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A comparative study of short proximal femoral nail and dynamic hip screw in treatment of intertrochanteric fractures

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Abstract
Background: Incidence of intertrochanteric fractures has increased significantly during recent years due to rising age of population and sedentary life style. They are one of the most frequently operated fracture types. Intertrochanteric fractures occur predominantly in elderly patients with osteoporosis. Operative fixation is the treatment of choice. It can be extra medullary implant like dynamic hip screw (DHS) or intramedullary implant like proximal femoral nail (PFN).
Objectives
- Evaluation of effectiveness of PFN and DHS in the management of intertrochanteric fractures.
- The advantages and disadvantages of the PFN and DHS in intertrochanteric fractures

Materials and methods: These is a prospective study which was carried out from feb 2015 to feb 2016 in Government Medical College Kozhikode. In this study period 48 cases of intertrochanteric fractures were studied, out of which 24 cases were operated with PFN and 24 cases were operated with DHS. The results were evaluated and compared.
Results: Most of the patients were between 50 to 80 years of age. Most common mode of injury was domestic fall. The mean time of fracture union was 16 weeks. 54.2% patients operated by PFN were unstable fractures and 58.3% patients operated by DHS were stable fractures.
The functional outcome was calculated by Harris hip score during follow up in 2 week, 6 weeks.3 months 6 Months and 1 year. By 1 year follow up of operated patients 96% of patients with PFN had good to excellent results 4% had fair results. 88% patients with DHS had good to excellent results and 12% patient had fair results.
Conclusion: There is not much difference in functional outcome of intertrochanteric fractures treated by DHS and PFN in our settings. PFN is used mainly in unstable fracture and DHS in stable intertrochanteric fractures. Surgical exposure is minimal in PFN so minimal blood loss and wound complication. Early mobilization is an advantage with PFN. PFN needed better operative skill than DHS.

Keywords: Intertrochanteric fractures, short proximal femoral nail, dynamic hip screw

Introduction
Incidence of intertrochanteric fractures has increased significantly during recent years due to rising age of population and sedentary life style. They are one of the most frequently operated fracture types and have the highest postoperative fatality rate of surgically treated fractures. Intertrochanteric fractures occur predominantly in elderly patients with osteoporosis[1]. In young patients it is usually associated with high energy trauma
Clinical presentation depends on type, severity and etiology. Displaced fractures are symptomatic. Patient cannot walk and exhibit classical shortening and externally rotated limb. On the other hand in undisplaced fractures there may be only minimal pain and they may be ambulant and may present with no deformity[1].Older patients with intertrochanteric fractures may have associated other osteoporotic fractures like distal radius, proximal humerus. In young patients these fractures usually result from high velocity injuries and may be associated with chest, head, neck, abdomen injuries. Intertrochanteric fractures can be managed by conservative or operative. Operative treatment is the mainstay of treatment since conservative management is associated with high mortality and complications.

The goals of treatment in intertrochanteric fractures are to restore mobility safely and efficiently while minimizing the risk of medical complications and technical failures and to restore the patient to preoperative status [1].

DHS is the commonly used device for fixing Intertrochanteric fractures. Latest implant for management of Intertrochanteric fracture is PFN [1]. It has advantages like being intramedullary load transfer is more efficient, less transfer of stress and less implant failure, controlled impaction is maintained, less shortening and deformity, less soft tissue dissection and less blood loss.

In view of these conditions, this study is taken up to compare the result of DHS and short PFN in treatment of Intertrochanteric fractures.

Materials and methods

The study was a prospective comparative study involving 48 patients of different Intertrochanteric fractures from February 2015to February 2016 in Department of Orthopedics, Govt. Medical College Kozhikode. 24cases were treated with DHS and 24 patients with Short PFN

All the cases were treated initially with emergency care as per ATLS principle in casualty itself. Once the patient is stabilized and investigated thoroughly, preoperative planning was done. A case documentation form was used for intra-operative data including age, gender, mechanism of injury, type of fracture, side of injury, associated injury.

Paediatric fractures, patients with pathological fractures, polytrauma, and those not will to participate were excluded from study.

Sample size calculated by the formula: 24 each

$$N=\frac{\{z_{1-\alpha/2}\sqrt{2p(1-p)}+z_{1-\beta}\sqrt{p_1(1-p_1)+p_1(1-p_1)}\}^2}{(p_1-p_2)^2}$$

Where, $p=\frac{p_1+p_2}{2}$

P1=proportion of patients with hip score good to excellent in group PFN

P2= proportion of patients with hip score good to excellent in group DHS.

α =significant level, 5%

1- β =power, 80%

Based on similar study 'proximal femoral nail versus dynamic hip screw for intertrochanteric fracture femur' journal of orthopedic 2013.21(3):317-22

Patients are grouped in two from the beginning of the study after numbering from 1 to 48 and patients are selected to two groups by the order of presentation in outpatient/casualty odd ones are selected in DHS and even ones are selected in PFN group.

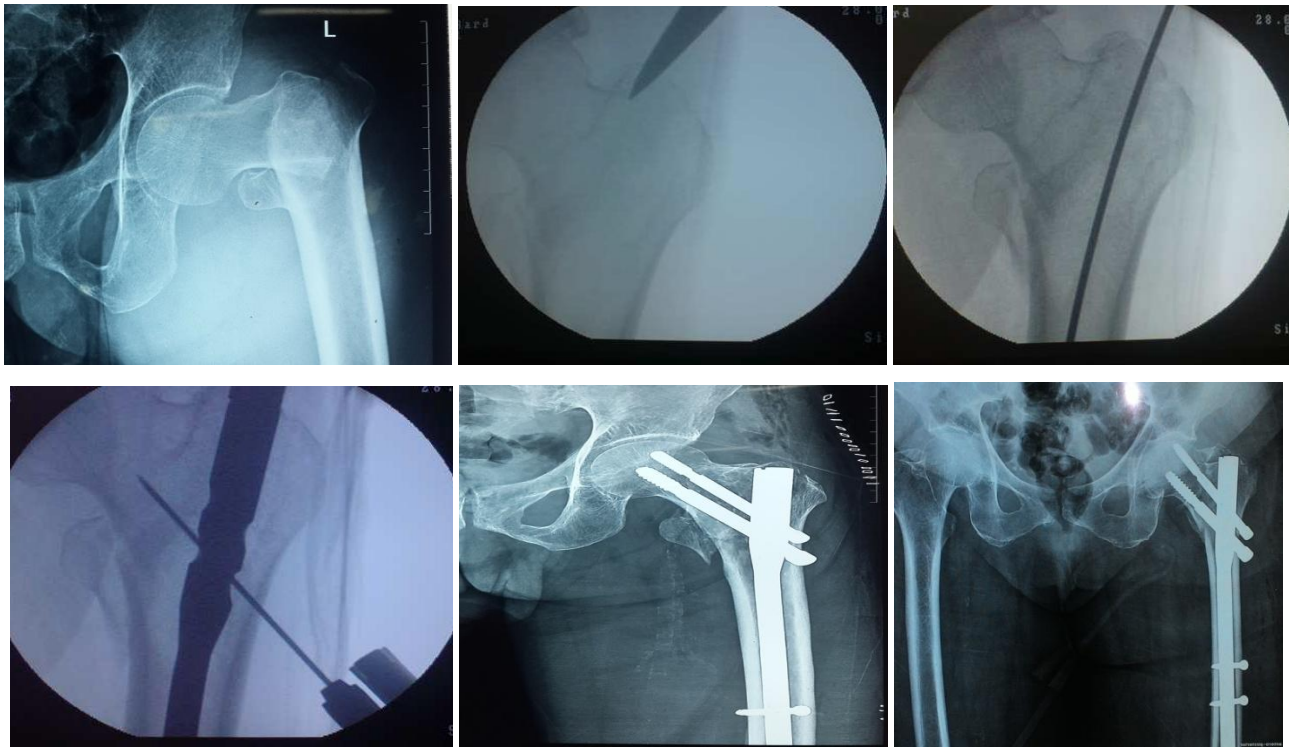
Management of patients

As soon as the patient with suspected intertrochanteric fracture was seen, necessary clinical and radiological evaluation done and admitted to the ward after necessary resuscitation and splint using skin traction. All the patients were evaluated for associated medical problems and referred to respective departments and necessary treatments were given. Associated injuries were evaluated and treated simultaneously. All these patients were operated electively after anesthesia fitness.

Operative technique

Proximal femoral nail [2]

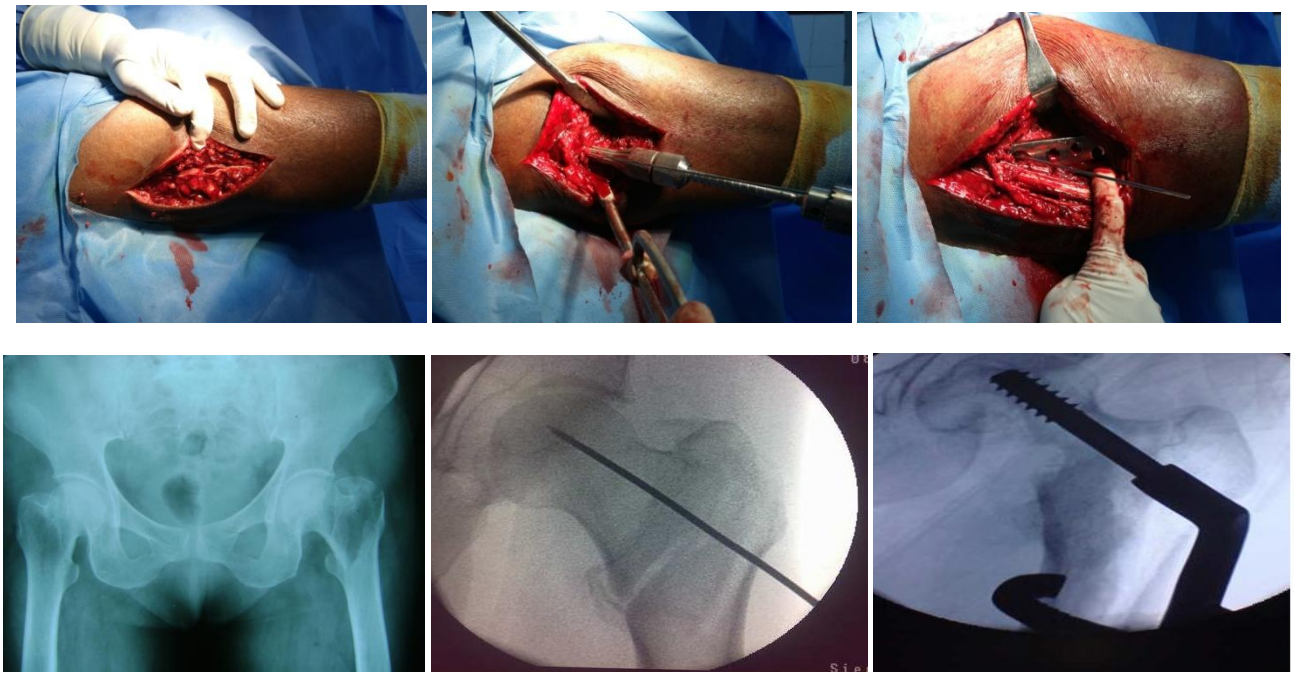
The patient was placed in supine position on fracture table with adduction of the affected limb by 10 to 15^0 and closed reduction of the fracture was done by traction and gentle rotation. In trochanteric fractures we fixed the fracture percutaneously using two "k" wires which pass along the anterior cortex of greater trochanter and neck of femur into the head of femur. Lateral longitudinal incision 5cm long is made from the tip of the greater trochanter. Tip of the greater trochanter is exposed. In AP view on C-arm, the entry point is on the tip or slightly lateral to the tip of the greater trochanter. In lateral view guide wire position confirmed in the center of the medullary cavity. Over the guide wire, a cannulated rigid reamer is inserted through the protection sleeve and manual reaming of femur was done. After confirming satisfactory fracture reduction an appropriate size nail was inserted. A 2.8 mm guide wire was inserted through the drill sleeve after a stab incision with its position in the caudal area of the femoral head for neck screw. The final position of this guide wire should be in the lower half of the neck in AP view and in the center of the neck in lateral view. Another second 2.8 mm guide wire is inserted through the drill sleeve above the first one for hip pin. The hip pin is inserted first to prevent the possible rotation of the medial fragment when inserting the neck screw. Drilling is done over the guide wire with 6.5 mm drill bit to a depth up to the length of hip pin previously measured. The same length 6.5 mm hip pin is inserted with the help of hexagonal cannulated screw driver. Neck screw is inserted after reaming by 8 mm reamer. Distal locking is usually performed with two cortical screws.



Surgical steps of DHS fixation [2]

The patient is positioned on the fracture table supine. In unstable fracture the varus and rotational deformities corrected, occasionally leaving the distal fragment medially opposed. A lateral approach was used to expose the femur. Vastus lateralis was retracted anteriorly. The use of the angle guide facilitated positioning of the guidevpin at the desired angle and made later the application of the side plate easier. The entry point is 2cm distal to the trochanteric flare. After placing the pin centrally or slightly inferiorly in both planes which makes the screw less likely to shift. The triple reamer was set 10mm shorter than the reading of the direct measuring device. The triple reamer was placed over the guide wire and the neck portion was reamed. Generally for osteoporotic bone there was no need to tap. The richard hip screw was inserted over the guide pin utilizing a T-handled wrench that was marked to indicate the proper depth of insertion and the position of the slot in the screw. Once satisfactory position of the screw was achieved, the guide pin is removed, and by means of the barrel guide the appropriate locking side plate was positioned over the screw. The plate was fixed to the shaft with locking screws of appopriate length and the traction was released. Tapping the handle of the wrench against the plate and then tightening the compression screw achieved compression of the fragments.

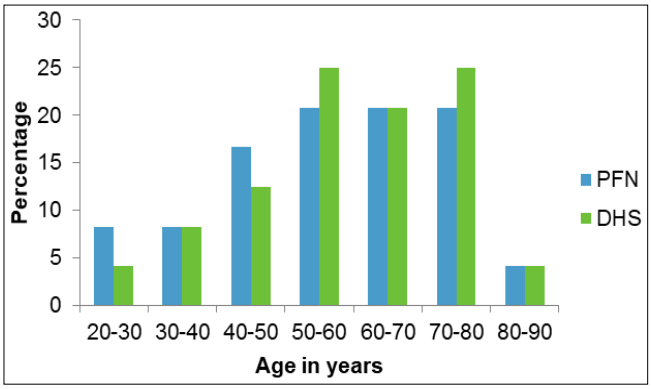
All Patients were discharged from the hospital when the operation site wound healed and patient general condition stable and were followed up at 2 weeks, 6 weeks, 3 months, 6 months and 1 year. At every visit patient was assessed clinically regarding hip and knee function, walking ability, fracture union, deformity and shortening. Modified Harris Hip scoring system was used for evaluation.



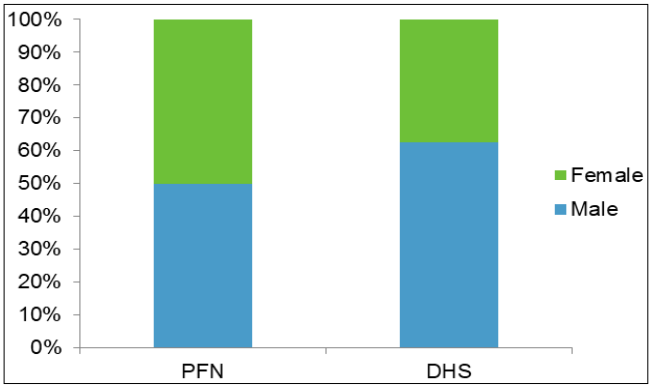
Results

We studied 48 patients 24 treated by PFN and 24 treated by DHS in Intertrochanteric fractures. The following are the observations made and the available data are analyzed as follows.

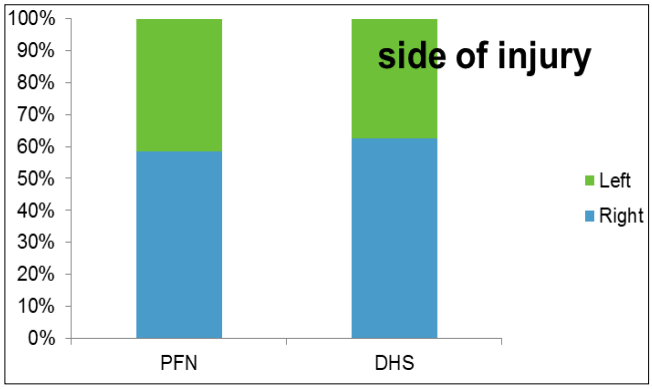
The age group in our study ranged between 20yrs and 90yrs. The mean age of subjects treated by PFN was 56.4, while the mean age of patients treated by DHS was 57.5. Most of the patients are between 50 to 80yrs in both groups.



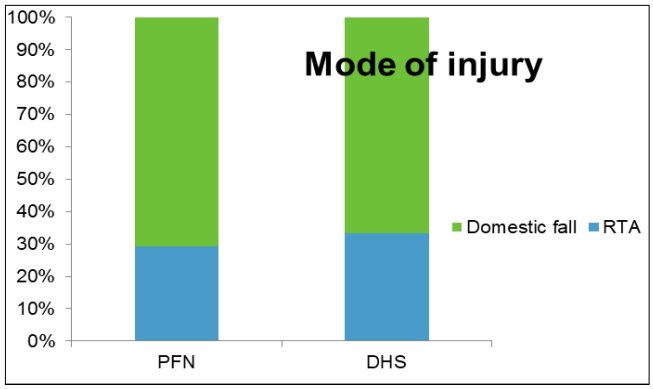
In 48 patients 27 were males (56.3%) and 21females (43.8%) PFN group include 12(50%) male and 12(50%0 female while DHS group include 15 male (62.5%) and 9 females (43.8%).



In patients treated with PFN 14 (58.3%) were right sided fracture and 10(41.7%) left sided. in DHS group 15(62.5%) right sided fracture and 9(37.5%) left sided.



Most of them are due to domestic fall and seen in age above 50 years. Road traffic accidents are more in younger age group. Total of 33(68.8%) domestic fall and 15(31.3%) RTA



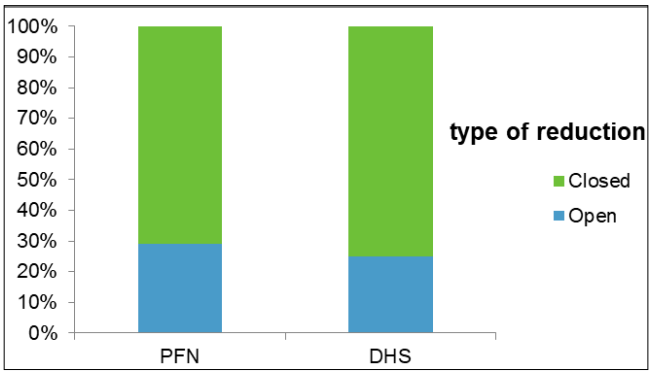
In our study 25 patients (52.1%) were stable fracture and 23(47%) had unstable fractures based on Evans classification. In patients who were operated by PFN 13(54.2%) unstable and 11(45.8%) stable. In DHS group 14(58.3%) were stable and 10(41.7%) were unstable.

	Implant				Total	
Type of fractures	**PFN**		**DHS**			
	N	**%**	**N**	**%**	**N**	**%**
Stable	11	45.8	14	58.3	25	52.1
Unstable	13	54.2	10	41.7	23	47.9
Total	24	100	24	100	48	100

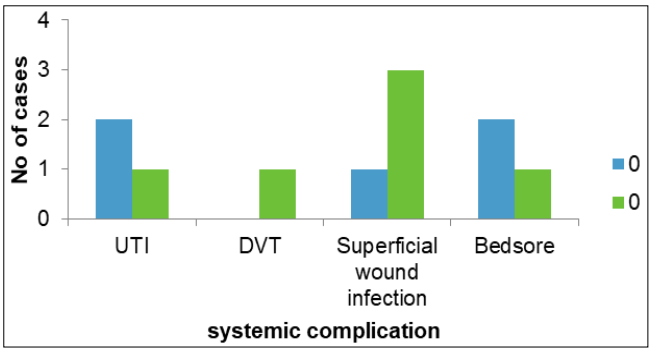
Out of 48 cases, 4 (8.4%) patients had associated injury fracture distal end of radius. All the 4 patients were treated conservatively by cast immobilization.

Associated injury	Implant				Total	
	PFN		DHS			
	N	%	N	%	N	%
Fracture distal radius	2	100	2	100	4	100
Total	2	100	2	100	4	100

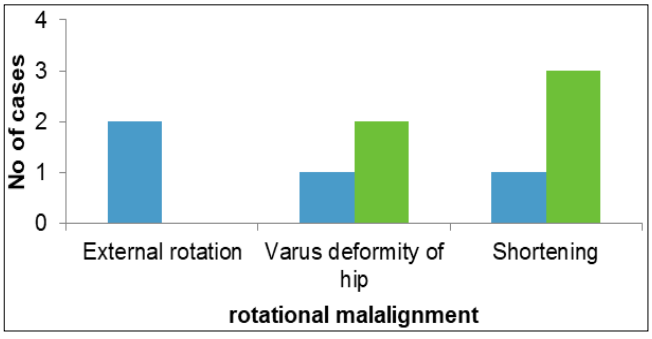
In PFN 7(29.2%) needed open reduction were as in DHS 6(25%) needed open reduction. Most of the operations were taken less than 90 minutes.



Out of the 48 total 11(22.2%) had systemic complications. 2 in PFN group and 1 in DHS had urinary tract infection. One patient in DHS had deep vein thrombosis. One case of wound infection in PFN and 3 in DHS, 2 patients in PFN had bedsore and 1 patient in DHS had bedsore. Complications are more in old age patients with other comorbid illness.

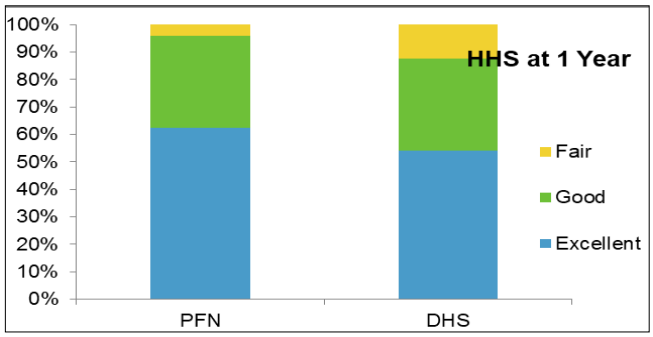


Total of 9 in 48 had rotational malalignment.2 with PFN had external rotation deformity.3 in DHS had varus deformity of hip. 3 cases with DHS and 1 with PFN had shortening.1 patients with PFN had reverse Z effect. 1 patient with DHS had cortical screw loose and plate projected out of bone. 3 patients had lag screw cut out.



Harris hip score was used to asses the functional outcome of hip. Calculated at 2 weeks, 6 weeks, 3 months, 6 months and 1 year follow up. By 1 year follow up 62.5% cases operated by PFN had excellent score, 33.3% patients had good and 4.2% had fair score. The cases operated by DHS 54.5% had excellent score, 33.3% cases had good and 12.5% patients had fair score. The p value was 0.556, not significant difference between two groups.

functional outcome	Implant				Total	
	PFN		DHS			
HHS at 1 Year	N	%	N	%	N	%
Excellent	15	62.5	13	54.2	28	58.3
Good	8	33.3	8	33.3	16	33.3
Fair	1	4.2	3	12.5	4	8.3
Total	24	100.0	24	100.0	48	100.0



Discussion

Hip fractures are one of the most common fractures, mostly affect the elderly and have a tremendous impact on health services and the family. The incidence of hip fractures are also on the rise among young patients sustaining injury in the era of high-speed traffic. Incidence of osteoporotic fractures are on a rise as a result of increase in the geriatric population.

The goals of treatment in intertrochanteric fractures are to restore mobility safely and efficiently while minimizing the risk of medical complications and technical failures and to restore the patient to preoperative status [1].

Operative treatment in the form of internal fixation permits early rehabilitation and offers the best chance of functional recovery, hence has become the treatment of choice for all fractures in the trochanteric region. Amongst the various

types of implants available the Dynamic compression hip screw is most commonly used. But recently closed intramedullary nailing have gained popularity.

In our study an attempt was made to compare the results of proximal femoral nail and dynamic hip screw in Intertrochanteric fractures. The study was conducted on 48 patients (24 cases by PFN and 24 cases by DHS) of proximal femoral fractures attending outpatient/casualty Department of Orthopedics, Government Medical College, Kozhikode.

Most of patients in the present study were from age group of 50 to 80 years of age [3]. Mean age in years for group operated by PFN is 56.4. Mean age in years for group operated by DHS is 57.5. This signifies the fact that patients from these age groups are involved in low energy trauma and are osteoporotic [4, 5, 6]. Gallaghar *et al*. 1980 reported the incidence of hip fractures increases with age, doubling for each decade after 50 years is two to three times higher in women than men [7].

The trochanteric region is the most common site of senile osteoporosis. Hip joint being a major joint in the mechanism of weight bearing, this already weakened part due to osteoporosis cannot withstand any abnormal stress. The space between bony trabeculae is enlarged and loaded with fat as age advances, while the compact tissue is thinned out and calcar is atrophied. These are the reasons why trochanteric fracture are common in old age.

Most of patients from our study were males. Amongst them majority were in 5th-8th decade of life, while young patients were from 2nd to 4th decade of life. Most of the females were in the age group of 5th - 8th decade. Melton J.L., Ilistrup DM, Riggs BL *et al* (1982) in their study titled 'fifty years trend in Hip fracture incidence' and reported a female to male ratio of 1.8:1 [8]. H. B. Boyd and L. L. Griffin [9] in their study found a marked sex difference. 75.8% of the patients were females and 24.2% were males.

Most of our patients were above 50 years and most of them had domestic fall and trivial trauma as the main reason for fracture. Most of them are osteoporotic fractures. While in young patients the major cause was road traffic accidents. This may be attributed to the following factors as enumerated by Cummings and Nevitt in 1994 [10] like inadequate protective reflexes, inadequate local shock absorbers like muscle and fat around hip, inadequate bone strength at the hip on account of osteoporosis. Other factors include poor vision, labile blood pressure, vascular diseases and coexisting musculoskeletal abnormalities.

In patients who were operated by PFN 13cases (54.2%) were unstable and 11(45.8%) stable. In DHS group 14cases (58.3%) were stable and 10(41.7%) unstable. Most the patients treated with DHS are with stable fractures and most of the patients treated with PFN are unstable according to Evans classification [11, 12].

In our study total of 4 patients had associated injury of fracture distal end of radius. All were above the age of 50. All the 4 patients were treated conservatively by cast and had good results. In PFN 7 cases (29.2%) needed open reduction where as in DHS 6 cases (25%) needed open reduction. Open reductions are associated with increased duration of surgery and more blood loss. Adequate reduction is important for perfect placement of neck screw and to prevent deformities like rotation and shortening. We had 3 patients with urinary tract infection, one with deep vein thrombosis, 3 with bed sore as complications which were not implant related. In 3 cases (12.5%) operated cases by Proximal Femoral Nailing (PFN), there was ill fitting of the jig as corresponding holes of jig and nail was not matching and one patient had difficulty in distal locking.

In Dynamic Hip Screw (DHS) group 3 cases (12.5%) had difficulty in reduction. And they are due to severe comminution of fracture. In Proximal femoral Nail (PFN) group one case had external rotation of 15° and another had 10° Varus deformity was noted in one case (5%). It might be due to early backing out of screw. There was shortening of one centimeter in one case which was not significant functionally for the patient.

In DHS group two cases (10%) of varus deformity was seen probably due to the pull of the muscle which causes migration of the distal shaft fragment upwards.

Three Cases (15%) of shortening were seen. This shortening ranged from 1-1.5 cms. Patients were given shoe raise which compensated for the necessary shortening. Patients did not have any difficulty later while walking.

One patient with PFN had reverse Z effect. Z effect was first described by Werner - Tutshcku *et al* [17]. It is a phenomenon of characteristic sliding of proximal screw to opposite direction during postoperative weight bearing.

Normally vertical forces passing from centre of femoral head tends to move the hip into varus as soon as patient is mobilized. This leads to normal sliding of both screws and thus compression at fracture site. Sometimes this sliding occurs only at one of proximal screws while other screw remains at initial position leading to protrusion o femoral head.

The reverse Z effect is described by Boldin *et al*. [19] Movement of hip screw occurs towards the lateral side. Mechanism of this effect is similar to Z effect but here Anti rotation screw slides back and the neck screw remains impacted to hole of nail.

In patients with DHS during follow up 1 patient had loosening of cortical screws and plate lift off. 3 patients had neck screw cut out. They are seen in old osteoporotic patients. By the time they presented all the fractures were almost united and they were treated by implant removal. Baumgaertner M.R Chvostoski [18]. (1995) reported the incidence of fixation failure to be as high as 20% in unstable fracture patterns. Osteoporosis was found to be the most important predisposing factor for fixation failure.

Superficial wound infection was seen in 4 cases, one in patient operated by PFN and 3 in those operated by DHS. In all these patients treatment with IV Antibiotics was prolonged. A. Bodoky, U. Neff, M. Heberer & F. Harder [13], according to their study antibiotics prophylaxis significantly reduces incidence of wound infection. Verley GW, Milner SA [14] (1995) in their study of patients with proximal femoral fracture, they found out that patients who received wound drainage showed statistically better wound healing in terms of the asepsis wound scoring system and reduced infection rate.

Average period of admission in our hospital were 7 to 10 days. During postoperative period, they were made to mobilize knee and do quadriceps drills, mostly by 2nd to 3rd post op day as tolerated by the patient. Patients were discharged with instruction not to bear weight till further follow up. In patients with PFN partial weight bearing is allowed by 2 weeks based on the postoperative xray. But in patients with DHS partial weight bearing is advised only 5to 6 weeks after surgery. Walking with walker is advised on further follow up. In the series of B. Mall [15] (30 patients) average time of ambulation was 14 days.

• Average time of fracture union in our series was about 16 weeks. Range from 12 to 20 weeks.

• Functional outcome: calculated by Harris hip score. By 1 year follow up almost 92% of patient had good to excellent result.8.3% patients had fair results which was attributed to the poor compliance of the patients for regular physiotherapy and in some cases due to poor general condition of patient and complication of implants like screw cut out, reverse Z effect. By 1 year follow up there was not much difference in functional outcome with PFN and DHS.96% with PFN had good to fair results, 4% had fair result. In DHS group 88% had good to excellent results and 12% had fair results.

In other studies PFN and DHS gave equally good results in stable trochanteric fractures. But in unstable fractures PFN was superior to DHS. In our study PFN and DHS had almost similar results. It may be due to the quality of implant and instrumentation in our study. The use of PFN is limited in our set up because of the difference in cost of the implant compared to DHS, and most of our patients cannot afford costly implants.

Summary

The present study "A comparative study of short proximal femoral nail and dynamic hip screw in intertrochanteric fractures" is a prospective study conducted in government medical college Kozhikode between February 2015 to February 2016. The study included 48 cases of inter trochanteric fractures, 24 treated with short proximal femoral nail and 24 treated with dynamic hip screw. After meticulous post operative care, patients were followed up for clinical and radiological assessment, complications and functional recovery observation. The results are analyzed by radiological parameters and functionally by Harris hip score.

- The maximum patients were between age group of 50 to 80.
- Males predominated in our study (56.4%).
- Most common mode of injury was domestic fall.
- Right side was affected in 60% of patients in our study.
- Stable fracture 52% and unstable 48% according to evans classification.
- 27% fractures required open reduction.
- 8.3% patients had associated injury fracture distal end of radius.
- The complications were mainly urinary tract infection, deep vein thrombosis, bedsore, which were not implant related.
- Wound complications: superficial wound infection seen in 4cases 3 with DHS and 1 with PFN. This was attributed to low immune status, associated illness, low socio economic status of patients and more in DHS due to more soft tissue exposure.
- Implant related intra operative complications: In 3 cases operated with PFN had ill fitting jig. 1 patient there was difficulty in distal locking. 3 patients treated with DHS had difficulty in reduction. DHS is a relatively simple procedure but requires more soft tissue exposure. On the other hand PFN needs less soft tissue exposure but demands expertise in operating.

Average time of fracture union: it was about 16 weeks. Range from 12 to 20 weeks.

• Functional outcome: calculated by Harris hip score. By 1 year follow up almost 92% of patient had good to excellent result.8.3% patients had fair results which was attributed to the poor compliance of the patients for regular physiotherapy and also in some cases due general condition of patient and complication of implants like screw cut out, reverse Z effect. By 1 year follow up there is no much difference in functional outcome with PFN and DHS. 96% with PFN had good to fair results, 4% had fair result. With DHS 88% had good to excellent results and 12% had fair results.

Conclusion

In this study we aimed to evaluate whether the theoretical advantages could be proved in practice, by a comparison of the results of Proximal Femoral Nail (PFN) and Dynamic Hip Screw (DHS) implants in inter trochanteric fractures.

Most common age group of hip fractures is above 50 years. Most common mode of injury is domestic fall. The systemic complication following operation were not Dependant on implant used, it mainly affected by the general condition and other associated illness of patient. There is not much difference in functional outcome in patients treated by dynamic hip screw and proximal femoral nail in 1 year follow up in our settings. In our study PFN is used more in unstable and DHS in stable fractures. The use of PFN is limited in our settings because the difference in cost of the implant compared to DHS and most patients are from low socioeconomic status.

With proximal femoral nail smaller exposure is required than for a DHS, it may therefore be associated with lesser blood loss, lesser wound complications but it required better operating skills. Malrotation and deformity after trochanteric fracture fixation is usually a result of improper fixation of fracture fragments in rotation at time of surgery. In fractures managed by closed intramedullary nailing, incidence of malrotation & deformity is found to be lower. The incidence of wound infection was found to be lower with intramedullary implants which resulted in early ambulation of the patients. The learning curve for the treatment of fractures by Dynamic Hip Screw was smaller as compared to Proximal Femoral Nail.

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