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Functional and Surgical Outcome of Intertrochanteric Fractures of Femur Treated with the Gamma 3 Nail

Dr. Arun K N[1], Dr. Koushik Suresh[2], Dr. Suman N V[3]

[1]Professor and Medical Superintendent, Navodaya Medical College & Research Centre, Raichur, Karnataka, India, 584103

[2]Post Graduate, Navodaya Medical College & Research Centre, Raichur, Karnataka, India, 584103
Email: *kouvva[at]gmail.com*

[3]Professor and HOD, Navodaya Medical College & Research Centre, Raichur, Karnataka, India, 584103
Email: *sumannv86[at]gmail.com*

Abstract: ***Background: Intertrochanteric fractures occur both in the elderly and the young, but they are more common in the elderly population with osteoporosis due to a low energy mechanism. These fractures along with other hip fractures are associated with high morbidity and mortality. Currently, 280,000 fractures occur annually with nearly half of these due to intertrochanteric fractures. There are few treatment modalities are available for this kind of fractures such as: DHS, SHS, PFN, PFNA2, Gamma nail, Zimmer Natural Nail, Trigen Intertan nail, and TFN. Materials and Method: This study of 20 patients with intertrochanteric fractures was conducted over a period of 18 months from April 2023 to October 2024 in the Department of Orthopaedics, Navodaya Medical College Hospital and Research Centre. In this study 20 patients (13 male, 7 females) with intertrochanteric fracture treated with closed reduction internal fixation by Gamma 3 nail. Functional outcome was assessed as per the Harris Hip Score. Results: A total of 20 patients were evaluated in our study of which there were 13 males and 7 females. Out of all 20 patients, who were evaluated based on Harris Hip Score at 12 months post operatively, majority 10 cases (50%) had a good outcome.,8 cases (40%) had excellent outcome and only 2 patients (10%) had Fair outcome. Not a single patient had poor outcome according to Harris Hip score. Conclusion: GAMMA 3 is a significant advancement in the treatment of trochanteric fractures which has the unique advantages- a simple operation, closed reduction, preservation of fracture hematoma, minimal soft tissue damage during surgery, less bone loss, early rehabilitation and early return to work with good functional outcome with good recovery despite, patients having several associated injuries.***

Keywords: Intertrochanteric fracture; older adults; PFNA 2; Gamma 3; Harris Hip Score

1. Introduction

Intertrochanteric fractures are defined as extracapsular fractures of the proximal femur that occur between the greater and lesser trochanter. The intertrochanteric aspect of the femur is located between the greater and lesser trochanters and is composed of dense trabecular bone[(1)]. These fractures occur both in the elderly and the young, but they are more common in the elderly population with osteoporosis due to a low energy mechanism. The female to male ratio is between 2:1 and 8:1. These patients are also typically older than patients who suffer femoral neck fractures. In the younger population, these fractures typically result from a high-energy mechanism[(2)].

These fractures along with other hip fractures are associated with high morbidity and mortality. Currently, 280,000 fractures occur annually with nearly half of these due to intertrochanteric fractures. By 2040, it is estimated to increase 500,000[(3)].

The distribution in accordance to sex distribution was 50% among the sexes whereas when considered in ages 60 and above a female predominance was noted with 62.5% constitution of females. However, when compared to worldwide age standardized distribution hip fractures were noted twice more in females in comparison to males[(4)].

2. Materials and Method

This study of 20 patients with intertrochanteric fractures was conducted during the period between April 2023 to October 2024 in the Department of Orthopaedics, Navodaya Medical College Hospital and Research Centre, Raichur and were treated with Gamma 3 nailing system.

Inclusion Criteria

1) All patients with age group equal to or more than 18 years
2) All Acute post-traumatic inter-trochanteric fracture of femur
3) All stable and unstable trochanteric fractures
4) Patient with and without co-morbidities like Diabetes mellitus, Hypertension, Ischaemic Heart disease, Cardio-vascular diseases and Seizure disorders

Exclusion Criteria

1) Patients Age <18yrs
2) Patients with active infection
3) Patients with bilateral fractures
4) Patients with Pathological fractures
5) Patients with open fractures.
6) Patients with congenital anamolies or bone disease.
7) Patients with high anaesthetic risk. Any medical contraindication for surgery

Options for Treatment of Intertrochanteric Fractures

Plate and Screw Construct

- **Fixed-angle devices:** Impacted nail–type plate devices (i.e., blade plates)
- **Sliding hip screws:** Large single sliding screw or nail femoral head components with side plate attachments (e.g. standard SHSs)
- **Linear compression class:** Multiple head fixation components controlling rotation and translation but allow linear compression (e.g. Gotfried PCCP)

Cephalomedullary Interlocking Nails

- **The Impaction class** or "Y" nail class originated with the Küntscher "Y" nail and currently represented by the trochanteric femoral nail (Titanium femoral nail [TFN]
- The **dynamic compression** or **Gamma class** pioneered by the Grosse and A B Kempf, gamma nail (Stryker, NJ)
- The **Reconstruction class** developed by Russell and Taylor (Smith & Nephew, Memphis, TN)

The InterTAN class (Smith & Nephew, Memphis), comprising a medial trochanteric entry design with a trapezoidal proximal cross section (similar to a hip arthroplasty stem) and an integrated two-screw construct with linear compression at the fracture site, developed by Russell and Sanders

3. Operative Treatment

Patients were given spinal anesthesia and shifted on to a radiolucent fracture table in a supine position, with the injured leg put on traction on a leg holder, with the ipsilateral hip in adduction to allow nail entrance and to facilitate this, push the torso 10°–15° to the contralateral side. Opposite limb was put in a full abduction, in lithotomy position as to give space for the C-arm in between the legs. Reduction was achieved by traction and internal rotation primarily and adduction or abduction as required. Reduction was checked in image intensifier with anterior-posterior and lateral view. Limb was scrubbed, then painted and draped under sterile condition. For preliminary fixation, place a K-wire or Steinman pin through the neck into the femoral head. The paths for planned implants should be avoided. For nailing, this K-wire needs to be anterior to the nail path and superior to the blade path. To approach the entry point, incise the skin in line with the femoral shaft axis and about 5 cm proximal to the tip of the trochanter and deepened to the gluteus medius muscle. Tip of the greater trochanter is palpated and minimal muscle attachment was cleared off. The entry point is on the tip of the greater trochanter or slightly medial at the virtual meeting point of the line drawn in the center of the neck and a line drawn in the femoral shaft. Insert the 2.8 mm guide wire through the tip of the greater trochanter and in line with the middle of the femoral neck, and slightly lateral to a line corresponding to the anatomical axis of the shaft. Advance the guide wire in the femur shaft and across the fracture site in 5º of valgus. Insert the protection sleeve with its trocar over the guide wire and push it through the soft tissues until it abuts against the greater trochanter, withdraw the trocar and insert an appropriate drill bit or reamer over the guide wire. Reaming of the proximal femur is done with the reamer provided with the set .Mount the nail on the insertion handle. Insert the nail over the guide wire. Once the nail engages with the medullary canal, remove the guide wire and advance the nail fully and the alignment is checked. Insert the nail to such a depth that it will allow the blade or lag screw to be placed in the center of the femoral head confirmed under C-arm. Insert the drill-sleeve assembly through the aiming arm and advance it through the soft tissues to the lateral cortex. Drilling hole for the blade, open the lateral cortex with the 11.0 mm drill bit. By rotational locking of the lag screw, a fracture gap can be reduced, interfragmentary compression may be performed. One or two static or dynamic 4.9mm interlocking bolts are inserted via the jig in to the distal part of the nail. Out of which one is a static and another is a dynamic hole. It should be done after removing the traction along with the tightening of the proximal screws. For simple and multifragmentary pertrochanteric fractures, static locking is sufficient.

Insert a cortical screw of appropriate length bicortically. After thorough wash the wound was closed in layers without putting the drain, strict hemostasis was maintained throughout the procedure. Aseptic dressing was done

Case 54 year female A/H/O fall from bike and sustained Injury to right hip

Pre-Operative X-Ray

Approach to Entry Site

Intra Operative Image

Wound Closure

Post Operative X-Ray

Radiography after 3 months post-surgery, it is showing complete bony union

6 months post OP

12 months post OP

Function Outcome at End of Study Period

1) Flexion and Extension,
2) Abduction and Adduction,

Post Surgery

Patients were advised non weight bearing walking with walker as soon as tolerable usually after suture removal.The elderly patient may start with weight bearing as tolerated with walking aids the day after surgery. Initial restricted weight bearing is required for the young patient, partial weight bearing walking was started at about 6 weeks post operatively after reassessing. Unrestricted range-of-motion exercises of the hip joint are allowed. Full weight bearing walking was allowed after assessing radiological and clinical union.

4. Results

Table 1: Duration of Surgery

Duration of Surgery	No. of Patients	Percentage
31-40 minutes	2	10%
41-50 minutes	16	80%
51-60 minutes	1	5%
>61 minutes	1	5%
Total	20	100%

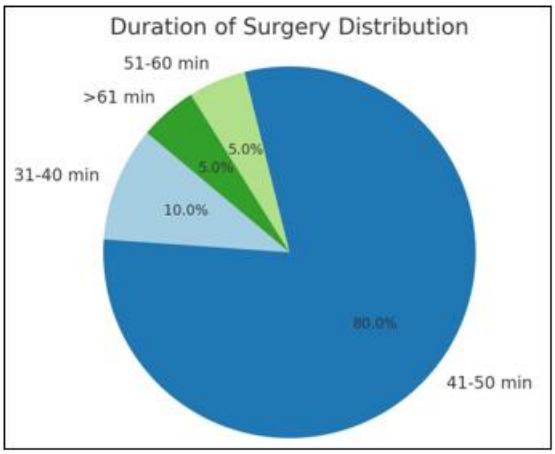


Table 2: Blood Loss

Blood Loss	No. of Patients	Percentage
50- 75 ml	17	85%
76-100 ml	2	10%
>101 ml	1	5%
Total	20	100%

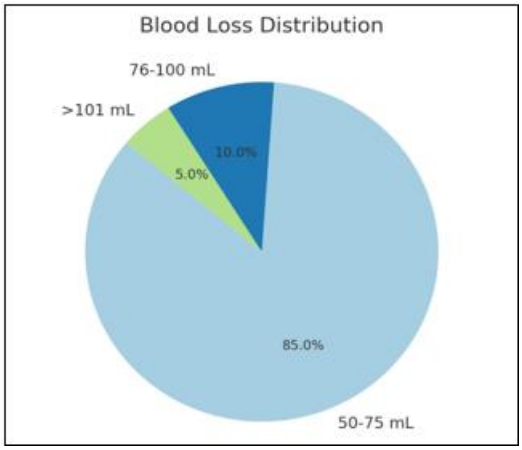


Table 3: Radiological Callus

Radiological Callus	No. of Patients	Percentage
5 weeks	1	5%
6 weeks	15	75%
7 weeks	2	10%
8 weeks	2	10%
Total	20	100%

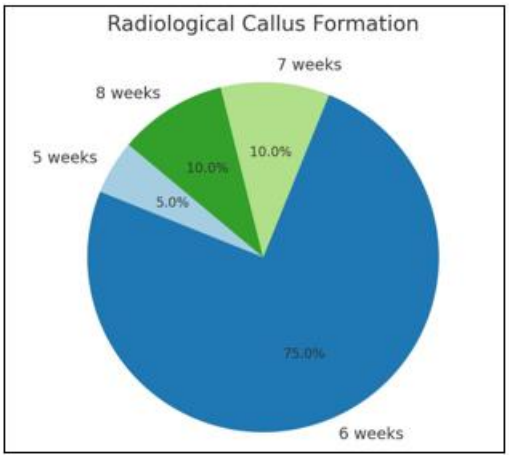
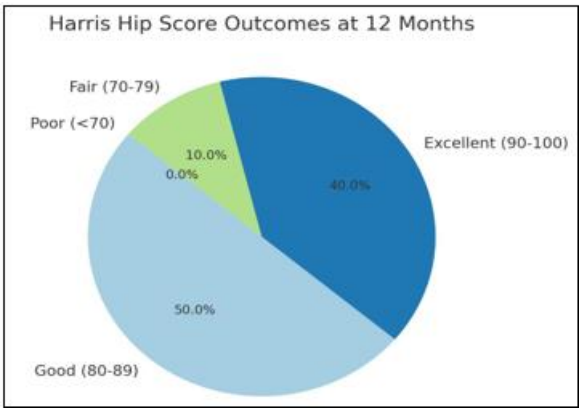


Table 4: Functional Outcome according to Harris Hip Score at 12 Months Post Operation

Functional Outcome	No. of Patients	Percentage
<70	0	0
70-79	2	10%
80-89	10	50%
90-99	8	40%
Total	20	100%



5. Discussion

Nonoperative treatment is rarely indicated and should only be considered for non-ambulatory patients and patients with a high risk of perioperative mortality or those pursuing comfort care measures. The outcomes of this method of treatment are poor due to an increased risk of pneumonia, urinary tract infection, decubiti, and deep vein thrombosis[5][6][7].

Operative management of these fractures is considered urgent, not emergent. This allows the many comorbidities with which patients often present to be optimized preoperatively, to reduce morbidity and mortality. Most of these fractures are treated operatively with either a sliding hip screw or intramedullary hip screw, although arthroplasty is a rare option. Indications for the sliding hip screw include stable fracture patterns with an intact lateral wall. When used for the appropriate fracture pattern, this treatment affords outcomes similar to intramedullary nailing. The advantages of the dynamic hip screw are that they allow for dynamic interfragmentary compression and are low cost compared to intramedullary devices. The main disadvantages include increased blood loss and open technique. Implant failure can occur due to a lack of integrity of the lateral wall or the placement of the screw, which should be placed at a tip apex distance of less than 25 millimeters.

Intramedullary are more appropriate than extramedullary devices for unstable fractures. Nails prevent mechanical failures due to their centromedullary position that acts as a buttress against uncontrollable medialisation, especially when the lateral wall is missing[8]. Nails preserve proximal femoral anatomy by effectively resisting deforming forces in unstable fracture. Prospective randomized trials support a better preservation of reduction

Intramedullary nails like PFNA II has a superior performance over PFN in the setting of IT fracture, which is attributed to compaction of cancellous bone by the helical blade, less operative time, intraoperative complications, union rates[9].

Gamma 3 Locking Nail (GN) (Stryker GmbH & Co. KG, Duisburg, Germany) has been developed with a reduction of the diameter of the nail, a change to the valgus angle from 10 to 4 degrees, a change in the design of the femoral neck screw, and the possibility of dynamization [10]. The GN system can provide better clinical outcomes and a higher biomechanical stability compared with with older cephalomedullary devices[11]

The newer intramedullary nail like the gamma 3 nail showed that the reduction quality of fractures treated with Gamma 3 was better than those treated with PFNA.[12]

Benjamin Buecking e al. concluded that Surgical treatment of trochanteric fractures with theGamma3TM nail seems to be a quick and safe procedure, even in vulnerable patient samples. The procedure can also be successfully performed by residents in training, although valuable guidance by consultants seems to be necessary in this kind of surgery. The use of theGamma3TM could be an improvement in surgery, compared to older cephalomedullary devices[13].

J. Vaqueroaet al. concluded that The PFNA andGamma3fixation devices were similar in terms of complication rates. The risk for experiencing a postoperative complication after Gamma3 nailing was 40% versus 45% after PFNA fixation. At the 6-month and 1-year follow-up evaluations, there were no significant differences in terms of range of motion, clinical scores and radiological outcomes[14]
Dimitrios Georgiannos et al. concluded that the intra- and postoperative complications with the use of Gamma3 nail was less. Femoral fractures and lag screw cutout were significantly lower. The reoperation rate was significantly higher in the TGN group. Gamma3 nail has proved to be a safe and efficient implant for the treatment of pertrochanteric fractures. The improvement of the biomechanical characteristics has led to a significant decrease in complication rates, demonstrating superiority over its predecessor[19].

Yan-Hui Li et al. concluded that TGLN group had shorter operation time and less intraoperative blood loss, compared with those in the INTERTAN group (P<.05) [15].

Duration of Surgery
The time requirement for the fixation of the fracture from incision to closure ranged from 35 to 70 minutes, with mean average time being 46.03 minutes, while 80% patient's that is 16 patients were operated within 41 to 50 minutes. In 1 cases that is 5% cases the operated time was more than 60 minutes which was mainly due to fracture pattern, unstable comminuted fractures - reverse obliquity.

When we compare the duration of surgery with micheal D et al, Andreas et al- gamma 3, Xianyoy Zheng et al, Jianzhong et al- gamma 3. there is very strong evidence

Blood Loss:
Though the amount of blood loss can't be measured definitely, only the visible blood loss was measured in our study. The patient's coagulation profile was checked preoperatively, and patients who were anemic were transfused with PRBC preoperatively, once the patient was

fit for surgery patient was taken for operation. The mean blood loss in our study was 67 ml, with the range being 60 to 110 ml. In our study 17 patients, 85 % patient's blood loss was within 50-75 ml.

There is strong association with the studies of Christian et al – gamma 3, Zhiwei Ma et al- gamma 3

Radiological Callus:
The radiological status of healing, visible callus was visualized the mean period was 6.25weeks. In our study the callus was visualized in 1 patients at 5 weeks, in 2 patients at 8 weeks. Though it is not a definitive measure of fracture union but gives an idea, the signs of healing

There is strong association with the studies of Jian xiong et al – gamma 3, Hong wei xing et al- gamma 3

Functional Outcome
The functional outcome of the patient was assessed in 30 patients, at 6 weeks; 12 weeks; 6 months and 12 months with the mean being 58.84± 2.71; 65.71±3.34; 79.74±4.59 and 90.62±4.34 respectively.

At 6 weeks the HHS range was 55- 64, at 12 weeks the range was 60-71; at 6 months the range 72-88.1 and 12 months the range is 70 – 90.
The mean HHS at 12 months was 83

At 12 months the functional outcome was excellent in 18 patients, good in 11 patients and fair in one patient. There is very significant score outcomes at the end of 1year when the scores of our study was compared with Jian xiong ma et al- gamma 3 and Zhiwei ma et al- gamma 3 has a strong significance.

6. Conclusion

Intramedullary nailing with the GAMMA 3 has distinct advantages over conventional methods of fracture construct with PFN or DHS like shorter operating time, smaller incisions, lesser blood loss, ideal in elderly osteoporotic unstable trochanteric fractures.

Early mobilization and weight bearing is allowed in patients treated with GAMMA 3 thereby decreasing the incidence of bedsores, VTE, uraemia and hypostatic pneumonia. The operative time is much lower compared with other procedures which also contributes with lesser blood loss.

The incidence of non-union rates in GAMMA 3, postoperative femoral shaft fractures can be reduced by good preoperative planning and correct surgical techniques, adequate reaming of the femoral canal, insertion of implant and meticulous placement of distal locking screws.

GAMMA 3 is a significant advancement in the treatment of trochanteric fractures which has the unique advantages- a simple operation, closed reduction, preservation of fracture hematoma, minimal soft tissue damage during surgery, less bone loss, early rehabilitation and early return to work with good functional outcome.

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