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### **A solution to z effect and lateral wall comminution in nailing of per trochanteric fractures: A retrospective study of 54 cases**

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#### **Abstract**

**Background:** Pertrochanteric femur fractures are fractures which extends from extra capsular basilar neck of the femur to the lesser trochanter. Since this region bears the maximum mechanical stress as compared to other parts of the femur it's a site for comminuted fractures, and accounts for 10% to 34% of all hip fractures with the incidence estimated to double by 2040. In the quest for perfect implant in pertrochanteric femur fractures we have been using hip fracture nail since past 2 years for all pertrochanteric fractures in our institution.

**Methods:** This is a retrospective study of 54 cases of pertrochanteric femur fractures operated using hip fracture nail from 2017 to 2019 in our institute. All the patients were above 55 years of age with an average age group of 67 years. We analyzed rate of union, complications and functional outcome. All the patients were followed up at 3 months interval up to 1 year.

**Results:** Average modified Harris hip score were satisfactory in 48 patients. Average time taken for fracture union was 9 months.

**Conclusion:** We concluded that hip fracture nail solves many a problem of earlier generation nailing systems for unstable pertrochanteric femur fractures. Our study suggests that a twin screw integrated cephalo-medullary nail system effectively prevents the z effect and provides a solution to the lateral wall comminution which is the key predictor for a revision surgery after an unstable intertrochanteric femur fracture.

**Keywords:** Hip fracture nail, pertrochanteric femur fractures, lateral wall fracture complexity

#### **Introduction**

With the ageing population, the incidence of intertrochanteric fractures (IFs) is increasing [2-4]. Because elderly patients have comorbidities, the mortality rate from intertrochanteric fractures in these patients within 6 months is 12 to 41% [5, 6]. Various studies have reported that mortality can be significantly reduced in such patients with early surgical intervention (within 24 hours) [7]. Data from recent studies have confirmed that an increasing number of elderly patients have been presenting with osteoporotic intertrochanteric femur fractures. It may, therefore, be very meaningful to know what happens to this group of patients. The advantages of intramedullary fixation are it withstands the stress of the axis shift, has good anti-fatigue performance, can be achieved with smaller incisions, there is less damage to the local blood supply, and is the most current treatment for unstable intertrochanteric fractures [3, 7, 8]. Many scholars have studied extensively on DHS and PFN in intertrochanteric fractures but only few have studied the results with the hip fracture nail.

The quest for the optimal internal fixation device for unstable pertrochanteric femur fractures is still work in progress. De Bruijn K and his associates has rightly said that the "Success rate of the operation partly depends on factors that the surgeon cannot influence. Surgeons should therefore be aware of the factors that they can manipulate with a positive outcome" [9]. The purpose of the study was to assess the outcome of hip fracture nail in pertrochanteric femur fractures with lateral wall comminution and to assess the incidence of z effect.

#### **Materials and Methods**

Our study was a retrospective study consists of 54 cases of isolated closed pertrochanteric

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femur fracture selected after applying inclusion and exclusion criteria operated with hip fracture nail at Jayanagar Orthopaedic centre from 2017 to 2019 (2 years) and we obtained institutional review board approval.

#### Inclusion criteria

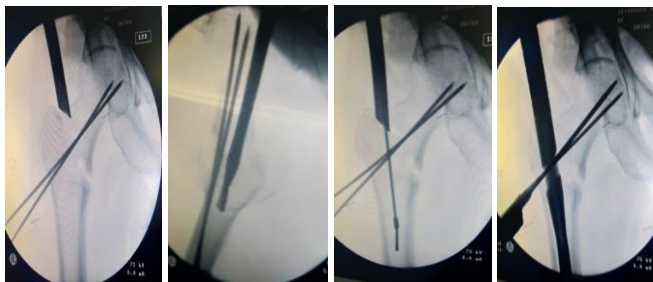
1. Patients above 55 years of age
2. Patients with minimum of 12 months follow up

**Study period:** 2017 January to 2019 January (2 years). AO/OTA Classification system was used. Implant used was HFN- hip fracture nail (Adler Syncera) and intervention and surgical technique: Closed reduction and internal fixation. We used 2, 3mm k-wires to hold the fracture reduction and the nail was passed with the k-wires in position without losing the fracture reduction. (Figure 1)

#### Post operative protocol

Full weight bearing walker mobilisation was started as tolerated from 2<sup>nd</sup> post-op day. All patients were followed up for a minimum of 12 months. Outcome measurement done at the end of 12 months were analysed.

Parameters considered: Radiological outcome: Rate of union, **Complications:** Z – effect, Functional outcome: Modified Harris hip score.



**Fig 1:** Showing k-wires holding the fracture reduction and negotiating the nail.

#### Results

A total of 78 cases were operated in the study period, we had 4 mortalities, 8 patients lost follow up and 8 patients were < 55 years of age. 4 patients had other associated fractures, hence 54 cases fulfilled the inclusion criteria. Males - 15, females - 39. Mean age was 67 years (range of 55 - 98 years). We had 16 - 31A1 type; 14 - 31A2 type; and 24 - 31A3 type fractures. Position of hip screw in our study was: 46 centre, 7 posterior and 1 anterior. In all the patients the tip-apex distance of the femoral neck screw less than 20 mm was achieved. 50 patients had fracture union at 9 months, 4 had delayed union, 3 of which consolidated subsequently within 3 to 4 months, but 1 had to be dynamized. Short HFN was used in 40 % of the total cases, and in rest 60 % long HFN was used. (Figure 4) Mean duration of surgery was 80 min (45 - 90 min) in all the patients. Mean intra operative blood loss was 160 mL (110 - 200 mL) Modified Harris hip score at the end of 12 months was excellent in 30 patients, good in 18 patients, fair in 4 and poor in 2 patients. (Figure 5) Average time taken for fracture union was 9 months.

#### Complications

We had zero screw cut out (z effect), and 4 delayed union – for which we waited and watched, but one had to be dynamised. We had 2 mortalities immediate post op (pulmonary embolism), 2 mortalities 1 month after surgery (Myocardial infarction), zero non unions, zero infection,

progressive fracture displacement was zero and subsequent fracture around the implant was zero.



**Fig 2:** (a) X-ray showing unstable four part trochanteric fracture [A3] in 80 yr old male; (b) post op X-ray showing anatomical reduction by HFN at 3 months; (c) X-ray after 6 months follow-up, (d) X-ray after 9 months follow-up Fracture united with good radiological and functional outcome.

#### Discussion

In old osteoporotic individuals, intertrochanteric femur fractures are one of the most commonly encountered fractures [10]. With the increase in high energy trauma these fractures are on the rise even in younger individuals. Aspiration pneumonia, deep vein thrombosis and decubitus ulcer are some of the serious complications associated with these fractures being treated non-operatively [11-15].

There is still a lot of debate with the ideal implant to be used for unstable intertrochanteric fractures. For the treatment of intertrochanteric femur fractures dynamic hip screw was the implant of choice until recently [12-17]. However dynamic hip screw have led to many failures in unstable intertrochanteric femur fractures. Failure of dynamic hip screw in such fractures can be implicated to the lever arm being long and its placement away from the mechanical axis of the body which makes a load bearing device.

Intramedullary devices works on the load sharing principle and has smaller bending moments, hence it is advantageous in an unstable trochanteric fractures fixation and allows for early weight bearing and prevents excessive fracture collapse [18-19]. Some of the implant related complications in trochanteric fractures stabilization are lateral protrusion of screws, screw cutouts, Z or reverse Z effect, and the fracture of lateral trochanteric wall [16]. Lateral femoral wall stable construct remains to be the key predictor for a revision surgery after an unstable intertrochanteric femur fracture [20-21].

Ganjale S.B, and his associates opines that in PFN surgery also lateral wall instability is as important as it is in DHS fixation. Failure rate of a gamma nail for the treatment of

unstable trochanteric fractures ranges from 12.7% to 15% [23]. Secondary varus collapse in 25.7%, cutout of proximal screws in 5.7%, 5.7% nonunion, and reoperation in 14.3% cases was reported by Uzun *et al.* [10] Fogagnolo *et al.* in their study had a complication rate of about 23.4% by using PFN in the treatment of an unstable trochanteric fractures [24].

Then came the PFNA- antirootation nail with the helical blade for stabilization of these fractures and showed varying results. Many authors in their studies claimed that PFNA device had theoretical advantage over DHS system in fixing the osteoporotic bones. But high complication rates were observed with the use of these implants.

Takigami *et al.* observed 14% complication rate of the cases and 4% required reoperation after use of PFNA [25]. Though the proximal femoral nail acts as a buttressing device and prevents medialization in cases of posteromedial defects, it provides no stability on the lateral side if lateral wall is compromised [26]. Comminuted intertrochanteric femur fractures with coronal plane splitting are even more difficult to fix by these intramedullary nails and chances of varus collapse in such fractures are high [27].

To prevent varus collapse and implant failure complications in comminuted lateral wall trochanteric fractures anatomical reconstruction of lateral wall becomes very important. Many authors have used a combination of implants or have augmented PFN with a plate, a circlage wire or a lag screw to restore the lateral wall and have achieved significant reduction in varus collapse and subsequent reduction in limb length discrepancy.

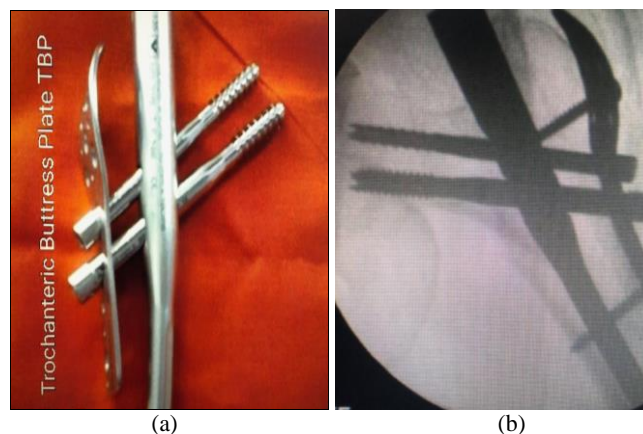
Babst *et al.* in their study have combined DHS with TSP and has shown to reduce excessive varus collapse. But showed significant blood loss and surgery time when compared to our study which is less invasive [27]. Proximal femoral locking plates in unstable trochanteric fractures was studied by few authors and have shown to be associated with a high complication rate [29].

Babhulkar *et al.* in their study augmented PFN with circlage wire and lag screws to reconstruct the comminuted lateral wall in unstable trochanteric fractures and has shown to have achieved less complication rate [23]. But disadvantages of this procedure are increased operating time, additional dissection of soft tissues circlage wire loosening, and only screw cannot be used when the trochanter is multifragmentary. And the circlage wire does not prevent the penetration of cephalomedullary screws in up to the nail on weight bearing.

S. B. Ganjale *et al.* recently have shown that their newly designed plate has significantly reduced incidence of z effect and excessive varus collapse and reduced lateralization of greater trochanter. And this specialized plate enhances fixation strength of PFN even in coronal split fractures. And has demonstrated the importance of integrity of lateral femoral wall construct to prevent reoperation in an unstable trochanteric fractures. There was no z effect or screw cutout noted in their series of 32 hips [26].

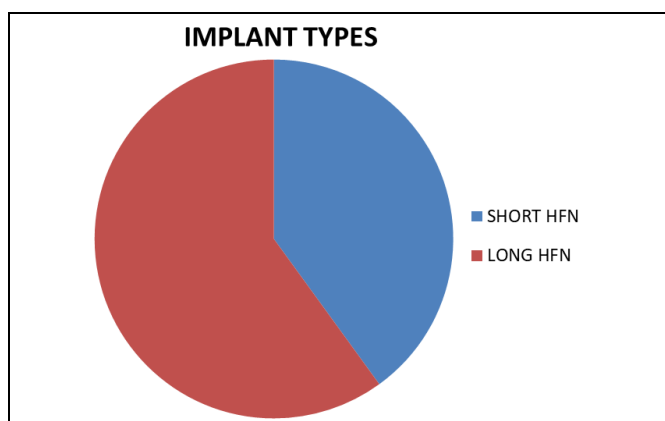
In our study the complication rates was less when compared with other implants and other studies on unstable trochanteric femur fractures. The lateral wall comminution was not attended to, in any of our cases. This did not have any adverse effects on the final outcome. In our study with the use of this implant; we have achieved good primary fracture compression during fixation and maintenance of reduction without varus collapse and shortening up to fracture union. Although some authors in their studies have used trochanteric buttress plate to address the lateral wall comminution we did not chose it.

Z – effect: The dreaded z effect seen with earlier generation implants was not seen in any of the 54 cases.

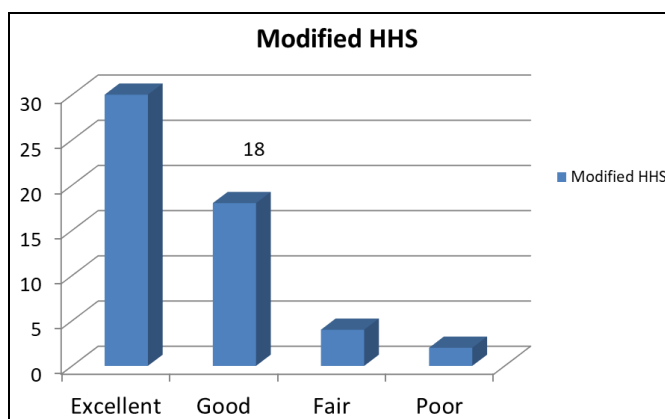


**Fig 3:** showing (a) trochanteric buttress plate designed by Gangale SB and his associates which was used in their study for treating unstable trochanteric fractures. 3 (b) radiographic image of the same.

**Limitations:** There was no objective comparison to other implant, absence of a control group. The results of the retrospective study remain to be further confirmed by prospective randomised controlled trials and the follow-up period was short and the long term outcomes need to be evaluated.



**Fig 4:** Usage of short and long nails in the study.



**Fig 5:** Modified Harris Hip score chart in 54 cases of our study.

## Conclusion

Our study suggests that a twin screw integrated cephalomedullary nail system (hip fracture nail) effectively prevents the z effect and provides a solution to the lateral wall comminution. Hence reduces the incidence of complications,

revision surgeries, morbidity and mortality in geriatric age group.

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