The Asia proximal femoral nail antirotation versus the standard proximal femoral antirotation nail for unstable intertrochanteric fractures in elderly Chinese patients

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Background: The best options of internal fixation for unstable intertrochanteric fractures in elderly Chinese patients remain controversial. The Asia proximal femoral nail antirotation (PFNA-II) was specifically designed for Asian patients, which could be more effective than the regular proximal femoral nail antirotation (PFNA). Compared to PFNA, whether PFNA-II is associated with shorter operative time and lower rates of complications is unknown.

Hypothesis: The rate of complications using PFNA-II is lower than PFNA for the treatment of unstable intertrochanteric fractures in elderly Chinese patients, and the operation using PFNA-II is quicker.

Materials and methods: Between June 2008 and December 2011, 188 patients with unstable intertrochanteric fractures treated with the PFNA-II (n = 118) or PFNA (n = 70) were retrospectively evaluated. Follow-up evaluations were performed at 1, 3, 6, 9 and 12 months, and every year thereafter. According to residual valgus-varus deformation, the quality of the fracture reduction was graded as poor (>10° deformation), acceptable (5° to 10° deformation), or good (<5° deformation). The operative time, intraoperative blood loss, overall time of fluoroscopy, blood transfusion volume, postoperative drainage, length of hospital stay and postoperative complications were recorded.

Results: The mean operative time in the PFNA-II group was significantly shorter than that in the PFNA group (66.25 ± 13.15 vs 79.50 ± 21.12 minutes; P < 0.05), intraoperative blood loss was smaller (131.86 ± 69.16 vs 162.14 ± 66.18 mL; P < 0.05), and fewer local complications were observed (25% vs 46%; P < 0.05). There was no significant difference in the postoperative blood transfusions, overall time of fluoroscopy, postoperative drainage, length of hospital stay, fracture reduction, the position of the implant and tip apex distance between the two groups. At follow-up, no significant difference was found between the two groups in Harris hip score (HHS) (86.19 ± 6.53 vs 85.27 ± 5.47; P > 0.05), visual analogue scale (VAS) (0.87 ± 0.85 vs 0.97 ± 0.87; P > 0.05).

Discussion: Due to its special design for the Asian population, PFNA-II offers a better match with the Chinese people’s proximal femur anatomic structure. This study showed that the rate of complications using PFNA-II is lower than PFNA for the treatment of unstable intertrochanteric fractures in elderly Chinese patients, and the operation time is shorter.

Level of evidence: Level III, case control study.

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1. Introduction

Intertrochanteric fractures are relatively common among the elderly, 90% of such fractures occurring in persons aged over 65 years [1]. Most elderly patients with intertrochanteric fractures have osteoporosis [2]. This type of geriatric fracture has a relatively high mortality and causes severe impairment of function [3]. Common treatment options for Chinese patients include intramedullary nailing with either the proximal femoral nail antirotation or Asia proximal femoral nail antirotation, both of which represent the most commonly used implants for the treatment of unstable intertrochanteric fractures [4–8].
compaction around the blade to retard rotation and varus collapse [9]. Several studies showed few complications and positive results with PFNA for unstable intertrochanteric fractures [10–12]. However, the proximal end of the nail was not matched with the specific anatomy of some short elderly patients. Further modifications of the nail are necessary for the elderly Chinese population, intra- and postoperative complications, such as difficulty inserting it, pain in the hip and thigh, lateral blade migration, femoral shaft fracture, and lateral cortex splitting intraoperatively, have been reported since it began being used in Asian patients [4,13]. In response to these concerns, AO/ASIF developed the Asia proximal femoral nail antitrotation (PFNA-II) specifically for Asian patients. Although both nails have been reported to have good clinical outcomes, no study has compared the outcomes of the PFNA and PFNA-II. Therefore, we conducted a case control study to assess if the PFNA-II was associated with shorter operative time and lower rates of complications. We hypothesized that the rate of complications using PFNA-II is lower than PFNA for the treatment of unstable intertrochanteric fractures in elderly Chinese patients, and the operation using PFNA-II is quicker.

2. Patients and methods

2.1. Patients

From June 2008 to December 2011, all patients with unstable intertrochanteric fractures were treated with a PFNA or a PFNA-II (Synthes GmbH, Oberdorf, Switzerland) in our hospital. The study was approved by the Ethics Committee of The Second Hospital of Anhui Medical University. All patients have provided their written informed consent to participate in this study. We did not conduct our clinical investigations outside of our country of residence.

The PFNA or PFNA-II was chosen according to surgeon preference and availability of the device. Patients eligible for the study were at least 60 years of age. Exclusion criteria included pathological intertrochanteric fractures, open fractures, multiple fractures, presence of degenerative osteoarthritis/arthritis in the injured hip and severe concomitant medical condition (grade V on the American Society of Anesthesiologists [ASA] scale) [14]. All the patients' records, including gender, age, body mass index (BMI), ASA class rating and fracture type according to AO/OTA classification, were complete.

2.2. Surgery and rehabilitation

Surgery was carried out under general anaesthesia. A fracture table and image intensifier were used in all cases. The PFNA was inserted without diaphyseal reaming, which was a solid titanium nail 170, 200 or 240 mm in length and 10 or 11 mm in diameter. The helical blade attached to which a particular inserter was introduced over the guide wire with hammer. While the introduction was finished, the helical blade could be fixed to prevent rotation. The PFNA could be distally fixed either statically or dynamically. Somewhat differently, the PFNA-II nail used in the study is a solid titanium nail that is 170 or 200 mm long and 9, 10, or 11 mm in diameter. The surgical procedure was the same as the one used for the standard PFNA [6,10].

Postoperatively, analgesic care and diet were related to local standards and equal for both groups. Antithrombotic prophylaxis was administered using low–molecular-weight heparin (Lovenox 40 mg) for 3–5 days, and all patients received prophylactic antibiotics (Cefotiam 4.0 g) for 3 days. As the importance of rehabilitation, patients were encouraged to move the hip, knee and ankle joints on the first postoperative day and partial weight bearing was allowed with the aid of crutches on the following day.

Fig. 1. A: anteroposterior hip radiographs of intertrochanteric fracture treated with PFNA. B: anteroposterior hip radiographs of intertrochanteric fracture treated with PFNA-II.

2.3. Method of assessment

Follow-up evaluations were performed at 1, 3, 6, 9 and 12 months, and every year thereafter. The operative time, blood loss during surgery, amount of transfused blood, overall fluoroscopy time, postoperation drainage, duration of hospitalization, postoperative complications, and assessment of nail handling for Asia proximal femoral nail antitrotation were compared with those of proximal femoral nail antitrotation.

Plain anteroposterior and lateral radiographs were obtained at each visit (Fig. 1). At the last follow-up, the degree of pain was measured by visual analogue scale (VAS) and the functional outcome was evaluated on the basis of Harris Hip Score (HHS) [15]. The radiographs of affected hip were achieved in the AP. The mediolateral planes at every follow-up visit, the extent of fracture and any changes in the position of the implant were noted.

The quality of the fracture reduction was graded as poor (>10° varus/valgus), acceptable (5°–10° varus/valgus), or good (<5° varus/valgus). The position of the implant was graded as optimal if the blade was placed into the centre of the neck on a lateral view and lower half on a AP view [6]. Which was graded as suboptimal if the blade was not placed into the centre of the neck on a lateral view or lower half on a AP view.

2.4. Statistical analysis

Statistical analysis was performed using SPSS statistical package, version 16.0 (SPSS Inc., Chicago, IL, USA) for Windows. Quantitative variables were analysed using the Student’s t-test and categorical variables were analysed by the χ² test or Fisher’s exact test where appropriate. The level of statistical significance was set at a two-sided P-value of 0.05.

3. Results

Between June 2008 and December 2011, 188 elderly Chinese patients with unstable intertrochanteric fractures were treated...
Table 1

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<th>PFNA-I</th>
<th>PFNA</th>
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<tr>
<td>Age (y)</td>
<td>67.42±16.40</td>
<td>66.31±16.44</td>
<td>0.655</td>
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<tr>
<td>BMI</td>
<td>22.49±3.88</td>
<td>22.94±3.56</td>
<td>0.425</td>
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<tr>
<td>Side (left/right)</td>
<td>58.60</td>
<td>34.36</td>
<td>0.939</td>
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<tr>
<td>Injury mechanism</td>
<td>82</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Traffic</td>
<td>36</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>AO type of fracture</td>
<td>98</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>ASA classification</td>
<td>20</td>
<td>15</td>
<td>0.456</td>
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<tr>
<td>Follow-up (months)</td>
<td>29.08±9.07</td>
<td>29.49±9.29</td>
<td>0.772</td>
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PFNA-II: As proximal femoral nail anteversion; PFNA: proximal femoral nail antirotation; BMI: body mass index; ASA: American Society of Anesthesiologists.

with PFNA \(n = 70\) or PFNA-II \(n = 118\). No significant differences were found between the two groups in gender, age, BMI, side of fracture, type of fracture, ASA score and follow-up time (Table 1).

The mean surgical time in the PFNA-II group was 66 min and was significantly shorter than that in the PFNA group, in which the mean time was 79 min \((P < 0.05)\) (Table 2). Blood loss was significantly less than in the PFNA-II group than that in the PFNA group \((P < 0.05)\). There was no significant difference in amount of transfused blood, overall fluoroscopy time, postoperation drainage and duration of hospitalization between the two groups \((P > 0.05)\) (Table 2).

Fracture reduction was considered good or acceptable in 181 patients \((113\) in the PFNA-II group, 68 in the PFNA group) on postoperative radiographs. The position of the implant was optimal in 155 patients \((102\) in the PFNA-II group, 53 in the PFNA group). The mean tip apex distance was 19.25 mm in the PFNA-II group and 19.04 mm in the PFNA group. There was no significant difference between the two groups in fracture reduction, the position of the implant and tip apex distance \((P > 0.05)\) (Table 2).

In our study, six main postoperative systemic complications occurred, including pneumonia, cardiovascular disorder, urinary tract infection, hypoproteinemia, deep vein thrombosis and pressure sore. No significant difference was found between the two groups in systemic complications. Two cutouts occurred in the PFNA group, but none occurred in the PFNA-II group. Several patients reported thigh pain during the follow-up period: 8 patients in the PFNA-II group and 18 in the PFNA group \((P < 0.05)\). In the

Table 2

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<th></th>
<th>PFNA-I</th>
<th>PFNA</th>
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<tr>
<td>Operation time (min)</td>
<td>66.25±13.15</td>
<td>43–128</td>
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<tr>
<td>Blood loss (mL)</td>
<td>131.86±69.16</td>
<td>30–300</td>
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<tr>
<td>Blood transfusion (U)</td>
<td>2.37±0.88</td>
<td>1–4</td>
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<tr>
<td>Fluoroscopy time (s)</td>
<td>87.36±21.80</td>
<td>25–200</td>
<td></td>
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<tr>
<td>Postoperation drainage (mL)</td>
<td>68.56±26.34</td>
<td>20–200</td>
<td></td>
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<tr>
<td>Hospitalization duration (d)</td>
<td>10.81±3.28</td>
<td>6–16</td>
<td></td>
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<tr>
<td>Fracture reduction</td>
<td>93</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Acceptable</td>
<td>20</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>The position of implant</td>
<td>102</td>
<td>53</td>
<td>0.075</td>
</tr>
<tr>
<td>Suboptimal</td>
<td>16</td>
<td>17</td>
<td></td>
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<tr>
<td>Tip apex distance (mm)</td>
<td>19.25±4.71</td>
<td>9–36</td>
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PFNA-II: As proximal femoral nail anteversion; PFNA: proximal femoral nail antirotation.

PFNA-II group, fewer local complications were observed \((P < 0.05)\) (Table 3).

The mean HHS was 86.19 in the PFNA-II group and 85.27 in the PFNA group, and the mean VAS was 0.87 in the former and 0.97 in the latter group. The mortality rate at one year was 7% in the PFNA-II group, compared with 6% in the PFNA group. No significant difference was found between the two groups in HHS, VAS and the one-year mortality rate \((P > 0.05)\) (Table 4).

4. Discussion

In the present study, we compared PFNA and PFNA-II for the treatment of unstable intertrochanteric fractures in elderly Chinese patients. Our results suggested that the rate of complications using PFNA-II was lower than PFNA for the treatment of unstable intertrochanteric fractures in elderly Chinese patients, and the operation time was shorter.

A weakness of this study is that the operations were performed by different surgeons, however, a single observer collected data and the surgical procedure was the same. The study design was a
retrospective design; the two groups were comparable according to major variables (gender, age, BMI, side of fracture, type of fracture, ASA score and follow-up time). However, a randomized, prospective study is needed in the future to further confirm the current findings.

Intertrochanteric fractures is one among the most common injuries in the elderly population, and patients’ quality of life is affected significantly [16–19]. The goal of treating these osteoporotic fractures is the same as for other hip fractures: to decrease pain and to restore the patient’s walking ability to the pre-injury level [20,21]. The treatment of unstable intertrochanteric fractures remains challenging to orthopedic surgeons, because of old age and poor bone quality [22–24]. Moreover, the ideal treatment for unstable intertrochanteric fractures in elderly patients remains controversial [25–27]. The proximal femoral nailing (PFN) has been widely used in the unstable intertrochanteric fractures [28]. The AO/ASIF group further modified PFN to the PFNA to ameliorate the angular and rotational stability with one single element. It is an intramedullary device with a helical blade rather than a screw for better purchase in the femoral head and was tested in a clinical study [10]. Because of the height in Asian population on average is less than that of Americans or Europeans, the femoral neck diameter and proximal femoral length are relatively shorter [29]. The standard proximal femoral nail intertrochanteric nail has a mediolateral angle of 6° and a proximal diameter of 17 mm. To insert the nail, a much larger femoral canal needs to be prepared to accommodate the nail of the given diameter [30]. This means that a mass of cortical bone has to be reamed, thus weakening the osteoporotic bone in most patients. This study shows that the necessary over-reaming of the shaft weakens the entire shaft, and then reaming of the medulla can result in increased blood loss [31,32]. Moreover, this geometric mismatch between the proximal end of the nail and proximal femur is the most probable cause of the intraoperative complications of jamming and fracturing of the lateral cortex. The PFNA-II was designed to avoid these problems, which was designed to have a mediolateral angle of 5° and a proximal diameter of 16.5 mm. The modified nail has a considerably better anatomic fit. This effectively decreases the hoop stress inside the femoral shaft and may have led to a significant decrease in intraoperative and postoperative diaphyseal fractures [33].

Unstable intertrochanteric fractures were treated successfully with the PFNA or PFNA-II in elderly Chinese patients. However, PFNA-II is superior to PFNA in terms of surgical time, intraoperative blood loss, and postoperative complications in elderly Chinese patients. Further study is needed to confirm these early results.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References