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A study of results of long closed proximal femoral nailing in complex proximal femoral fractures

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Abstract
Introduction: Fractures of the proximal femur are a big challenge in traumatology. Patients Of all age groups are affected, but the group belonging to the 5th – 7th decades of life is involved the most. The complex proximal femoral fractures are - difficult to treat. Various studies shows that Dynamic Hip Screw (D.H.S.) has documented problems in the form of failure of implant & mal union (coxa vara) in the treatment of complex proximal femoral fracture. So, the chase to have least problem in the treatment, proximal femoral nail (sirus type) has emerged as a perfect solution for complex proximal femoral fractures. The goal is to achieve union of the fracture both clinically & radiologically so as to return to the maximal functional range of the hip as early as possible.
Aim: To study the results of proximal femoral nail (sirus) in the treatment of complex proximal femoral fracture with respect to clinical and radiological union of the fracture and final ambulatory status of the patients assessed by hip scoring system and complications and failure rate.
Materials and methods: 50 patients from the Orthopaedics OPD, having complex proximal femoral fracture (according to AO classification type 31A2 & 31A3) were included in the study. Patients were treated by Intramedullary fixation with proximal femoral nail (sirus). Final ambulatory status of the patients assessed by hip scoring system and complications and failure rate. We used Salvati and Wilson hip scoring system to assess the results.
Results and Discussion: Finally, to assess the outcome of the whole study, we have used the Salvati and Wilson Hip scoring system. The Salvati and Wilson Hip score was >20 in 92% of the patients in present study and in 78% of patients in AL-YASARI study.70% patients had an excellent results, 22% patients had good results, 4% each had a poor or fair results in present study.
Conclusion: From the resent study, we concluded that Proximal femoral nail (Sirus) can be considered as the implant of choice for treatment of Proximal Femoral fractures due to various advantages.

Keywords: Proximal femoral nailing, femoral fractures, clinically & radiologically

Introduction
Fractures of the proximal femur are a big challenge in traumatology. Patients Of all age groups are affected, but the group belonging to the 5th – 7th decades of life is involved the most. Older patients face many problems as they become bedridden during the period. They are threatened with hypostatic pneumonia, cardio respiratory failure and decubitus ulcer. Moreover, problems of nursing care is also aggravated by psychological changes due to atherosclerosis. All the circumstances mentioned above require an urgent surgical solution for a vital indication because early rehabilitation and mobilization of the patient can only be possible in this way [1].
Intertrochanteric fractures account for nearly 50% of all fractures of proximal femur [2]. This fracture has advantage of abundant blood supply because of various muscle attachments. So as far as the stable intertrochanteric fracture is concerned, union is not a major problem.
But, the complex proximal femoral fractures are - difficult to treat. Various studies shows that Dynamic Hip Screw (D.H.S.) has documented problems in the form of failure of implant & mal union (coxa vara) in the treatment of complex proximal femoral fracture. So, the chase to have least problem in the treatment, proximal femoral nail (sirus type) has emerged as a perfect solution for complex proximal femoral fractures. The goal is to achieve union of the fracture both clinically & radiologically so as to return to the maximal functional range of the hip as early as possible.
In my series, I have used AO classification in which type 31A2 and type 31A3 are regarded as complex proximal femoral fractures.

I studied 50 such cases with use of proximal femoral nail (sirus). The aim was to study the results of proximal femoral nail (sirus) in the treatment of complex proximal femoral fracture with respect to clinical and radiological union of the fracture and final ambulatory status of the patients assessed by hip scoring system and complications and failure rate.

Aim

To study the results of proximal femoral nail (sirus) in the treatment of complex proximal femoral fracture with respect to clinical and radiological union of the fracture and final ambulatory status of the patients assessed by hip scoring system and complications and failure rate.

Materials and methods

Patients coming to an Orthopaedics O.P.D. or in the emergency casualty department having proximal femoral fractures (according to AO classification type 31A2 & 31A3) were assessed as a whole with special regards to the limbs as well as other systems. Patients having Head injury/ Abdominal or chest injury were ruled out and the patients were then adviced to undergo proper X- rays. The patients were then admitted to the hospital if they fell in the inclusion criteria. Patients were treated by Intramedullary fixation with proximal femoral nail (sirus).

Materials

Fracture table
C-arm image intensifier television
Routine surgical instruments
Reamers & guide pins
Proximal femoral nail (Sirus Nail)
D= 10, 11 L=34 to 46 (in difference of two)
Sirus instrument set with jig.

Anesthesia

Spinal Anesthesia
Epidural Anesthesia
Combined Spinal Epiural Anesthesia
General Anesthesia

Sequence of events

Table: fracture table with pelvic post.

Position: supine with affected limb in slight adduction and other limb in possible max abduction to give enough space for image intensifier.

Reduction: Under image intensifier (IITV) guidance, closed reduction achieved in both AP and lateral planes.

Difficult Reduction

In case of the difficult reduction, following methods were used to achieve reduction.

1. ST- pin insertion in to the proximal fragment, and manipulate it to achieve reduction.
2. Slight adducting the affected for easy entry from the tip of the trochanter.
3. Keeping the jig as much close to the body.
4. Pulling the trunk of the patient towards normal side.

Incision

Greater trochanter was palpated between thumb and index finger. 5cm skin incision was made starting from tip of trochanter and extending up wards. Skin, subcutaneous tissue cut, gluteus fascia were also cut along with gluteus medius muscle along the direction of the muscle fibre. Entry was taken with special cannulated entry tool at the tip of greater trochanter. Reduction was again confirmed under IITV. Guide pin was inserted from the cannulated entry tool. Reaming of the proximal part was done with cannulated reamer. Size of the nail was confirmed under IITV and nail was fitted with the jig. Nail jig assembly was checked on the trolly to check if they match properly. Nail was introduced manually initially to start with, again checked under IITV. Nail was then inserted with hammer until the hole for the lag screw lie in line almost flush with calcar in AP view

Skin mark was done with guide sleeve and obturator and incision made. Two sleeves were introduced across the hole until it touched the bone. Guide pin was inserted making just flush with the calcar (inferior to mid third of the neck) in AP view and in center or just posterior to the center in the lateral view. Guide pin was inserted with drill up to the subchondral region of the head of femur, size taken with the help of the other guide pin and then guide pin was transfixed.

Drilling was done by canulated drill bit up to the subchondral region Canulated lag screw of measured size was inserted over a guide pin. Similarly the other proximal lag screw is inserted. Distal locking was done with free hand under IITV guidance. Closure was done in layers. Patient was shifted to post operative ward after dressing.

Salvati and wilson hip scoring system [3, 4, 5]

Pain

0 = constant and unbearable, frequent strong analgesia
2 = constant but bearable, occasional strong analgesia
4 = nil or little at rest, with activities
6 = little pain at rest, pain on activity
8 = occasional slight pain
10 = no pain

Walking

0 = bedridden
2 = wheel chair
4 = walking frame
6 = one stick, limited distance up to 400 yards
8 = one stick long distances
10 = unaided and unrestricted

Muscle power and motion

0 = ankylosis with deformity
2 = ankylosis with functional position
4 = poor muscle power, flexion< $60^{0,}$ abduction $<10^{0}$
6 = fair muscle power, flexion 60-90^{0}, abduction 10-20^{0}
8 = good muscle power, flexion >90^{0}, abduction >20^{0}
10= normal muscle power, full range of movement

Function

0 = bedridden
2 = housebound
4 = limited house hold work
6 = most household work, can shop freely
8 = very little restriction
10= normal activities

Grading of results

Excellent	>31
Good	24-31
Fair	16-23
Poor	<16

Total score: 40

Observation & results

This was a prospective study involving 50 cases of complex proximal femoral fracture.

Complex proximal femoral fractures (classified according to AO classification as 31 A2 and 31 A3 treated by Intramedullary fixation with proximal femoral nail (sirus). We followed up on these patients fully and observations made are given here. All the cases have been followed up for minimum 1 year.

The results of this study were evaluated by salvati and wilson hip score system.

Following were the observation during the present study

(1) Age distribution of the patients

Age Groups(years)	Number Of Patients	Percentage (%)
18-30	3	6
31-50	13	26
51-70	28	56
>70	6	12
Total	50	100

Mean Age (years)	Present Study
Years	58

So the average age of the patients in this study was 58 years. The maximum number of the patients belonged to age group 51-70 years and the least one was in the age group 18-30 years i.e younger age group.

(2) Sex distribution

Sex	Present Study	
	Number of Patients	Percentage (%)
Male	29	58
Female	21	42
Total	50	100

58% patients involved in present study were males.

(3) Type of injury

Type of trauma	Number of patients	Percentage (%)
High velocity	17	34
Low velocity	33	66
Total	50	100

Sex	Number of patients	Type of injury	
		HVT	LVT
Male	29	16	13
Female	21	1	20
Total	50	17	33

Mode of injury	Number of patients	Percentage (%)
Road traffic accident	17	34
Fall down	33	66
Total	50	100

Most of the injuries in our study occurred due to trivial trauma in old age i.e. (66%) while high velocity trauma accounted for 34% of the patients (most commonly road traffic accidents).

Amongst male, road traffic accidents (HVT) were the most common cause of fracture. i.e. 55.17%.While in case of the female most common cause was low velocity trauma. i.e. fall in bathroom or fall while walking.

(4) Side

Side	Number of patients	Percentage (%)
Right	26	52
Left	24	48
Total	50	100

Right sided fractures were found to be little bit more common than Left sided fracture

(5) Classification

Type of fracture	Present study	
	Number of Patients	Percentage (%)
31 A2	39	78
31 A3	11	22
Total	50	100

Complex proximal femoral fracture was classified and evaluated by AO classification, and amongst them 31A2 and 31A3 type of fractures were regarded as Complex proximal femoral fracture.

Above data suggests that amongst complex proximal femoral fractures, 31A2 fracture accounted for 78% in present study. The ratio between 31A2: 31A3 is 4:1.

(6) Associated injury

Associated injuries (Fractures)	Number of patients	Percentage (%)
Distal end radius	3	6
Clavicle	2	4
Scapula	1	2
Pubic rami	2	4
Metatarsal	1	2
Total	9	18

The common fracture associated in present study is distal end radius fracture, followed by fracture clavicle, pubic rami fracture and fracture scapula and fracture metatarsal were also reported.

(7) Associated medical illness

Illness	Number of patients	Percentage (%)
Hypertension	15	30
Diabetes	3	6
IHD	5	10
COPD	4	8
Total	27	54

Above data suggests that most common co morbid condition was hypertension, occurring in 30% of the cases, followed by IHD (10%), COPD (8%), and Diabetes Mellitus (6%).

(8) Trauma surgery interval

Trauma surgery interval	Present study
Days	2.36 days

The trauma surgery interval in present study was 2.36 days.

(9) Pre opretive factors

Average operative time (minutes)	40 minutes
Average blood loss (cc)	70 cc

The average operative time for surgery was 40 mins. Total blood loss during surgery was 70 cc on an average which was counted

on the basis of fully stained mop. A medium sized mop fully stained with blood is equivalent to an average blood loss of 70 cc.

(10) Reduction

Reduction	Number of patients	Percentage (%)
Anatomical reduction	20	40
Near anatomical reduction	20	40
Relative reduction	8	16
Varus alignment	2	04
Total	50	100

In present study as far as the reduction is concerned, in 40% cases we achieved anatomical reduction, near anatomical reduction in 40%, relative reduction in 16%, varus alignment in 4% of patients.

(11) Fracture union

Union	Present study(days)
Clinical	87
Radiological	121

In, present study average time for clinical union was 87 days. As far as the radiological union is concerned, the average time for it was 121 days.

(12) Infection rate

Type of infection	Number of patients	Percentage (%)
Superficial	1	2
Deep	1	2
Localized hematoma	3	6
Total	5	10

In present study two patients developed local infection in form of serous discharge from the local site which was treated aggressively with thorough dressing and higher antibiotics. Out of two patients, one patient was treated conservatively and the wound healed but the other required open lavage and debridement which also healed in due course of time. Rest all the patients had no infection but three patients developed hematoma.

(13) Implant complication

Implant complications	Present study	Percentage (%)
Screw backout	3	6
Screw breakage	0	0
Nail breakage	0	0
Joint penetration	1	2
Screw cutout	0	0

Out of fifty patients of complex proximal femoral fracture who were treated with proximal femoral nail (Sirus nail),

1) Screw back out was problem in three patients, in all the three cases proximal screw backed out but as the fracture was united both clinically and radio logically, the backed out screw were removed.
2) Penetration of the hip joint by screw had occurred in one patient, but as fracture was united, so the screw was removed.

(14) Ambulatory status

Study	Period	Percentage (%)			
		Unaided	Walking stick	Walk frame	Wheel chair
Present	Pre injury	92	8	0	0
	Final follow up	76	20	4	0

In present study, walking stick was needed in 12% of the patients, who did not need walking stick before injury.
In summary, walking aid was needed in 16% of patients who did not need any type of walking aid before injury. There was no patient in present study that was using walking frame or wheel chair before injury.
Walking stick was used in preinjury period in 8 % patients of old age, with severe osteoporosis, severe osteoarthritis knee, degenerative spine disease and associated medical comorbidities.

(15) Final Results
(Using Salvati and Wilson Hip Score System)

Results	Present study	
	Number of patients	Percentage (%)
Excellent	35	70
Good	11	22
Fair	2	4
Poor	2	4
Total	50	100

The SALVATI AND WILSON HIP scoring system was used at final assessment. According to that total 92% of the patients were rated as excellent or good. Only 8% patients were having fair or poor outcome.

(16) Results based on classification

AO Classification	Results								Total
	Excellent		Good		Fair		Poor		
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	
31A2	27	69.23	10	25.65	1	2.56	1	2.56	39
31A3	8	72.73	1	9.09	1	9.09	1	9.09	11
Total	35	–	11	–	2	–	2	–	50

Above data suggest that amongst type 31A2 fractures 95% patients and 81% of the 31A3 fractures showed excellent or good results.

Discussion & analysis

The need for internal fixation and early mobilization of patients with complex proximal femoral fractures is generally accepted, not only to reduce the morbidity/mortality rates associated with prolonged immobilizations, but also to improve the functional result by avoiding malunion and encouraging mobility.

The best treatment for these fractures remains controversial. DHS fixation [9] is widely preferred but failure of fixation still occurs up to 20% of cases whereas in cases of low subtrochanteric fractures, DHS fixation usually prevents dynamisation at the fracture site. In Complex proximal femoral fracture D.H.S usually fails due to medialisation of the distal fragment and loss of reduction of head and neck in to varus.

Intramedullary device, such as Gamma nail [10], have some theoretical advantage over DHS, as they do not depend on screw fixation of a plate to the lateral cortex, which can be a problem in very osteoporotic bone.

In addition they have a shorter moment arm, because the load is transmitted to the femur along a more medial arm.

The Gamma nail is more rigid than DHS, has greater stability under cyclical loading and greater stiffness under strain. On the other hand the Gamma nail has a significantly increased risk of fracture at the tip of nail, which had reached up to 18% in various studies and other technical failures (8-15% of the cases resulting in a high risk of reoperation.)

In case of Proximal femoral nail (P.F.N.) A.O. type, following are the drawbacks:

- Proximal diameter is very wide which is unsuitable for indian femoral neck
- Technical difficulty for correct placement of two screws in the neck
- Nail is short i.e. leading to fracture at the tip of the distal end of nail in which splinted & Unsplinted bone junction is a stress riser.
- Dissymmetrical diameter of two hip screws at times preventing collapse.
- Neck occupancy is very high.

These are the reasons for using Sirus femoral nail

- Easy to put even in small proximal femoral funnel because proximal diameter is not more than 13 mm.
- 6 to 8 degree mediolateral angle of the proximal part of the nail, which automatically converts your fracture in to desired valgus.
- Sirus Nail has an angle of anteversion (inbuilt), so there are less chances for screws to go out of neck
- Being an anatomical shaped nail, it is easy to introduce the nail which avoids excessive hoopstress in femoral shaft.
- Entry point which is just lateral to tip of the trochanter which is extra-articular so penetration of the joint is avoided.
- When tip of greater trochanter is broken, entry will be very easy so broken tip of greater trochanter is the indication for Sirus femoral nail unlike our belief of not passing through fracture.
- Reverse oblique intertrochanteric fracture which is the most complex of proximal femoral fractures, where commonly used D.H.S. has given unsatisfactory outcome, sirus nail has offered satisfactory outcome (in present study, we have 11 reverse oblique intertrochanteric fractures).

At our institute, 50 patients of the complex proximal femoral fractures were treated between June 2007 to June 2009. The prospective study of 50 such patients treated with sirus femoral nail (an intramedulary fixation) was done. We used the modified proximal femoral nail (sirus type) in all the cases that was made and modified locally. It has an inbuilt 10^0 ante version plus 7^0 valgus with specialized assembly for insertion of nail.

We classified all the cases according to AO classification.

All the cases were followed up for an average 12 months. The functional results were evaluated on the bases of Salvati and Wilson hip scoring system. At the same time, results of the present study were compared with AL-YASSRI Study [6] who had studied the AO/ASIF proximal femoral nail for the treatment of unstable intertrochanteric fracture femur in 51 cases at orthopaedics department, university hospital Hillingdon, Middlesex, U.K.

Age Distribution: The average age of the patient is 58 years; most of them were of old age. Maximum number of patients belonged to age group 51-70 years. The mean age in AL-Yassari study is 84 years that is higher as compared to present study. This can be explained by higher average life span of the U.K people than Indians. So, as far as the age is concerned Complex Proximal femoral fractures are more common in older age groups.

Sex Distribution: In present study male and female ratio m:f is 1:1, while in AL-YASSRI study male female ratio m:f is 1:3.

Trauma Surgery Interval

Trauma surgery interval	Present study	Al-yassari study
Days	2.36 days	3 days

The trauma surgery interval in present study is 2.36 days is similar to AL-Yassari Study 3 days. This early operative treatment greatly reduces the mortality and morbidity, meanwhile giving best chance of early mobilization that reduces the risk of the prolonged bed rest.

Type of Injury: The most common mode if injury is low velocity trauma i.e. fall while walking or fall in bathroom.66% of the patients in the present study incurred injury due to fall or trivial trauma. So, low energy falls indoors account for most of the injuries.

Ambulatory status

Study	Period	Percentage (%) of patients			
		Unaided	Walking stick	Walking frame	Wheel chair
Present	Pre injury	92	8	0	0
	Final follow up	76	20	4	0
Al-yassari	Pre injury	52	24	20	4
	Final follow up	16	34	42	8

8% patients in present study were already using walking aid prior to incurring the injury. So in this study 16% of the patients needed walking aid after surgery but did not need it before surgery.
In AL-YASSARI study 36% of the patients needed walking aid after surgery but did not need it before surgery.

Pain score

Average score for pain	Present study	Al-yassari study
Score (out of 10)	8	8.2

Average score for pain in present study is 8 out of 10 while it was 8.2 in the AL-YASSARI study. So both studies show similar values for pain in the thigh.

Reduction

Reduction	Percentage (%)	
	Present study	Al-yassari study
Anatomical reduction	40	11
Near anatomical reduction	40	66
Relative reduction	16	23
Varus alignment	04	-

As far as the reduction is concerned, in 40% cases, we achieved anatomical reduction, near anatomic reduction in 40%, relative reduction in 16%, varus alignment in 4% of the patients, while in AL-YASSARI study figures for same are 11%, 66%, 23% respectively and no varus alignment noted.

Implant complications

Implant complications	Number of patients	
	Present study	Al-yassari study
Screw backout	3	n.a
Screw breakage	0	0
Nail breakage	0	0
Joint penetration	1	n.a
Screw cutout	0	4

8% 0f patients had cut out screw in AL-YASSARI study, out of them 4% of patients required removal. No such patient was found in our study.
In our study 6% of the patients had back out screw but as the fracture was united clinically and radiologically backed out screw was removed.
In our study 2% of the patient had joint penetration of the screw but as the fracture was united the screw was removed. No such patient was found in Al- yassari study.

Final results
(Using salvati and wilson hip score system)
Finally, to assess the outcome of the whole study, we have used the Salvati and Wilson Hip scoring system. The Salvati and Wilson Hip score was >20 in 92% of the patients in present study and in 78% of patients in AL-YASARI study.70% patients had an excellent results, 22% patients had good results, 4% each had a poor or fair results in present study.

Comparision with other similar studies
The present study was further compared to a study conducted by Ulfin rethnam, James Cordell-smith, Thirumoolanathan M Kumar and Amit sinha at Department of orthopaedics, glan Clwyd Hospital, Bodelwyddan, U.K [7].

Operative time: They concluded in a study of 42 patients that mean operative time was 131.6 +/- 41.1 minutes (range: 85-255 minutes) which reflected surgical experience, problems associated with fracture reduction and intraoperative technical difficulties most commonly relating to piriformis fossa access and locking.

Post operative complications
Post operative complications were encountered in 18/42 patients (42.8%). 3 patients developed wound infection one was a superficial wound infection that settled with antibiotics while the other 2 patients required surgical debridement.

Implant complications
Additional surgery was necessary in 7 patients (16.6%). One patient had implant failure at 13 months due to nonunion which was treated by exchange reconstruction nailing and the fracture united uneventfully subsequently. 3 patients required proximal locking screw removal. 2 for "backout" causing impingement syndrome (Reverse "Z" effect), and 1 for proximal migration into the hip joint ("Z" effect) which was identified on serial radiographs and removed before intrapelvic or abdominal injury occurred. 2 patients needed surgery for excision of prominent bone fragment.

Conclusion
Proximal femoral nail (Sirus) with two screws inserted in head and neck proximally with at least one distal interlocking screw makes Sirus Nail as implant of choice for Complex Proximal Femoral Fractures from our study because:

a) Close procedure – so less wound problems, less blood transfusion.
b) Early mobilization of surrounding joint.
c) Short hospital stay.
d) Less operative time
e) Maintenance of fracture hematoma.
f) Maintenance of length of femur.
g) Minimal bone loss
h) Less periosteal and soft tissue devastation, and hence less infection rate
i) Lesser neck occupancy by screws than PFN
j) Uniform distribution of the weight so less deforming forces exert on the fracture
k) Entry point is at the tip of the trochanter so easy to operate in supine position and allow the neutral alignment [8].
l) Sirus Nail is very much anatomical to the Indian femur by having inbuilt ante version, mediolateral curve, and lesser proximal diameter of the nail
m) Controlled dynamisation in desired direction is possible
n) Two parallel proximal screws of same diameter helps in collapse as well as give rotational stability in axial plane.
o) Less postoperative morbidity
p) In highly Complex Proximal femoral fracture, one can do the open reduction and take the advantage of nailing also.
q) Postoperative pain is reduced due to less soft tissue devastation.

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