Original Article - 4

Dynamic hip screw versus proximal femoral nail for treatment of trochanteric hip fractures: an outcome analysis with a minimum 2 years of follow-up

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Abstract :

Introduction : During last 6 yrs study of Intertrochanteric fracture fracture femur was carried out at Department of Orthopaedics, PDVVPF'S Medical College and Hospital. Total 155 patients were treated with P.F.N and D.H.S. 103 patient were P.F.N and 52 were treated with D.H.S. **Study Design :** Intertrochanteric fracture femur patient were surgically treated with P.F.N and D.H.S with plate. Total no. of 155 patients were oprated under c-arm control and spinal or epidural anaesthesia .103 were treated with P.F.N and 52 patient treated with D.H.S plate. P.F.N 72 were rt. side and 31 were lt. side 62 were male, 41 were females, avg. age was 62 yrs. D.H.S. were 52 patients. Of which 30 were male, 22 were females. Rt. side were 25, l.t side 27; Avg. age was 55 yrs. **Aim :** To compare the procedure during operative intervention and post-operative follow up for 2-3 yrs.

Comparision were made on the following points:

1. Intra-operative time
2. Intra-operative blood loss
3. Post-operative mobilization
4. Post-operative electrolyte imbalance and disorientation
5. Healing and weight bearing
6. Implant cut through and failure
7. Limb length deficit and deformity
8. Failed procedure
9. Infection **Results :** Results of P.F.N were superior to D.H.S. P.F.N was found more useful for osteoporotic and A2, A3 fracture types. **Conclusion :** PFN is preferable to DHS in the treatment of Inter-trochanteric fractures of femur.

Key words: P.F.N: Proximal femoral nail,

D.H.S: Dynamic hip screw and plate,

I.T # N.F.: Intertrochanteric fracture neck femur.Go to:

Introduction : Hip fractures in older patients are associated with frequent complications and high mortality rates. Although numerous reports regarding these fractures have been published, treatment alternatives for trochanteric fractures remain controversial[1]. Dynamic hip screw (DHS) systems have been the standard means of fixation of trochanteric fractures in the last few decades, but high failure rates for unstable fractures nearing 23% have been reported. For this reason, intramedullary devices combining good stability and minimal surgical exposure have been developed in the last 20 years[2]. However, prospective and randomized clinical trials have not confirmed the theoretical advantages of these intramedullary devices[3,4]. With early designs, femoral diaphyseal fractures at the implant tip brought into question the reliability of these intramedullary implants [5,6]. Therefore, in 1996, AO/ASIF (Arbeitsgemeinschaft fuer Osteosynthesefragen—Association for the Study of Internal Fixation) designed a new intramedullary device: the proximal femoral nail (PFN)[7].

The PFN has several modifications in its design to overcome nail-related complications including an additional antirotational hip screw that prevents rotation collapse of the head–neck fragment, and a specially shaped tip together with a smaller distal shaft diameter that produces less stress concentration at the tip and pre- vents shaft fractures[8]. But there are few studies in the literature comparing the PFN with DHS [9,10,11]and conclusive data regarding which method is more advantageous are lacking. The goal of this study is to compare the clinical and radiographical results of the DHS and PFN for the treatment of trochanteric hip fractures.

Method :

Study design : 155 Intertrochanteric hip fractures, which were surgically treated between 2010 and 2015 at our institution, were enrolled for this study.

The 155 patients who met the inclusion criteria with a minimum 2 years of follow-up and who had regular clinical and radiographic assessments (6, 12, 24 weeks and annually thereafter) were accepted as the major study group and their charts were identified and retrospectively analyzed for the final evaluation. For each of the 155 Intertrochanteric fractures, one independent investigator (OS) reviewed the medical records to record sex, age at the time of fracture, mechanism of injury, fracture type (AO/OTA classification)[12], total operative time (the time that close reduction was started to the time that the wound was sutured[13], hospital stay, time to union (radiographical confirmation), types of initial and secondary surgical procedures performed, complications (early and late), and mortality (early and late).

standard PFN (135° shaft/neck angle with a length of 240 mm) were implanted through a 4–5 cm skin incision, which extended from the cranial part of the femur to the tip of the greater trochanter. All nails were interlocked distally depending on the type of fracture with one and/or two screws (distal dynamic and/or static)

Figure 1: Inter-trochanteric fracture Left

Figure 2: I.T. fracture fixed with PFN

According to AO/OTA classification[12], A1 fractures are simple, two-part fractures, whereas A2 fractures have multiple fragments. A3 fractures include reversed oblique and transverse fracture patterns. The distinctive characteristic of A3 fractures is a fracture line that extends through the lateral femoral cortex distal to the vastus ridge of the great trochanter[10].

Study groups : The fractures were divided into two groups for analysis: Group 1-52 fractures treated with DHS and Group 2-103 fractures treated with PFN. The decision for the type of the operation was based on surgeon's preference and availability of the implant. Prior to hip surgery, each patient was evaluated by the same trauma team. The overall time from injury to surgery averaged 3.2 days (range, 1–6 days). Steps were taken to ensure that every individual was in the best possible medical condition at the time of surgery. Surgical techniques: All procedures were performed by two trauma surgeons. All surgeries were started on the traction table following closed reduction confirmed with fluoroscopy on two different planes. The operative technique for PFN was the same as that previously described by Simmermacher and associates including the placement of the hip screw and hip pin[9]. The

For fixation with DHS, closed reduction on fracture table and internal fixation as described in detail in the manufacturer's manual are performed under fluoroscopic control[14]. After reduction was confirmed by fluoroscopy on two different planes, the incision level was determined under fluoroscopic guidance, and a straight lateral incision of 4–5 cm was made. After adequate exposure with standard technique, a 4 hole-side plate with 135° lag screw was inserted with 4.5-mm cortical screws. [15]

Figure 3: I.T. fracture fixed with DHS

Postoperative treatment and evaluation : A physiotherapist working as a member of the orthopedic team ensured adherence to a standardized rehabilitation protocol. Patients were mobilized and instructed not to bear weight for the first 2 days due to the soft tissue healing and suction drains. After drains were taken out, full weight bearing/weight bearing as tolerated was allowed. Antibiotic treatment was used postoperatively for 3–5 days. Before each patient was discharged from the hospital, radiographs of the affected hip were made in the anterior–posterior and medio-lateral planes to assess fracture reduction. The quality of fracture reduction was graded as good, acceptable (5-10 degrees varus/valgus and/or anteversion/retroversion) or poor(more than 10 degrees varus/valgus and/or anteversion/retroversion). The clinical outcome for each group was analyzed and intra-operative, early (the first month after hip fracture repair) and late complications (after first month) were recorded. Prolonged drainage (>4 days), hematoma (confirmed with ultrasonography), superficial infection (confirmed with cultures), complications were classified; whereas loss of reduction, non-union, implant failure (confirmed radiologically), and late infection (confirmed with cultures) were considered late complications. Early mortality (death in the first year following hip fracture) and late mortality (death after the first year) were also analyzed. The radiographic outcome for each group was analyzed with anterior–posterior and medial–lateral radiographs at each follow-up visit. Any changes in the position of the implant and the extent of fracture union were noted. Fractures were judged to be healed radiographically if bridging callus was evident on three of four cortices as seen on two views[16]. Statistical analysis: Four types of statistics were used in the outcome analysis. The success of the homogeneity between study groups was tested by comparing descriptive variables with student t test. A comparison of total surgery time and time to union was assessed using the Mann–Whitney U test. The chi-square test was used to compare differences between overall mortality rates. Finally, a Z test was used to compare the intraoperative, early and late complications of the two treatment groups. All calculations were performed using SPSS software (Statistical Package for the Social Sciences, version 11.5, SPSS Inc, Chicago, IL, USA). Values for P less than 0.05 were considered statistically significant.

Results : Both groups were comparable in terms of age, gender, mechanism of injury, and category of fracture. There were 92 male and 53 female (mean age: 62 years; range, 50–87 years). The mechanism of injury was a simple fall while walking or climbing stairs for all patients. Mean follow-up for this series was 26 months (range, 24– 60 months). The demographic data of the study groups were summarized in Table 1.

Table1 : Demographic data of the study groups

Study Groups	Sex (M/F)	Age (Range)	Follow up (Range)	Fracture type		
				A1	A2	A3
1(DHS)	30/22	55(50-81)	25(24-48)	10	25	17
2(PFN)	62/41	62(55-87)	26(24 -36)	20	55	28

Table 2 :Early complications

Early Complications	Group 1 (DHS)	Group 2 (PFN)	Total
Prolonged drainage	1	1	2
Hematoma	1	0	1
Superficial infection	3	1	4
Total	5	2	7

The mean duration of surgery was 80-90 minutes for group 1 and 40-70 minutes for group 2. The mean time to union for group 1 was 2 months (range, 1–3 months) and 1.50 months for group 2 (range, 1.5–2.5 months). Early complications for group 1 and 2 were summarized in Table 2. In Group 1, the superficial infection was debrided in a second operation 20 days after the initial surgery. The late complications were reduction loss (3 varus displacement, 1 medial displacement of the femoral shaft), nonunion (3 hips), and implant failure (3 screw back-out) (Fig.4-6). There were no late infections in this group. Of the 3 non-unions, 2 were treated by hemi-arthroplasty 6 months after the initial surgery, and 1 was lost to follow-up after 9 months (Table 3).

Table 3 : Late complications

Late complications	Group 1 (DHS)	Group 2 (PFN)	Total
Reduction loss	3	1	4
Non -union	3	1	4
Implant failure	3	0	3
Late Infection	0	0	0
Total	**9**	**2**	**11**

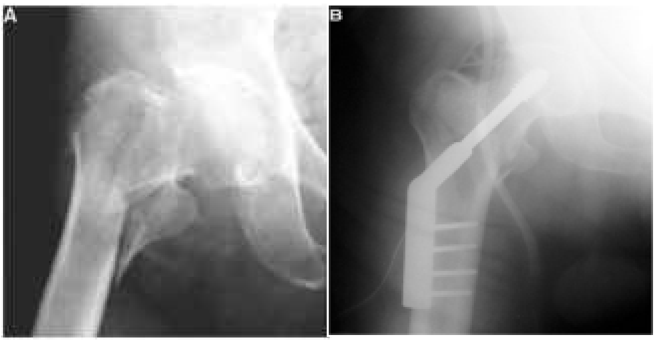

Figure 4 : Pre-op x-ray of unstable I. T. fracture
Figure 5: Early post-op x-ray fixed with DHS

Figure 6: Late post-op x-ray with loss of reduction

In Group 2, there was 1 superficial infection treated with antibiotic and dressing. The late complications were reduction loss (1 varus displacement), nonunion (1 hip), and implant failure (Z effect) (Fig.7-9). There were no late infections in group 2. Of the 1, non-union was treated by hemi-arthroplasty 6 months after the initial surgery, (Table 3). There was only one intra-operative complication in Group 1. A closed reduction could not be achieved, and open reduction was performed. There were no intra-operative complications in group 2. There was no fracture of greater trochanter or femoral shaft. The total mortality for group 1 was 3 patients. Of group 2-1 patients died in the first year after hip fracture surgery (early mortality). The total mortality for group 2 was 1 patient.

Figure 7: Pre-op x-ray of unstable I.T. fracture
Figure 8: Early post-op x-ray fixed with PFN

Figure 9: Late post-op x-ray with implant failure

A comparison of intraoperative, early and late complication rates revealed statistically significant differences between study groups. Group 2 was superior in result than Group 1. Total duration of surgery was significantly lower in group 2 than it was in group 1. A comparison of time to union demonstrated no statistically significant differences between study groups. There were also no statistically significant differences regarding overall mortality rates.

Discussion : The goal of this study was to determine whether there is any clinical or radiographic difference between DHS and PFN for treating trochanteric fractures. Although there have been numerous reports about these fractures, treatment alternatives still remain controversial [16].

Since the initial reports which described DHS for the treatment of intertrochanteric fractures, it was considered as the gold standard method [5, 7]. These implants provide a secure fixation and controlled impaction of the fracture; however, a cut-out of the screw from the implant is a frequent complication [17]. In addition, problems may arise from the need for extensive dissection and subsequent blood loss[10]. To circumvent these drawbacks of DHS, intramedullary implants were developed that combine the advantages of good stability and minimal surgical exposure[18]. In the current study, we compared DHS with one of these intramedullary implants (PFN) and tried to find out which implant system has better clinical and radiographic outcome.

In the literature, there are several prospective randomized clinical studies that compare DHS with several intra-medullary nails. In most of these studies, the nails used for comparison were Gamma nails[3,7]. In most fractures, which are stable and minimally displaced, DHS produces reliable results[11,19]. However, in unstable fractures, the device performs less well, with an incidence of cutout failure ranging from 5 to 10% [4, 5]. To resolve this problem, the Gamma nail was developed. Initial reports showed the Gamma nail to be useful[20], but randomized controlled trials comparing DHS with the Gamma nail reported a high incidence of femoral shaft fractures and re-operations in groups treated with the Gamma nail [7]. In a metaanalysis by Parker and associates, this problem was also confirmed with a re-operation rate in the Gamma nail group[3]. To overcome these nail-related complications, AO designed a new intramedullary device, PFN, in 1996 [2]. In the PFN design, the offset was increased, and the diameter of the nail was reduced with an anti-rotational hip pin. From the mechanical point of view, a combined intramedullary device inserted by means of a minimally invasive procedure seems to be better [2]. In addition, it lets the surgeon minimize soft tissue dissection thereby reducing surgical trauma, blood loss, infection rates, and the number of wound complications[9,21,23]. Additionally, closed reduction in the fracture preserves the fracture hematoma, an essential element in the consolidation process [24]. In the current study, we had only 1 reoperation out of 103 patients. This is a better rate than the re-operation rates of the Gamma nail reported in the literature[25]. In addition, we had no femoral shaft fractures in our series.

The PFN also had some disadvantages associated with its use such as intra-articular migration; loosening or lateral protrusion of the lag screws; local tenderness over the lateral aspect of the thigh; and intraoperative technical or mechanical problems including difficult reduction, problems with distal locking[18,26]. A study by Boldin and associates examined 55 patients with proximal femoral fractures who were all treated with PFN with a mean follow-up of 15 months. As a conclusion, the authors stated that if closed reduction is possible, PFN must be preferred. However, if open reduction becomes necessary, the treatment choice must be DHS [2].

Few studies have compared PFN with DHS [10,27], and conclusive data about which method is more advantageous are lacking. In a study by Saudan et al. [27], 206 patients were randomized into 2 treatment groups (PFN vs. DHS) and prospectively analyzed. The minimum follow-up was 1 year. The authors did not find any statistically significant differences-intra-operatively, radiographically, or clinically between the 2 study groups. The authors concluded that there are no advantages to an intramedullary nail versus a DHS with regard to cost, complications, or improved patient outcomes. In another study by Sadowski and associates [10], 39 elderly patients with AO/OTA 31-A3 intertrochanteric fractures of the femur were randomized into two treatment groups. Patients treated with an intramedullary nail had shorter operative times, fewer blood transfusions, and shorter hospital stays compared with those treated with a 95° screw plate. In conclusion, the authors support using an intramedullary nail rather than a 95° screw plate. In another study by Baumgartner et al.[28], 135 patients who were treated with either a sliding hip screw or an intramedullary hip screw were analyzed, and in the group of patients with unstable intertrochanteric fractures, the intramedullary device was associated with 23% less surgical time and 44% less blood loss. In our study, the results were comparable with the literature [10, 28]. Patients treated with PFN had shorter operative times and fewer blood transfusions (In our study, although there was significant difference with regard to complications including implant failures, DHS had a 3-times more reduction loss compared with PFN.

The rates of implant failures were differing between the studies in the literature [10, 16]. In general, it is accepted that fracture type is one of the major concerns about these failures. A3 fracture pattern is a reverse oblique fracture type and considered as unstable. Although 95 degrees dynamic compression plates or DHS with/without TSP were used previously; in the recent years, the recommended treatment for these fractures is intramedullary nails [10]. Intramedullary nails, especially PFN demonstrated better biomechanical results than the other treatment alternatives. They had lower rates of implant failure and fewer complications when used for the treatment of reverse oblique intertrochanteric fractures [29]. On the contrary, there are several other studies in the literature analyzing the outcomes of DHS with/without (Trochanteric stabilization plate) TSP for the treatment of A3 reverse fractures. In these studies, the failure rates for DHS were reported between 11 and 56% [29,30,31]. In a study by Willoughby, 35 reverse oblique fractures were treated with DHS and a total of only 4 failures were recorded (11%). As a result, it was stated that DHS had significantly better outcomes than that previously documented results in the literature for the same fracture type and could be accepted as an effective device for the treatment of reverse oblique fractures [31]. Our study has comparable results with the literature. Although the failure rate of DHS for A3 reverse fractures was reported as high as 56% [16], in our study, we found better results than the other series in literature. In our study, a total of 17 A3 reverse fractures were treated with DHS. Out of these 17 cases, 3 implant failures were recorded. This rate of failure may be due to the insufficient stability of the DHS for the treatment of reverse oblique fractures. Nevertheless, we believe that with experience and more accurate placement of the lag screw in the femoral head, the failure rates can be decreased as did in our study [31]. For this reason, the implant choice is a critical factor for the treatment of A3 reverse fractures. In the current study, the implant choice (DHS or DHS with TSP) was made through surgeons' choice and the implant

availability. In our study, no TSP was used for A3 reverse fractures. In the literature, it was reported that the addition of TSP was effective in preventing medialization of the femur. However, it did not lower the failure rates and the requirement for revision surgery [31–33]. Although we did not use any TSP, we judged the purchase of the lag screw intra-operatively and meticulously controlled the placement of the lag screw. By this way, we believe that we had lower failure rates for the A3 reverse fractures compared with literature.

Conclusion:

In conclusion, the ideal implant for treating trochanteric fractures of the femur remains a matter of discussion. The most important limitation of our study is that we did not analyze the outcome separately for the different fracture types. However, although most studies have studied stable and unstable trochanteric fractures, individually [10, 26, 27], we completed one of the largest series in which analysis of two implant types was performed regardless of fracture type. Secondly, we could not analyze the complications separately as we had very few hips with complication. We detected differences between two treatment groups with regard to early versus late complications, time to union, and overall mortality; however, with its shorter operative period, PFN is a good alternative to the DHS. For this reason, we believed that it might be the implant of choice for the treatment of trochanteric fractures by surgeons who have an experience in interlocked femoral nailing systems. P.F.N has upper hand over D.H.S in treatment of Intertrochanteric fracture femur.

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