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ORIGINAL ARTICLE

A COMPARATIVE STUDY OF FUNCTIONAL OUTCOME BETWEEN DYNAMIC HIP SCREW AND PROXIMAL FEMORAL NAIL IN SURGICAL MANAGEMENT OF PER-TROCHANTERIC FRACTURES

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ABSTRACT: BACKGROUND: The choice of implant between the extramedullary Dynamic Hip Screw (DHS) and intramedullary Proximal Femoral Nail (PFN) in the surgical management of pertrochanteric fractures is still an enigma. Various meta-analysis conducted so far have yield conflicting results. **METHODS:** Prospective randomized controlled study including 30 patients with 30 pertrochanteric fractures out of which 15 were treated with DHS and 15 with PFN. **RESULTS:** The overall functional outcome of patients treated with the PFN was significantly better than those treated with DHS ($p<0.037$), especially in patients with unstable fractures. Other advantages of PFN included smaller incisions, shorter operative times, relatively less blood loss and less postoperative pain and early ambulation. **CONCLUSION:** We conclude that in stable intertrochanteric fractures, both the PFN and DHS have similar outcomes. However, in unstable intertrochanteric fractures the PFN has significantly better outcomes in terms of earlier restoration of walking ability and less limb length shortening.

KEYWORDS: Per-trochanteric fractures, Dynamic Hip Screw, Proximal Femoral Nail.

INTRODUCTION: Trochanteric fractures are one of the commonest injuries sustained predominantly in elderly patients due to trivial fall and in younger individuals due to significant trauma. The type of implant used has an important influence on complications of fixation. Sliding devices like the Dynamic Hip Screw (DHS) and Intramedullary devices like the proximal femoral nail (PFN) have their own advantages & disadvantages and various meta-analysis conducted so far have come out with conflicting results regarding superiority of PFN over DHS. The purpose of this study was to verify the theoretical advantages of the intramedullary device (PFN) over the dynamic hip screw devices (DHS) and also to know whether it actually alters the eventual functional outcome of the patient.

AIMS AND OBJECTIVES: To compare the surgical treatment of intertrochanteric fractures of the femur with the intramedullary device (Proximal femoral nail) and Dynamic Hip Screw device, with respect to:

1. Union rates of the pertrochanteric fractures treated by Dynamic Hip Screw and Proximal Femoral Nail.
2. Early mobilization and return of prefracture ambulatory status.
3. Assessment of results based on subjective parameters, objective parameters and radiological findings.
4. Complications of dynamic hip screw and proximal femoral nail.

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MATERIALS AND METHODS: This is a prospective study conducted at Sapthagiri Institute of Medical Sciences & Research Center, Bangalore between March 2013 to March 2014. An inclusion criterion includes all Patients with pertrochanteric fracture, skeletally mature patients, and closed fractures. An exclusion criterion includes Patients with open pertrochanteric fracture, malunited fractures of ipsilateral limb and medically unstable patients and those under the age of 16 years were excluded from the study.

The mode of injury resulting in intertrochanteric fracture was classified under 3 different categories taking into consideration whether the injury was due to a road traffic accident, trivial fall or a fall from height. All the patients were initially evaluated as to their general condition, hydration and corrective measures were undertaken. The pre-injury walking ability of the patients was classified as per grades described by Sahlstrand[1]:

Grade 1 – Walk without support.

Grade 2 – Walk with a cane or minimal support.

Grade 3 – Walk with 2 canes, crutches or living support.

Grade 4 – Confined to bed or wheel chair.

Anteroposterior and lateral radiographs of the affected hips were taken. The patients were then put on skin traction over a Bohler–Braun frame. The fractures were classified as per AO/ASIF Classification of intertrochanteric fractures. 31-A_1- stable fracture, 31-A_2 and 31-A_3 were considered as unstable fractures. Patients were taken up for surgery as soon as their general condition permitted. Adequate blood transfusion and other supportive measures were given depending on the pre-operative condition of the patient and also post-surgery based on the blood loss during surgery.

The fractures were fixed with either dynamic hip screw device (DHS) or an intramedullary device.

SURGICAL TECHNIQUE: All patients were positioned supine on a fracture table. The unaffected lower limb was flexed and abducted to allow easy access for the image intensifier.

Reduction: The fracture was reduced by traction in neutral, slight internal or external rotation depending on the nature of the fracture and checked by anterior posterior and lateral views on the image intensifier. All fractures were reduced by the closed method. The objective of reduction is to confer weight bearing stability and correct varus and rotational deformities. In stable fractures this is achieved by reduction of the calcar femorale. However, in comminuted fractures anatomic reduction does not confer stability.

Method of Fixation: A. Dynamic Hip Screw: Through lateral approach by standard technique dynamic hip screw fixation was carried out.

B. Proximal Femoral Nail: Through lateral approach by standard technique intramedullary hip screw proximal femoral nail was introduced.

Postoperative Care: All patients were given Pre-operative antibiotics for 24 to 48 hours and Patients were allowed to sit up in bed on the second post-operative day. Static quadriceps exercises where started on the second and third post-operative day. Sutures were removed after 10 to 14 days. Patients were mobilized non-weight bearing as soon as the pain or general condition permitted.

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Weight bearing was commenced depending upon the stability of the fracture and adequacy of fixation, delaying it for patients with unstable or inadequate fixation.

All patients were followed up at an interval of 6 weeks till the fracture union is noted and then after once in 3 months till 1year. At every visit patient was assessed clinically regarding hip and knee function, walking ability, fracture union, deformity and shortening. X-ray of the involved hip with femur was done to assess fracture union and implant bone interaction.

Walking ability of each patient was recorded at the end of four months and compared with pre-injury walking ability using the Sahlstrand[1] grading. Post-operative pain was evaluated using the four-point pain score as also used by Saudan.[2]

1. No pain.
2. Mild pain not affecting ambulation.
3. Moderate pain affecting ambulation requiring regular analgesics.
4. Severe pain, even at rest, requiring stronger analgesics.

The fracture union was considered as malunion if varus angulation was greater than 10 degrees. The outcome was assessed based on the postoperative pain, walking ability, hip joint range of motion, and limb length shortening as follows:

An excellent result was when there was no postoperative pain, shortening of up to 0.5cm, hip range of motion of more than 80 per cent of normal and ability to walk without support.

A good result was when there was mild postoperative pain not affecting ambulation, hip range of motion of 60-80 per cent of normal, shortening of 0.5-1.5cm and ability to walk with a cane or minimal support.

A fair result was when there were moderate postoperative pain affecting ambulation requiring regular analgesics, a hip range of motion of 40-60 per cent of normal, shortening of 1.5-2.5cm and ability to walk with two canes, crutches or any other living support.

A poor result was when there was severe postoperative pain even at rest requiring stronger analgesics, a hip range of motion of less than 40 per cent of normal, shortening of more than 2.5cm and confined to bed or a wheel chair.

Statistical Analysis: The collective data was analyzed by the Z-Test, Student T-test, Chi-square test, using SPSS software to evaluate the results. P value <0.05 will be considered as significant.

OBSERVATION AND RESULTS:

Pre-Operative Variables:

1. **Age Distribution:** The youngest patient in this series was aged 42 years and the oldest was 90 years. 24 of our patients were older than 55 years and presented with a history of trivial fall. The most common age group was in the range of 61 – 80, with a mean of 67.13 years.
2. **Sex Distribution:** Equal sex distribution was found in this study.
3. **Mode of Injury:** The most common mode of injury was a trivial fall (80%).
4. **Side of Injury:** Injuries to the left hip and right hip are equal.
5. **Type of Fracture:** There were 17 stable fractures and 13 unstable fractures. Out of the 17 stable fractures, 8 were in the DHS group and 9 in the PFN group. Out of the 13 unstable fractures, 7 were in the DHS group and 6 in the PFN group.

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INTRA OPERATIVE VARIABLES:

6. **Length of the Incision:** Patients treated with PFN required a significantly smaller incision.
7. **Duration of Surgery:** Proximal femoral nailing required 14.67 per cent less operative time as compared to Dynamic hip screw fixation.

POST OPERATIVE VARIABLES:

1. **Post-Operative Complications:** Malunion was seen in 20% of the patients in the DHS group while there was no non malunion in the PFN group. Hip screw cut out was seen in 1 patient in the DHS group. Wound infection was seen in 4 patients in the DHS group and in 1 patient in the PFN group.
2. **Post-Operative Pain:** In the DHS group only 2 patients were pain free, whereas 6 patients were pain free in the PFN group at sixth month of follow up.
3. **Pre-Injury V/S Post-Operative Walking Ability:** Seven patients in the PFN group regained their pre-injury walking ability at the fourth month of follow up as compared to only five in the DHS group.
4. **Post-Operative Shortening:** Significantly less limb length shortening was seen in the PFN group as compared to the DHS group with a mean of 1.30 cms in the DHS group and 0.67 cms in the PFN group.
5. **Post-Operative Range of Movement:** The patients treated with PFN recovered 74.6667 per cent of their hip range of movement as compared to those treated with DHS who recovered only 57 per cent of their hip range of movement.
6. **Time of Fracture Union:** All the fractured united at a mean of 12 weeks.
7. **Functional Outcome:** Excellent results were seen in 3 patients (20.0%) in the DHS group and in 6 patients (40%) in the PFN group.
8. **Functional Outcome V/S Type of Fracture with DHS:** Of the stable fractures 62.5% had a good outcome, while 69.4% of the unstable fractures had a poor outcome in the DHS group.
9. **Functional Outcome V/S Type of Fracture with PFN:** Of the stable fractures 66.7% had an excellent outcome while all the unstable fractures had a good outcome in the PFN group.
10. **Functional Outcome V/S Method of Fixation (Stable Fractures):** The outcomes of stable fractures treated with either DHS or PFN were similar.
11. **Functional Outcome V/S Method of Fixation (Unstable Fractures):** Unstable fractures treated with PFN had a significantly better outcome with all the patients having good outcomes as compared to those treated with DHS.

DISCUSSION: The goal of this study was to compare the functional outcomes of patients with pertrochanteric fractures treated by two different fixation devices, the extramedullary dynamic hip screw and the intramedullary proximal femoral nail. Our study consisted of 30 patients with 30 pertrochanteric fractures out of which 15 were treated with DHS and 15 with PFN.

In our series, the highest number of patients was in the 61-80 years age group. All the fractures that occurred in patients younger than 55 years were either due to a fall from height or a road traffic accident. This supports the view that bone stock plays an important role in the causation of fractures in the elderly, which occur after a trivial fall.

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Our series consisted of 17 stable and 13 unstable intertrochanteric fractures as classified according to AO/ASIF classification. The distribution of stable and unstable fractures in both groups was similar.

The pre-injury walking ability was similar in both groups of patients treated with DHS or PFN. 80 per cent of patients in the DHS group and 73.3 per cent of the patients in the PFN group were walking without support prior to the injury.

Simmermaches[3] in his article reports that the proximal femoral nail has advantage like decreased moment arm (Fig1) and it can be inserted by closed technique. The length of the incision in the DHS group ranged from 14cm to 18cm with a mean of 16cm as compared to a mean of only 6cm in the PFN group. The smaller incision in the PFN group meant that there was less intraoperative blood loss.[3,4]

While comparing the duration of surgery in the DHS group and PFN Group noted a mean of 66.66 minutes and mean of 52 minutes respectively the difference in both the groups was found to be highly significant and we attributed to the smaller incisions in the PFN group. Baumgaertner et al[5] also found that the surgical times were 10 per cent higher in the DHS group in their series. Saudan and colleagues[2] found that there was no significant difference between the operative times in the two groups in their series.

The occurrence of femoral shaft fractures does not seem to be a major problem with the PFN due to a narrower distal diameter as compared to other intramedullary nails.[6] Also, rotational control is inherent in the nail design and is not dependent on multiple parts that are likely to increase the risk of mechanical failure. Due to the smaller diameter lag screws in these intramedullary nails, the proximal aspects of the nail do not need to be flared to prevent mechanical failure of the nail and hence requires less reaming of the proximal femur, thereby reducing the risk of iatrogenic proximal femoral fracture.[7] In our study, both intra-operatively and postoperatively, there were no instances of femoral shaft fractures or extension of the original fracture. This was similar to the findings of Saudan et al[2] in their series. Other studies have also reported femoral shaft fracture rates of 0-2.1 percent.[8,9] We did not encounter any intraoperative complication in this study.

The complications we encountered in this series were malunion; hip screw cut out, and wound infection. There was no significant difference between the two groups with regards to time of fracture union as all fractures united at a mean of 12 weeks. Three patients (20 per cent) in the DHS group had a malunion whereas there was no malunion in the PFN group with all the fractures uniting with less than ten degrees of varus angulation, which was statistically significant ($p<0.018$). Only one patient (6.7 per cent) in our study had a hip screw cut out. This was seen in the DHS group involving an unstable intertrochanteric fracture.

The screw cutout was due to misplacement of screw in superior part of head and use of a135^0 barrel side plate as result of which, as the fracture site collapsed the screw cutout from the femoral head. Diffuse osteoporosis also may be contributing factor for screw cutout. However this patient was relatively mobile and hence re-operation was not necessary.

There was no implant cut out in the PFN group which was similar to the series by Menezes and co-workers[6] (0.7 per cent). In our series, 4 patients (26.67 per cent) of the DHS group had wound infections as compared to only one patient (6.7 per cent) in the PFN group, which was not statistically significant ($p>0.153$). We attributed the higher number of wound infections in the DHS group to the longer incisions, diabetes mellitus, and subsequently more soft tissue handling in this group as compared to the PFN group.

However all were only superficial wound infections, wound healing was delayed by about a week and healed without any further surgical intervention or complications with regular dressings. Saudan and associates[2] also did not find any significant difference between the infection rates in the two groups in their series.

In this series the average limb length shortening of patients in the DHS group was 1.30cm as compared to 0.67cm in the PFN group which was highly significant ($p<0.009$). This could be due to the increased sliding of the lag screw in the DHS group, allowing greater fracture impaction, as compared to the PFN[10]. Three of the patients in the DHS group with poor results, all had 2cm or more of shortening. Three of these patients had malunion of the fractures. The patients in the PFN group neither had a shortening of more than 1cm nor a malunion.

In our study we found a significant ($p<0.039$) difference in the postoperative pain in the two groups with (13.3%) in the DHS group who were pain free at the sixth month of follow up as compared to (40%) in the PFN group who were pain free at the same time of follow up. In addition (20%) in the DHS group had severe pain as compared to (1%) with severe pain in the PFN group. This difference could be due to the greater amount of impaction of the fracture fragments in the DHS group, thus altering the biomechanics of the hip, producing pain. Saudan and colleagues[2] found that the amount of persistent pain was similar in both groups in their series.

The average range of motion of the hip joints was 57 per cent of normal in the DHS group and 74.67 per cent of normal in the PFN group at sixth month of follow up. Hence, in our study, the patients in the PFN group regained a significantly better range of motion as compared to those in the DHS group ($p<0.002$).

The overall functional outcome of patients treated with the PFN was significantly better than those treated with DHS ($p<0.037$). However when we compared the stable and unstable fractures separately, we found that there was no significant difference in the outcomes of the stable fractures in the two groups ($p>0.198$). While comparing the unstable fractures in the two groups we found that the functional outcome of the patients in the PFN group was significantly better than the outcome of the patients in the DHS group with good results for all the unstable fractures treated with PFN compared to only fair and poor results for the unstable fractures treated with DHS. Banan H[11] believed that PFN is a good choice for stabilizing subtrochanteric and unstable trochanteric fractures.

We also found that patients in our study treated with a PFN regained their pre-injury walking ability at four months significantly more often than those treated with a DHS. In our series, only five of the fifteen patients (33.33 per cent) in the DHS group regained their pre-injury mobility level as compared to eight of the fifteen patients (53.33 per cent) in the PFN group at the fourth month of follow up. Similar findings were also seen in a series by Pajarinen et al[10] comparing the postoperative rehabilitation of patients treated with DHS and PFN. This suggests that the use of a PFN may favor better restoration of the function in the elderly population compared with the use of a DHS. One explanation might be the significantly greater impaction of the fracture in the DHS group with shortening of the proximal femur, thus altering the biomechanics of the hip and preventing restoration of the ability to walk. Moreover, the lack of compression in the PFN group did not seem to interfere with the healing of the fracture.

Meta-analysis conducted by Zeng C et al[12] revealed that PFN was superior to DHS in terms of the duration of surgery, intra operative blood loss and rates of fixation failure and overall complications. However, Shen et al[13] opined that this superiority was attributable to variation in the skills of the surgeons and different patterns of per-trochanteric fractures.

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In contrast to Zeng et al, a meta-analysis conducted by Xiao H et al[14] revealed that PFN had the same effectiveness as DHS with regards to operation time, blood loss, hospital stay, wound complications, mortality and re-operation. This conflicting results obtained by different meta-analysis may be due to heterogeneity of the trials included. Recent study by Ujjal B et al[15] revealed that the unstable fracture patterns in old aged patients with osteoporosis had a better outcome with PFN compared to DHS group. Further long term studies are required to know the impact on the mortality.

CONCLUSION: We conclude that in stable intertrochanteric fractures, both the PFN and DHS have similar outcomes. However, in unstable intertrochanteric fractures the PFN has significantly better outcomes in terms of earlier restoration of walking ability and less limb length shortening. In addition, as the PFN requires shorter operative time and a smaller incision, it has distinct advantages over DHS even in stable intertrochanteric fractures. Hence, in our opinion, PFN may be the better fixation device for most intertrochanteric fractures.

BIBLIOGRAPHY:

1. Sahlstrand T. The Richards Compression and Sliding Hip Screw System in the Treatment of Intertrochanteric Fractures. Acta Orthop Scand. 1974; 5: 213-9.
2. Saudan M, Lubbeke A, Sadowski C, Riand N, Stern R, Hoffmeyer P. Pertrochanteric fractures: is there an advantage to an intramedullary nail? A randomized, prospective study of 206 patients comparing the dynamic hip screw and proximal femoral nail. J Orthop Trauma. 2002; 16: 386–393.
3. Simmermacher R K J, Bosch AM, Vander Werken C. The AO/ASIF- Proximal femoral nail (PFN); a new device for the treatment of unstable proximal femoral fractures. Injury 1999; 30: 327-32.
4. Radford PJ, Needoff M, Webb JK. A prospective randomized comparison of the dynamic hip screw and gamma locking nail. J Bone Joint Surg (Br) 1993; 75: 789-93.
5. Baumgaertner MR, Curtin SL, Lindskog DM. Intramedullary versus extramedullary fixation for the treatment of intertrochanteric hip fractures. Clin Orthop. 1998; 348: 87–94.
6. Menezes, Daniel FA, Gamulin A, Bruno. Is the Proximal Femoral Nail a Suitable Implant for Treatment of All Trochanteric Fractures? Clin Orthop. 2005; 439: 221-7.
7. Kubaik E, Bong M, Park S, Kummer F, Egol K, Koval K. Intramedullary Fixation of Unstable Intertrochanteric Hip Fractures –One or Two Lag Screws. J Orthop Trauma. 2004; 18: 12-17.
8. Fogagnolo F, Kfuri M, Jr., Paccola Ca. Intramedullary fixation of per trochanteric hip fractures with short AO ASIF PFN. J Arch Orthop Trauma Surg 2004; 124 (1): 31-7.
9. Boldin C, Seibert FJ, Fankhauser F. The proximal femoral nail (PFN): A minimal invasive treatment of unstable proximal femoral fractures: A prospective study of 55 patients with a follow-up of 15 months. Acta Orthop Scand. 2003; 74: 53-8.
10. Pajarinen J, Lindahl J, Michelsson O, Savolainen V, Hirvensalo E. Peritrochanteric femoral fractures treated with a dynamic hip screw or a proximal femoral nail - A randomized study comparing post-operative rehabilitation. J Bone Joint Surg. 2005; 87B: 76-81.
11. Banan H, Al-Sabti A, Jimulia T, Hart AJ: The treatment of unstable, extracapsular hip fractures with the AO/ASIF proximal femoral nail (PFN) – our first 60 cases. Injury.2002 Jun; 33 (5); 401-5.

DOI: 10.14260/jemds/2015/1087

12. Zeng C, Wang Y-R, Wei J, Gao S-G, Zhang F-J, Sun Z-Q, Lei G-H: Treatment of Trochanteric Fractures with Proximal Femoral Nail Antirotation or Dynamic Hip Screw Systems: a Meta-analysis. The Journal of International Medical Research 2012; 40: 839 – 851.
13. Shen L, Zhang Y, Shen Y, Cui Z: Antirotation proximal femoral nail versus dynamic hip screw for intertrochanteric fractures: A meta-analysis of randomized controlled studies. Orthopaedics & Traumatology: Surgery & Research (2013) 99, 377—383.
14. Huang X, Leung F, Xiang Z, Tan P-Y, Yang J, Wei D-Q, Yu X: Proximal Femoral Nail versus Dynamic Hip Screw Fixation for Trochanteric Fractures: A Meta-Analysis of Randomized Controlled Trials. The Scientific World Journal Volume 2013, Article ID 805805, 8 pages.
15. Ujjal B, Ranadeb B: Comparitive Study between Proximal Femoral Nailing and Dynamic Hip Screw in Intertrochanteric Fracture of Femur. Open Journal of Orthopedics, 2013, 3, 291-295.

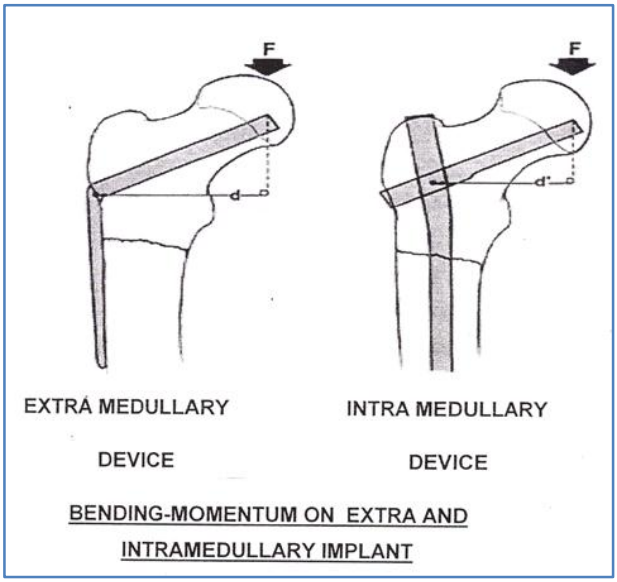

Fig. 1: Bending momemtum on extra and intramedullary implant

Fig. 2: Pre-operative radiography of 62 yrs old male

Fig. 3: Patient positioning on fracture table

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Fig. 4: Immediate post-operative radiography after PFN fixation

Fig. 5: Twelve weeks post-operative radiograph

Fig. 6: Pre-operative radiography of 55 yrs old male

Fig. 7: Immediate post-operative radiography after DHS fixation

Fig. 8: Twelve weeks post-operative radiograph

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