e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2022; 12(5); 01-09

Original Research Article

To Evaluate the Results of Dynamic Hip Screw (DHS) & Proximal Femoral Nail (PFN) In Intertrochanteric Fractures of Proximal Femur with Special Reference to Surgical Site Infection

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Received: 01-02-2022 / Revised: 27-02-2022 / Accepted: 25-03-2022

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Conflict of interest: Nil

Abstract

Introduction: Though dynamic hip screw is considered as a gold standard in the management of intertrochanteric fractures, its role is debatable in the management of unstable intertrochanteric fractures and intramedullary devices such as PFN are considered better implants for these fractures. Surgical site infection is an important problem in these surgeries that needs special consideration.

Material and methods: The study was conducted on 80 patients with intertrochanteric fracture femur attending the outpatient and emergency department of Bundelkhand Medical College, Sagar (M.P) between January 2021 to February 2022. The patients were divided randomly in two groups A and B, patients of group A were treated by CRIF/ ORIF with Dynamic hip screw and patients of group B were treated by CRIF/ ORIF with long PFN.

Results: Results for DHS and PFN were compared. Mean age in both the groups was 65 years. In DHS group, there were 22(55%) males and 18(45%) females. In PFN group, there were 21(52.5%) males and 19(47.5%) females. In DHS group, there were 15(40%) patients who injured because of high energy trauma like RTA, while 25(60%) were injured due to low energy trauma like trivial fall.

Conclusion: In intertrochanteric fractures femur, PFN helps in achieving biological reduction and imparts stability. PFN is a load bearing device and gives stability of fracture area proximally and shaft distally. Therefore, we advocate the use of PFN in comparison to DHS in intertrochanteric fractures femur except when trochanteric entry point for the PFN is fractured.

Keywords: Dynamic Hip Screw (DHS), Proximal Femoral Nail (PFN) , Intertrochanteric fracture, Surgical Site Infection.

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 composed of dense trabecular bone. The vast metaphyseal region has a more abundant blood supply, contributing to a higher union rate and less osteonecrosis compared to femoral neck fractures.[1-3] Intertrochanteric fracture is one of the most common fractures of the hip especially in the elderly with osteoporotic bones, usually due to low-energy trauma like simple falls.

Intertrochanteric femur fractures are typically treated by orthopaedic trauma surgeons as surgical treatment. Intertrochanteric fractures can be treated **via** internal fixation with a dynamic hip screw (DHS), percutaneous compression plate (PCCP), proximal femoral locked compression plate, less invasive stabilization system or intramedullary fixation devices like proximal femoral nail(PFN).[4-6]

DHS is load sparing device, needs extensive soft tissue stripping which further jeopardize the vascularity of periosteum & bone, but its biomechanical properties like short liver arm, greater implant strength, additional antirotation screw in the femoral neck and possibility of anatomical reduction have their own advantages making it standard in the management of intertrochanteric fracture.[7] On the other hand intramedullary device (PFN) is a load sharing devices, provide more biomechanical strength than DHS, permit early mobilization, minimally invasive, can be performed with closed procedures without further jeopardizing the vascularity and soft tissue envelop permits better rotational stability even in osteoporosed bone of elderly.

Surgical site infection is an important complication in fracture implant surgery that causes significant morbidity that requires special consideration in these surgeries. In this study we defined an infection developing within 30 to 90 days post-operatively as SSI, including superficial infection and deep infection. Superficial infection is the infection of the skin or subcutaneous tissue occurring within 30 days post-operatively, with at least one more symptom involving: localised pain, purulent discharge, spontaneous incision dehiscence and positive results of bacterial culture. The deep infection was diagnosed if an infection were associated with fascial and muscular layers occurring within 90 days, combined with at least one of the above-mentioned symptoms. Surgical site infection (SSI) is a challenging postoperative complication for the patient and hospital, the rate of which following hip fractures is between 2.7% and 14.9%.[6-8] It not only leads to more hospital stay, poor functional outcomes, and greater costs but also results in a substantially increased mortality risk. A variety of risk factors of SSI were documented, including age, associated comorbidities, obesity, experience of the surgeon, haematoma, surgical duration, increased duration of anaesthesia, high body mass index (BMI), current smoking, preoperative hospital stay, serum albumin, warfarin treatment etc.[6,11] As reported by Harrison, the method of fracture fixation was also significantly associated with the SSI. The surgical variables included: time to surgery (from admission to surgery), duration of surgery, type of anaesthesia, the implant (intramedullary devices or extramedullary devices), reduction methods, type of operating surgeon, intraoperative blood loss etc.

This study was done to evaluate the functional and radiological outcome of DHS and PFN in treatment of intertrochanteric fractures with special reference to surgical site infection.

Materials and Methods: This prospective comparative study was conducted on 80 patients with intertrochanteric fracture femur attending the outpatient and emergency in the Department of Orthopaedics of Bundelkhand Medical College, Sagar M.P from January 2021 to February 2022.

The patients were assessed clinically and radiologically and were divided randomly in two groups A & B, group A were treated by CRIF/ ORIF with DHS & group B were treated by closed /open reduction internal fixation with long PFN.

Patients personal information, clinical findings, risk factors regarding surgery and infection, radiological findings and follow-up findings were recorded. The results were evaluated and compared.

During this period 80 patients with intertrochanteric fractures of femur were selected according to the inclusion criteria. Alternate patients who fulfilled the inclusion criteria underwent DHS or PFN respectively.

Inclusion Criteria: Patients with both gender & age more than18 years with intertrochanteric fractures of less than 2 weeks of duration are included.

Exclusion Criteria: Pathological fractures, polytrauma, patients with co-morbid conditions like stroke that may hinder rehabilitation, patients unfit for surgery.

Follow up Protocol: Patients were called for follow up every month, on each follow up following aspects were noted- complaints of pain if any, range of hip and knee movements,shortening, whether the patient assumes his/ her occupation to previous injury state, able to sit cross-legged, squat, walking ability with or without support etc.

Standard pre-operative planning was done. Radiographs of the pelvis with both hips antero-posterior view and traction-internal rotation view was obtained to confirm the diagnosis.

Non-locking DHS plate with minimum of 6 cortices were fixed to the shaft distal to the fracture. In case of long PFN, a standard length and 135° angle nail was used in all our cases. The diameter was determined by measuring diameter of the femur at the level of isthmus on an AP X-ray. All cases were operated on a single standard fracture table under spinal anaesthesia using standard operating techniques. C-arm was used in all cases. As a standard protocol, intra-venous cefoperazone and sulbactum 1.5 gms was administered intravenously prior to the skin incision. The same combination was used for 48 hours postoperatively in standard doses. Intra-operatively the duration of surgery, the radiation exposure, intra-operative blood loss (method of Lee et al.)[6] size of the incision & any associated complications were noted.

Results:

In our study in DHS group, there were 22(55%) males and 18(45%) females. In PFN group, there were 21(52.5%) males and 19(47.5%) females. There was a male preponderance in both the groups in comparison to the females shown in Table 1.

Table 1: Distribution of patients according to Gender in both the groups (n=80)

GENDER DISTRIBUTION	DHS group	PFN group
Males	22(55%)	21(52.5%)
Females	18(45%)	19(47.5%)
Total	40	40

In DHS group, there were 15(37.5%) patients who injured because of high energy trauma like RTA, while 25(62.5%) were injured due to low energy trauma like trivial fall. In PFN group, there were 12(30%) patients who injured because of high energy trauma like RTA, while 28 (70%) were injured due to low energy trauma like trivial fall. We found that intertrochanteric fractures due to trivial trauma (66.25%) was the most common mode of injury, followed by road traffic accidents (33.75%). In both groups, higher number of patients of trivial trauma were there as shown in Table 2.

Table 2: Distribution of patients according to Mode of injury in both the groups (n=80)

MODE OF TRAUMA	DHS group	PFN group
High Energy (eg RTA)	15(37.5%)	12(30%)
Low Energy (eg FALL)	25(62.5%)	28(70%)
Total	40	40

In our study, the average age was 65 years with 90 years being the maximum and 24 years being the minimum. Patients with road traffic accidents were younger while patients with trivial trauma were older. 55% of the fractures occurred on the right side and 45% on the left side showing that fracture on right side is commoner than left side.

Table 3: Distribution of patients according to age in both the groups (n=80)

AGE GROUP	DHS group	PFN group
<21 yrs	0	0
21-50 yrs	8	7
51-70 yrs	23	24
71-80 yrs	7	8
>80 yrs	2	1
Total	40	40

The duration of surgery was calculated from the time of incision to skin closure. The average duration of surgery for DHS was 110.3 mins and that for PFN was 96.6 mins, which was shorter than DHS(**P**=0.04).

Table 4: Distribution of patients according to the duration of surgery in both the groups (n=80)

DURATION OF SURGERY	DHS group	PFN group
<=60 min	15	28
60-120 min	23	11
>120 min	02	01
Total	40	40

As the surgical approach suggests, DHS which was found to be more than twice the length (17cm) incision than PFN which required a smaller incision (6.1 cm) to access the entry site into the medullary canal.

The sliding of both groups was compared at the end of 1 year on the radiographs as described by Hardy et al. There was an average 6.6 mm sliding in the DHS group[8] (**P**=0.001) as compared to 4.9 mm of sliding in the PFN. The average limb shortening in DHS group was 10.33 mm as compared with PFN group which was only 7.72 mm (**P**=0.02). Even though there was more shortening in the DHS group it was not significant enough to cause any gait or functional impairment. The average hospital stay was 7.4 days (8 -12 days) in case of DHS while 5.8 days (4-10 days) in case of PFN (**P**=0.001). Return to pre-injury walking ability in DHS group was on an average of 18 weeks compared to PFN which was 14 weeks (**P**=0.03) as shown in Table 5.

Table 5: Distribution of patients according to average time of mobilization (n=80)

Patient Mobilization	DHS group	PFN group
Active hip and Knee mobilization	2.27 days	1.2 Days
Non- weight bearing crutch walk	4.93 weeks	3.9 weeks
Partial weight bearing walking	7.87 weeks	6.27 weeks
Full weight bearing walking	18 weeks	14 weeks

The comparison of mean blood loss in both the groups showed a statistically significant difference (P < 0.0001), with a higher mean blood loss in DHS group in comparison to PFN group. All the details are mentioned in Table 6. Following surgery, all swabs and mops with blood contamination from the surgical procedure were weighed to determine the amount of blood loss, similar to the method of Lee et al[6]. The average blood loss during DHS procedure was 159 ml than that of PFN procedure was 73ml, which was significantly less(**P**=0.001) than DHS. 5 out of 40 patients in DHS group and 2 patients in PFN group required blood transfusion either intra or postoperatively. Since the incision was smaller and duration of surgery was shorter in PFN, there was less tissue damage and hence lesser blood loss. In DHS group, there were 2(5%) patients who had blood loss between 50-100 ml, in 5 (12%) the blood loss was between 101-200 ml, in 12(30%) patients it was between 201-300 ml, in 13(32%) patients it was between 301-400 ml and in 8(20%) patients it was more than 400 ml. In PFN group, there were 32(85%) patients who had blood loss between 50-100 ml, in 6(15%) the blood loss was between 101-200 ml and 2 of the patients had a blood loss between 200-300 ml. None of the patients had blood loss more than 300 ml.

Table 6: Distribution of patients according to the amount of blood loss (n=80)

BLOOD LOSS	DHS group	PFN group
50-100 ml	2(5%)	32(85%)
101-200 ml	5(12%)	6(15%)
201-300 ml	12(30%)	02
301-400 ml	13(32%)	00
>400 ml	8(20%)	00
Total	40	40

In DHS group, 36 (90%) patients had no complications, 1(2.5%) had DVT and 1(2,5%) had cut out of screw, 2(5%) had infection. In PFN group, 1(2.5%) had infection, 1 (2,5%) had z effect, 1(2.5%) had implant failure in the form of nail breakage and 37(92.5%) shows no complication as given in Table 7.

Table 7: Distribution of patients according to complication (n=80)

COMPLICATIONS	DHS group	PFN group
Nil	36(90%)	37(92.5%)
Infection	2(5%)	1(2.5%)
DVT	1(2.5%)	0
Cut out of stabilizing screw	1(2.5%)	0
Z effect	00	1(2.5%)
Implant failure(breakage)	00	1(2.5%)
Total	40	40

As shown in Table 8 in DHS group, in 2(5%) patient the union time was 2-2.5 months, in 16(40%) it was2.5- 3 months and in 22(55%) it was more than 3 months. The mean time for union in DHS group was 3.26 ± 0.47 months. In PFN group, in 18 (55%) patients the union time was 2-2.5 months, in 20(40%) patients the union time was 2.5-3 months and in 2(5%) it was more than 3months. The mean time for union in PFN group was 2.20 ± 0.50 months. The difference in mean union time was significant ($P < 0.0001$) with a higher union time in DHS group in comparison to PFN group. Radiological outcome was assessed at 3rd months, 6th months and 12th month post-op.

Table 8: Distribution of patients according to type of time period of union(n=80)

TIME PERIOD	DHS group	PFN group
2.-2.5 Months	2(5%)	18(45%)
2.5-3 Months	16(40%)	20(50%)
>3 Months	22(55%)	2 (5%)
Total	40	40

Figure 1: X-ray showing fixation with DHS

Figure 2: X-ray showing fixation with PFN

Cases of superficial and deep surgical site infection were recorded. There was 1 cases of superficial surgical site infection in DHS group that resolved with antibiotics with no case of superficial surgical site infection in PFN group . There were 1 cases of deep surgical site infection in DHS group and 1 cases of deep surgical site infection in PFN group that developed into chronic osteomyelitis. In DHS group there were more chances of infection because of more surgical trauma in DHS group. On culture, in 2 cases *Staphylococcus aureus* was the causative organism followed by the 1 case each of Streptococcus pyogenes, Pseudomonas.

Table 9: Showing incidence of infection in both groups

Infection rate	DHS group	PFN group
Superficial infection	1(2.5%)	0
Deep infection	1(2.5%)	1(2.5%)

Discussion:

Pertrochanteric hip fractures still are a major orthopaedic challenge, and those that are unstable have the poorest prognosis. Despite the fact that union rates are high in intertrochanteric hip fractures, sometimes results are disappointing. Excessive Fracture collapse is one of the postoperative complications reported in association with these fractures. Duty of every orthopaedic surgeon is to get the patient up and out of bed with little pain as soon as possible while causing minimal surgical trauma to already traumatized patients.

Historically, Smith Peterson nail and Jewet nail were introduced in1930's. In the 1950's and 60's Pugh and Massie modified sliding devices and dynamic hip screw (DHS) were developed. Kuntscher, Zickle, Grosse, Kempf and Russel and Taylor developed intramedullary nail (IMN) with sliding hip screw (SHS).[9-11] In the early 90s intramedullary devices were developed for fixation of intertrochanteric fractures. These devices had numerous biomechanical and biological advantages over the conventional dynamic hip screw. The advantages and disadvantages of the original design of the Gamma nail have been well established in several studies done in the past, usually by comparing the results with the dynamic hip screw (DHS).[8,12-13] Recent data suggests intramedullary devices have been very good with union rates up to 100% compared with other extramedullary devices which show union up to 80% only.[12-13]

Kyle et al. has noted that increased forces are required to initiate sliding in intra medullary devices as compared to sliding hip screw with plate.[14] Amongst all intra medullary devices the gamma nail requires the largest force. The explanation lies in the barrel of the side plate, the barrel provides a free passage for the screw to slide, thus the longer the barrel length the less the forces required to initiate sliding. The nail in the medullary canal provides a physical block to significant shortening of the head and neck segments in the fractures which explains the minimum shortening in the PFN group as compared to DHS group.[9] In our study patients who underwent PFN returned to pre-injury walking status earlier than patients who underwent DHS. Proximal femoral nailing creates a shorter lever arm, which translates to a lower bending moment and a decreased rate of mechanical failure.[8] PFN has shown to be more biomechanically stronger because they can withstand higher static and several fold higher cyclical loading than dynamic hip screw. The implant compensates for the function of the medial column. Proximal femoral nail also acts as a buttress in preventing the medialization of the shaft.[15-16]

Our study have found that the extramedullary devices were associated with a higher risk for SSI after intertrochanteric fractures, compared with the intramedullary devices (Table 9). Harrison et al[13] found a similar result in their study of the incidence of SSI after hip fracture surgery. According to their data, the incidence of SSI after hip fractures in extramedullary fixation was significantly higher than that in intramedullary fixation (0.78% vs 0.00%, $P = .002$). Compared with the extramedullary devices, some advantages of the intramedullary devices might result in a lower rate of SSI in this study, including small incision with less disruption to deep tissues, shorter operative time with less exposure, and surgical area farther from the skin incision.

PFN is better than DHS in Type II intertrochanteric fractures of femur in terms of decreased blood loss, reduced duration of surgery, early weight bearing and mobilization, reduced hospital stay, decreased risk of infection and other complications.[17] It is just a matter of time that PFN replaces DHS as the gold standard for intertrochanteric fractures through following points- 1. PFN helps in achieving biological reduction and imparts stability. PFN prevents excessive collapse and limb shortening, thus it helps in achieving overall good functional outcome. 2. PFN is a load bearing device and gives stability of fracture area proximally and shaft distally, therefore biomechanically PFN is better choice of implant for fixation of peritrochanteric femoral fractures. 3. PFN is better choice of implant than DHS in terms of blood loss during surgery and early rehabilitation. Therefore, we advocate the use of PFN in comparison to DHS in intertrochanteric fractures femure except when trochanteric entry point for the PFN is fractured.

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