Original Research

Subtrochanteric femur fractures treated with extramedullary or intramedullary fixation at tertiary care centre

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Received June 13, 2016. Accepted August 2, 2016

Abstract

Background: Subtrochanteric fractures account for 10–30% of all hip fractures, affecting persons of all ages. Mostly, these fractures are seen in older osteopenic patients after a low-energy fall and younger patients involved in high-energy trauma. Extramedullary as well as intramedullary fixation techniques have been used to fix such fractures.

Objective: To study the clinical outcomes in patients with subtrochanteric femur fractures treated with extramedullary or intramedullary devices for fixation.

Materials and Methods: Prospective study of traumatic subtrochanteric fractures of femur was carried out among 36 patients at department of Orthopaedics, New Civil Hospital, Surat during January 2013 to December 2014. During surgery, reduction was aimed by closed techniques but when required direct or indirect methods were applied as deemed necessary. Reduction of medial wall and calcar buttress were given prime importance. Pre designed and pre tested semi structured questionnaire was used and analysed with MS Excel and SPSS.

Result: Extramedullary fixation among 17 cases and intramedullary fixation among 19 cases were carried out. Mean follow up was 23.9 months (16.5–27.6 months). Mean age was 42.4 years (19–60 years). A mean incision size was 10.3 cm in intramedullary fixation and 21.8 cm in extramedullary group. Average stay in hospital was 15 days (8–46 days) for intramedullary group and 20.41 (7–55 days) for extramedullary group.

Conclusion: Intramedullary method of fixation requires smaller exposure (incision size) hence lesser blood loss, shorter operating time and shorter hospital stay than extramedullary method of fixation.

KEYWORDS: Subtrochanteric femur fractures, extramedullary, intramedullary, fixation

Introduction

Subtrochanteric fractures have been a major challenge for orthopaedic surgeons not only for achieving fracture union, but also for rapid restoration of functional mobility. Subtrochanteric fractures of femur account for 10–34% of hip fractures.[1] Compression, tensile, and torsional stresses along with decreased vascularity of the subtrochanteric region have challenged orthopaedic surgeons with problems of mal-union and non-union.[2] Moreover, subtrochanteric fracture causes more blood loss than neck femur or intertrochanteric femur fracture.[3] Incidences of implant failure and poor functional outcome following subtrochanteric fractures of femur are not uncommon.[1-11]

Its management is difficult due to instability of fracture pattern with a tendency to varus collapse and the muscular forces acting on the fractured fragments resulting in shaft medialization.[12] Implant used for fixation of subtrochanteric fracture should provide necessary mechanical strength while maintaining functional mobility of the limb until bony union is achieved. Extramedullary as well as intramedullary fixation techniques have been used to fix such fractures. Extramedullary fixation devices are used for more than a century but they have been associated with extensive surgical dissection, periosteum and soft tissue damage.[4] Intramedullary devices have allowed surgeons to treat these complex fractures less invasively. Superiority of intramedullary devices has been shown by biomechanical studies in comminuted subtrochanteric femur

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2017.13062016582	

fractures.[5-8] However, intramedullary fixation in subtrochanteric fractures is not without complication. Various authors have reported improper reduction with resultant mal-union or non-union after intramedullary nailing of comminuted fractures.[9-11] Meta-analysis by Parker et al.[13] showed no significant difference between two fixation methods in over 3500 patients. The superiority or equality between the two fixation methods cannot be established due to dearth of literature on comparison of the two fixation methods.

So a prospective non-randomised clinical study was carried out at a tertiary care centre with an aim to compare two fixation methods. Peri-operative parameters and long term outcomes were used to analyse the two fixation methods. The objective of the study was to draw a comparison between two methods in terms of blood loss, duration of surgery, radiation exposure, total hospital stay, time to obtain clinical or radiological union, time to achieve full weight bearing, and Harris hip score.

Materials and Methods

Prospective study of traumatic subtrochanteric fractures of femur was carried out at a tertiary care centre. A revision rate of 32% was proposed in extramedullary fixation group with 0% in intramedullary group by Sadowski et al.[14] Revision surgeries were mainly due to implant failure, infection and non-union all of which seriously affect functional outcome. Hence, to detect significant difference (95% significance level) in functional outcomes with 80% power, minimum 17 patients were required in each group for study to draw a valid conclusion.

Inclusion criteria

- Isolated subtrochanteric fracture
- Subtrochanteric fractures with extension to intertrochanteric region
- Age >18 yrs and <65 yrs

Exclusion criteria

- Subtrochanteric fractures with neck femur fracture
- Pathological fractures (e.g. osteoporosis, tumour)
- Previous surgery of the proximal femur on ipsilateral side
- Ongoing chemotherapy or radiotherapy due to malignancy
- Polytrauma with additional fracture in lower limbs, pelvis and spine
- Patients with less than 6 months post-operative follow up

Patients were grouped either into intramedullary or extramedullary fixation group by operating surgeons. However, due care was taken to ensure two groups remain comparable with respect to age as well as fracture pattern. Patients were operated in elective or emergency basis as deemed necessary.

During surgery, reduction was aimed by closed techniques but when required direct or indirect methods were applied as deemed necessary. Reduction of medial wall and calcar buttress were given prime importance. For extramedullary fixation either a direct or indirect reduction were aimed. Direct reduction was done in patients with two or three fragments with minimal or no comminution. Large butterfly fragments were fixed with lag screws. Indirect or biological reduction techniques were used in presence of comminution so as to attain anatomical length, alignment and rotation and to avoid iatrogenic devascularization.

In perioperative period, patients were evaluated for incision size, intraoperative blood loss, and intraoperative radiation exposure, duration for surgery, distal neurovascular deficit, and limb length discrepancies. Antibiotics were given usually for a period of 72 hours, however they were continued for longer duration if required according to wound condition, longer duration of surgery, constitutional symptoms of infection. Quadriceps strengthening as well as hip and knee range of motion exercises were encouraged from first postoperative day as tolerated by patients. From second postoperative day patients were encouraged for mobilization out of bed with a walker.

Follow up examinations were done at 4–6 weeks, 10–12 weeks, 18–24 weeks and further monthly follow-up as required. Radiographs were taken during each follow up visits. Patients were kept non-weight bearing for 8 weeks and further weight bearing was advised based on periodic radiographic evaluation. Delayed union was defined as no sign of fracture healing at 24 weeks after initial operation.[11] Non-union was defined as absence of bone union (3 cortices in two orthogonal views) 48 weeks after the initial operation.[11]

Following parameters were evaluated in follow up:

- Duration of fracture union
- Loss of reduction and/or implant failure requiring revision surgery
- Wound condition
- Hip and knee range of motion
- Limb length discrepancies

Functional recovery of patients at 6 months (Harris hip score)

Result

A total of 51 subtrochanteric femur fractures were operated during the study period. However, 5 cases had their age more than 65 years, 2 cases had pathological fracture, 5 cases were lost during follow up, 3 cases had associated fractures in lower limbs or spine and hence all were excluded. Total 36 cases were evaluated and distributed into extramedullary fixation group (17) and intramedullary fixation group (19).

Mean follow up was 23.9 months (16.5–27.6 months). Mean age was 42.4 years (19–60 years). Equal distribution of data between two groups in terms of age distribution (p, 0.8); fracture classifications: Seinsheimer (p, 0.29) Russel Taylor (p, 0.59); mode of Trauma (p, 0.09). This study has

preponderance of young patients with 72% of patients below 50 years of age and predominance of males (83 %) (Table 1).

Incision size was measured immediately after taking sutures ranges from 7.7 cm (average) for closed procedures and 12 cm (average) for open fixation with a mean of 10.3 cm in intramedullary fixation group. In extramedullary group it was 21.8 cm (12–32 cm). Distal locking incisions were included for intramedullary group.

Average stay in hospital was 15 days (8–46 days) for intramedullary group and 20.41 (7–55 days) for extramedullary group.

Extramedullary fixation group requires longer incision (p,<0.00001),

more blood loss (p,<0.00001), longer duration of surgery (p,<0.00001),

longer hospital stay (p,0.03). However, no difference was observed in radiation exposure (p,0.8449).

In intramedullary fixation group fractures were reduced by open reduction in 8 (42%) cases while 11 cases were reduced in closed manner.

Table 1: Distribution of study population according to their demographic profile, mode of injury and classification

	Intramedullary fixation group	Extramedullary fixation group	Total
Age			
18–30	5	3	8
31–50	9	9	18
>50	5	5	10
Gender			
Male	17	13	30
Female	2	4	6
Mode of injury			
RTA	15	11	26
Fall from height	2	3	5
Others	2	3	5
Seinsheimer's Classification			
Type 1	0	0	0
Type 2a	2	0	2
Type 2b	4	5	9
Type 2c	1	1	2
Type 3a	7	4	11
Type 3b	3	5	8
Type 4	0	2	2
Type 5	2	0	2
Russel Taylor classification			
1a	6	4	10
1b	6	8	14
2a	1	2	3
2b	6	3	9

Selection of implants was based on surgeon's preference for a particular fracture pattern. In extramedullary group, 5 were treated with proximal femoral plate (29.5%), 8 with dynamic condylar screw (47%) and 4 with angle blade plate (23.5%).

Extramedullary fixation group required more time for union compared to intramedullary group but difference is not statistically significant. Similarly full weight bearing and return to works showed no significant difference.

Harris hip score calculated at 6 months post-operative period showed no statistical difference between two groups (p, 0.549). Mean Harris hip score in extramedullary fixation group was 85 with majority of patients being in 80–89 group range while mean Harris hip score for intramedullary fixation group was 81.3 with majority of patients being in 90–100 group range. Infection, non-union, and revision surgeries all adversely affected Harris hip score at 6 month interval.

94.7% of intramedullary group were satisfied, while 88.2% cases of extramedullary group were satisfied. Overall satisfaction of patients in this study was 91.6% (Table 2).

Two patients in intramedullary fixation group required revision. One patient had chronic infection with screw backing out and leading to ankylosis of hip. Patient's implants were removed, injectable antibiotics were given and subsequent hip replacement was planned once infection subsided. The other patient had Z effect with penetration of proximal screw into hip joint leading to painful hip movements and backing out of inferior screw.

In extramedullary fixation group 4 patients required revision. There were 2 patients who had non-union with varus collapse leading to implant failure. Both were revised with proximal femoral plate and iliac crest bone grafting and showed union within 24 weeks post-surgery. Out of 3 infected cases, 2 resolved with antibiotics (superficial infections) and one patient required implant removal after clinic-radiological union. In one patient, DCS plate was removed and changed to proximal femoral plate within first post-operative week due to medial comminution and varus collapse after DCS (Table 3).

Discussion

The equitable distribution of patients in two groups with respect to age and fracture classification makes the comparison between two groups valid. The outcomes were obtained with a mean follow up of 23.9 months. Majority of patients in this study belonged to 4th–6th decade of life and so the conclusions drawn can be validated to this age group only. Intramedullary fixation group had lesser blood loss, smaller incision size, and shorter hospital stay. The patients in this group showed early union (14.1 *v/s* 16 weeks) and early mobilization but the difference is not statistically significant. Union was significantly delayed in cases having gross infection (21.6 weeks in infected patients) and in cases requiring revision (22.5 weeks in patients requiring revision). Revision

Table 2: Distribution of study population according to their intra-operative parameters and outcomes

	IM Group Mean (SD)	EM Group Mean (SD)	Significance level, *p*	Total
Incision size (cms)	10.3 (4.24)	21.8 (5.43)	<0.00001*	15.7 (7.5)
Blood loss (ml) (intra op)	210.5 (138)	697 (175.4)	<0.00001*	440.2 (290.7)
Radiation exposure (secs)	197.1 (39.4)	194.05 (50.3)	0.8449*	195.6 (44.3)
Duration of surgery(mins)	68.6 (11.5)	112.6 (30)	<0.00001*	89.4 (31.25)
Hospital stay (days)	15.7 (12.4)	20.41 (11.3)	0.03*	18.8 (12.6)
Union (wks)	14.1 (1.94)	16 (4.5)	0.12*	15.0 (3.5)
Full weight bearing (wks)	16 (1.64)	17.1 (3.7)	0.27*	16.5 (2.8)
Return to work	19.6 (2.8)	19.9 (4.8)	0.88*	19.7 (3.8)
Harris hip score	85 (18.5)	81.3 (17.7)	0.549$^{\delta}$	83.2 (18)
Patient satisfaction %(*n*)	94.7 (18)	88.2 (15)		91.6 (33)

*Unpaired Student 't' test, $^{\delta}$ Mann-Whitney Rank Sum test

Table 3: Complications among study population

Revision surgery rate	IM group	EM group	Significance level, *p*	Total
Revision required	2	4	0.27^{+}	6
Percentage (%)	10.5	23.5		16
Infection				
No. of patients infected	2	3	0.44^{+}	5
Percentage (%)	10.5	17.6		13.8
Implant related complications				
No. of patient affected	1	3	0.25^{+}	4
Percentage (%)	5.25	17.6		11.1

$^{+}$Fisher's exact test

rate of 10.5% was observed in intramedullary fixation group while 23.5% in extramedullary fixation group however difference is not statistically significant (*p*,0.27). There was no statistically significant difference in the functional outcomes of the 2 groups which states that null hypothesis proposed at initiation of this study holds true. However, in cases with poor Harris hip score, the main reasons were infection, nonunion and implant failure especially when revision surgeries are required. Two patients in intramedullary group had poor results, one was due to infection (subsequent ankylosis of hip) and the other one due to z effect (subsequent varus collapse). While in extramedullary fixation group two patients had poor results due to varus collapse and secondary loss of fixation ultimately requiring revision surgeries. Apart from this one patient who was treated with DCS was revised immediately within a week following collapse and showed good functional outcome. Among patients with varus reduction, intramedullary implants (Harris hip score of 90) performed better than extramedullary group (Harris hip score of 49.5).

Older patient with weaker bones sustains subtrochanteric fractures with trivial trauma while younger patient will have such fractures following high-energy trauma. Elderly patients were excluded in this study as fixation ability of either a DCS or IM nail is affected in osteoporotic patients and their less favorable results and high implant failure rates have been reported by Kulkarni and Moran[15] and Garnavos et al.[16] Meta-analysis by Kuzyk et al.[12] suggested that different studies should be carried out using young high energy trauma population and elderly low energy trauma population separately for better comparison of the two fixation technique. Our 83% cases belonged to type II and type III of the Seinsheimer classification. Lee et al.[11] focused more on comminuted subtrochanteric femur fracture with majority of patients in type IV and type V, however he also obtained no difference between the two methods of fixation. While Rahme and Harris[17] had equal distribution of cases in type III and type V and with a more elderly population having observed a revision rate of 28% in blade plate group and 3% in intramedullary nailing group. Rybicki et al.[18] found that higher forces are generated with eccentrically placed devices, such as plate and screw devices, compared with centromedullary devices. Biomechanical studies carried out by Kummer et al.[5] showed that intramedullary and extramedullary fixation devices provides similar stability for fixation of type II and type III subtrochanteric femur fracture. Curtis et al.[7] and Mahommed et al.[8] concluded that

intramedullary devices provide significantly stiffer construct for unstable subtrochanteric fractures than DHS. Lee et al.[11] in 2007 had smaller incision size, less intraoperative blood loss and lesser hospital stay in extramedullary group {11.2 cm (6.6 cm + 4.6 cm)} as his study had comminuted subtrochanteric fractures which were treated with biological plating principles trying to preserve fracture hematoma, reducing the periosteal stripping, preserving soft tissue integrity. Hence, it can be concluded that for type II and type III subtrochanteric fractures both group has similar functional outcomes. Harris hip score is the most frequently used and adapted as single rating system by the orthopaedic community to standardized reporting system. Only slight variations occur in Harris hip score after 6 months interval.[19] Sixth and seventh parameters of Harris hip score 'put on socks and shoes' and 'sitting' with 'squatting' and 'cross legged sitting' were modified to assess the results as per Indian activities of daily living. Mohammed[20] in 2012 had observed that mean Harris hip score in his study was 85 when using DCS for treating Subtrochanteric fractures which correlates with the present study. Similarly, Rohilla et al.[21] in 2008 observed mean Harris hip score of 88 in treating subtrochanteric femur fractures by DCS. Subramanyam et al.[22] in 2014 observed mean Harris hip score 80.7 while treating subtrochanteric femur fractures by intramedullary nailing.

The most important concern while considering an implant is its ability to avoid varus collapse and shaft medialization. As shown in this prospective study, majority of subtrochanteric fractures can be treated with minimally invasive approach with the availability of second generation of intramedullary nails. However, improper reduction with resultant mal-union or non-union, cephalic screw cutting out, z-effects or reverse z-effects are not uncommon after intramedullary nailing of comminuted fractures as observed in the present study.[9-11,23,24] In patients with lateral wall fracture, reaming can cause fragmentation and can cause peritrochanteric instability.[23-25] In this series, one planned case of IM nailing has to be converted to extramedullary fixation intraoperatively. Plating is still recommended for fractures with proximal trochanteric extension or with lateral wall fracture (especially when medial cortical contact can be restored), subtrochanteric femur with acetabular fracture and patients with narrowed femoral canal. The main advantage with this method of fixation is that it preserves medullary blood supply and vascularity of the medial fragment if complied with biological methods of dissection and fixation.[25] Proximal femoral plate can serve like an external fixator holding all major fragments without lateral stress on greater trochanter fragment.[26-30] Kim et al.[6] also concluded that locking compression proximal femoral plate provides stronger construct than DCS in terms of ultimate strength. In extramedullary group all cases were revised using proximal femoral plate as a salvage implant.

Limitations of this study: This study was not randomized and not double blinded. Hence, bias of surgeons cannot be neglected. Moreover, surgical expertise of the operating surgeon has a definitive impact on the outcome. Secondly, subtrochanteric fractures in older population were not included here. Hence, conclusion drawn cannot be applied to osteoporotic elderly population.

Hence, it can be inferred from the study that proper implant selection taking into consideration the advantage and disadvantages of fixation techniques and fracture pattern is obligatory. Further comparative study should be carried out to evaluate superiority of proximal femoral plate amongst extramedullary implants.

Conclusion

Intramedullary method of fixation requires smaller exposure (incision size) hence lesser blood loss, shorter operating time, and shorter hospital stay than extramedullary method of fixation. Time to achieve radiological union and time required for full weight bearing are more in extramedullary fixation group than in intramedullary fixation group, however this difference was not statistically significant. Anatomical reduction of medial buttress and calcar with caution to avoid varus collapse is a must for avoiding non-union and ensuring good functional outcome especially in extramedullary group.

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How to cite this article: Patel R, Menon H, Chaudhari N, Chaudhari V. Subtrochanteric femur fractures treated with extramedullary or intramedullary fixation at tertiary care centre. Int J Med Sci Public Health 2017;6:2385-231

Source of Support: Nil, **Conflict of Interest:** None declared.