THE EFFECT OF PFNA MINIMALLY INVASIVE INTERNAL FIXATION ON THE POSTOPERATIVE SLIPPAGE OF FIXING NEEDLE IN ELDERLY PATIENTS WITH FEMORAL INTERTROCHANTERIC FRACTURE AND THE CHANGE OF RESET IMAGE

QIANG DONG, YIN-GUANG ZHANG, WEI TIAN
Department of Traumatology, Tianjin Hospital, Tianjin, China 300211
First author: Qiang Dong, male, 1974-, deputy chief physician, Department of Traumatology, Tianjin Hospital, address: No. 406 of Jiefang South Road, Hexi District, Tianjin, China 300211

ABSTRACT

Objective: To compare the effect of PFNA minimally invasive internal fixation and Gamma nail internal fixation on the postoperative slippage of fixing needle in aged subjects with femoral intertrochanteric fracture and the change of reset image.

Patients and methods: Patients who were treated in our hospital from January 2015 to April 2016, about one hundred seventy-eight of them, having femoral intertrochanteric fracture were chosen as the subjects. As per a random number table, they were divided into two groups- Group A and Group B. A group of patients with PFNA minimally invasive internal fixation, B group of patients with Gamma nail internal fixation. The clinical efficacy, hip joint function, slippage of fixing needle and reset image were evaluated in both groups.

Results: Compared to the control group, it was observed that Group A's effective rate was greater by a significant amount (P <0.05). Compared to Group B, the operation time, discharge time and healing time were much lesser (P <0.05). The bleeding volume in group A was significantly less than that in group B (P < 0.05). In the amount of fixing needle slippage between the two groups, no main variations were found (P > 0.05). Six months after operation, the Group A patients' TAD lagged behind group B patients', and the collodiaphysial angle of group A was higher than that of group B, statistically, there was much variation (P < 0.05). In the incidence of complications such as infection, femoral fracture, nonunion, coxa varus and dysfunction, there was not much variation between the two groups (P > 0.05).

Conclusion: The two kinds of internal fixation both have good clinical curative effects on the elderly femoral intertrochanteric fracture, however, the PFNA minimally invasive internal fixation is more effective, with smaller changes of postoperative TAD and collodiaphysial angle.

Keywords: PFNA minimally invasive internal fixation, Elderly femoral intertrochanteric fracture, fixing needle slippage, Reset image.

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Introduction

The rapid development of social economy has brought about the extension of human survival time, and also caused an increase in aging population, meanwhile, some of the incidence of elderly diseases increased year by year, China is about to enter the aging society, and this trend will be more obvious. Intertrochanteric fractures of the femur is a common disease caused by falls and other indirect forces, and is more serious, due to the reduced body function and slow bone regeneration rate in elderly patients, which has a great impact on the life and health of elderly patients. At present, conservative therapy and surgical treatment can be used to treat the elderly femoral intertrochanteric fracture, but the time of conservative treatment is longer, and often resulted in decreased cardiopulmonary function, bed sores and hypothyroidism and other complications, posing serious complications to the life of a patient. Therefore, the current clinical treatment of the disease is surgery, however, because the patient's general condition is poor and cannot tolerate trauma surgery, combined with elderly patients...
usually with more osteoporosis, decreased holding power between the internal fixation and bone, increased risk of postoperative implant cutting, so the choice of treatment must be simple, rapid, effective, and fewer postoperative complications. It has been observed from the research that different surgical methods for the treatment of intertrochanteric fractures were presented: especially in recent years, clinical application of a variety of closed surgical instruments in different health status and fracture degree of the elderly patients, can effectively promote the recovery function of patients and early weight loss, and thereby decrease the chances of postoperative complications, thereby significantly increasing the quality of life.

In recent years, because of its obvious advantages in biomechanics and surgical technique, intramedullary fixation has become the first choice for most departments of orthopedics doctors, but after fixed operation, because of the patient’s strenuous exercise, heavy load and other factors, can make the fixation slip, and thus have a greater impact on the clinical efficacy. PFNA minimally invasive internal fixation and Gamma nail internal fixation is commonly used in the current clinical internal fixation; however, the systematic study on the clinical efficacy of different surgical methods has not been reported. Hence, comparing the effects of PFNA minimally invasive internal fixation and Gamma nail internal fixation on the postoperative slippage of fixing needle in aged subjects with femoral intertrochanteric fracture and the change of reset image, and giving a scientific course for the disease to be clinically treated is the purpose of this research.

**Patients and methods**

**Clinical data**

Patients who were treated in our hospital from January 2015 to April 2016, about one hundred seventy eighty of them, having femoral intertrochanteric fracture were chosen as the subjects. As per a random number table, they were divided into two groups- Group A and Group B. Among them, 89 of them in Group A, with 49 males and 40 females, aged 63-87 (70.7 ± 2.8), 21 cases had traffic accident, 48 cases were caused by fall, 12 cases were caused by crush, the other reasons for 8 cases, according to Evans-Jensen improved type, 12 type I cases, 13 type II cases, 31 type III cases, 18 type IV cases, 15 V type cases; 35 cases of cardiovascular and cerebrovascular diseases, 16 cases with diabetes, 11 cases with cerebral embolism, 16 cases with pulmonary infection, 7 cases with other diseases. Situation of osteoporosis: 18 cases were mild, 19 cases were moderate, 9 cases were severe, 43 cases were normal bone. There were 89 males in group B, 48 males and 41 females, aged 63-87 (70.7 ± 2.8), 21 cases had traffic accident, 48 cases were caused by fall, 12 cases were caused by crush, the other reasons for 8 cases, according to Evans-Jensen improved type, 12 type I cases, 13 type II cases, 31 type III cases, 18 type IV cases, 15 V type cases; 35 cases of cardiovascular and cerebrovascular diseases, 16 cases with diabetes, 11 cases with cerebral embolism, 16 cases with lung infection, 7 cases with other diseases;

**Situation of osteoporosis:** 21 cases were mild, 16 cases were moderate, 11 cases were severe, 41 cases were normal bone. No major variation existed in age, sex ratio, comorbidities, and bone data between the two groups (P> 0.05) (Table I).

**Inclusion criteria:** (1) the patients age was greater than or equal to 60 years, and before the injury have self-care ability; (2) patients qualified femoral intertrochanteric fracture diagnostic criteria; (3) patients are eligible for surgery, can carry out fixation.

**Exclusion criteria:** (1) Pathological fracture impacted subjects; (2) subjects with other multiple injuries; (3) patients who had received other operations on the affected side.

**The method of treatment**

The two groups of patients underwent continuous epidural anesthesia, in supine position, patients were reset in traction bed before operation, under the C arm fluoroscopy, and traction of the affected limb was reset until the patient was satisfied with the operation. Patients in group PFNA were treated with minimally invasive internal fixation with 4-5 cm incision at the apex of the great trochanter to the proximal side; at the apex of the rotor, the needle was inserted into the bone marrow cavity, after reaming, the PFNA main nail was inserted into the bone marrow cavity of the proximal femur and then the needle was removed. After that, the needle was inserted into the femoral neck, according to the length of the femoral neck, at the corresponding position of the lateral cortex, the spiral blade is driven into the needle direction, at the distal end, according to the patient’s condition, and the 1-2 clavicle nails were inserted.
Main nail cap was screwed, finally, depending on the patient’s choice to set drainage or direct suture. Group B patients with Gamma nail internal fixation, from the large rotor near the vertex to the proximal to do 4 ~ 5 cm longitudinal incision. The muscle tissue was separated layer by layer, separating the exoplance and revealing the apex of the large rotor, in a slightly interior punched with bone awl, when into the proximal medullary cavity, guide pin was inserted, and then reamed. The Gamma nail’s correct length was selected to be inserted along the guide pin and to ensure that the opening is aligned with the femoral marrow cavity, the Gamma pin reached the set position. The appropriate length of pressure screw was selected, and fixed screw was screwed at the top of the Gamma nail. Gate apparatus was removed, the top of the intramedullary nail was fixed by compression screw, the drainage strip was detained and the wound was sutured.

Observation indexes and methods

Clinical efficacy evaluation: According to Harris score14, the pain was 44/100, functional recovery was 47/100, deformity 4/100, joint activity was 5/100. The score of (<70) was bad, 70-79- Moderate, 80-89- Good, 90-100 was superior or excellent.

Clinical analysis: In both the groups, the following parameters were analyzed: The operation time, blood loss, length of stay and postoperative hemoglobin decline values.

Fixing needle slippage: the incidence of fixing needle slippage and caput femoris rotation rate were recorded in each group at the end of the 4 week after operation. The fixation slip is measured by the following methods: first, on X-ray positive film, a point N in the turning point of the saddle was selected, then an extension line that perpendicular to the fixing pin axis, this line intersected with the other side of the femoral neck at N’. A point H in the outer surface of caput femoris was selected, then an extension line that perpendicular to the fixing pin axis, this line intersected with the other side of the femoral neck at H’. After 4 weeks, H’: H or N’: N ratio was significantly higher than the immediate postoperative ratio that determined the rotation of caput femoris.

Analysis of the change of reset image: Followed up for 6 months. Postoperative radiographs were taken to evaluate the reduction, tip apex distance (TAD), collodiaphyseal angle; TAD value, collodiaphyseal angle measured through the picture archiving and communication system (PACS)12.

Statistical processing

SPSS 19.0 software for data processing, measurement data was represented with the mean ± standard deviation (± s), Chi square test and t test was used for comparison between groups. Count data expressed in percentage, for analysis of rank data, Rank sum test was used. The variation was taken to be considerable statistically if the probability was less than 0.005 (Table II).

<table>
<thead>
<tr>
<th>Group</th>
<th>Age (±s)</th>
<th>Sex ratio</th>
<th>Cause</th>
<th>Evans-jensen improved type</th>
<th>Osteoporosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Traffic accident</td>
<td>Fall</td>
<td>Crush</td>
</tr>
<tr>
<td>Group A</td>
<td>70.2±2.3</td>
<td>49/40</td>
<td>22</td>
<td>47</td>
<td>11</td>
</tr>
<tr>
<td>Group B</td>
<td>70.7±2.8</td>
<td>48/41</td>
<td>21</td>
<td>48</td>
<td>12</td>
</tr>
<tr>
<td>Statistical value</td>
<td>1.302</td>
<td>0.02</td>
<td>0.959</td>
<td>0.844</td>
<td>0.739</td>
</tr>
<tr>
<td>P</td>
<td>0.195</td>
<td>0.88</td>
<td>0.08</td>
<td>0.2</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Table I: Comparison of general information between two groups of patients.

The effect of PFNA minimally invasive internal fixation on the postoperative slippage of fixing needle in elderly patients ...

<table>
<thead>
<tr>
<th>Groups</th>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Bad</th>
<th>Excellent rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A (n=89)</td>
<td>24</td>
<td>31</td>
<td>21</td>
<td>13</td>
<td>75(84.2)</td>
</tr>
<tr>
<td>Group B (n=89)</td>
<td>18</td>
<td>24</td>
<td>29</td>
<td>18</td>
<td>32(35.9)</td>
</tr>
<tr>
<td>χ²</td>
<td>χ²=1.770</td>
<td>43.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>0.076</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table II: Comparison of clinical efficacy between two groups of patients.
Results

Comparison of clinical efficacy between the two groups
It was shown by Rank sum test showed that as far as the clinical effect was concerned, there was no significant difference between groups A and B with probability greater than 0.005. Chi square test showed that the effective rate of group A was considerably more than the effective rate of the control group, there was a considerable significance statistically with the difference was statistically significant, the probability less than 0.005.

Comparison of clinical indicators between the two groups
The time of operation, the time of discharge and the time of healing in group A were considerably less than those in the second group with probability less than 0.05 Group A's blood loss was much lesser than Group B’s, there was a considerable difference statistically with probability less than 0.05 (Table III).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Operation time (min)</th>
<th>Discharge time (d)</th>
<th>Healing time (week)</th>
<th>Bleeding volume (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A (n=89)</td>
<td>48±11</td>
<td>143.1±14.7</td>
<td>10.3±0.8</td>
<td>13.11±1.23</td>
</tr>
<tr>
<td>Group B (n=89)</td>
<td>62±14</td>
<td>246.9±21.2</td>
<td>12.6±1.2</td>
<td>15.74±1.22</td>
</tr>
<tr>
<td>T</td>
<td>7.418</td>
<td>37.958</td>
<td>15.045</td>
<td>14.322</td>
</tr>
<tr>
<td>P</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table III: Comparison of clinical indicator between the two groups of patients.

Comparison of the amount of fixing needle slippage and the rotation rate of caput femoris
Regarding the amount of fixing needle slippage, there was not much of a difference between the two groups (P> 0.05). Although the rotation rate of caput femoris of A < that of B, there was no considerable difference statistically with the probability more than 0.05. (Table IV).

<table>
<thead>
<tr>
<th>Groups</th>
<th>The amount of fixing needle slippage (mm)</th>
<th>The rotation rate of caput femoris (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A (n=89)</td>
<td>4.37±0.65</td>
<td>6(6.7)</td>
</tr>
<tr>
<td>Group B (n=89)</td>
<td>4.42±0.48</td>
<td>11(12.3)</td>
</tr>
<tr>
<td>T</td>
<td>0.584</td>
<td>1.63</td>
</tr>
<tr>
<td>P</td>
<td>0.56</td>
<td>0.202</td>
</tr>
</tbody>
</table>

Table IV: The amount of fixing needle slippage and the rotation rate of caput femoris in two groups.

Reset image changes
In the same group, the TAD in the two groups of patients at the half of a year after surgery was considerably more compared to that of the patients at immediate postoperative time, and there was a considerable difference statistically with the probability less than 0.05 The collodiaphysial angle in the two groups of patients at the half of a year after surgery was significantly lower than that at immediate postoperative time, the difference was statistically significant (P < 0.05). At immediate postoperative time between the two groups (P> 0.05), There was no significant difference of the collodiaphysial angle. At the half of a year after operation, group A’s TAD < Group B’s, and the collodiaphysial angle of group A > that of group B, there was a considerable difference statistically with probability <0.05 Not much of a variation existed in the changes of collodiaphysial angle that more than 10° between the two groups (P> 0.05) (Figure I).

The occurrence of complications
A group of patients infected with 4 cases, 0 cases of femoral rupture, 1 case of hip varus, 0 cases of nonunion, 1 case of dysfunction, the incidence of complications was 6.74% (6/89). Group B patients infected with 2 cases, 2 cases of femoral fracture, 2 cases of hip varus, 1 case of nonunion, 1 case of dysfunction, the incidence of complications was 8.98% (8/89). In the event of complication such as infection, femoral fracture, nonunion, hip varus and dysfunction, there was not a considerable variation between the two groups (P> 0.05), and in the overall cases of complications between Group A and Group B, there was not any considerable (P> 0.05).
Discussion

The bone in femur intertrochanteric is crisp, and carrying the stress from different directions, and the muscle group has a strong contraction, so the site is mostly comminuted fracture. Because femur intertrochanteric has a wealth of blood supply, less non-healing and ischemic necrosis of caput femoris after injury, due to medical technology is not developed, the conservative treatment is common, but patients have to bear long-term bed, and teratogenicity and mortality are high. According to statistics, the mortality rate in conservative treatment of femoral intertrochanteric fracture within one year as high as 20%, only 60% of the patients can complete the simple life without the help of accompanying conditions, in nearly half of patients in the remaining 40% cannot walk independently. In order to make the patients get good fracture reduction, strong fixation, early rehabilitation training, and avoid a series of complications caused by conservative treatment, surgical treatment has become the first choice of orthopedics physicians.

Aged people due to bone loss, bone fragility, bone strength and other factors exist, the risk of fracture is high, especially in the intertrochanteric fracture in recent years, and the incidence increased year by year. At present, the clinical treatment of such diseases are more use of internal fixation, but need to pay attention to the elderly patients with various physical function decline, and combined with a variety of other diseases, so the treatment process must take into account other symptoms. In patients with physical conditions permitting, the use of internal fixation treatment is to improve the prognosis of elderly patients.

At present, there are a variety of clinical internal fixation, including PFNA minimally invasive internal fixation and Gamma nail internal fixation, but on two different surgical procedures, the systematic study on the fixed needle slippage and the changes of reset image is less. Hence, the study’s objective is comparing the effect of PFNA minimally invasive internal fixation and Gamma nail internal fixation on the postoperative slippage of fixing needle in aged subjects with femoral intertrochanteric fracture as well as the change of reset image.

This study showed that the group A’s effective rate of was considerably more than the control group’s, and there existed a considerable statistical difference. The duration of operation, the time of discharge and the time of healing in Group B were more than that of Group A. Group A’s blood loss was far lower than Group B’s and a considerable statistical variation existed. These results indicated that PFNA minimally invasive internal fixation in the treatment of intertrochanteric fractures in aged subjects is better than Gamma nail internal fixation. The reason may be that PFNA minimally invasive internal fixation carries the benefit of most proximal femoral nail, and it can be more effective fixation of the femur, and with simple operation. In addition, the use of the spiral blade locking technology to replace the screw fixation can be effective extrusion of bone to achieve the best riveting force, and doesn’t come loose easily. Its stability, anti-rotation stability and anti varus deformity ability are better than the traditional screw system, and has wide adaptability. In addition, as Gamma nail is only a nail screw, and the screw is fine, anti-rotation ability in the caput femoris internal is limited, and the screw in caput femoris is very easy to cause the stress concentrated on the tip of the screw, leading the screw passes through the caput femoris and the risk of hip varus appeared significantly increased.

The study shows in predicting the cutting-out of caput femoris screws, TAD is one of the important factors. The risk of screw cutting-out increased significantly. When the TAD value is > 25 mm, and, when TAD is at 15 mm, the risk of screw cutting-out is significantly reduced. For the treatment of intertrochanteric fractures, the screw cutting-out is recognized as an important complication of intramedullary fixation. The reason for the screw cutting-out is usually interpreted as a theory of bone support deficiency, which suggests that the fracture itself leads to a lack of bone support which will cause the screw to slip off the original railway, which in turn causes the caput femoris to rotate, eventually cutting the screw out and the operation fails.

In the amount of fixing needle slippage between the two groups of patients in this study, there was no statistically significant difference. However, the rate of caput femoris rotation in group A < than that in group B, even though there was not much of a variation statistically, and PFNA minimally invasive internal fixation was possible to reduce the risk of fixation. In addition, it was shown by the research outcome that no considerable variation of the collodiaphysial angle at immediate postoperative time between the two groups...
existed. At six months after operation, the TAD of group B was more than that of group A, and the collodiaphysial angle of group A was greater than Group B’s, the difference was statistically significant. Those results indicated that TAD of PFNA minimally invasive internal fixation is small, helping to reduce the risk of fixation of the needle and improve the prognosis and promote functional recovery. The normal value of adult collodiaphysial angle is between 110–140°, when the collodiaphysial angle greater than the normal value is known as hip valgus, when it is less than the normal value is known a hip varus. The collodiaphysial angle in the normal range can increase the movement of the lower limbs and to convey the power of the torso to the wider base. This study found that collodiaphysial angle of group A was greater than Group B’s, there existed a statistically considerable variation, also shows that PFNA surgery on the elderly intertrochanteric fractures have more definite clinical efficacy, and the relevant research results are basically the same25-26.

In addition, this study analyzed the adverse reactions of the two groups of patients, the results show that there was no considerable difference was found in the cases of complications such as infection, femoral fracture, nonunion, hip varus and dysfunction between the two groups, these results indicated that the two kinds of internal fixation have high safety.

References

21) Yang S, Liu Y, Yang T, Zou J, Yang H. Early clinical efficacy comparison study of Gamma 3 nail, percutaneous compression plate (PCCP) and femoral head


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Corresponding author
QIANG DONG
e-mail:381245249@qq.com
(China)