

Evaluation of the Functional and Clinical Outcome of Intramedullary Osteosynthesis with Gamma Nail in Treatment of Unstable Peritrochanteric Fractures

AHMED M. MOHAMMED, M.D.; YASSER A. RADWAN, M.D.; MOHAMMED ABO ELSOUD, M.D.; EHAB A. HUSSEIN, M.D. and HOSSAM ELDIN E. MOHAMMED, M.D.

The Department of Orthopaedic Surgery, Faculty of Medicine, Cairo University and Al-Helal Hospital

Abstract

Background: Peritrochanteric fractures of the femur rank among the most common fractures in elderly people. The Gamma Nail is one of the latest advances in the treatment of trochanteric fractures based on intramedullary nailing principles during closed procedures.

Purpose: This paper is made to assess the Functional & clinical Outcome of closed intramedullary osteosynthesis with a gamma nail in the treatment of unstable peritrochanteric fractures.

Material and Methods: The study was based on a total of 30 patients surgically treated for unstable peritrochanteric femoral fracture by gamma nail fixation in the period between June/2012 till February/2014, including 10 males and 20 females with the mean age is 67.63 (range 50 to 81). The right side was affected in 16 patients and left side was affected in 14.

Results: There were 28 patients (93.33%) with good reductions while there was 2 cases with mild displacement (<8mm) in both AP & lateral views but considered accepted. The fracture had healed in all the patients with no significant varus displacement except in 2 patients where their fracture had healed with mild (<20) degrees varus angulations. No intraoperative complication were reported. Post operative fracture of femur midshaft had occurred in 1 patient after 10 weeks. Screw cutout had occurred also in 1 case while 3 cases sustained superficial infection. Recovery situations of all patients were evaluated based on Harris scoring with an average of 87 points. There are indications and improved functional outcome in the treatment of unstable intertrochanteric fracture with Gamma 3 intramedullary nail.

Conclusion: Various studies found favorable results with gamma nail in managing a greater variety of unstable hip fractures with a less invasive technique and with better results. Other studies have reported favorable results with GN in terms of shorter operation time, less blood loss, shorter hospital stay, decreased wound infection and reduced complication rate.

Correspondence to: Dr. Ahmed M. Mohammed,
The Department of Orthopaedic Surgery, Faculty of Medicine,
Cairo University and Al-Helal Hospital

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Introduction

TROCHANTERIC fracture is common in elderly population. Ninety percent of trochanteric fractures in the elderly patients result from a simple fall [1].

Hip fractures have a bimodal age distribution: Approximately 97% occur in patients over 50 years of age usually occur in alcoholics or patients with multiple medical diseases, whose fractures are related to osteoporosis, and only 3% in patients under 50 years, due to high-energy trauma [2].

Approximately 50-60% of all trochanteric fractures are classified as unstable. This represents a great challenge to the operating surgeon, as the rate of failure for these kinds of fractures vary from 8 to 25% [3].

Treatment options include nonoperative treatment and operative treatment. Operative options include closed reduction and internal fixation with dynamic hip screws, dynamic condylar screws and intramedullary fixation devices [4].

Treatment goals for these patients include early rehabilitation, restoration of anatomical alignment and maintenance of the fracture reduction by internal fixation [5].

Since its introduction in the late 1970's, the dynamic hip screw (DHS) had become a standard device for the fixation of all trochanteric fractures of the femur [6]. However, in unstable fractures the DHS has performed less well with substantial rates of fixation failure, poor functional outcome and associated morbidity [7].

To overcome the difficulties encountered in the treatment of unstable fractures, cephalomedullary nails have been developed. The main principle of trochanteric-entry nail fixation is based on a sliding screw in the femoral neck-head fragment, attached to an intramedullary nail. The nail has major advantages over a DHS from the bio-mechanical point of view; including a semi-closed procedure and a shorter lever arm giving greater stability and allowing rapid rehabilitation [4].

The Gamma nail was the first trochanteric-entry nail introduced in 1988, and was designed specifically for the treatment of unstable fractures.

The nail occupies the medullary canal, preventing excessive sliding and medialization of the shaft even in A3 fractures. It also covers all the other fracture patterns like reverse obliquity and trochanteric fracture with subtrochanteric extension effectively [8].

The biggest advantage of intramedullary implants is the early full weight-bearing ability. Intramedullary fixation remains the treatment of choice for proximal femoral fracture, because of its biomechanical superiorities in regard to axial loading. This rigid structure provides a good purchase, even in osteoporotic bone, for preventing the screws from sliding and pull-out [9].

Patients and Methods

The study was based on a total of 30 patients presented to The Emergency Department of Al-Helal Hospital & Kasr Al-Aini Hospital of Cairo University. All patients are surgically treated and followed-up for the peritrochanteric femoral fracture in the period between June /2012 till February /2014. The pre-operative parameters that were recorded included the age that ranged from 50 to 81 years with the mean age about 67.63 years, sex which was 10 male & 20 female, the side of the fracture was 16 fractures involving the right femur & 14 fractures involving the left side, while the pattern of fracture was 83% of type A2 & A3 while the remaining 17% is type A1.3 according to AO classification. All patients were assessed preoperatively by thorough history taking and clinical examination. All patients were assessed radiographically by plain X-ray. Surgical technique: General or regional anesthesia was determined by the anesthesiologist according to the patient's medical condition. The patient is placed in a supine position on the fracture table and closed reduction of the fracture is recommended. The incision is made approximately 3 to 5cm proximal from the tip of

the greater trochanter. The correct entry point (Fig. 1) is located at the junction of the anterior third and posterior two-thirds of the tip of the greater trochanter.

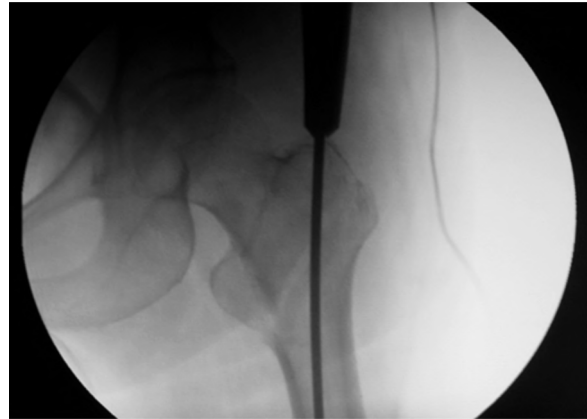


Fig. (1): Entry point at the tip of the greater trochanter.

The medullary canal has to be opened under image intensification by the use of the cannulated curved awl and a 3mm guide wire is passed through it as a reamer guide and check its position by c-arm. Then reaming of the proximal femure is done using 15.5 reamer up to the level of lesser trochanter. After that we insert the gamma nail with its target device by hand over the guide wire till its final position. Insertion of the lag screw into the neck of femure over a guide wire inserted under c-arm is done after reaming the neck of femure by special reamer. Then we insert a small lock screw from upper end of the gamma nail to lock the lag screw in its position to prevent its rotation and sliding (Fig. 2).

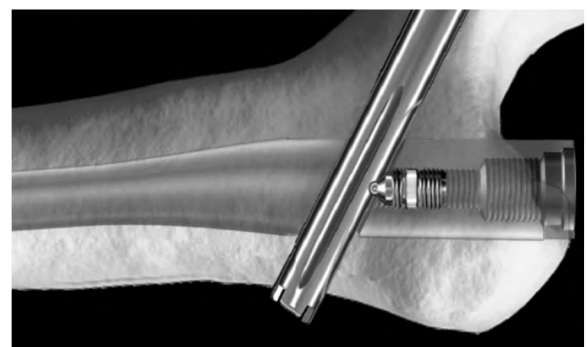


Fig. (2): Set Screw Position [11]

After that we insert the distal locking screw through the target device into either dynamic or static holes in the distal part of the nail. Post operative care: Physiotherapy, mobilization from bed and partial weight bearing were allowed for patient as soon as the patients' condition enabled it using crutches, then we proceed for full weight bearing when callus appears usually after 5-6

weeks. Patients were discharged from the hospital by the fifth day and were seen regularly at the outpatient clinic at two, six weeks, then after three, six & twelve months from operation where they followed-up using Harris hip score. Healing was assessed by the following:

Clinically: Absence of local tenderness.

Radigraphically: Presence of callus and fracture line disappearance.

Results

The mean follow-up of 30 patients was 17 months (12-23). The final Harris hip score was excellent in 7 patients (23 %) as it ranged between (90-100), while it was good in 13 patients (44%) as it ranged between (80-89). It was fair in 5 patients (17%) as it ranged (70-79) & it was poor in 5 patients (16%) as it ranged less than 70 (Diagram 1).

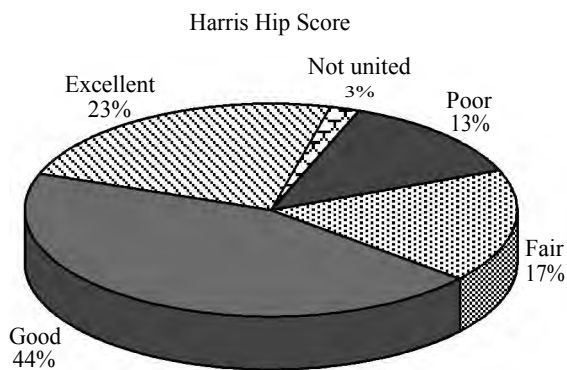


Diagram (1): Showing percentage of Harris hip score outcome.

The Gamma nail requires short incision (4-6 cm). The blood loss ranged from (100-250ml) with the mean blood loss was 196ml. The operative time ranged from (45-90min.) with the mean operative time was 67.5 minutes. The average time of c-arm exposure was 2.9 minutes as it ranged from (1.5-3.5min.). The time to union of the fracture ranged from 8 to 13 week with the mean time to union was 10.9 weeks, 29 patients showed good & complete union (97%) while one patient only complicated by non union & screw cut out (3%).

Complications: We have 5 cases with complications in our study, one case complicated by deep infection, non union and screw cutout, another case sustained postoperative femoral fracture at lower end of the prosthesis due to mechanical fall from the bed at the tenth week post operative. Also there are more 3 cases complicated by superficial infection not reaching the prosthesis deeply.

Discussion

Unstable peri and subtrochanteric fractures of the proximal femur are complicated by the massive tension moments laterally and compressive forces created medially by the weight of the body, hip flexors and external rotators and by the abductor musculature, resulting often in fracture displacement, loss of fixation and implant failure [9].

The goal of any fracture fixation is to provide and maintain stable fixation while improving functional results. The available published literature on this subject has shown that these fractures may be treated by a variety of devices, including Nail Plate devices, Dynamic hip screw (DHS) and Medullary devices, e.g. Ender's Nail, Zickel nail, Gamma Nail devices. The compression hip screw is currently the device most commonly used to stabilize trochanteric fracture, however, failure rates and complications as varus, collapse and limb shortening, cut-out through the head and neck and, rarely, lateral pulling out of the side plate were reported [10].

To decrease these complications, the Gamma nail (GN) was developed. The design of the Gamma nail combines the advantages of the sliding lag screw and those of intramedullary fixation with decreasing the moment arm as compared with that for the compression nail-plate system. It has the advantage of closed insertion, preservation of fracture hematoma and less dissection, which is an important consideration in fracture healing [11].

The Gamma nail proved to be an adequate implant to stabilize stable and unstable peri- and subtrochanteric fractures. Calvert in his study found that GN was better for the management of complex peritrochanteric fractures with subtrochanteric extension [12].

Various other studies found favorable results with GN in managing a greater variety of hip fractures with a less invasive technique and with better results [13]. Other studies have reported favorable results with GN in terms of shorter operation time, less blood loss, shorter hospital stay, decreased wound infection and reduced complication rate [14].

Also, it has been observed that the rate of complications associated with GN decreases appreciably with increase in learning curve of the operating surgeons [15]. However, problems with the old generation of Gamma nail were reported and included fracture of the nail, pain in the thigh,

and intraoperative and late diaphyseal femoral fractures. Three aspects of the old implant design have been implicated: Curve, stiffness and size [16]. The original Gamma nail had a mediolateral curvature of 10° that differed from the trochanter-to-diaphysis angle in an average patient. This shape of the Gamma nail is thought to cause three-point loading across the trochanteric and diaphyseal cortices. Therefore stress is concentrated mainly along the medial cortex in contact with the nail curvature and on the nail tip in contact with the lateral cortex, thus exposing the femur to intraoperative and postoperative fractures, even under physiologic loads [16]. Moreover the high implant stiffness also results in a stress rising effect at the nail tip [17].

Mismatch between implant size and medullary canal diameter, particularly with inadequate reaming and forceful nail insertion (hammer), can create high hoop stresses. This can result in nondisplaced fractures during nail insertion, which may propagate after weight-bearing. A new modifications of the gamma nail has been introduced with recent design features that may improve the clinical results and decrease the complication rates [18]. The newer generation Gamma 3 nail has a 15.5mm proximal diameter, 4 degree valgus inclination, and a 10.5mm diameter lag screw. The distal locking screw is 5mm in diameter. Available lag screw insertion angles are 120,125, and 130 degrees with a distal nail diameter of 11 mm.

In our study, pain in the mid portion of the thigh is observed with the use of gamma nail. This is consistent with the other studies using Gamma nail. The operating time in our study ranged from 45 to 90 minutes and this was almost identical to operative time for fractures treated by GN by Leung et al., and Sharma et al., the blood loss in our patients (196ml in average) was less comparing to other reports [11]. The results regarding postoperative weight-bearing were also comparable to other studies [19].

Functional assessment of the operated hip joint according to the Harris scale indicates a predominance of excellent and good results in unstable peritrochanteric fractures. The average time of fracture healing in our study is 10.2 weeks while the average time of radiological exposure is 3.9 minutes & this was comparable to other studies [20].

There were no intraoperative diaphyseal femoral fractures associated with the intramedullary hip

screw in the present study but there is one case reported 10 weeks postoperatively with femoral shaft fracture after a mechanical fall. Both intraoperative and late femoral fractures were reported with the use of Gamma nail [21]. These fractures may be caused by excessive loads around the end of the nail. The angle of the gamma nail in the mediolateral plane is only 4 degrees with fewer forces transmitted to the end of the nail. This may explain the low incidence of late diaphyseal fractures associated with the new generation of gamma nail [18].

Conclusion: Osteosynthesis with gamma nail is operational procedure with extraordinary results in operations of the peritrochanteric fractures. The main advantage of this procedure includes less tissue damage and better operation outcomes. Gamma nails are theoretically more load-sharing with the medial cortex of the femoral neck than are lateral cortical constructs. Because of more medial placement of the intramedullary nail compared to the side plate of the compression hip screw, the bending moment at the nail-screw junction is lower than that at the plate-screw junction.

References

- 1- KOVAL J.K. and CANTU R.V.: Trochanteric fractures In: Bucholz R.W., Heckman J.D., Court-Brown C.M., editor. Rockwood and Green fractures in adults. 6th ed. Philadelphia Lippincott Williams & Wilkins, 1793-825, 2010.
- 2- ROBINSON C.M., COURT-BROWN C.M., MCQUEEN M.M. and CHRISTIE J.: Hip fractures in adults younger than 50 years of age. *Epidemiology and results. Clin. Orthop.*, 238-246, 1995.
- 3- ROGERIO NAIM SAWAIA and WILLIAM DIAS BELANGER: The treatment of trans-trochanteric fractures of the femur with a minimally invasive technique using an extramedullary implant MINUS system international orthopaedics (SICOT), 32 : 159-165, 2008.
- 4- DAVID A., VAN DER HEYDE D. and POMMER A.: Therapeutic possibilities in trochanteric fractures: Safe - fast - stable. *Orthopade.*, 29: 294-301, 2000.
- 5- SINGH A.K., THONG G., LALOO N., SINGH A.M. and SINGH S.: Management of trochanteric fractures. *Indian. J. Orthop.*, 40: 100-102, 2006.
- 6- KYLE R.F., WRIGHT T.M. and BURSTEIN A.H.: Biomechanical Analysis of the Sliding Characteristics of Compression Hip Screws. *J. Bone. Joint. Surg. Am.*, 61: 1308, 1998.
- 7- HARRINGTON P., NIHAL A., SINGHANIA A.K. and HOWELL F.R.: Intramedullary hip screw versus sliding hip screw for unstable intertrochanteric femoral fractures in the elderly. *Injury*, 33: 23-28, 2002.
- 8- SAUDAN M., LIIBBEKE A., SADOWSKI C., RIAND N., STERN R. and HOFMEYER P.: Peritrochanteric

- fractures: Is there an advantage to an intramedullary nail? A randomized, prospective study of 206 patients comparing the dynamic hip screw and proximal femoral Nail. J. Orthop. Trauma, 16: 386-393, 2002.
- 9- BYUN Y.S., et al.: Comparison of proximal femoral nail antirotation blade and reverse less invasive stabilization system-distal femur systems in the treatment of proximal femoral Article first published online: 27 JAN DOI: 10.1111 /j.1757-7861.2010.00118.x, 2011.
- 10- LOCH D.A., KYLE R.F., BECHTOLD J.E., KANE M., ANDERSON K. and SHEMN R.E.: Forces required to initiate sliding in second-generation intramedullary nails. J. Bone. Joint. Surg., 80-A: 1626-31, 1998.
- 11- LEUNG K.S., SO W.S., SHEN W.Y. and HUI P.W.: Gamma nail and dynamic hip screws for peritrochanteric fractures: A randomized prospective study in elderly patients. J. Bone. Joint. Surg., 74-B: 345-35 1, 1992.
- 12- CHEVALLEY F. and GAMBA D.: Gamma nailing of petrochanteric and subtrochanteric fractures: Clinical results of a series of 63 consecutive cases. J. Orthop. Trauma., 11:412-415, 1997
- 13- LANDOLT M.: Comparison and presentation of technique and results of the Gamma Nail and Dynamic Hip Screw. Helv Chir Acta (Switzerland), 59: 965-9, 2007.
- 14- MIEDEL R., PONZER S., TORNKVIST H., SODERQVIST A. and TIDERMARK J.: The standard Gamma nail or the Medoff sliding plate for unstable trochanteric and subtrochanteric fractures. A randomised, controlled trial. J. Bone. Joint. Surg. (Br.), 87: 68-75, 2005.
- 15- KUKLA C., HEINZ T., GAEBLER C., et al.: The standard Gamma nail: A critical analysis of 1,000 cases. J. Trauma, 51: 77-83, 2001.
- 16- RANTANEN J. and ARO H.: Intramedullary fixation of high subtrochanteric femoral fractures: A study comparing two implant designs, the gamma nail and the intramedullary hip screw. J. Orthop. Trauma, 12: 249-252, 2002.
- 17- CURTIS M.J. and JINNAH R.H., Wilson V. and CUNNINGHAM B.W.: Proximal femoral fractures: A biomechanical study to compare intramedullary and extramedullary fixation Injury, 25: 99-104, 2002.
- 18- VALVERDE J.A., ALONSO M.G., PORRO J.G., RUEDA D., LARRAURI P.M. and SOLER J.J.: Use of the Gamma nail in the treatment of fractures of the proximal femur. J. Orthop. Trauma., 12: 177-85, 1998.
- 19- GOLDHAGEN P.R., O'CONNOR D.R., SCHWARZE D. and SCHWARTZ E.: A prospective comparative study of the compression hip screw and the Gamma nail. J. Orthop. Trauma., 8: 367-372, 1994.
- 20- BAUMGAERTNER M.R., CHROSTOWSKI J.H. and LEVY R.N.: Intertrochanteric hip fractures. In: Browner B.D., Levine A.M., Jupiter J.B., Trafton P.G., eds. Skeletal trauma, vol 2. Philadelphia: WB Saunders, 1833-1881, 1998.
- 21- HABERNEK H., WALLNER T., ASCHAUER E. and SCHMID L.: Comparison of ender nails, dynamic hip screws, and Gamma nails in the treatment of peritrochanteric femoral fractures. Orthopedics., 23 (2): 121-7, 2000.

تقييم النتائج الوظيفية والا كليلنيكية لاستخدام المسمار النخاعي (جاما) فى علاج كسور بين المدوريين غير الثابتة باعلى عظمة الفخذ

كسور اعلى عظمة الفخذ تمثل ثانى أكثر الكسور شيوعا خاصة لكبار السن وهذه النوعية من الكسور المصاحبة لامراض الشيخوخة تؤدى الى زيادة معدلات الوفاة. ويهدف علاج كسور اعلى عظمة الفخذ الى تقليل معدلات الوفاة وعودة المريض الى ما كان عليه قبل حدوث الكسر من أكثر الوسائل المتاحة هذه الايام لعلاج هذه الكسور مسمار الفخذ الديناميكي ومسمار الفخذ النخاعي.

ان مسمار الفخذ الديناميكي يمثل وسيلة اساسية لعلاج مثل هذه الكسور خاصة الثابت منها ولكن غير الثابت منها يلقى كثير من الفشل وعدم التئام الكسر وحدث الكثير من المضاعفات.

ان المسمار النخاعي (جاما) لتثبيت كسور بين المدوريين تم ابتكاره عام ١٩٩٧ مع اعادة تصميم راس المسمار بحيث يقلل المقاومة اثناء تثبيت المسمار وبالتالي يقلل خطورة حدوث كسور عظمة الفخذ اثناء وبعد عملية تثبيت الكسر.

يقلل المسمار النخاعي الادنى القصير تركيز الاجهاد فى راس المسمار وكذلك صغر قطر المسمار قد يمنعان كسور العمود الفقري

وبتحليل النتائج الاحصائية باستخدام نقاط هاريس بعد سنة من متابعة ٣٠ مريض من يونيو ٢٠١٢ وحتى فبراير ٢٠١٤ جاء ٦٧٪ من المرضى بنتيجة ممتاز وجيد بينما كانت النتيجة مقبولة فى ١٧٪ من المرضى وضعيفة فى ١٦٪ من المرضى مما يؤكد على ان استخدام المسمار النخاعي (جاما) يعتبر بديل جيد فى علاج كسور بين المدوريين غير الثابتة.