS or PFNA-II devices at our institution. In this study, 120 patients with prior DHS devices and 70 with prior PFNA-II devices were converted into CTHAs and evaluated. Patient characteristics were expressed as means with SDs and frequencies and percentages. Primary outcome was clinical outcome as defined by the HHS, collected pre- and post-operatively at 2 months, 12 months, 24 months and last follow-up. Secondary outcome was the incidence and distribution of complications.

Surgical methods

All patients were treated with CTHAs by the same surgeons after failed treatment (PFNA-II or DHS fixation) of IFF. All operations were performed under general anesthesia. Posterolateral and anterolateral surgical approaches were used for the CTHA procedures. All patients received the fixation of uncemented acetabular component. 100 of 190 (52.6%) underwent uncemented femoral components. 90 (47.4%) received cemented femoral fixation at conversion. No significant difference existed between patients in the DHS and PFNA-II groups who received cemented femoral fixation (P = 0.88). All patients received clinical evaluation of the HHS. All complications of intra- and post-operation were recorded.

Categorical variables were expressed as count and percentage, and the Chi-square test was utilized to test the distribution difference between both groups. Continuous numeric variables were expressed as mean and SD and Wilcoxon test was utilized to compare population location parameters between both groups. Statistical analyses were performed with use of SPSS software (Version 22.0, IBM Inc). A *p* value of < 0.05 was considered to be significant for all statistical tests.

Results

Eighty-eight male patients and 102 female patients were evaluated in this study. Group DHS had 52 (43.3%) men and 68 (56.7%) women. Group PFNA-II had 37 (52.9%) men and 33 (47.1%) woman. No significant difference in gender existed in the DHS or PFNA-II groups (P = 0.20). The average age at CTHA procedure was 68.57 years old (range, 50-88 years, SD 10.85) in Group DHS and 70.07 years old (range, 50-90 years, SD 11.76) in Group PFNA-II (P = 0.37) (**Table 1**).

Harris hip scores

Both groups demonstrated improved HHS from pre-operation to the last follow-up at an aver-

Table 2. Study measurements between the 2 groups for Harris hip score for the 72 hours pre-operatively, 2 months postoperatively, 12 months postoperatively, 24 months postoperatively, 2 months postoperatively, and last follow-up

	DHS group	PFNA-II	p
72 hours Pre-operatively	47.47 ± 2.10	46.84 ±3.13	0.10
2 Months Postoperatively	79.41 ± 2.48	78.80 ± 2.69	0.61
12 Months Postoperatively	85.40 ± 2.39	85.40 ± 2.39	0.57
24 Months Postoperatively	87.03 ± 2.43	86.21 ± 3.27	0.07
Last follow-up	87.28 ± 1.88	86.97 ± 1.96	0.28

age of 37 and 35 months for the PFNA-II and DHS groups, respectively. Group PFNA-II improved from 46.84 ± 3.13 to 86.97 ± 1.96, and Group DHS from 47.47 ± 2.10 to 87.28 ± 1.88. No significant difference existed in HHS at last follow-up between the two groups ($P > 0.05$) (**Table 2**). Nevertheless, there was a statistically significant in score comparing pre- and post-operative conditions ($P < 0.01$).

Complications

Orthopedic and non-orthopedic complications occurred in both the DHS group and PFNA-II group. The complication rate in Group DHS was 10.8% (13/120 patients affected) in comparison with 32.9% (23/70 patients affected) in Group PFNA-II. Sixteen complications in 13 patients were observed in the DHS group. These included post- and intra-operative periprosthetic and trochanteric fractures, Brooker class 6 Heterotopic ossification, intraoperative nerve injury, early deep infection, and atrial fibrillation (**Table 3**).

In the PFNA-II group, complications were significantly higher at a rate of 32.9% ($P = 0.000$). Twenty-five complications in 23 patients existed in this group. Complications included intra- and post-operative periprosthetic and trochanteric fractures, abductor muscle deficiency, dislocation, intraoperative nerve injury, heterotopic ossification, late deep infection requiring removal of hardware, pulmonary embolism, atrial fibrillation and acute renal failure. The complications of medicine and orthopaedics were assessed in both groups. There were no cases of aseptic loosening. A 22.9% (16/70 patients affected) orthopedic complication rate in Group PFNA-II existed as compared with an 8.3% (10/120 patients affected) orthopedic complication rate in Group DHS ($P = 0.005$). No significant difference existed in medical complications in both groups ($P = 0.102$) with 6/120 (5.0%) patients affected in Group DHS and 8/70 (11.4%) patients affected in Group PFNA-II.

Discussion

The importance of CTHA after treatment for IFF with prior DHS or PFNA-II has become evident in recent years in China. Our initial understanding is that patients receiving CTHA after the fixation of DHS or PFNA-II for IFF have a lower complication rate and a good clinical result. Nevertheless, with complication rates reported to be 11.1%-54% [18-20], CTHA should be considered a non-routine arthroplasty procedure. The purpose of this paper is to evaluate the complication rates and clinical results of CTHA devices after treatment for IFF with prior DHS or PFNA-II and to be clear which device (DHS or PFNA-II) is more suitable for CTHA. A significantly higher complication rate was observed in Group PFNA-II of 32.9% versus 10.8% in Group DHS. The higher-than-expected complication rate following conversion of a DHS or PFNA-II should cause enough attention.

Group PFNA-II has multiple factors resulting in higher orthopaedic complication (fracture, dislocation, abductor tendon deficiency, heterotopic ossification, intraoperative nerve injury) in comparison to Group DHS [15]. An osteoporotic lateralwall, a large-bore reamer, and incomplete reduction contribute to produce this fracture. Posterior sags in some IFF with prior PFNA-II treated with CTHA (uncemented or cemented femoral components) can lead to the possibility of lateral wall fractures. Without the guide pin or nail for PFNA-II collinear with the shaft of the femur and the femoral neck, uncemented femoral components of CTHA are easier to produce femoral shaft fractures and dislocation compared with cemented femoral components. As demonstrated by recent biomechanical testing [1], patients treated with PFNA-II can have poor bone quality compared with patients treated with DHS, and the part reasons might be the destruction of the femoral marrow cavity and the disusatrophy of proximal femoral part.

Prior treatment with PFNA-II compared with DHS can obviously result in damage to the

Table 3. The main results of the research

	DHS (n = 120)	PFNA-II (n = 70)	*P* Value
Perioperative complications	16	25	
Patients affected	13 (10.8%)	23 (32.9%)	0.000
Medical complications	6	9	
Patients affected	6 (5.0%)	8 (11.4%)	0.102
Periprosthetic infection	2	2	
Urinary tract infection	2	2	
Pulmonary embolism		2	
Atrial fibrillation	2	2	
Acute renal failure		1	
Orthopaedic complications	10	16	
Patient affected	10 (8.3%)	16 (22.9%)	0.005
Fracture	7	5	
Dislocation		4	
Abductor tendon deficiency		2	
Heterotopic ossification	2	4	
Intraoperative nerve injury	1	1	
Aseptic loosening			

abductor mechanism due to most minimally invasive incisions. The nail is inserted at the tip of the greater trochanter (the area of insertion of the abductor tendon) [21]. Also, the greater diameter of PFNA-II can damage the abductor mechanism. Perez et al. [22] demonstrated damage to approximately 25% of the gluteus medius tendon after reaming for a PFNA-II device in 10 cadaveric specimens. Damage to the abductor tendon at the time of insertion and by the time of extraction may result in new or further damage. Abductor mechanism failure after CTHA can cause recurrent remarkable lateral pain and dislocations [21, 23].

Currently, few studies have concentrated on CTHA after failed PFNA-II fixation of IFF in the English literature. There are several reports of CTHA after failed internal fixation of IFF. Pui et al. [21] performed a multi-institutional study in which 60 patients with SHS devices and 31 patients with CMN devices were converted to CTHAs, and reported the complication rate in converted CMN patients was 41.9%. Hammad et al. [24] reported 32 patients receiving THA after failed DHS fixation and found only one periprosthetic fracture and one dislocation, and demonstrated a 2/32 (6.2%) complication rate. D'Arrigo et al. [25] demonstrated 21 conversion total or bipolar hip arthroplasties after failed treatment of IFF. Only one complication (a femoral fracture during preparation of the femoral canal) was observed. Zhang et al. [15] reviewed retrospectively 19 patients receiving the conversion of failed internal fixation of IFF to THA, demonstrated a 47% complication rate. There was a 32% rate of intraoperative fracture of the greater trochanter and 3 postoperative dislocations. Archibeck et al. [4] performed 102 CTHAs after failed internal fixation of a prior hip fracture, and demonstrated a 11.8% (12/102) complication rate, including 5 dislocations (4.9%), 4 periprosthetic fractures (4%), 2 hematomas, and 1 infection.

One weakness of this study relates to the fact that because conversion often happens several years after the initial treatment with PFNA-II or DHS, the initial fracture pattern had been recorded. Possibly, those fractures treated with PFNA-II become more complex such as the "unstable IFF" in comparison with those treated with DHS, which may have caused more malunions in the PFNA-II group, and thus making intra- and post-operative complications more randomized controlled cohort, which may have had inherent bias.

In conclusion, CTHA has been demonstrated to be viable method after failed internal fixation (DHS or PFNA-II) of IFF. However, in this study, a remarkable complication rate associated with conversion is observed in both groups. Furthermore, Group PFNA-II is associated with a higher complication rate compared with Group DHS. This finding may have the extremely vital clinical significance due to the increasing trend of treatment of IFF with PFNA-II devices. Therefore, orthopaedic surgeons performing the operations of CTHA after PFNA-II fixations of IFF can't ignore the risks associated with these procedures.

Disclosure of conflict of interest

None.

Abbreviations

PFNA-II, Proximal femoral nail antirotation-Asia; DHS, Dynamic hip screw; IFF, Intertrochanteric

femur fractures; CTHA, Conversion total hip arthroplasty; HHS, Harris hip score; SD, Standard Deviation.

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