

# Comparison of Gamma Nail and Locking Plate in Treatment of Intertrochanteric Fractures

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## Abstract

**Background and Objectives:** The effective method for the surgical treatment of intertrochanteric femoral fractures has not been established. Two commonly used techniques are Gamma nail and locking plate. We performed a retrospective study to compare these two treatment strategies.

**Materials and Methods:** A total of 42 patients were selected for review. Each patient was treated by one of the two methods. Data including operative time, blood loss, pain scale, radiological result, Harris hip score and operative complications were collected.

**Results:** Twenty-two patients were treated with Gamma nail and the rest (20) were treated with locking plate fixation. Gamma nail group was associated with significantly shorter operative time and length of hospital stay, lesser blood loss and lower postoperative pain ( $P < 0.05$ ). There was no significant difference in Harris hip score, radiological result and complications between the two groups.

**Conclusion:** Gamma nail technique is similar in effectiveness to the locking plate in the treatment of intertrochanteric femoral fractures, but with a shorter operative time and hospital stay, lesser blood loss and lower postoperative pain.

**Keywords:** Intertrochanteric femoral fractures, gamma nail, locking plate

## INTRODUCTION

The common type of hip fractures is intertrochanteric fractures with 20-30% of these cases experiencing complications and a mortality rate of approximately 17%<sup>1</sup>. In the elderly, these fractures typically resulted from mild to moderate trauma due to osteoporotic bones while in young adults, these fractures are generally due to high energy trauma, such as road accidents<sup>2</sup>. The incidence of hip fractures is 2-3 times more common in females and the risk of fracture will double, every 10 years after the age of 50<sup>3</sup>. Operative treatment is the best option in hip fractures<sup>4</sup>.

There are several devices that may be used for fracture fixation.

Cephalomedullary devices, with their course of evolution and improvement of implant designs, have been demonstrated to be useful in the management of unstable fractures<sup>5-8</sup>. But they are associated with intraoperative technical and mechanical complications<sup>9-10</sup>. Moreover, geometrical mismatch between proximal femoral nail and the femora of Asians make surgery more difficult and complicated<sup>11-12</sup>.

One such new device is the locking plate, an implant plate with a stable angle for management of

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comminuted and osteoporotic fractures. The locking plate is stated to be more suitable for stable and osteoporotic intertrochanteric fractures<sup>13-15</sup>. The use of the locking plate device by some surgeons has warranted an examination of the effectiveness of these method<sup>16</sup>.

The proposed theoretical advantages of the Gamma nail are reduced blood loss due to the percutaneous technique, minimal tissue damage, and shorter operative time<sup>17-18</sup>. In addition, the possible mechanical advantage over plate fixation is that the nail is closer to the axis of weight bearing through the femoral head, and leverage is therefore reduced<sup>19</sup>. The use of the Gamma nail has also been found to cause many complications, the most common of which is fracture of the femoral shaft at the tip of the intramedullary nail<sup>20</sup>.

The aim of the present study was to compare Gamma nail with locking plate in the management of intertrochanteric fractures.

## MATERIALS AND METHODS

A retrospective review was conducted from 2007 to 2015; 42 consecutive patients with intertrochanteric femoral fractures were surgically treated at Sawangdaendin Crown Prince Hospital. Inclusion criteria for this study were (a) patients with an acute and unilateral fractures, (b) treated with either Gamma nail or locking plate, (c) age greater than 18 years, and (d) operated within 3 weeks. Exclusion criteria included (a) pathological fracture, (b) multiple injuries, (c) fractures with significant subtrochanteric extension ( $> 3$  cm), (d) previous ipsilateral hip or femur surgery, and (e) inability to give informed consent or refusal to participate and those unfit for surgical intervention.

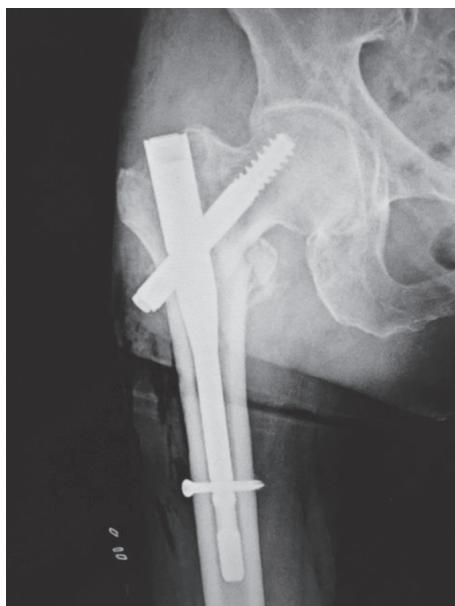
The operative technique for each group was as follows:

*Gamma nail group:* after preoperative assessment, patient was taken on the traction table under spinal anesthesia. Maintaining traction, closed reduction was achieved by applying slight traction in anatomic axis of the limb without any abduction or adduction and slight internal rotation or external rotation depending on underlying fracture geometry. The opposite limb was kept in flexion and abduction. C-Arm reduction was verified on image intensifier. If acceptable, part was cleaned, painted and draped. The tip of the greater

trochanter was identified by palpation and a 2-cm incision extended proximally from it. Care was taken not to extend the incision too proximally as this would damage the inferior gluteal nerve. Incision was deepened through fascia lata, splitting the abductor muscle immediately above the tip of the greater trochanter, thus exposing its tip. The entry site was opened up with a cannulated curved awl and a guide wire passed into the medulla simultaneously achieving reduction at fracture site. Short gamma nail was used in all cases. Nail of chosen size was templated. Nail was then passed manually with rocking motion. The incision was made on the skin overlying the lateral for introduction of lag screw. Lateral cortex was incised. A guide wire was passed through guide sleeve across the lateral cortex into the posteroinferior sector of femoral head under image intensifier control and an appropriate-sized lag screw was inserted after drilling over lag screw guide wire and was introduced deep in the subchondral region in the center of head in antero posterior and lateral plane. Distal locking was done under image intensifier. If the fracture site had a bone gap, an iliac bone graft was inserted. In cases where closed reduction was not possible, a mini open or open reduction was done and the rest of the steps were the same (Figure 1, 2). Wound was closed in layers.



**Figure 1** Radiograph of an intertrochanteric fracture of a 72-year-old woman



**Figure 2** Radiograph 2 weeks after surgery



**Figure 3** Radiograph of an intertrochanteric fracture of a 38-year-old man

*Locking plate fixation group:* the patient was placed in supine position on the fracture table. Closed reduction was attempted and checked under image intensifier in both anteroposterior (AP) and lateral views. If acceptable, part was cleaned, painted and draped. An incision, about 5 cm in size, was made over the greater trochanter. Fascia of the vastus lateralis muscle was incised at its proximal insertion and flipped anteriorly to visualize the bone. The plate was introduced through the proximal incision and slid down distally beneath the muscle without stripping the periosteum of the lateral femur. The plate was maneuvered onto the distal fragment through a short distal incision, using bone holding forceps. In this position, proper placement of the plate was checked. Three to five proximal locking screws were passed through threaded screw hole up to the center of the neck. Satisfactory position of screw was checked in AP and the lateral planes. Following this, distal fixation was performed with three to four screws through the distal incision. In cases where closed reduction was not possible, a mini open or open reduction was done and the rest of the steps were the same. If the fracture site had a bone gap, an iliac bone graft was inserted. (Figure 3, 4). The wound was irrigated and closed in layers.

Intra-operative variables that were recorded were duration of surgery, blood loss during surgery and type of reduction. Radiographs were obtained on the first



**Figure 4** Radiograph 4 weeks after surgery

post-operative day, and analyzed for reduction of the fracture and position of the implant. The patient was allowed to sit up in bed on the day after surgery, and active exercises of the operated hip and knee were started. Depending on the patient's condition and the stability of the internal fixation, weight-bearing was started using axillary crutches or walking frame as soon as possible. Sutures were removed at post-operative day 14.

Radiographs were evaluated for tip-apex distance

(TAD). TAD is the most valuable factor in determining the likelihood of lag screw cut-out, with a distance  $> 25$  mm as an indicator of unsatisfactory screw placement and a significantly increased rate of cut-out. In addition to TAD, the position of the cephalic screw in one of nine zones in the head has been described<sup>21</sup>. The ideal position is center-center, but a short screw which is center-center may still allow for a TAD  $> 25$  mm.

Patients were advised to visit for follow up at two weeks, three months, six months and one year. Patients with a minimum follow up of six months were included in the final analysis. Union was defined as bridging callus in three or more cortices on radiographs with ability to bear full weight on the extremity. However, with this protocol, it was not possible to know when exactly the union occurred in each individual patient.

The data recorded for all patient included pain visual analogue pain scale (0: none to 10: severe) on the first post-operative day and operative complications.

At the 6-month follow-up, functional outcome was assessed by Harris hip score (HHS). HHS measures the general health status from the patient's point of view and results are expressed in terms of two meta-scores: HHS of 90-100 was considered as excellent, 80-89 as good, 70-79 fair and  $< 60$  as poor.

Descriptive statistics were compiled for all data points. Chi-square analyses were used to compare categorical variables. Independent samples students t-tests were used to compare continuous variables between two groups. Two-sided p-values of less than 0.05 were considered statistically significant.

## RESULTS

There were 42 patients in the present study, with an average age of 56.7 years (range 23-78 years). All

were followed up for more than six months after discharge from the hospital. The average follow-up time was 12.7 months (range 6-24 months). Forty-two patients were divided into two groups, based on the method of treatment. The Gamma nail group included 22 patients and the locking plate group included 20 patients. The average length of hospital stay was 10.8 days (range 4-17 days) for the Gamma nail group and 13.5 days (range 6-21 days) for the locking plate group; this difference was significant ( $P < 0.01$ ). The mechanisms of injury and demographics data related to each group are shown in Table 1.

Both groups were similar in fracture pattern on Evan classification. The difference between in the two groups was not significant ( $p = 0.516$ ) (Table 2).

The mean operative time was 89 minutes (range 71-112 minutes) for the Gamma nail group and 108 minutes (range 91-128 minutes) for the locking plate group; this difference was significant. Average blood loss during surgery was 95 ml (range 10-200 ml) for the Gamma nail group and 212 ml (range 100-300 ml) for the locking plate group; this difference was significant. Thirteen patients in Gamma nail group and ten patients in locking plate group received closed reduction. The difference between the two groups was not significant ( $p = 0.554$ ). The average pain score on the first post-operative day was 5.8 for the Gamma nail group and 7.3 for the locking plate group; this difference was significant. Detail of outcomes was summarized in Table 3

At the 6-month follow-up in the Gamma nail group, the mean HHS was 86.3 points. In the locking plate group, the mean score was 85.7 points. There were no significant difference in the scores between the two groups ( $p = 0.418$ ).

The TAD was 22.2 mm in the Gamma nail group

**Table 1** Injury mechanism, length of hospital stay, preoperative demographics for both treatment groups

Characteristics	Gamma nail (n=22)	Locking plate (n=20)	p-value
Gender (M/F)	10/12	9/11	0.976
Age, years:mean (SD)	55.9 (5.7)	57.1 (6.1)	0.147
Follow-up (months):mean (SD)	12.6 (3.3)	12.8 (3.4)	0.586
Falling (%)	12 (54.5%)	9 (45%)	0.537
Injury time (days):mean (SD)	4.5 (1.3)	4.7 (1.4)	0.675
Length of hospital stay:mean (SD)	10.8 (3.5)	13.5 (4.4)	< 0.01

and 21.9 mm in the locking plate group. The difference between the two groups was not significant ( $p = 0.685$ ) (Table 4).

**Table 2** Characteristic of fracture

Fracture type	Gamma nail	Locking plate
Stable	11	8
Unstable	11	12
<b>Total</b>	<b>22</b>	<b>20</b>

Post-operative complications were noted in five patients in Gamma nail group and four patients in locking plate group. In the Gamma nail group, there was one patient who had superficial infection. The superficial infection was diagnosed clinically at the first follow-up visit at seven days after surgery. After seven days of treatment with oral antibiotics, the wound healed uneventfully. In the locking plate group, there were two patients with superficial infection. Oral antibiotics resolved the problem. There was no

**Table 3** Comparison of outcome between the two treatment groups

Outcome	Gamma nail (n=22)	SD	Locking plate (n=20)	SD	p-value
Operative time, min	89 (range 71-112)	9	108 (range 91-128)	10	< 0.01
Blood loss, ml	95 (range 10-200)	24	212 (range 100-300)	48	< 0.01
Closed reduction, n	13		10		0.554
Pain scale	5.8 (range 3-9)	1.4	7.3 (range 4-10)	1.6	< 0.01

**Table 4** Comparison of hip scores and radiological result between the two groups

	Gamma nail	SD	Locking plate	SD	p-value
HSS, points (range)	86.3 (74-98)	5.5	85.7 (71-96)	6.5	0.418
TAD, mm (range)	22.2 (18-26)	2.1	21.9 (17-27)	2.5	0.685

**Table 5** Comparison of complications in both groups

	Gamma nail	Locking plate
Infection	1	2
Limb Length Discrepancy	1	0
Malunion	1	1
Pain on walking	1	1
Limited hip flexion	1	0

difference ( $p = 0.830$ ) (Table 5).

## DISCUSSION

An increase in the elderly population has resulted in a higher incidence of peritrochanteric fractures of the femur. To prevent the complications of prolonged immobilization, timely management with appropriate methods and early mobilization of the patients become the best way for these fractures.

It was previously held that the Gamma nail in the management of peritrochanteric fractures theoretically

lifted the weight off the inner cortex of the femoral neck more than the outer cortex. Compared to the plates, intramedullary nails, being more recently developed, were mechanically advantageous because they were internal. The bending moment in the joint on the intramedullary nail and the screw was less than in that of the plate and the screw.

The screw of the Gamma nail proved more likely to go up the central axis of the femoral neck, and to give a better screw position. This may be because the entry point of the guide wire into the neck is controlled by the position of the nail within the medulla, close to

the base of the neck, a point which is less variable than an entry point on the lateral cortex. Placement of the screw close to the subchondral bone may improve fixation.

In the study of intertrochanteric fractures treated with the LCP device by Yuming *et al.*, the mean operating time was 53.2 minutes, HSS were “excellent” (53.5%), “good” (37.5%), “fair” (6.5%) and “poor” (2.5%) and no infection or limb shortening was reported<sup>22</sup>. In the present study, the rate of good HSS was higher.

Other reports proposed that fixation with the LCP device is better because placement of the plate is more adaptable for the surgeon and it reduces the deformity of flexion or extension<sup>23</sup>.

In this study, at the 6-month postoperative examination, patients treated with the Gamma nail had higher HSS. On the basis of this score which shows the qualitative improvement of the hip joint function, we believe that the Gamma nail device is preferred over the LCP device. Various factors including the type of fracture, related complications, and experience can affect the function of hip joint as demonstrated using the HSS.

Of the postoperative complications, fracture of the femur shaft was unique to the Gamma nail group. This could be due to the stress riser created by the rigid implant inside the usually osteoporotic proximal medullary canal. The femoral component of the standard nail in the small Asian femur causes impingement of the tip of the nail. This may also explain the incidence of early thigh pain, release by fracture healing, when the load is taken by bone.

In general, device failure is due to several factors including the type of fracture and its stability, osteoporosis and the incorrect placement of the screw into the femoral head. However, proper exercise and rehabilitation of the patients is important<sup>24</sup>.

This study had a few limitations: (a) it was a retrospective study and not randomized, so there was selection bias, (b) the size of the study was relatively small, thus a few comparisons lacked statistical power, and (c) the follow-up period of one year may be too short to draw final conclusions on long-term outcome and complications.

## CONCLUSION

Gamma nail technique is similar in effectiveness

to the locking plate in the treatment of intertrochanteric femoral fractures, but with a shorter operative time and length of hospital stay, lesser blood loss and lower postoperative pain.

## REFERENCES

1. Campbell WC, Canale ST, Beaty JH. Campbell's operative orthopaedics. 11th ed. Philadelphia, PA: Mosby/Elsevier; 2008.
2. Paganini-Hill A, Chao A, Ross RK, Henderson BE. Exercise and other factors in the prevention of hip fracture: the Leisure World study. *Epidemiology* 1991;2(1):16-25.
3. Rockwood CA, Green DP, Bucholz RW. Rockwood and Green's fractures in adults. 7th ed. Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2010.
4. Dhanwal DK, Cooper C, Dennison EM. Geographic variation in osteoporotic hip fracture incidence: the growing importance of asian influences in coming decades. *J Osteoporos* 2010;2010:757102.
5. Khan N, Askar Z, Ahmed I. Intertrochanteric fracture of femur: outcome of dynamic hip screw in elderly patients. *Professional Med J* 2010;17:328-33.
6. Pajarinen J, Lindahl J, Michelsson O, Savolainen V, Hirvensalo E. Pectrochanteric femoral fractures treated with a dynamic hip screw or a proximal femoral nail: A randomized study comparing post-operative rehabilitation. *J Bone Joint Surg (Br)* 2005;87-B:76-81.
7. Klinger HM, Baums MH, Eckert M, Neugebauer R. A comparative study of unstable per- and intertrochanteric femoral fractures treated with dynamic hip screw (DHS) and trochanteric buttress plate vs. proximal femoral nail (PFN). *ZentralblChir* 2005;130(4):301-6.
8. Domingo LJ, Cecilia D, Herrera A, Resines C. Trochanteric fractures treated with a proximal femoral nail. *Int Orthop* 2001;25:298-301.
9. Banan H, Al-Sabti A, Jimulia T, Hart AJ. The treatment of unstable, extracapsular hip fractures with the AO/ASIF proximal femoral nail-our first 60 cases. *Injury* 2002;33:401-5.
10. Al-yassari G, Langstaff RJ, Jones JWM, Al-Lami M. The AO/ASIF proximal femoral nail (PFN) for the treatment of unstable trochanteric femoral fracture. *Injury* 2002;33:395-9.
11. Leung KS, Procter P, Robionek B, Behrens K. Geometric mismatch of the Gamma nail to the Chinese femur. *ClinOrthopRelat Res*. 1996;323:42-48.
12. Hwang JH, Oh JK, Han SH, Shon WY, Oh CW. Mismatch between PFNa and medullary canal causing difficulty in nailing of the pectrochanteric fractures. *Arch Orthop Trauma Surg* 2008;128:1443-6.
13. Egol KA, Kubiak EN, Fulkerson E, Kummer FJ, Koval KJ. Biomechanics of locked plates and screws. *J Orthop Trauma*. 2004;18(8):488-93.
14. Kregor PJ, Obremskey WT, Kreder HJ, Swiontkowski MF. Unstable pectrochanteric femoral fractures. *J Orthop Trauma*. 2005;19(1):63-6.
15. Whitelaw GP, Segal D, Sanzone CF, Ober NS, Hadley N.

Unstable intertrochanteric/subtrochanteric fractures of the femur. ClinOrthopRelat Res 1990;(252):238-45.

16. Yong C, Tan C, Penafort R. Dynamic hip screw compared to condylar blade plate in the treatment of unstable fragility intertrochanteric fractures. Malays orthop J 2009;3:13-8.
17. Bridle Sh, Patel AD, Bircher M, Calvert PT. Fixation of intertrochanteric fractures of the femur: a randomised prospective comparison of the gamma nail and the dynamic hip screw. J Bone Joint Surg [Br] 1991;73:330-4.
18. Halder SC. The Gamma nail for pertrochanteric fracture. J Bone Joint Surg [Br] 1992;74:340-4.
19. Parker MJ, Pryor GA. Gamma versus DHS nailing for extracapsular femoral fractures: meta-analysis of ten randomised trials. IntOrthop (SICOT) 1996;20:163-8.
20. Radford JP, Needoff M, Webb JK. A prospective randomised comparison of the dynamic hip screw and the Gamma locking nail. J Bone Joint Surg [Br] 1993;75:789-93.
21. Jalovaara P, Berglund-R den M, Wingstrand H, Thorngren KG. Treatment of hip fracture in Finland and Sweden. ActaOrthop Scand 1992;63(5):531-5.
22. Yuming Y, Yong L, Weiping Z. A clinical therapeutic effect analysis of LCP fixation for osteoporotic femoral intertrochanteric fracture with Singh's classification I, II. Chin J Bone Joint Injury 2011;10:8.
23. Hasenboehler EA, Agudelo JF, Morgan SJ, Smith WR, Hak DJ, Stahel PF. Treatment of complex proximal femoral fractures with the proximal femur locking compressionplate. Orthopedics 2007;30(8):618-23.
24. Li P, Yang H, Zheng L. Postoperative complications of Dynamic hip screw and its prevention in the treatment of intertrochanteric fracture. J Dalian Med Univ 2009;3:17.

บทคัดย่อ การเปรียบเทียบระหว่าง Gamma Nail และ Locking Plate ในการรักษาผู้ป่วยที่มีกระดูกสะโพกหักระหว่างโกรแคนเตอร์

สมบูรณ์ วุฒิพิริยะอัจกร, พ.บ.

กลุ่มงานศัลยกรรมออร์โธปีดิกส์ โรงพยาบาลสมเด็จพระบูพราษร์สวัสดิ์วนดิน จังหวัดสกลนคร

**วัตถุประสงค์:** เพื่อเปรียบเทียบผลการรักษาระหว่าง Gamma nail และ locking plate ในการรักษาผู้ป่วยที่มีกระดูกสะโพกหักระหว่างโกรแคนเตอร์

**วิธีการ:** การศึกษาวิจัยแบบข้ออ่อนหลัง โดยคุณระยะเวลาในการผ่าตัด, การเสียเลือด, ระดับความเจ็บปวดหลังการผ่าตัด, Harris hip score, ผลทางรังสีวิทยา และข้อแทรกซ้อน

**ผลการรักษา:** ผู้ป่วย 42 ราย แบ่งเป็น 2 กลุ่ม ได้แก่ กลุ่ม Gamma Nail จำนวน 22 ราย และ กลุ่ม locking plate จำนวน 20 ราย ผลการรักษาไม่แตกต่างกันอย่างมีนัยสำคัญใน Harris hip score ผลทางรังสีวิทยาและข้อแทรกซ้อน แต่กลุ่ม Gamma nail ใช้ระยะเวลาในการผ่าตัดน้อยกว่า, ระยะเวลาอนโรงพยาบาลนานกว่า, เสียเลือดน้อยกว่าและมีระดับความเจ็บปวดหลังการผ่าตัดน้อยกว่าอย่างมีนัยสำคัญ ( $P < 0.05$ )

**สรุป:** การผ่าตัด Gamma nail มีคุณภาพเท่ากับ locking plate ในการรักษาผู้ป่วยที่มีกระดูกสะโพกหักระหว่างโกรแคนเตอร์ โดยใช้ระยะเวลาในการผ่าตัดน้อยกว่า, ระยะเวลาอนโรงพยาบาลนานกว่า, เสียเลือดน้อยกว่าและมีความเจ็บปวดหลังผ่าตัดน้อยกว่า