

Comparative study on proximal femur locking plate and proximal femoral nail anti-rotation II in treating intertrochanteric fracture in the elderly.

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Abstract

Objective: To compare and analyse retrospectively the clinical effect of Proximal Femoral Nail Anti-Rotation II (PFNA-II) and Proximal Femur Locking Plate (PFLP) for the treatment of intertrochanteric fracture in the elderly.

Methods: A total of 161 elderly patients with intertrochanteric fracture, who underwent either PFNA or PFLP in our hospital from March 2012 to March 2013, were enrolled in the study. These patients were assigned into PFNP group and PFLP group. The perioperative bleeding, duration of the surgery, mean out-of-bed time after surgery, mean length of stay, complications, mean perioperative loss of hemoglobin, mean healing time of fracture and Harris scores of both groups were evaluated. The postoperative adverse reactions were compared.

Results: In comparison with PFLP group, the perioperative bleeding, duration of the surgery, mean length of stay, mean off-bed time after surgery, mean perioperative loss of hemoglobin and mean healing time of fracture were significantly lower in PFNA group, $P < 0.05$. However, the duration of fluoroscopy time and hip function between 2 groups were not significantly different, $P > 0.05$. And there were no significant differences in patient satisfaction, cutting of head and neck, incidence of incision infection, failure rate of internal fixation, and mortality in follow-up period between 2 groups, $P > 0.05$. In comparison with PFNA group, the greater trochanter pain of patients was significantly milder and the rate of loose screws was significantly lower in PFLP group, $P < 0.05$.

Conclusion: For the treatment of intertrochanteric fracture in the elderly, surgery methods should be selected appropriately based on the fracture type and degree of osteoporosis.

Keywords: Internal fixation, Proximal femoral nail anti-rotation, Intertrochanteric fracture, Proximal femur locking plate.

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Introduction

Intertrochanteric fracture refers to the fracture which occurs in the region between the proximal end of the neck of femur and horizontal part of lesser trochanter, and its fracture line can cross the region between greater and lesser trochanter, or run along intertrochanteric crest, but not through two trochanters usually [1]. With the acceleration of aging society, the incidence of osteoporosis are increasing, leading to intertrochanteric fracture caused by low power, and this kind of fracture becomes most common in the elderly, with a prevalence ratio between male and female is 1: 3 [2]. For intertrochanteric fracture, if the bone is normal, most internal fixations are useful, however, if the bone is osteoporotic, the best fixation method is still unknown [3]. Given this, study chooses two internal fixations used commonly to treat intertrochanteric fracture in the elderly. The purpose is to

determine the advantage and disadvantage of PFNA and PFLP, and to provide clinical references for the proper selection of internal fixation.

Materials and Methods

General information

A total of 161 elderly patients with intertrochanteric fracture, who underwent either PFNA or PFLP in our hospital from March 2012 to March 2013, were enrolled in the study. These patients were assigned into PFNA group and PFLP group. There were 82 patients in PFNA group, 27 male, 55 female, mean age 79.95 ± 3.41 years (60-97 years). According to AO classification, 18 patients were type A1, 53 patients were type A2, and 11 patients were type A3. In PFLP group, there were 79 patients, 19 male, 60 female, mean age 76.27 ± 5.12 years

(62-91 years). Based on AO classification, 17 patients were type A1, 41 patients were type A2, and 21 patients were type A3. In comparison with preoperative conditions of both groups, there were no significant differences, $P > 0.05$.

Inclusion criteria

Age ≥ 60 years old; PFNA or LPFP; fracture was due to trauma; according to AO classification, the classification of fracture was from A1:1 to A3:3; knee and hip movement were normal before injury.

Exclusion criteria

Age < 60 years old; fracture was caused by osteopathy or tumor; knee and hip had limited activity or malformation before surgery; severe complex injury.

Preoperative preparation

After admission, patients underwent correlated examinations, including blood biochemical test, coagulation function, complete blood count, Electrocardiogram (ECG), posteroanterior and lateral radiograph of hip joint, posteroanterior radiograph of chest, cardiac ultrasound, vascular ultrasonography of lower limbs and Computed Tomography (CT). Generally, the surgeries were performed on day 2 to day 7 after injury.

Surgical procedures

The patients received either general or epidural anesthesia. PFNA group: After onset of anesthesia, the patient was asked to lie on traction table supinely for fluoroscopy, and was monitored under C-arm X-ray. Then reduction of the fracture was performed. After successful reduction, a lateral incision with a size of 2~3 cm was made at 2 cm superior to the apex of greater trochanter, then the apex of greater trochanter was exposed by bluntly dissected gluteus medius. With the guidance of C-arm X-ray, a hole was made on the apex with hollow pointed cone, a guide pin was inserted, and then a hollow intramedullary drill was used to enlarge the medullary cavity along the pin. After enlarging the cavity, the main nail of PFNA was inserted along the pin. The reduction of fracture was confirmed with C-arm X-ray, and then the pin was driven into the neck of femur from the proximal locking hole with matching guider. Posteroanterior film of C-arm X-ray showed that the pin was 5~10 mm beneath the articular surface of femur, and the lateral film showed that it was located at middle of or partially posterior to the femur. Moreover, the distance between the pin tip and the apex of femur could be visible in posteroanterior and lateral film, namely Tip-Apex Distance (TAD), which was not over 20 mm. The drill was used to enlarge the medullary cavity along the pin again. According to the depth measured by guide pin, a helical blade of appropriate length was driven into the bone, and then tightened. Later, distal locking nail and screw cap were installed with the guidance of C-arm X-ray. The reduction of fracture was satisfactory according to posteroanterior and lateral

fluoroscopy. The wound was washed, sutured and dressed without postoperative drainage.

PFLP group: After onset of anesthesia, the patient was asked to lie on traction table supinely for fluoroscopy. The incision (5~7 cm) was stretched downward from the apex of greater trochanter. Slitting line was made in the posterior space of vastus lateralis, and then the vastus lateralis was cut off at the posterior 2/3 of the end of its trochanter and pulled forward to expose the fracture. The reduction of fracture was performed through traction. If the bone was splintered, Kirschner wires should be used firstly for temporary fixation. If there were crushed bones at longitudinal fracture line, lag screws should be used for temporary or permanent fixation after reduction. The reduction of fracture was confirmed through C-arm X-ray, after that, a proximal femur locking plate was put at 1 cm approximately to the distal of greater trochanter apex. With the help of locking sleeve, two Kirschner wires for location were embedded. Then fluoroscopy was used to ascertain whether their position were proper or not. According to the direction, two locking screws were embedded. The third Kirschner wire was implanted into the femur, and then fixed with locking screw or lag screw at the distal of fracture based on the fracture condition. The drainage tube was implanted into the wound, and the incision was sutured.

Postoperative management

After surgery, antibiotics was administrated for 24~48 h, the complicated pre-existing diseases were disposed, and deep venous thrombosis was prevented. In addition, alendronate sodium and zoledronic acid were routinely used for the treatment of senile osteoporosis. The drainage tube in patients of PFLP group was withdrawn within 24~48 h. Patients implemented extension and flexion activity passively on day 1 or 2 after surgery to contract their quadriceps femoris. On day 2 or 3 after surgery, they moved their affected limb in semireclining position. Weight bearing time was determined according to the fracture type, the degree of osteoporosis, and postoperative X-ray film. Regular follow-up was performed for all patients and postoperative parameters and were recorded carefully, including the perioperative bleeding, duration of the surgery, mean off-bed time after operation, mean length of stay complications, mean perioperative loss of hemoglobin and mean healing time of fracture. Complications of the surgery included iatrogenic fracture, iatrogenic, deep venous thrombosis, urinary system infection, pulmonary infection and cardio-cerebrovascular diseases.

Evaluation of postoperative functions

Postoperative functions were assessed based on the Harris scores of hip, which included function, pain, joint movement, and joint deformity. A full score was 100, a score of 90~100 was excellent, 80~89 was good, 70~79 was okay, and < 70 was bad.

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Follow-up

At 1, 3, 6, and 12 months after operation, patients were followed up, and underwent evaluation of imaging science and postoperative function.

Statistical analysis

Statistical analysis was performed by SPSS17.0 software. The difference in sex, age, and fracture type were analysed by Crosstab method. Related parameters of the surgery, scores of hip function, fracture healing, and postoperative complications were analysed with independent sample.

Results

Perioperative data in both groups

As shown in Table 1, the perioperative bleeding, duration of the surgery, mean perioperative loss of hemoglobin, mean length of stay, mean off-bed time after surgery and mean healing time of fracture in PFNA group were significantly lower than PFLP group, P<0.05. However, the fluoroscopy time and hip function were not significantly different, P>0.05.

Adverse reactions in both groups

As shown in Table 2, there were no significant differences in patient satisfaction, cutting of head and neck, incidences of

Table 2. Adverse reactions in both groups (n (%)).

Group	n	Patient satisfaction	Kutting of head and neck	Incision infections	Failure rate of internal fixation	Death follow-up	Greater trochanter pain	Loose screws
PFLP group	79	74 (93.67)	0 (0)	5 (6.33)	0 (0)	1 (1.27)	0 (0)	2 (2.53)
PFNA group	82	75 (91.46)	2 (2.44)	3 (3.66)	0 (0)	1 (1.22)	4 (4.88)	14 (17.07)
P		>0.05	>0.05	>0.05	>0.05	>0.05	0.05	0.05

Discussion

About 50% of hip fractures are senile intertrochanteric fracture, and the incidence of hip fractures is higher in female than male. The elderly patients are of high risk of osteoporosis, thus most fractures are caused by fall. Hip fractures are usually resulted from external force directly or torque force indirectly to the greater trochanter [4,5]. Conservative treatment will easily lead to complications which cause morbidity and mortality (such as bedsores, pneumonia, urinary system infection, and deep vein thrombosis of the lower limbs), so it is appropriate for elderly patients. In order to avoid too much complications caused by conservative treatment, surgery is commonly used [6,7].

The key points of PFNA-II for the treatment of intertrochanteric fracture in elderly patients include good reduction of fracture, precise insertion of intramedullary nail and correct position of the main nail of trochanter neck. Better reduction of fracture can contribute successful surgery and decrease perioperative complications. When implanting helical

incision infections, failure rate of internal fixation, and mortality in follow-up period of both groups, P>0.05. In comparison with PFNA group, the greater trochanter pain of patients in PFLP group was significantly milder and the rate of loose screws was significantly, P<0.05.

Table 1. Perioperative data in both groups ($\bar{x} \pm s$).

Parameters	PFLP group	PFNA group	P value
n	79	82	-----
Fluoroscopy time (s)	11.98 ± 1.49	20.36 ± 1.51	>0.05
Perioperative bleeding (ml)	350.63 ± 63.55	78.87 ± 4.86	<0.05
Duration of the surgery (min)	65.82 ± 7.31	55.15 ± 4.86	<0.05
Mean perioperative loss of hemoglobin (g)	29.35 ± 3.42	25.17 ± 2.56	<0.05
Mean length of stay (d)	19.73 ± 2.93	10.28 ± 2.45	<0.05
Mean off-bed time after surgery (d)	31.50 ± 3.95	16.37 ± 2.97	<0.05
Mean healing time of fracture (m)	15.13 ± 2.52	13.14 ± 0.58	<0.05
Harris score in the last follow up	92.05 ± 1.05	92.14 ± 1.03	>0.05

blade, the blade should accord with the mechanical axis of hip to enhance its pull-out strength of the internal of femoral head and prevent varus deformity of the hip.

Great reduction after incision and the height of plate placement are the key points of PFLP. Moreover, the proximal locking nail should be inserted into the femoral head through the femoral neck. Before surgery, intertrochanteric shortening deformity should undergo traction for reduction, which will be helpful for the reduction of fracture. The proximal femur locking plate is very important for reduction, so its location should be appropriate. If the lateral cortex of femoral neck is reduced well, and the neck-shaft angle and the anti-version angle recover well, when the lesser trochanter cannot be reduced, it is not necessary to be reduced deliberately [8-10].

This study selected these two internal fixations that were commonly used to treat senile intertrochanteric fracture. The results showed that patients in both groups could recover their preoperative functions, namely both fixations had better efficacy in senile intertrochanteric fracture. However, in

comparison with PFLP, PFNA was superior in perioperative bleeding, duration of surgery, mean perioperative loss of hemoglobin, mean length of stay, mean off-bed time after surgery and mean healing time of fracture. So PFNA was more suitable for the treatment of intertrochanteric fracture in elderly patients to some extent. The incision of PFNA was smaller, with hollow main nail of the helical blade and intramedullary nail, which implantation was guided by a guide pin. So the periosteum of fracture site was not necessary to be stripped, so the fracture was easy to heal. In addition, the surgical procedures of PFNA were standardized, so it was less technically difficult [11].

In addition, this study suggested that the patients in PFLP have less great trochanter pain and lower rate of loose screws than the patients in PFNA-II group. The reason may be that the reduction after incision was performed under direct view, while the nail needed to be observed through X-ray only. Besides, for osteoporotic fracture in the elderly, PFLP had not only better tensile capacity and riveting force, but also antibending force and anti-rotation force, which could prevent femoral head from nail cutting effectively. However, the fixation of PFLP was eccentric, and it was hard to overcome shear stress, so the patients could not get off bed early after surgery. Especially for instable intertrochanteric fracture, early off-bed after PFLP operation may break the plate. But for those with longitudinal and splitting fracture, Kirschner wire or lag screw could be temporary fixed under direct view in PFLP, avoiding longitudinal and splitting fracture which was caused by enlarged medullary cavity in PFNA. So preoperative preparation should be complete, and appropriate method should be selected.

Before surgery, systemic conditions of patients should be evaluated, and their pre-existing diseases disposed properly. On this basis, the surgery should be performed timely. The selection of surgeries needs to consider the fracture type and osteoporotic degree comprehensively, aiming to make a good outcome.

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