ORIGINAL ARTICLE

Gamma Nail in Complex Subtrochanteric Femur Fractures

SOHAIL AHMAD, RIZWAN AKRAM, NAEEM AHMED, AMER AZIZ

ABSTRACT

Background: Femoral shaft fractures are common in adult population due to vulnerability to road traffic accident and firearm injuries. The Gamma nail was introduced for the treatment of subtrochanteric fractures with the theoretical advantage of a load-sharing femoral component which could be implanted by a closed procedure. Gamma nails were implanted with significantly shorter operating times, smaller incsions, and less intraoperative bleeding.

Objective: To determine the outcome of Gamma nail in complex subtrochanteric femur fractures in terms of clinicoradiological evidence of union.

Study Design: Descriptive case series.

Setting: Department of Orthopaedics and Spinal Surgery, Ghurki Trust Teaching Hospital/Lahore Medical & Dental College, Lahore.

Duration of Study with Dates: One Year (1st November, 2010 to 31st, 2011).

Methods: After evaluation according to Advance Trauma Life Support (ATLS) protocol, 50 cases of subtrochanteric femur fractures were included. Gamma nail of appropriate size and angle was introduced with help of jig. Proximal lag screw fixation was done. Patients were mobilized on first postoperative day with help of crutches or walker. Full weight bearing was allowed within six weeks. Clinical evidence of bone healing was scored according to pain and mobility scale.

Results: There were 20 males and 30 females. Male to female ratio was 1:1.5. The mean±SD between the ages was 42.24±13.76 years. There were 36 closed procedures and 14 open procedures done in all patients. The outcome of Gamma nails in complex subtrochanteric femur fractures were 43 patients having union and 7 patients have non-union.

Conclusion: Gamma nail is an alternative treatment of choice for complex subtrochanteric femur fractures. It allows the patients to get out of bed early and good rates of union.

Key words: Outcome, Gamma nail, Subtrochanteric femur fracture

INTRODUCTION

Subtrochanteric fractures are relatively rare, accounting for 10–34% of all hip fractures.[1]These fractures may occur at any age if the injury is severe enough; but most occur with relatively trivial trauma, as simple fall in elderly patients with osteoporosis.[2]

Osteoporosis is a bone disease in which the amount of bone is decreased and the structural integrity of trabecular bone is impaired. Cortical bone becomes more porous and thinner. This makes the bone weaker and more likely to fracture. On the other hand osteomalacia is a disorder of mineralization of newly formed organic matrix that occurs in adults. Given the significant impact it has on patients' survival and cost of care some preventable measures would be appreciated.[3]

Correspondence: Dr. Sohail Ahmad, Department of Orthopaedics & Spine Surgery, Ghurki Trust Teaching Hospital, Lahore. Email: sohail.ranjha@yahoo.com

In younger patients, Sub-trochanteric fractures occur due to high-energy trauma, such as motor vehicle accidents, vehicular-pedestrian accidents, falls from significant heights, or gunshot injuries.[4] These fractures occur due to large compressive forces on medial cortex and tensile stresses on the lateral cortex.[5]

Hip fractures are common and often devastating injury in the geriatric population, with an impact that extends far beyond the obvious orthopedic injury into the domains of medicine, rehabilitation, psychiatry, social work, and medical economics. Despite improvements in patient care, including advances in surgical technique and implant technology, hip fractures continue to pose a huge economic burden on the medical systems in the developed and the developing world.[2]

The affected limb lies externally rotated and short. Thigh is markedly swollen due to blood loss. Movement of the limb becomes very painful. These fractures are diagnosed on plain radiographs. Radiological findings like involvement of piriformis

fossa and fracture of lesser trochanter are very important to decide the management plan of these fractures. The geometry of the fracture may be transverse, oblique, or spiral, and most of the time it is comminuted.[6]

Treatment plan and its prognosis vary according to the type of fractures. The different classification systems to describe subtrochanteric fractures are KMG, Russel–Taylor, AO and Seinsheimer classification. Seinsheimer is the most descriptive one. It influences the treatment plan and prognosis as well.[7]

The management of complex subtrochanteric fractures is challenging for orthopaedic surgeons. Fracture may be reduced either closely or sometimes it needs open reduction. Stabilization in the form of internal fixation is the treatment of choice. Internal fixation may be achieved with extramedullary or intramedullary devices. Extramedullary fixation may be achieved with dynamic compression screw or minimally invasive plate osteosyntheseis. While intramedullary fixation may be achieved with standard intramedullary nail or cephalomedullary nails like Gamma nail. Intramedullary fixation has excellent results even in high velocity gunshot injuries.[8,9] Gamma nail being an intramedullary device is preferable especially when there is comminution of the medial cortex.[10]

Most fractures of the subtrochanteric region of the femur heal when treated using contemporary methods of internal fixation.[11] Improved understanding of the biomechanics of this region has shifted treatment toward the use of intramedullary devices (IMD) as the shorter-levered arm on the proximal fixation results in greater load sharing and less bending movement across the fracture and implant[12,13], reducing the rate of implant failure.[12,14] The overall incidence of failure for any type of fixation and subsequent nonunion of subtrochanteric fractures varies from 7% to 20%.[15]

Intramedullary nailing has many advantages including ease of insertion using closed technique, retaining the fracture haematoma and a lower infection rate due to less surgical dissection. The results of most nailing systems in comminuted fractures of the proximal femur were poor. This led to the innovation of the Gamma nail, combining intramedullary fixation of the femoral Shaft with a sliding screw in the femoral neck. Closed nailing constitutes a form of biological fixation of the femur, which may be credited for a shorter time to union.[16]

Gamma nail is the device which has potential to address all complex subtrochanteric fractures including involvement of lesser trochanter and extension into piriformis fossa. Ipsilateral shaft fractures associated with complex subtrochanteric fractures can be addressed with Gamma nail at the same time. Long gamma nail allows early weight bearing and it is effective in 85% of cases having high rates of bone union and minimal soft tissue damage.[17] After fixation with Gamma nail, 80% of the patients have no or only limited pain at the hip, 46% regain their prefracture walking ability, 48% regain their prefracture level of activities of daily living function and 71% regain living conditions similar to those before the fracture. Union occurs in 95% cases.[18] But in our circumstances expected union rates are low due to increased chances of infection and nutrition problems. The reoperation rate is 8%.[19]

It has reduced Chances of failure.[20] Wound infection, malunion, delayed union, nonunion and device failure are some postoperative complications after Gamma nail fixation. The incidence of these complications is less in Gamma nail fixation than fixation with extramedullary devices.[18]

Gamma nail is a very useful device to deal with subtrochanteric fractures but no study has been done in Pakistan. I am interested to assess outcome of Gamma nail in complex subtrochanteric femoral fractures, so that a better treatment may be offered to the patients presenting with these fractures.

PATIENTS AND METHODS

After evaluation according to Advance Trauma Life Support (ATLS) protocol, 50 cases fulfilling the inclusion and exclusion criteria, were selected from department of Orthopaedics and Spine Surgery, Ghurki Trust Teaching Hospital Lahore, for a period of One year. Each case was followed up for a period of six months to observe union, of fracture after Gamma nail fixation. All patients were asked to sign informed consent. The confounding factors like age, gender and type of fracture was counteracted through stratification.

Demographic information, history and examination were completed. Investigations including biplane radiographs (Anteroposterior and lateral projections) of femur and hip and knee joint will be done to rule out associated injuries. Skin traction were applied and patient was prepared for surgery. Prophylactic preoperative antibiotic of second generation cephalosporin plus aminoglycoside was given. The procedure will be

carried out under spinal anesthesia or general anesthesia. Patient was put on traction table in supine position keeping the affected limb straight. A transcondylar sterile Steinmann pin was used for traction. Fracture was reduced closely under image intensifier. If close reduction failed then open reduction was done. Entry was made through the junction of anterior one third and posterior two third of the tip of greater trochanter. A guide wire was passed under image intensifier. Flexible power reamers were used and reaming was done according to the size of medullary cavity. Gamma nail of appropriate size and angle were introduced with help of jig. Proximal lag screw fixation was done. Distal locking was done with interlocking screws. Wound was closed over suction drain and sterile dressing was done.

Patient was mobilized on first postoperative day with help of crutches or walker. Drain was removed after 48 hours. Stitches were removed on fourteenth postoperative day. Full weight bearing was allowed within six weeks. Patient was called for follow up at interval of six weeks for a period of six months. On every follow up biplane radiographs was done to observe radiological bone healing. Clinical evidence of bone healing was scored according to pain and mobility scale proposed by Sikorski and Barrington.

The data was entered and analyzed accordingly by using SPSS version10.0. The quantitative variable like age was presented as Mean and Standard deviation. The qualitative variables like gender and union will be presented as percentages and frequencies. Data was stratified for the effect modifiers i.e. age, gender and type of union.

RESULTS

There were 20 males (40%) and 30 females (60%). Male to female ratio was 1:1:5 (Table 1).

The patients shown in Table 2 were divided into three age groups. The first group patients aged 15-30 years (n = 13) 26%, in second age group patients aged 31-45 years (n = 14) 28% and in the third age group patients aged 46-60 years (n = 23) 46%. The mean±SD between the ages was 42.24±13.76 years.

There were 15 patients (30%) of type IV, 12 patients (24%) of type V, 10 patients (20%) of type IIIA, 6 patients (12%) of type IIIB, 4 patients (8%) of type IIC (Table 3).

In 36 (72%) patients procedure was done by closed method and in 14 (28%) Patients, procedure was done with open technique (Table 4).

In 43 patients (86%) union was achieved at the end of 6 months follow up and in 7 patients (14%) union could not be achieved at end of 6 months follow up these 7 patient were having either delayed union or Non-union at end of 6 months Follow up and they required another procedure either bone graft or revision surgery (Table 5).

Table 1: Distribution of patients according to sex (n = 50)

Sex	Frequency	Percentage
Male	20	40.0
Female	30	60.0

Male to female ratio 1:1.5

Table 2: Distribution of patients according to age (n = 50)

Age in years	Frequency	Percentage
15 – 30	13	26.0
31 – 45	14	28.0
46 – 60	23	46.0

Mean±SD 42.24±13.76

Key word: SD = Standard deviation

Table 3: Distribution of patients according to Diagnosis (n = 50)

Diagnosis	Frequency	Percentage
Type II C	4	8.0
Type III A	10	20.0
Type III B	6	12.0
Type IV	15	30.0
Type V	12	24.0
Type IIIA + Ipsilateral femur fracture	1	2.0
Type IIIB + Ipsilateral femur fracture	1	2.0
Type IV + Ipsilateral femur fracture	1	2.0

Table 4: Distribution of patients according to procedure done (n = 50)

Procedure done	Frequency	Percentage
Close	36	72.0
Open	14	28.0

Table 5: Distribution of patients according to outcome (n = 50)

Outcome	Frequency	Percentage
Union Acheived	43	86.0
Union not Achieved	7	14.0

DISCUSSION

Dynamic fixation devices including the dynamic hip screw and the gamma nail have afforded a significant advance in the treatment of complex subtrochanteric Femur fractures. This is because they allow controlled displacement of the fragments which increases the stability at the fracture site. Dynamic fixation becomes rigid when a buttress occurs between the fragments or when the sliding mechanism is jammed so the implant will act as a conventional one-piece device.[20] Arrest of sliding can occur when a callus grows over the upper end of the plate or the lag screw itself jams within the barrel.[21] Failure of sliding may result in penetration[21,22] or it may predispose to implant breakage in unstable fractures unless the device can withstand loads imparted upon it until the fracture heals.[20] When dynamic fixation is provided by a sliding hip screw, lateral position of the plate related to the line of load bearing predisposes to mechanical failure.[23] The plate depends on screws in the lateral cortex, which may not have a strong purchase in old patients with osteoporotic bones.[24] A dynamic device must be strong enough to withstand physiologic loading otherwise the results will be no better than those of rigid devices.[25]

The gamma nail has a more advantageous lever arm and has provided more reliable in both static and dynamic testing.[26] The presence of the gamma nail in the center of the medulla has reduced the compressive stress on the lag screw by 30%.[27] The nail itself prevents medialization of the shaft in relation to the proximal fragment.[28] Treatment with the long Gamma nail allows patients immediate full weight bearing after surgery.[29] Heinz[30] reported early weight bearing (1.2 weeks) in patients with complex subtrochanteric femur fractures treated with Gamma nail.

Good reduction and proper implants are prerequisites for stability in the osteosynthesis of complex subtrochatric femur fractures. Gamma nails show a 30% greater load to failure than sliding hip screws.[31]

Khairy[32] used Gamma Nail for treatment of complex subtrochanteric femur fracture. He reported the 88% rate of union, 4% delayed union and 8% non-union. In the present study, union was achieved in 43 cases (86%) and union could not be achieved in 7 cases (14%) at end of 06 months follow up. These cases were either delayed or non-union (Table 5). These cases required a second procedure (bone graft or revision surgery).

Complex subtrochanteric femur fractures are highly unstable. Close fixation results in high incidence of mal-reduction in varus position leading to greater chances of mal-reduction mal-union, non-union and implant failure. Open reduction in these situations avoids such complications. Shukla[33] noted that such problems occur more commonly if varus angulation is more than 10^0. He also found that varus deformity occurs more commonly in unstable subtrochanteric femur fractures when they are reduced by close method. He recommended open reduction in difficult situations to avoid such complications. He reported 19 cases of complex subtrochanteric femur fractures treated with Gamma nail by open method. In present study, 14 procedures were done by open technique in difficult situations to avoid varus deformity. Table 4.

CONCLUSION

Gamma nail can be used in complex subtrochanteric femur fractures as an alternative to extra medullary implants. The presence of plant Gamma nail adds to the versatility of this implant, allowing its use even when there is long subtrochanteric extension or shaft involvement. Performing the procedure carefully, attending to every detail, and being warned of the possible complications are enough to allow the surgeon to fix the fracture and reach a satisfactory results. The main advantage of gamma nail is the superior strength of the device and its

excellent purchase, even in osteoporotic bones. Ability to lock the lag screw proximally and to lock the nail distally affords a stable fixation, which provides the patients with a sense of security and stability around the fracture and allows them to get out of bed early and results in good outcome in terms of union.

REFERENCES

1. Whittle AP. Fractures and dislocations of the hip. Campbell's operative orthopaedics. 11th ed. Philadelphia: Mosby; 2008;3262.
2. Riaz S, Alam M, Umer M. Frequency of Osteomalacia in elderly patients with Hip Fractures. JPMA 2006;56:273-6.
3. Sato Y, Asoh Y, Kondo I, Satoh K. Vitamin D Deficiency and risk of hip fractures among elderly stroke patients. Stroke 2001;32:1673-7.
4. Pesce V, Speciale D, Sammarco G, Patella S, Spinarelli A, Patella V. Surgical approach to bone healing in osteoporosis. Clin Cases Miner Bone Metab 2009;6:131-5.
5. Wolinsky P, Stephen DJG. AO principles of fracture management. 2nd ed. Switzerland: Thieme, 2007;781-99.
6. Solomon L, Warrick D, Nayagam S. Apaley's system of orthopaedics and Fractures. 8th ed. London: Arnold 2001;694-5.
7. Guyver PM, Jain NPM, McCarthy MJH, Keenan J. Is there any point in classifying subtrochanteric fractures? The reproducibility of four classification systems. JBJS 2009;91-B:500-4.
8. Oh CW, Kim JJ, Byun YS, Oh JK, Kim JW, Kim SY, Park BC, Lee HJ. Minimally invasive plate osteosynthesis of subtrochanteric femur fractures with a locking plate: a prospective series of 20 fractures. Arch Orthop Trauma Surg 2009;129:1659-65.
9. Ali MA, Hussain SA, Khan MS. Evaluation of results of interlocking nails in femur fractures due to high velocity gunshot injuries. JAMC 2008;20:16-9.
10. Saarenpaa I, Heikkinen T, Jalovaara P. Treatment of subtrochanteric fractures: a comparison of the Gamma nail and the dynamic hip screw - short-term outcome in 58 patients. Orthop 2007;31:65-70.
11. Haidukewych GJ. Nonunion of fractures of the subtrochanteric region of the femur. Tech Orthop 2008,23:131-6.
12. Kuzyk PR, Bhandari M, McKee MD, Russell TA, Schemitsch EH. Intramedullary versus extramedullary fixation for subtrochanteric femur fractures. J Orthop Trauma 2009;23:465-70.
13. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. Cochrane Database Syst Rev 2008;3:CD000093.
14. Shukla S, Johnston P, Ahmad MA, Wynn-Jones H, Patel AD, Walton NP. Outcome of traumatic subtrochanteric femoral fractures fixed using cephalo-medullary nails. Injury 2007;38:1286-93.
15. DeVries JS, Kloen P, Borens O, Marti RK, Helfet DL. Treatment of subtrochanteric nonunions. Injury 2006;37:203-11.
16. Delee JC. Fractures and dislocations of the hip: subtrochanteric fractures. In: Rockwood CA Jr, Green DP, Bucholz RW, Heckman JD, eds. Rockwood and Green's fractures in adults. 4th ed. Philadelphia: Lippincott-Raven Publishers, 1996;1741-55.
17. Sehat K, Baker RP, Pattison G, Price R, Harries WJ, Chesser TJS. The use of the long gamma nail in proximal femoral fractures. Injury 2005;36:1350-4.
18. Shukla S, Johnston p, Ahmad MA, Jones HW, Patel AD, Walton NP. Outcome of traumatic subtrochanteric femoral fractures fixed using cephalo-medullary nails. Injury 2007;38:1286-93.
19. Ekstroma W, Nemethac G, Samnegard E, Dalen N, Tidermark J. Quality of life after a subtrochanteric fracture: a prospective cohort study on 87 elderly patients. Injury 2009;40:371-6.
20. Baixauli F, Vicent V, Baixauli E, Serra V, Sánchez-Alepuz E, Gómez V, Martos F. A reinforced rigid fixation device for unstable intertrochanteric fractures. Clin Orthop Relat Res 1999;361:205-15.
21. Simpson AH, Varty K, Dodd CA. Sliding hip screws: modes of failure. Injury 1989;20:227-31.
22. Matthews LS, sonstegard DA, Dumbleton JH. Repair of intertrochanteric fractures with a sliding nail. In: Black J, Dumbeton JH. Clinical biomechanics: a case history approach. New York: Churchill Livingstone, 1981;116-39.
23. Halder SC. The Gamma nail for peritrochanteric fractures. J Bone Joint Surg Br 1992;74:340-4.
24. Butt MS, Krikler SJ, Nafie S, Ali MS. Comparison of dynamic hip screw and gamma nail: a prospective, randomized, controlled trial. Injury 1995;26:615-8.

25. Wolfgang GL, Bryant MH, O'Neill JP. Treatment of intertrochanteric fractures of the femur using sliding screw plate fixation. Clin Orthop 1982;163:148-58.
26. Landolt M. Comparison and presentation of technique and results of the gamma nail and dynamic hip screw. Helv Chir Acta 1993;59:965-9.
27. Mahomed N. Biomechanical comparison of the Gamma nail and the sliding hip screw. Proceedings sixth annual meeting of the Orthopedic Trauma Association, Toronto 1990; 57.
28. Guyer P, Landolt M, Keller H, Eberle C. The Gamma Nail in per- and intertrochanteric femoral fractures--alternative or supplement to the dynamic hip screw? A prospective randomized study of 100 patients with per- and intertrochanteric femoral fractures in the surgical clinic of the City Hospital of Triemli, Zurich, September 1989 - June 1990. Aktuelle Traumatol 1991;21:242-9.
29. Hotz TK, Zellweger R, Kach KP. Minimal invasive treatment of proximal femur fractures with the long gamma nail: indication, technique, results. J Trauma 1999;47:942-5.
30. Heinz T, Vecsei V. The gamma nail: a new implant for the management of hip para-articular fractures. Aktuelle Traumatologie 1992;22:163-9.
31. Mahomed N, Harrington I, Kellam J, Maistrelli G, Hearn T, Vroemen J. Biomechanical analysis of the Gamma nail and sliding hip screw. Clin Orthop Relat Res 1994;304:280–8.
32. Khairy A. Gamma nailing for unstable subtrochanteric femoral fractures. Pan Arab J Orth Trauma 2002;6:151-7.
33. Shukla S, Johnston P, Ahmad MA, Wynn-Jones H, Patel AD, Walton NP. Outcome of traumatic subtrochanteric femoral fractures fixed using cephalo-medullary nails. Injury 2007;38:1286-93.