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ORIGINAL ARTICLE

A Comparative Study of Functional Outcome of Intertrochanteric Fractures Operated with PFNA and Intertan in a Tertiary Care Center

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Abstract

Background: Modalities of fixation in intertrochanteric fractures have been a topic of debate since times immemorial. Our special aims at comparing the functional outcome of INtertan fixation with PFNA fixation in 40 patients of intertrochanteric fractures. **Methods:** 40 patients of intertrochanteric fracture presented to our center were included in our study.20 patients at random were designated for Intertan fixation and 20 patients were designated for PFNA fixation, after applying inclusion and exclusion criteria. Preoperative AP and Lateral views of hip joint were taken for all patients. In post-operative period, the patients were reviewed at 2 weeks,1 month,3 months,6 months and 12 months by the operating surgeon. Xrays were obtained at each visit to assess union status. **Results:** 20 patients underwent Intertan fixation and 20 underwent PFNA fixation. We followed-up the patients at 2 weeks 1, 3, 6 and at 12 months postoperatively AP and lateral pelvic X-rays were obtained at each follow-up, and implant position changes, all complications, and fixation failures were recorded. We included a total of 40 patients meeting the criteria in this study and follow up was done till 12 months postoperatively. Intra-operative complications, time of hospital stay, varus fixation and fracture displacement were comparable between the groups. Advantages noted with Intertan fixation were excellent harris hip score, lesser screw cutout, early union rate. less. However, PFNA had greater incidence of anterior thigh pain at all intervals of follow-up. There were no significant differences in terms of local wound complications or duration of hospital stay.

Key words: Intertrochanteric, Intertan, PFNA

Introduction

There are multiple options for fixation of a stable and unstable intertrochanteric fracture in elderly population varying from closed reduction with a derotation boot to arthroplasty. Unstable patterns usually require an operative intervention that is an intramedullary fixation. Options for surgical management of intertrochantric femur fractures include extramedullary and intramedullary fixations. In unstable fractures, intramedullary devices have biomechanical advantage over extra medullary device. Intramedullary devices have a shorter lever arm and hence lesser forces applied over the implant [1-2]. Certain complications of intamedullary fixation have been documented, such as fracture of femoral shaft below the tip of the device, screw cutout, and collapse at the fracture site [1,3]. These problems have been reduced to an amount by application of Intramedullary nails with two lag screws which have better rotational control and better bony purchase within the femoral head, decreasing cutout and less fixation failure [4]. However, a new failure pattern has been identified with this modification, which is known as the Z-effect phenomenon. It manifests as collapse of the head/neck fragment which causes in protrusion of the superior lag screw and migration of the inferior lag screw lateral to the nail [5-6]. The exact etiology of this screw migration is not known till now.

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The proximal femoral nail (PFN) introduced by the AO/ASIF group in 1998 has become more relevant in treatment of trochanteric fractures recently [7]. Although there were many reports showing benefits of proximal femoral nail [8], but it was still associated with several technical failures [9]. It is an 3rd generation intramedullary nail manufactured by Synthes using AO design which has 2 cephalocervical screws and one distal locking screw. The recently introduced TRIGEN INTERTAN nail (Smith & Nephew, Memphis, Tennessee) should increase stability and decrease implant cutout as per

the manufacturer [10].

The Proximal Femoral Nail Antirotation (PFNA) [11], is a modification of the Proximal Femoral Nail, uses helical neck blade fixation which have high stability and decrease rotation and collapse. The helical blade avoids bone loss that occurs in drilling and insertion of the standard sliding hip screw. There are no obvious studies available for comparing the outcomes and complications of PFNA and Intertan. Hence the choice of intramedullary implant in unstable fracture patters is still debatable.

The aim of our study was to compare the short-term clinical outcomes of unstable intertrochanteric fractures managed with Intertan and PFNA.

Material and Methods

The study period included 24 months with a follow up at 2 weeks, 1 month, 3 months, 6 months and 12 months. The sample size was calculated to be 40.

Study Parameter

1. Age-sex groups
2. Types of fracture
3. Post operative pain, rate of union and functional scoring by Harris Hip score
4. Complications-local and systemic

Inclusion Criteria

1. Age 50-70 years
2. Both male and female
3. Boyd and Griffin Type 1,2,3,4 Intertrochanteric fractures without involving piriformis fossa
4. BMI<30 kg/sq. m
5. No evidence of recent/chronic infections
6. Presentation within 1 week of injury
7. Preinjury ambulatory status-unassisted community ambulators
8. High energy trauma

Exclusion Criteria

1. Patients who have history of previous hip surgery
2. Patients having deformities and pathologies of other joints of the lower limbs which have adverse effects on the functional outcome of the surgery.
3. Patients with acute hip infection/chronic systemic infection
4. Patients having associated fractures in other bones.
5. Patients having old proximal femoral fractures.
6. Pathological fractures
7. PIVD
8. BMI>30 kg/sq.m
9. Osteoporosis

Sampling Technique

Patients meeting inclusion and exclusion criteria were selected after obtaining written informed consent. They were randomized by using a random sampling software [12]. The operating surgeon and the patient both were blinded for the study (double blind study).

Statistical Analysis

The Pearson's Chi-Square test was used to observe the association of VAS score, union rate, complications, and functional outcomes in proximal femoral fracture after randomization in groups (Intertan and PFNA). $p>0.05$ was considered not so significant statistically, but $p<0.06$ to 0.09 was taken as poorly significant or suggestive. The probability value from $p<0.05$ to $p<0.02$ was considered as statistically significant while from $p<0.01$ to $p<0.0001$ was considered as statistically highly/strongly significant.

Method of Study

In our study, all patients underwent radiographic and laboratory evaluation. An anteroposterior and lateral view of pelvis with both hip was obtained during admission time. Skin traction was applied till pre-anaesthetic clearance. Mean waiting period from admission to surgery was 5 days. All patients underwent intramedullary fixation using standard techniques by same operating surgeons on a fracture table in supine position under fluoroscopic guidance. Most of the patients were discharged on 3rd post operative day. One patient had superficial wound infection. He underwent wound debridement and was discharged on 10th post operative day after healthy healing. Patients were followed up on 2 weeks, 1 month, 3 months, 6 months and 12 months after the surgery (Fig. 1 a,b & 2 a,b).They were evaluated using VAS score (Table 2), Harris Hip score (Table 4) and radiological parameters of union (Table 3) and complications (Table 5).

Closed Reduction Technique

The mentioned technique was used in all cases for closed reduction with fluoroscopic guidance. After anaesthesia and patient positioning on fracture table, traction is applied over the slightly abducted extremity. More abduction is required for fractures which have a varus deformity. Stable reduction requires in which medial & posterior cortical contact between major proximal & distal fragment in order to prevent varus and posterior displacing forces. If adequate cortical contact is obtained as seen on the AP view, and good posterior cortical contact is seen on lateral view, fracture can be fixed in anatomic position.

Reduction is generally obtained with direct traction,

abduction, & external rotation; Traction is most important component in reducing intertrochanteric fracture since it achieves neck shaft angle. Comminuted fractures in which lesser trochanter fragment is large displaced fragment, require more external rotation for closure of posterior defect. In comminuted fractures, it is more important to avoid internal rotation because the fracture fixed in internal rotation which is a gross functional disability.

Results

In our study there are 40 patients who underwent the study included 23 males (57.5%) and 17 females (42.5%). Their age ranged from 50-70 years as per the inclusion criteria with (mean ±SD) age of 61±7.8years. On 3rd post operative day the Visual Analogue Scale (VAS) did not vary among the two groups (Table 2). Fracture Non-union was reported in none of the patients of intertan group while in one patient of PFNA group which was statistically insignificant. Rate of union was 16 weeks noted in 14 patients of intertan group (70%) and rate of union was 18 weeks noted in 15 patients (78.9%) of the PFNA group (Table 3).

Functional results are assessed by Harris Hip Score in which Intertan group are better when compared to PFNA group but these differences were not statistically significant (p=0.713) (Table 4). As regards to complications, our study concluded better results in Intertan group with 75% having no complications as compared to 70%in PFNA group but these results are not statistically significant (p=0.717) (Table 5).

Discussion

The selection of proper implants for intertrochanteric fractures is still confusing the surgeon due to high rate of post operative complications, hip deforming forces at hip, inadequate evidence for appropriate implants etc.

PFN: AO/ASIF introduced a third-generation intramedullary

Table 1: Distribution as per Boyd and Griffin classification

Type of Fracture: Boyd & Griffin classification	Intertan group Frequency	Percent (%)	PFN group Frequency	Percent (%)
IT TYPE 1	5	25.0	4	20.0
IT TYPE 2	9	45.0	10	50.0
IT TYPE 3	3	15.0	3	15.0
IT TYPE 4	3	15.0	3	15.0
TOTAL	**20**	**100.0**	**20**	**100.0**

Table 2: Association of Pain Status of Patients at Post-Intervention with Groups

VAS Score	Intertan group No. of cases Percentage	PFN group No. of cases Percentage	Total
3	1/5.0%	2/10.0%	3/7.5%
4	9/45.0%	8/40.0%	17/42.5%
5	7/35.0%	6/30.0%	13/32.5%
6	3/15.0%	4/20.0%	7/17.5%
TOTAL	20/100.0%	20/100.0%	40/100.0%
χ^2_3 = 0.61 and p=0.894 (Insignificant)			

Table 3: Association of Rate of Union between Patients at Post-Intervention with Groups

Rate of union	Intertan group No. of cases Percentage	PFN group No. of cases Percentage	Total
16 Weeks	14/70.0%	0/0.0%	14/35.9%
18 Weeks	0/0.0%	15/78.9%	15/38.5%
20 Weeks	6/30.0%	0/0.0%	6/15.4%
22 Weeks	0/0.0%	4/21.1%	4/10.3%
TOTAL	20/100.0%	19/100.0%	39/100.0%
χ^2_3 = 39.00 and p=0.000 (High significant)			

Table 4: Association of Functional Scoring with Harris Hip Score at Post - Intervention with Groups

Functional scoring with Category		Intertan group No. of cases Percentage	PFN group No. of cases Percentage	Total
<70	Poor	0/0.0%	1/5.0%	1/2.5%
70-80	Fair	2/10.0%	3/15.0%	5/12.5%
80-90	Good	5/25.0%	5/25.0%	10/25.0%
90-100	Excellent	13/65.0%	11/55.0%	24/60.0%
TOTAL		20/100.0%	20/100.0%	40/100.0%

χ^2_3 = 1.37 and p=0.713 (Insignificant)

Table 5 : Association of Intraoperative and Post-Operative Complications of Patients with Grou

Complications	Intertan group No. of cases Percentage	PFN group No. of cases Percentage	Total
None	15/75.0%	14/70.0%	29/72.5%
Fracture of lateral cortex	1/5.0%	1/5.0%	2/5.0%
Fracture displacement at nail insertion/Lateral greater trochanteric fracture	2/10.0%	1/5.0%	3/7.5%
Cut out proximal screws	0/0.0%	1/5.0%	1/2.5%
Varus mal-union, shortening 2cm	2/10.0%	1/5.0%	3/7.5%
Non union	0/0.0%	1/5.0%	1/2.5%
TOTAL	20/100.0%	20/100.0%	40/100.0%

χ^2_3 = 3.70 and p=0.717 (Insignificant)

Fig 1 a,b : Intertan fixation - 6 months post OP

Fig. 2 a, b : PFNA fixation- 6 months post-OP

nail called Proximal Femoral Nail [5,11]. It works on principal of controlled collapse at fracture site but because it is an intramedullary nail so it has a short lever arm, place closed to the mechanical axis of femur so it is a load sharing implant [11]. The advantage of this device is less requirement of soft tissue dissection. Due to addition of 6.4 mm antirotation screw it reduces rotation of cephalocervical fragment during surgery [7,11]. Well documented complications are cut-out of screw cutout, fractures, varus fixation, nonunion, other implant related problems such as inability to put in antirotation screw [5] (Table 5).

Intertan Nail: The TRIGEN INTERTAN nail (Smith & Nephew, Memphis, Tennessee) was recently introduced, and according to the manufacturer the shape of the nail should increase stability and decreases cutout of implant. Slits at the end of the nail reduces femoral shaft fractures and interlocking head screws prevented cut off and increase compression at fracture site [13]. The Intertan system has become more popular with the development of inventive systems, which decreases rate of fractures of distal femur and increases stability [14]. But intertan has some drawbacks like high cost and steeper learning curve. There is no significant differences in terms of pain scale (Table 2). There are no significant differences in quality of life, or complication rates (Table 5). This is in conformity to recent studies and meta-analyses [1,15].

Butler *et al* [15] conducted an extensive analysis of the Cochrane database, Medline, Scirus and included 41 articles on intertrochanteric fractures. He concluded that age, sex, prefracture functioning, and cognitive impairment are related to mortality and functional outcomes. Mortality, pain, functional score, and quality of life did not differ by surgical implant class. According to Bhandari *et al*. [16] this should no longer be an issue with modern implant designs and more experience, however the authors of a Cochrane review [17] came to a different conclusion.

Parker *et al*. [17] conducted an analysis of Cochrane database, Medline, Embase and other sources, assessed all randomized control trials comparing cephalocondylar nails and extramedullary implants and concluded that Gamma nail was associated with increased risk of operative and later fracture of the femur, and increased rate of reoperation. Complication of fracture fixation were more common in the intramedullary implants.

In our study, no postoperative femoral fractures occurred in both the groups. In another study using intertan nails, femoral fractures were reported in two postoperative and five intraoperative cases [10]. This implies that this problem of femoral fractures still persists, however we did not encounter any such difficulties in our study. Still more extensive studies may be required to reach a conclusion. Displacement of greater trochanter, fracture fragments and damage to lateral cortex intra-operatively were reported in 1 PFN and 2 Intertan group (Table 5) but these results are statistically insignificant. It is may be due to high profile of instruments, trapezoidal anatomy of nail, or patient related factors such as osteoporotic bone. Cutting out is a familiar problem in intratrochanteric femoral fractures. Cut-out rates, including the Z effect, have been reported to range from 3% to 10% with the gamma nail [6,18,19].

In study of Vaquero *et al* [20], there is no statistical difference in the cut-out rates between the proximal femoral nail antirotation (PFNA) and the Gamma nail. Poor positioning of the screw, rather than implant-related causes resulted in cut-out of screws. In our study we observed that there are lesser cut-out related issues with intertan group than PFNA group but different is statistically insignificant (Table 5).

Ruecker *et al*. [13] reported only two implant cut outs in 48 patients with intertan nail during follow up of one year. Implant cut out has been more documented in PFN [5, 21]. The cutout rates for PFN have been documented between 0.6-8% [7, 22]. In our study no cases of implant cut outs were seen in intertan group but one case was seen in PFNA group but it is statistically insignificant. This can be avoided by proper placement of screw and early weight bearing and mobilization (Table 5). It is a well-known fact that implant positioning and proper surgical technique play a more significant role in eliminating this problem rather than implant itself. Our results may suggest that the design of the implant also plays some role in preventing cutout.

Unstable intertrochanteric fractures of femur treated with an intramedullary device are commonly related to mild pain at the site of the fracture and in the middle thigh. Ruecker *et al* encountered that there is no nail impingement or thigh pain problems in patients treated for an intertrochanteric fracture using this nail [13]. While both groups in this study documented no femoral shaft fractures in the post-operative period and the diameter of the intertan nail tapers from 13.5 mm in the middle to 11 mm at the tip, which has a stress dispersion effect on the nail and inner cortex and avoids stress over concentration around the nail tip. This nail has a split at distal tip which reduces overall cross-sectional tension of the distal implant. This might give the nail an added advantage. Post operatively neck shaft angle was measured and compared to the normal side for assessment of correction achieved.

There was varus deformity noted in two cases in intertan group and one case in PFN group, so these results are comparable and difference is statistically insignificant (Table 5). It may be due to inadequate reduction and failure to maintain neck shaft angle preoperatively or due to early backing out of screws. There were no non unions reported in

intertan group and only one in PFNA group, so these results are also comparable and difference is statistically insignificant (Table 5). Preoperative planning, implant size & optimal placement of implant i.e. placement of proximal screws in central & inferior quadrant of femoral head confirmed on AP & Lateral views are some of the probable important things which minimizes the complications. Fracture healing was assessed on clinical & radiological evidence of fracture union (Table 2). In our study average fracture union was 17 weeks in intertan group and 18 weeks in PFN group so these results are also comparable and it is statistically significant (Table 3).

Functional outcome was assessed by the modified Harris hip scoring system. In our study, good to excellent results were seen in 18/20 cases in Intertan group as compared to 16/20 cases in PFNA group and different is statistically insignificant (Table 4). In a similar study between Intertan nail and PFNA for treatment of unstable intertrochanteric fractures which was done by Weiguang Yu *et al*. [24] concluded that Harris hip scores was found to be statistically insignificant between these two groups, like in our study. All studies have shown significant improvement in post-operative Harris hip scores compared to preoperative but insignificant differences between the 2 study groups.

Excessive shortening of the neck (>5 mm) may cause weaking of gluteus medius strength and limit the movement of the hip joint. Starting from guide wire insertion, reaming, nailing and locking the fracture has to be fully kept reduced to avoid shortening. The Intertan device, converting rotational forces into linear compression, can overcome the shortening, which may be one of the main reasons why healing time is shorter in intertan group. Although in our study, 2 cases intertan group did show shortening as compared to one case in PFNA group, likewise varus collapse but these differences are statistically insignificant and no significant differences existed between the two groups regarding lateral migration of the hip screw, failure of implant and final functional outcomes. The number of patients was too small to allow comprehensive evaluation of the usefulness or the incidences of complications, and thus, we suggest that a large prospective study should be done to compare these two types of fixations.

Conclusion

In a background of rising incidence of intertrochanteric fractures in the elderly and availability of multiple implant options to the surgeon, our study aimed at establishing certain ground rules for selection of the appropriate implants for similar patters of fractures. Most patients treated with intertan nail had excellent to good outcome at the time of final follow up. Varus fixation was present in 2 patinets of Intertan group and in 1 patient of PFNA group. 3 patients had fracture displacement in Intertan group and 2 in PFNA group. These results are comparable for both groups. Resurgery was not required in any of the cases.13 patients (out of 20) had excellent Harris hip score in Intertan group but only 11 patients had excellent Harris hip score in PFNA group. There was no case of screw cutout in Intertan but 1 case of screw cutout in PFNA group. Intertan group had lesser incidence of distal femur fracture than PFNA. Average rate of union is 16 weeks for Intertan and 18 weeks for PFNA. PFNA had great incidence of anterior thigh pain. From this sample study, we conclude that Intertan Nail is a better implant for the treatment of intertrochanteric fractures of femur than PFNA.

Conflict of Interest:	All authors declare no COI
Ethics:	There is no ethical violation as it is based on voluntary anonymous interviews
Funding:	No external funding
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