

## Original Research Article

# A comparative study of the fracture union between long and short proximal femoral intramedullary nails antirotation in the treatment of intertrochanteric femur fractures in the elderly: a multicentric analysis

B. Hari Krishnan<sup>1</sup>, S. K. Rai<sup>2\*</sup>, Rohit Vikas<sup>1</sup>, Manoj Kashid<sup>2</sup>, Pramod Mahender<sup>3</sup>

Department of Orthopaedics, <sup>1</sup>Base hospital, Lucknow, Uttar Pradesh, <sup>2</sup>Base hospital, Guwahati, Assam, <sup>3</sup>Sacred Heart Hospital, Maqsudan, Jalandhar, Punjab, India

**Received:** 11 October 2018

**Revised:** 06 December 2018

**Accepted:** 08 February 2019

**\*Correspondence:**

Dr. S. K. Rai,

E-mail: [skrai47@yahoo.com](mailto:skrai47@yahoo.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

**Background:** The objective of the study was to compare the fracture union of long vs. short proximal femoral intramedullary nail antirotation (PFNA) in the treatment of intertrochanteric fractures in elderly patients who was more than 60 years old.

**Methods:** A retrospective analysis of 170 cases of intertrochanteric fractures of the femur (AO type A1 and A2) in the elderly was conducted. There were 64 males (37.6%) and 106 females (62.3%) with the age of 60–90 (mean age 75) years. The general demographic data of patients, operation time, intraoperative blood loss, length of hospital stay, blood transfusion rate, anterior thigh pain, postoperative complications like periprosthetic fractures, infections were recorded.

**Results:** The short nail group also had a significantly shorter operation time ( $41.5 \pm 15.3$  minutes vs.  $62.5 \pm 25.3$  minutes,  $p=0.002$ ) and lower rate of postoperative transfusion (31.3% vs. 58.7%,  $p=0.041$ ). However the length of hospital stay showed no significant differences. After surgery in short group there were 03 cases of periprosthetic fracture with a total incidence of 03%, however there were none in long nail group. At the end of the follow-up, all patients achieved bony union. The average fracture union time of the long nail group was ( $8.5 \pm 3.2$ ) months, and the short nail group was ( $7.8 \pm 4.7$ ) months, revealing no significant differences ( $p=0.09$ ).

**Conclusions:** Both the proximal femoral intramedullary long and short nail fixation has a good result in the form of fracture union in treating intertrochanteric femur fractures in the elderly. They showed no significant difference in terms of fracture union, hospital stay, and postoperative complications. The incidence of periprosthetic fractures and anterior thigh pain was slightly high in short nail group. In short intramedullary nailing group there was obvious decrease in the intraoperative blood loss, operation time and postoperative blood transfusion.

**Keywords:** Intertrochanteric fracture, Proximal femoral intramedullary nail antirotation, Periprosthetic fracture

### INTRODUCTION

With the aging of population and prolonged average life expectancy, especially in developing country like India, the incidence of osteoporosis in the elderly sharply increased and hip fracture in this age group has become a

focus of health problems. In the literature it is estimated that in 2050, there will be 6.3 million hip fractures in the elderly and about half of them will be intertrochanteric fractures, which has a high morbidity and mortality and seriously affects patient's quality of life.<sup>1</sup> Moreover due to the increased life expectancy, the total number of

intertrochanteric fractures in the proximal femur is expected to keep increasing.

It is reported that the intertrochanteric fracture-related mortality reaches as high as 20%–30% at the first 6–12 months after injury.<sup>2</sup> The femur has a rich blood supply at the proximal trochanteric region, thus intertrochanteric fractures rarely goes into nonunion, however it mal unite in varus if not treated. Conservative treatment is more often used in the past, and now it is out of vogue.

In recent days proximal femoral (PFN) intramedullary nails have been widely used in the internal fixation of intertrochanteric fractures. However controversy comes about the effect of nail length on fracture union and other complication like periprosthetic fracture. Short PFN has shown a good biomechanical stability and acceptable clinical outcome. However, there is evidence that the use of short intramedullary nail can increase the stress at the nail tip making patient vulnerable to periprosthetic fractures. It is certain that intertrochanteric fractures among the elderly can cause pathological osteoporosis. To avoid this aspect the use of long PFN comes in vogue to protect whole femur.<sup>3</sup> This multicentric study was aimed to investigate this issue by comparing blood loss, operation time, postoperative complications, periprosthetic fracture and patient outcomes.

## METHODS

### General data

This multicentric study retrospectively analyzed related data of 170 patients with femoral intertrochanteric fractures treated in three different hospitals by the group of two authors from January 2010 to December 2015. The results from Department of Orthopaedics, tertiary care hospital Lucknow UP India, tertiary care hospital Jalandhar Punjab, and tertiary care hospital Guwahati, Assam, India, were analyzed.

### Inclusion criteria

The inclusion criteria were AO type 31-A1 or 31-A2 intertrochanteric fractures; injury due to low energy (falling in home or outside); patients older than 60 years; no history of previous hip trauma; not associated with fracture around hip (like fracture Acetabulum, iliac bone fracture etc); internal fixation by short or long PFNA intramedullary nailing; and postoperative follow-up minimum up to one year.

The radiological evaluation was assessed and recorded by the two or more authors.

### Exclusion criteria

The exclusion criteria were patients younger than 60 year; high energy fractures or combination of fractures at other regions; fractures fixed by other fixation systems

like DHS, patients had more than two or multiple comorbidity like NIDDM, Hypertension, CKD, IHD, or any other metabolic diseases; pathological fracture.

### Treatment strategy (followed at all centers)

After admission, routine examination was done and all patients underwent pre anaesthesia checkup. All patients were placed on skin traction. Patients with comorbidities were managed with consultation of respective specialists. Under spinal, epidural anesthesia or general anesthesia, patients were placed on fracture table in supine position. Closed reduction was done under C-arm fluoroscopy until anatomic reduction, followed by intramedullary internal fixation. Sequential manual reaming, introduction of guide wire, intramedullary nailing with long (320–360 mm) or short (180 mm) PFNA nails according to the surgeon's experience and judgment, insertion of lag screws, and director-assisted distal locking were sequentially performed. Preoperative and postoperative x-rays are shown in Figure 1 and 2. Each patient were given Tab Rivaroxaban 10 mg once daily for DVT prevention started at the time of admission which was withheld on the day of surgery till epidural catheter was taken out and again started till patient started ambulation. All patients were given intravenous Teicoplanin 400 mg unless contraindicated just before surgery and once daily for 3-4 days depending on clinical results. No major complication occurred during surgery and 4–6 days postoperatively, weight-bearing walking was allowed once patients became pain free.

### Clinical assessed parameters at all centers

The medical and surgical records of all the patients were checked and analyzed. General data including age, sex, mechanism of injury, time of presentation, surgery time from injury, type of fracture, length of hospital stay, preoperative hemoglobin level, postoperative transfusion reactions, wound infection, periprosthetic fractures and other complications were recorded. Intraoperative information including estimated blood loss, operation time, intraoperative complications, was also analyzed.

### Statistical analysis

All our data were processed using SPSS 19.0 software package. Shapiro–Wilk test and chi-square test were adopted to compare related data between long and short intramedullary nails.  $P < 0.05$  was considered statistically significant.

## RESULTS

### General demographic data

Altogether 170 patients, there were 81 cases (47.6%) in the short intramedullary nail group and 89 cases (52.3%) in the long nail group aged from 60 to 90 years, (mean 75) years on average, were included in this retrospective

study. The fracture type was AO 31-A1 in 87 cases (51.1%) and 31-A2 in 83 cases (48.8%). Among them, 102 intertrochanteric fractures (60%) were on the left side and 68 (40%) on the right side. All patients were followed up for 12–48 months, mean (21.3±6.8) months. During the follow-up period, there were 09 deaths (5%), and the average time of death after surgery was (11.8±5.9) months.

Short proximal femoral intramedullary nail group had 81 patients (47.6%) for whom 180-mm long nails were used; long nail group had 89 patients (52.3%), for whom three different length of nails were used, i.e. 320-mm nail in 36

patients, 340-mm nail in 28 patients and 360-mm nail in 25 patients.

In our study gender showed no significant difference between two groups (p=0.321), but the mean age in short nail group was much higher (p=0.003), suggesting that while choosing the nail length, surgeons may consider that short PFNA is easier to insert and can reduce the operation time as well as incidence of intraoperative complications.

**Table 1: General demographic and clinical details of patients–preoperatively.**

Group	No of patients	Sex Male/female	Age of patients (mean±SD, years)	Type of fracture (AO A1/A2)	Hemoglobin (g/L)	Associated comorbidities
<b>Long PFNA group</b>	89	34/54	73.5±7.6	33/56	8.4±3.8	DM, CKD,IHD, HT
<b>Short nail group</b>	81	29/60	61.7±9.8	27/54	9.2±2.8	DM, CKD, HT
<b>P value</b>		0.321	0.003	0.036	0.413	

Note: DM- diabetes mellitus was in 38 (42.6%), CKD- Chronic kidney disease was in 9 (10.1%), IHD = Ischemic heart disease was in 16 (17.9%), HT – hypertension was in 26(29.2%)

**Table 2: Comparison of intra and post-operative clinical condition.**

Group	Blood loss (ml)	Operation time (min)	Postoperative blood transfusion rate (%)	Length of hospital stay in days
<b>Long PFNA group</b>	121.8±80.3	62.5 min±25.3	58.7%,	12.2±6.2
<b>Short PFNA group</b>	92±50.6	41.5 min±15.3	31.3%	12.4±6.5
<b>P value</b>	0.004	0.002	0.002	0.42

**Table 3: Postoperative occurrence of complications between two groups.**

Group	Infection	Nonunion	Screw cut-out	Malunion	Ant thigh pain	Fascia lata pain	Periprosthetic fracture	Time of fracture union (months)
<b>Long nail group</b>	03	1	02	1	02	01	0	8.5±3.2
<b>Short nail group</b>	02	03	02	02	18	14	04	7.8±4.7
<b>P value</b>	>0.05	>0.05	>0.05	>0.05	<0.05	<0.05	<0.05	0.087

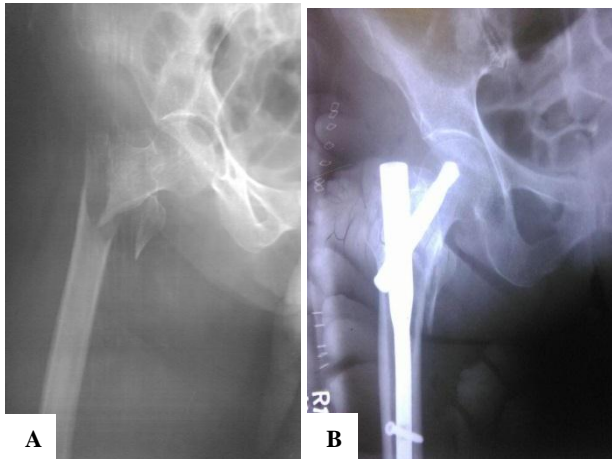
**Table 4: Functional assessment using Harris hip score- Short PFNA group.**

Harris hip score	Number (n)	Percentage (%)	P value
<b>Excellent</b>	21	25.9	<0.05
<b>Good</b>	41	50.6	<0.05
<b>Fair</b>	10	12.3	<0.05
<b>poor</b>	9	11.1	<0.05
<b>Total</b>	81		

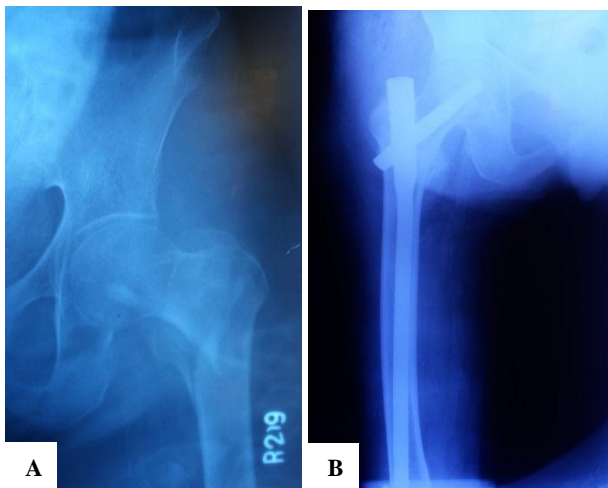
As for fracture type, A2 fractures were much more often treated by short PFNA in our study (p=0.037). A reasonable explanation may be that the more unstable the fracture was, the longer the intramedullary nail was needed. Preoperative hemoglobin levels in two groups

were similar, revealing no significant difference (p=0.413, Table 1). While operating these cases electrocautery was used in all centre and surgery was performed as per AO guidelines with slanted surgical approach. During operation the blood loss was (92±50.6) ml in short nail group, slightly greater in long nail group

(121.8±80.3) ml (p=0.004) besides the operation time (p=0.002) and postoperative transfusion rate (p=0.041) was also significantly lower in short nail group. The total length of hospital stay revealed no significant difference between two groups (12.2 d±6.2 d for long nail vs. 12.4 d±6.5 d for short nail, p=0.42). If we ignore the effect of nail length, there were no significant difference between type A1 and A2 intertrochanteric fractures in terms of blood loss, transfusion rate and hospital stay except operation time which was slightly higher because of distal locking (Table 2).



**Figure 1 (A and B): Preoperative and postoperative X-ray (short PFNA group).**

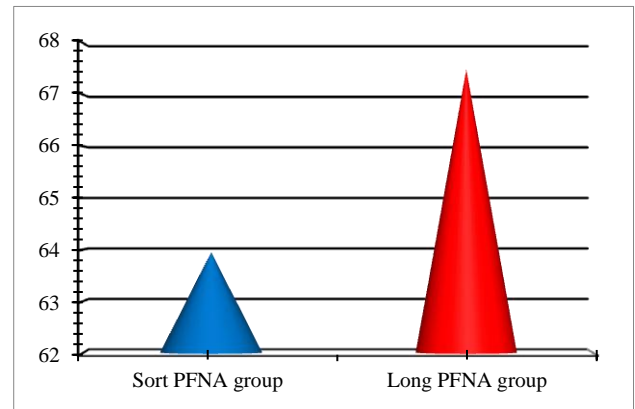


**Figure 2 (A and B): Preoperative and postoperative X-ray (long PFNA group).**

The occurrence of complications has been shown in Table 3. Clinical evaluation was done using Harris hip score (Table 4 and 5). Excellent and good results were accounted for 62 (76.5%) of cases in Short PFNA group and 72 (80.8%) in long PFNA group.

The mean lower extremity functionality scale in the short PFN group was 63.95 and the long PFN group was 67.50.

The two-tailed P value equals 0.0114 statistically significant as shown in Figure 3.



**Figure 3: The mean lower extremity functionality scale.**

**Table 5: Functional assessment using Harris hip score- long PFNA group.**

Harris hip score	Number (n)	Percentage (%)	P value
Excellent	45	50.5	<0.05
Good	27	30.3	<0.05
Fair	15	16.8	<0.05
poor	2	2.2	<0.05
<b>Total</b>	<b>89</b>		

## DISCUSSION

Hip fractures account for more than 50% of osteoporosis fractures in the elderly, and among them about a half is intertrochanteric fractures.<sup>4</sup> The elderly is a special and large group of people especially in developing country like India. Only 30% of geriatric patients with fractures can recover to the pre-injury status of life, provided timely fracture fixation causing heavy economic burden to the family.<sup>5</sup> It is reported that the mortality after intertrochanteric fracture reaches as high as 20%–30% in the first 6–12 months after injury, mainly caused by complications resulting from long-term bedridden, bed sore or deterioration of coexistent diseases.<sup>6</sup> Therefore, to improve the survival rate, rapid control and optimization of coexistent diseases. This age group required early effective treatment and early ambulation activities are very important.

Our retrospective series demonstrates there was not much clinically significant difference in fracture union however with short PFN group failure rate and anterior thigh hip pain rate was slightly higher. Periprosthetic fracture was associated with short PFNA group. The long nail group had significantly less failure rate and anterior thigh pain rate than those with short nails.

Recently intramedullary and extramedullary fixation systems are common choices for the treatment of intertrochanteric fractures. With the understanding of the concept “biological osteosynthesis”, emphasis is laid on the biological characteristics of the fractured bones during its management. Surgeons should pay particular attention to protect the normal physiological environment to promote callus formation and fracture healing. In the literature Intramedullary nail fixation shows apparent superiority over extramedullary fixation since it is minimal invasive, more in line with femoral canal and biomechanics and has a less stress riser. Therefore intramedullary fixation is superior to extramedullary devices in the treatment of intertrochanteric fractures amongst orthopedic surgeons and literature also supports this.

Several recently studies Kaplan et al, have found no differences using long or short intramedullary for femoral intertrochanter fractures in the elderly.<sup>7</sup> They attributes such no difference to the advanced changes in metallurgy and biomaterials, including more flexible titanium implants and adjusting the curvature to give a more anatomic fit for the femur in long nails. Similarly, short nails were modified in length, and incorporated a tapered end and smaller locking screws. All the above changes could achieve the goal of decreasing the incidence of periprosthetic fractures. Therefore, it could explain the reason of no differences between long nail and short nail for pertrochanteric hip fractures. However, the choice of implant for unstable intertrochanteric fractures is still debatable. PFNA are now favoured in developed country and there are multiple studies coming from that region to support this.<sup>8-10</sup> Very few studies has been done to compare outcome of short vs long PFNA nail treatment of pertrochanteric hip fractures in elderly Indian population. In our study of unstable intertrochanteric fractures treated by short and long PFNA in three different tertiary care hospital and data were analysed. We found good outcome with very few complication rate and high union rate with short operative time and early post-operative mobilization in both group. Our complication rate is comparable to previous studies.<sup>11-13</sup>

Hwang et al in their study preferred long over the shorter PFNA nail when there is excessive anterior curvature of the femur.<sup>14</sup> However, in our study, we noticed impingement of tip of short PFNA nail (240 mm length) to the anterior cortex in four cases due to excessive bowing and short femur length in Indians population. Pu et al they observed the same impingement in Chinese population.<sup>15</sup> Base on their study they recommend that it is better to use longer nail to bypass the curvature or relatively shorter nail to prevent this complication especially in patients with excessive anterior bowing of femur.

In our study population no case of intra operative femoral shaft fractures occurred during surgery. However Yaozeng et al reported 6 (5.6%) intra operative femoral

shaft fractures in their series of 107 intertrochanteric fractures.<sup>16</sup> Adequate reaming of the femoral canal especially when using longer PFNA nails can decrease the incidence of this complication.

Another study by Boopalan et al reported 21% incidence of intra operative lateral wall fractures in 31 A1 and A2 pertrochanteric fracture fixation.<sup>17</sup> The fracture union was not affected by the presence of lateral wall fractures in their study. In our study population, no cases of intra operative lateral wall fractures femur were noted. Gotfried reported 24 cases of lateral wall fractures in their study.<sup>18</sup> On radiographic examinations, he observed varus malalignment with medialisation of femoral shaft in all these cases. This was attributed to the use of a lateral cortex drill of 16 mm diameter for sliding screw. In the last few years, several studies<sup>19-23</sup> have reported successful outcome with low complication rates with short PFNA in unstable trochanteric fractures. Further, decreased time on the fracture table is associated with decreased risk of pudendal nerve palsy and less radiation exposure to patient and surgeon from intraoperative fluoroscopy.<sup>24,25</sup> It has been well-established fact that even low doses of ionizing radiation are associated with cancer, 50 mSv for acute exposure and 100 mSv for chronic exposure, and exposure should be minimized where possible.<sup>26</sup> The use of short nails offers an avenue for reducing radiation exposure. Our study too supports this finding, suggesting that short and long PFNA is a reasonable option in unstable trochanteric fractures however long PFNA has better outcome and lesser complication rate.

The overall incidence of periprosthetic fractures in our study was none in long nail group and 04 in short nail group, showing no significant difference. Although long nails are initially designed and used to reduce the risk of periprosthetic fractures, but both previous and our studies show that periprosthetic fractures seldom occur after long PFN intramedullary nail fixation. We believe that with the continuous improvement of the design of internal fixators, which are getting closer and closer to the biomechanical mechanisms of human body, the long PFNA nail certainly reduced the occurrence of periprosthetic fractures. On the contrary, the fracture type, degree of comminution and severity of osteoporosis are more related to the risk of periprosthetic fractures in these patients.

In conclusion, based on the results of the our current study, we believe that intramedullary nail fixation of intertrochanteric fractures in the elderly has good clinical result, particularly in early ambulation, reduction of bedridden-related complications like bed sore and improvement of quality of life. Long and short intramedullary nails PFNA have comparative clinical effects, though short nail has certain advantages in terms of operation time, intraoperative blood loss, and postoperative transfusion rate. The postoperative complications, periprosthetic fracture occurrence, anterior

thigh pain and secondary surgery revealed not much significant differences. During fracture fixation, surgeons need to take into account that the revision surgery of two techniques is different if periprosthetic fracture occurs. Short nail can be removed and replaced by a long PFNA nail while long nail usually required plate fixation on the lateral aspect of femur without removal of nail.

Therefore, during treatment of intertrochanteric fractures in elderly especially when bone is osteoporotic, surgeons should choose different length of intramedullary nails based on patient's general condition, fracture type, size of the anterior arch of the femur, distal locking technology and difficulty, and difficulty for fracture fixation if periprosthetic fracture happens.

## CONCLUSION

Thus based on our study we can conclude that once the intraoperative near anatomical reduction was achieved, the use of short PFNA can be more efficient, faster, however as far as fracture union rate is concern it was not statistically significant. The incidence of anterior thigh pain and periprosthetic fracture was higher in short PFNA groups as compared to long PFNA group.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the institutional ethics committee*

## REFERENCES

- Melton LJ 3rd, Gabriel SE, Crowson CS, Tosteson AN, Johnell O, Kanis JA. Cost-equivalence of different osteoporotic fractures. *Osteoporos Int.* 2003;14:383–8.
- Brauer CA, Coca-Perraillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. *JAMA.* 2009;302(14):1573-9.
- Raval P, Ramasamy A, Raza H, Khan K, Awan N. Comparison of Short vs Long Anti-rotation in Treating Trochanteric Fractures. *Malays Orthop J.* 2016;10(1):22-8.
- Zhang YZ. Hip fractures in the elderly—the chance and challenge for Chinese orthopedic surgeons. *Chin J Trauma.* 2014;30:193–5.
- Bansal R, Luscombe J, Cooper JP. Post-operative mortality related to waiting time for hip fracture surgery. *Injury.* 2005;36:984
- Hou Z, Bowen TR, Irgit KS, Matzko ME, Andreychik CM, Horwitz DS, Smith WR. Treatment of pertrochanteric fractures (OTA 31-A1 and A2): long versus short cephalomedullary nailing. *J Orthop Trauma.* 2013;27:318–24.
- Kaplan K, Miyamoto R., Levine BR., et al. Surgical management of hip fractures: an evidence-based review of the literature. II: intertrochanteric fractures *J Am Orthop Surg,* 16 (2008), pp. 665–673.
- Simmermacher RK, Ljungqvist J, Bail H, Hockertz T, Vochteloo AJ, Ochs U, et al. AO - PFNA study group The new proximal femoral nail antirotation (PFNA) in daily practice: results of a multicentre clinical study. *Injury.* 2008;39(8):932–9.
- Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg Am.* 1969;51(4):737–55.
- Zou J, Xu Y, Yang H. A comparison of proximal femoral nail antirotation and dynamic hip screw devices in trochanteric fractures. *J Int Med Res.* 2009;37(4):1057–64.
- Gardenbroek TJ, Segers MJ, Simmermacher RK, Hammacher ER. The proximal femur nail antirotation: an identifiable improvement in the treatment of unstable pertrochanteric fractures? *J. Trauma.* 2011;71(1):169–74.
- Boone C, Carlberg KN, Koueiter DM, Baker KC, Sadowski J, Wiater PJ, et al. Short versus long intramedullary nails for treatment of intertrochanteric femur fractures (OTA 31-A1 and A2). *J Orthop Trauma.* 2014;28:96–100.
- Kleweno C, Morgan J, Redshaw J, Harris M, Rodriguez E, Zurakowski D, et al. Short versus long cephalomedullary nails for the treatment of intertrochanteric hip fractures in patients older than 65 years. *J Orthop Trauma.* 2014;28:391–7.
- Hwang JH, Oh JK, Han SH, Shon WY, Oh CW. Mismatch between PFNa and medullary canal causing difficulty in nailing of the pertrochanteric fractures. *Arch Orthop Trauma Surg.* 2008;128(12):1443–6.
- Pu JS, Liu L, Wang GL, Fang Y, Yang TF. Results of the proximal femoral nail anti-rotation (PFNA) in elderly Chinese patients. *Int Orthop.* 2009;33(5):1441–4.
- Yaozeng X, Dechun G, Huilin Y, Guangming Z, Xianbin W. Comparative study of trochanteric fracture treated with the proximal femoral nail anti-rotation and the third generation of gamma nail. *Injury.* 2010;41(12):1234–8.
- Boopalan PR, Oh JK, Kim TY, Oh CW, Cho JW, Shon WY. Incidence and radiologic outcome of intraoperative lateral wall fractures in OTA 31A1 and A2 fractures treated with cephalomedullary nailing. *J Orthop Trauma.* 2012;26(11):638–42.
- Gotfried Y. Percutaneous compression plating of intertrochanteric hip fractures. *J Orthop Trauma.* 2000;14(7):490–5.
- Strauss E, Frank J, Lee J, Kummer FJ, Tejwani N. Helical blade versus sliding hip screw for treatment of unstable intertrochanteric hip fractures: a biomechanical evaluation. *Injury.* 2006;37(10):984–9.
- Gardenbroek TJ, Segers MJ, Simmermacher RK, Hammacher ER. The proximal femur nail antirotation: an identifiable improvement in the

- treatment of unstable pertrochanteric fractures? *J Trauma*. 2011;71(1):169–74.
21. Chang SM, Zhu XZ, Huang YG, Wang X, Zhang YQ, Ma Z. Extramedullary DHS and intramedullary PFNA in unstable pertrochanteric fractures with lateral wall risky AO/OTA type 31A2.2 and A2.3: A clinical retrospective comparison. *Orthop J China*. 2010;18:1868-72.
  22. Nikoloski AN, Osbrough AL, Yates PJ. Should the tip-apex distance (TAD) rule be modified for the proximal femoral nail antirotation (PFNA)? A retrospective study. *J Orthop Surg Res*. 2013;8:35.
  23. Chang SM, Song DL, Ma Z, Tao YL, Chen WL, Zhang LZ, et al. Mismatch of the short straight cephalomedullary nail (PFNA-II) with the anterior bow of the femur in an Asian population. *J Orthop Trauma*. 2014;28:17-22.
  24. Brumback RJ, Ellison TS, Molligan H, Molligan DJ, Mahaffey S, Schmidhauser C. Pudendal nerve palsy complicating intramedullary nailing of the femur. *J Bone Joint Surg Am*. 1992;74(10):1450–5.
  25. Baumgartner R, Libuit K, Ren D, et al. Reduction of radiation exposure from C-arm fluoroscopy during orthopaedic trauma operations with introduction of real-time dosimetry. *J Orthop Trauma*. 2016; 30(2):53–8.
  26. Brenner DJ, Doll R, Goodhead DT, Hall EJ, Land CE, Little JB, et al. Cancer risks attributable to low doses of ionizing radiation: assessing what we really know. *Proc Natl Acad Sci U S A*. 2003;100(24):13761–6.

**Cite this article as:** Krishnan BH, Rai SK, Vikas R, Kashid M, Mahender P. A comparative study of the fracture union between long and short proximal femoral intramedullary nails antirotation in the treatment of intertrochanteric femur fractures in the elderly: a multicentric analysis. *Int J Res Orthop* 2019;5:288-94.