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Original Research Article

Greater trochanteric versus piriformis fossa entry for antegrade femoral diaphyseal nailing: A study to establish technical superiority

Dr. Hitesh Bhandari[1], Dr. K.Venkatachalam[2], Dr. Balaji. B[1]
[1]Final year MS ortho PG, [2] Professor
Department of Orthopaedics, Sree Balaji Medical College and Hospital, No.7, Works Road, New Colony, Chormepet, Chennai- 600044, Tamil Nadu, India

***Corresponding author**
Dr. Hitesh Bhandari
Email: sairam137@yahoo.co.in

Abstract: Femoral shaft fractures are best managed surgically. This study included a group of 40 randomly distributed patients with femoral diaphyseal fractures. Each group of randomly distributed patients consisted of 20 patients. In the first group the entry point for the femoral nail was chosen to be the greater trochanter and in the second group, the entry point was chosen to be the piriformis fossa. It was deduced that in the group chosen to have the greater trochanteric entry, there was less consumption of image intensifier time, lesser operating time, the incisional length in cm was smaller and even the blood loss was less.

Keywords: Greater trochanteric tip entry, piriformis fossa entry, diaphyseal femoral fractures, Antegrade femoral nailing.

INTRODUCTION:

The femoral bone is the longest and among the strongest bone with sufficient vascular supply, mainly from the profunda femoris artery. The nutrient artery usually enters along the linea aspera in the proximal posterior aspect and supplies the endosteal circulation. The endosteal circulation supplies the inner two-thirds of the cortex, making the normal blood flow, centrifugal in direction. The periosteal circulation enters posteriorly for the most part along the linea aspera. The periosteal circulation is almost entirely directed in a circumferential direction with no longitudinal spread. This permits small SS wires to be placed around the femur, without devascularising an area, however large bands can cause devastating devascularization. The periosteal supply is for the outer one third of the cortex and very critical for diaphyseal femoral fracture healing. A large amount of force is needed to fracture this bone and once established the protective musculature enveloping the bone now becomes the primary cause for displacement of fracture fragments. While all age groups and both sex can be affected, the male in age groups of 14 to 38 years are most commonly affected, by injuries caused by high energy trauma of RTA. Causes other than trauma include lytic lesions caused by malignant metastasis, Paget 's disease and bone cysts. In post menopausal woman, osteoporosis could also be a cause of fragility fractures, resulting from trivial trauma.

The aim of femoral diaphyseal fracture treatment is to obtain near anatomical fracture union and restoration to its pre-injury functional levels. The method of surgical intervention is dictated by the type and location of the fracture, the degree of comminution and the age of the patient. An effective intervention should be one that causes minimal soft tissue and bone damage, restores near normal anatomical alignment and permits early functional rehabilitation. A sea change in the management of femoral diaphyseal fracture was witnessed after Kuntscher developed and utilized the intramedullary nail in 1937.

Surgical options in the adults include the intramedullary nailing which could be either antegrade or retrograde. In exceptional cases plate fixation (single or dual) or external fixation (illizarov or orthofix) are employed. In the pediatric age group, flexible rods are employed, which are safe in open physes. Intramedullary nail fixation has become the gold standard of treatment for femoral shaft fractures, with reported union rates approaching 97%. Intramedullary nailing of these fractures although technically demanding is in fact less traumatic than other fixation modalities. Antegrade femoral nailing has option of two entry portals. The former is the greater trochanteric portal and the latter is the piriformis fossa portal. Those preferring the piriformis portal argue that it aligns itself with the long axis of the femoral shaft. This makes for the easy insertion of the virtually straight nails. In view of the location of the piriformis fossa near the superior gluteal nerve (innervating the abductor muscle group) and branches of medial circumflex femoral artery and superior gluteal nerve, complications such as abductor palsy and compromise of the femoral head vasculature are possible [1-3]. Abductor and external rotator muscle groups have to be dissected to enter the portal. Complications such as iatrogenic fracture of femoral neck, persistent hip pain, palsy of hip abductors and heterotrophic ossification have all been reported.

There are some distinct advantages of using the greater trochanteric portal. This involves lesser operative time and lesser exposure to image intensifier. Chances of AVN of femoral head and latrogenic femoral neck fractures are avoided. It is also easier to visualise in the obese patients. Fracture site communition and varus malalignment of fractures are avoided. Awl slippage, a frequent problem with piriformis fossa portal and is avoided in trochanteric portal, as it is relatively flat. However, it is located laterally and therefore technically not collinear with the long axis of the femoral medullary canal and could be the cause for complications like eccentric reaming of proximal fragment [4,5].

In order to avoid any noticeable bias or asymmetry, patients for the two groups were allocated by using the random number table method. Patients informed consent for the specified method of surgery was obtained. All femoral shaft fractures were operated on the fracture table compatible for image intensifier imaging either under GA or RA as deemed appropriate by the anaesthetist. Inj. Cefopezone Sodium injection 500 mg was parentrally initiated, one hour prior to wheeling patient into the theatre, prophylactically DVT prophylaxis with low molecular weight heparin was also initiated. The same surgical team operated on all the 40 patients. Patient was put supine on a traction table and were prepared and draped.

Inclusion criteria:

- Age: Patients from age 18 to 45 were included in the study.
- Duration of Injury: Injury less than 10 days alone was included.
- Only closed femoral diaphyseal fracture with minimal or nil communition were included (AO TYPE A), Winquist & Hansen type O, I & II
- ASA category I, II, III was included.

Exclusion criteria:

- Open fractures
- Polytrauma
- Pathological fractures, previously operated fracture, concomitant ipsilateral fractures were excluded.
- Segmental, large butterfly fragments were excluded. (AO Type B, and C, Winquist and Hansen Type III and IV)
- ASA category IV, V, VI was excluded.
- Injuries older than 10 days were excluded.

AO classification and the Winquist and Hansen classification were used in this study. [Fig 1 and 2]

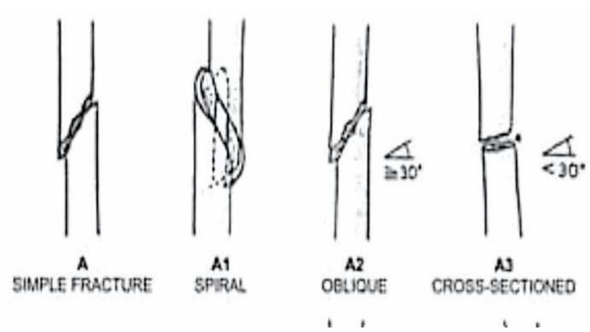

Fig 1: AO Femoral diaphyseal fracture

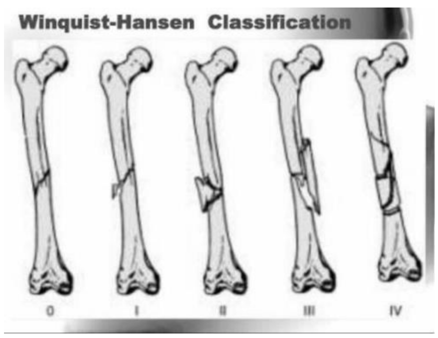

Fig 2: classification

Pre-operative planning

- Template instrumentation – measure diameter of intramedullary canal and the approximate length of nail needed.
- Sterilized antegrade femoral nailing system
- Pre op check of radiolucent flat top fracture table and working condition of C-arm image intensifier.
- Patient is positioned supine with a sand bag below the ipsilateral buttock.
- Both arms on arm board for monitoring and delivery of IV fluids.

Using the fracture table

- Feet well padded with cotton roll and placed firmly in the fracture boot fastened with crepe bandage.

- Contralateral leg also supported on the fracture boot and fastened with crepe bandage.
- Padded post deep intro groin, move genitals and Foleys catheter out of the way.
- Prepare and drape the entire leg upto the iliac crest.

Technique Lateral approach to hip is used.

- Dissect down to Greater trochanter or Piriformis fossa.
- Trochanteric starting point is on the medial tip of the Greater Trochanter and Piriformis starting point is on the Piriformis fossa.
- Confirm starting point with the C arm.
- It needs to be in center of the medullary canal in anteroposterior imaging and center of greater trochanter on lateral imaging.
- Alternatively cannulated awl can be used to get better control.
- Insert guide pin down to lesser trochanter and check biplanar images.
- Place and push soft tissue protector so that reaming is parallel to femur.
- Use traction on the extremity through the fracture table for obtaining reduction of fracture and then seat the guide wire down to the distal physeal scar.
- Check biplanar imaging.

Measure appropriate nail length .Reaming is started with size 9 mm and then incrementally by 0.5 to 1.0 mm. Ream upto 1.5 mm above the size of the final nail.

Insert nail over guide wire and following the anterior bow of the femur holding the nail by the handle, advance it by rotating it down. Manually advance the nail past the fracture site. After inserting the nail completely, check its seating in the distal femur radiologically by C-arm biplanar imaging. Then remove the long ball tip guide. Under C arm identify interlocking screw placement .Incise skin, subcutaneous tissue and fascia at the tip of trocar and spread down to the bone. Push the guides down to the bone and remove the inner most sleeve. Insert K wire or a drill bit in the inferior trocar. Confirm its positioning by C-arm. After drilling measure the length of screw with a depth gauge. After inserting the inferior interlocking screw, repeat the procedure for the superior trocar. Lastly remove the top jig locking screw from nail and remove handle and targeting guide. Take a final biplanar image of distal and proximal aspects of nail and fracture. Run the hip and knee through a range of motion check limb length and rotation. After irrigation and hemostasis, Deep closure of fascia lata is done with 3'0 vicryl and skin is closed with staples.
Sterile dressings are put at the incision sites.

Post - OP care:

Dressings are removed on POD 2. If drain tube had been used it also is removed at 48 hours. For pain management parenteral Diclofenac 75mg is given for 2 days post operatively. IV antibiotics and DVT prophylaxis is continued for 72 hours post operatively. Post OP X-rays of hip, femoral shaft and knee are obtained after DT removal.

Post – OP Rehabilitation:

Physical therapy like quadriceps and straight leg rising are started POD 2. Non weight bearing crutch walking or walker training is given from POD 5.
Suture and staples removal is done on POD 14.

Post – OP Review:

Patient is reviewed every two weeks for the first three months and thereafter once monthly till 6 months or until radiological union is visible. Partial weight bearing is initiated by 4 weeks, proceeding to full weight bearing by 8-10 weeks

RESULTS:

Table 1: Age Sex and portal of entry distribution

S.NO.	AGE	SEX		GTE	PFE	TOTAL	PERCENTAGE
		MALE	FEMALE				
1	18-24	9	6	7	8	15	37.5
2	25-34	6	7	8	5	13	32.5
3	35-45	6	6	5	7	12	30.0
TOTAL		21	19	20	20	40	100%

Table 2: Comparison of number of C arm shots (time in seconds)

Shots	Group PFE (n=20)		Group GTE (n=20)		P value
	Median 214	Interquartile Range 126-302	Median 93	Interquartile range 48-138	<0.001

Table 3: Comparison of duration surgery (time in minutes)

Group PFE (n=20)	Group GTE (n=20)	P value
Mean ± SD 105.13 ± 18.00	Mean ±SD 70.65 ± 13.53	<0.001

Table 4: Intra OP Complication

	Group PFE		Group GTE		P Value
	N	**%**	**N**	**%**	
NO	**18**	**90**	**19**	**95**	
YES	**2**	**10**	**1**	**05**	**1.000**
Total	**20**		**20**		

Table- 5: Comparison of incision length (in cm)

Group PFE (n=20)	Group GTE (n=20)	P value
Mean ± SD **7.5 ±0.75**	**Mean ±SD** **6 ± 0.68**	**<0.001**

Table-6: Comparison of intra op blood loss (in cc)

Group PFE (n=20)	Group GTE (n=20)	P value
Mean ± SD **155 ± 22.67**	**Mean ± SD** **110 ± 20.53**	**< 0.001**

DISCUSSION:

Intramedullary nailing is an excellent choice for treating the femoral shaft fractures which gives good union rates, while maintaining alignment. Pain around the hip is a common complaint sometimes interfering with activites of daily living. Hip and thigh muscle weakness was also observed in some patients. In this comparative study a total of 40 patients were included with 20 patients distributed to each group. The study was done at SBMCH, Chromepet from January 2015 to December 2016 (12 months of patient recruitment) and the cases had an average of 16 to 28 months of follow up. Distribution was done by random numbers into two groups and was operated with closed reduction and internal fixation with interlocking nailing via either piriformis fossa or greater trochanter entry portal and the data was compared in terms of number of C arm shots, duration of surgery, intra OP complication, incisional length and intra -op blood loss. In our study 37.5% were in the 18-24yr age group. The number of C arm shots required in greater trochanter entry (GTE) group was less than half of the Piriformis fossa entry (PFE) group. The duration of surgery for PFE group was approximately one and a half times of the GTE groups. Intra-op complication rates of PFE and GTE groups were 10% and 5% respectively. The incisional length was more by 25% in the PFE group. The intra OP blood loss was greater in PFE group by 41% approximately. Pain and abductor weakness of muscles on the operated side were common among the complication encountered in both the groups.

William Ricci *et al.;* also reported a preponderance of femoral shaft fractures in the second and third decades which compares similarly with our findings [6]. In our study the average fluoroscopy time required for the PFE group (214 seconds) was greater than that of GTE group (93 seconds) with p value-less than 0.001. Especially in obese patients the duration of surgery and fluoroscopy time is less if they are operated by the GTE portal.

William ricci *et al.;* in his series showed that the average operative time for PFE group was 75 minutes and for the GTE group was 62 minutes [6]. The average fluoroscopy time for the PFE group was 153 seconds and for the GTE group was 95 seconds, Similar are our deductions in the present study. J. Stannnard *et al.;* in 2011, in his series, showed that the mean operative time was 104 minutes in PFE as compared to 75minutes in the GTE group[7]. This finding matches very closely with our conclusions (105 minutes and 70 minutes respectively). Michael Archdeacon *et al.;* in his study showed that the mean operative time averaged 84 minutes and the average blood loss was 219 cc [8]. In our study, blood loss were kept to as low as 110-155cc. J. Starr *et al.;* in 2006 concluded that the two groups did not differ with regard to blood loss, incisional length and the duration of surgery or intra –op complication [9]. Our study concludes positively the benefits of the GTE entry technique.

CONCLUSION:

Our study concludes that the GTE portal entry is better than PF portal entry with respect to C arm exposure, duration of surgery, intra-op complications, surgical incisional length and the amount of intra-op blood loss.

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