



CODEN [USA]: IAJ PBB

ISSN: 2349-7750

INDO AMERICAN JOURNAL OF PHARMACEUTICAL SCIENCES

<http://doi.org/10.5281/zenodo.2561224>
Available online at: <http://www.iajps.com>

Research Article

EFFECTIVENESS OF INTRAMEDULLARY FIXATION IN THE TREATMENT OF SUBTROCHANTERIC FEMORAL FRACTURES

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Abstract:

Desired Objective: Purpose of this study is to converse operative efficiency, surgical methods and clinical results of intramedullary fixation in the treatment of subtrochanteric femoral fractures

Study Design: Descriptive and observational study.

Place and Time Frame: Subject study is carried out in Orthopaedic Surgery Department of Mayo Hospital Lahore within time frame of about one year (December 2017 to November 2018).

Methodology: In above stated time frame the total 63 persons (41 men and 22 women) who visited our hospital with the cases of subtrochanteric femoral fractures were taken for study. All these cases are dealt by the intramedullary fixation. Age group was 35-69 years with mean of 52 years. All cases are categorized as per the Seinsheimer Classification and the cases were as 3, 5, 12, 19 and 24 cases of type-I, type-II, type-III, type-IV and type-V respectively. In starting phase, all the persons were suffered from closed reduction as per the C-arm fluoroscopy. Very small quantity of cases experienced the ultimate closed reduction with following of internal fixation. Rest all the cases required extra inadequate open reduction. We use the radiographic tests to make the testing confirmations of fracture therapeutic and bump structures in post-operative follow up of one, two, three and twelve months. By using the Harris Hip Scoring HHS system, the functional recovery of all cases is assessed. Closed reduction of the all fracture is in the management of C-arm fluoroscopy. In our study cases of ideal closed reduction was observed in one case of type-I and the 2 cases of type-III and treated by internal fixation.

Results: Almost all subtrochanteric femoral fractures were recovered with the exception of only one case that was not cured in time and got long time recovery. The average recovery time of bone union was 4.1 months. The functional recovery ratio as per the reference of Harris Hip Scoring HHS system was categorized as 54, 7, 2, and 1 case with categories of Excellent, Good, Fair and Poor respectively. Functional recovery ratio of the first three categories in contrast with poor had the percentage of 98.41%.

Conclusion: The Intramedullary fixation is effectively practicable the treatment of subtrochanteric femoral fractures but with the follow up of long-time frame. For the clinical outcomes the expertise in surgery and the accuracy of intra-operative reduction is necessary.

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Please cite this article in press Fabeeha Ijaz et al., *Effectiveness Of Intramedullary Fixation In The Treatment Of Subtrochanteric Femoral Fractures.*, Indo Am. J. P. Sci, 2019; 06(02).

INTRODUCTION:

Subtrochanteric femoral fracture is a fracture between the lesser trochanter and the area roughly 5 centimeters below the lesser trochanter. History of this fracture started in 1949 when Boyd and Griffin explained the subtrochanteric femoral fracture first time. They identify the distinction between subtrochanteric femoral fracture and intertrochanteric fracture. While their study they observed the poor post-operative results in several subtrochanteric femoral fracture cases [1].

As described in the study of Koch the subtrochanteric fractures were normally comminuted fractures because the value of the compressive stress on medial cortex was recorded as 1100 N and because of this reason reconstruction of the medial cortex is essential. The treatment of the subtrochanteric femoral fracture cases is difficult and mortality rate was high than 20% [2, 3, 4].

This subtrochanteric section is location of high value stressed area. When the stress is exerted in high value it is generally focused on the area of subtrochanteric. This area is consisting of thick cortical bone and the supply of blood is low in this area. Whenever this type of fracture is happened the recovery process is very low with respect to the others. Subsequently, the deformation of proximal segments and the distal segments occurred due to the nearby musculature of smaller and larger trochanters. Specifically, proximal segment side is bended and rotated outside due to the traction of iliopsoas and remained hold due to mechanical stress of hip short abductor muscle while on the other hand distal segment side remained hold due to pull of the great adductor muscle [5].

High compressive forces focused the medial cortices and posteromedial cortices while high tensile forces focused lateral cortex. High tensile forces and high compressive forces detached the segments and create the complication in the fracture stability. These cases have no absolute contraindication that is the reason due to this surgical treatment is preferably adopted if the patients can afford surgery. So, those cases which have no absolute contraindications, surgical treatments are best option as long as the patients can tolerate surgery. Totally 63 persons (41 men and 22 women) visited our hospital during the period of subject time frame with the cases of subtrochanteric femoral fractures and their treatment is done by intramedullary fixation.

MATERIALS AND METHODS:

In Orthopaedic Surgery Department of our hospital a total of 63 patients of subtrochanteric femoral fractures reported from December 2017 to November 2018 and treatment of all patients is done with intramedullary fixation. Age group was 35-69 years

with mean of 52 years. All cases are categorized as per the Seinsheimer Classification and the cases were as 3, 5, 12, 19 and 24 cases of type-I, type-II, type-III, type-IV and type-V respectively. In starting phase whole, the persons were suffered from subtrochanteric femoral fractures inspected as per the C-arm fluoroscopy inspection procedure. One case of type-I and 2 cases of type-III experienced the ultimate closed reduction with following of internal fixation treatment. Rest all 60 the cases experienced extra inadequate open reduction. The patients that we included our study were with following criteria: (a) fracture was found between the lesser trochanter and the area roughly 5 centimeters below the lesser trochanter and treatment is done by intramedullary fixation (b) the cases with the time period of less than 3 weeks were accepted for the operation and (c) the patients with no hip disease history with the normal subtrochanteric femoral structure are selected. All the patients with these criteria had record of follow up.

Procedure of the surgical treatment is adopted as position of the patient was supine on a fracture table by placing the opposite side leg on a leg support and the closed reduction of the fracture prepared under image intensifier control. Reduction accuracy is judged with help of the C-arm fluoroscopy by catering of the closed reduction. Cut was made on the skin tissue by sharp knife deeply so that it can depict the fracture point and this incision was 5.7-centimeter-long from the midpoint of the fracture. The haematoma removed near the segments of the fracture. There were main two categories of the fracture; the simple fracture and the complex or comminuted fractures. Both fracture categories are treated in different way. In simple fracture case the treatment is made by using a pointed clamp for the purpose of conditional fixation to sustain the reduction. In complex or comminuted cases auxiliary devices (such as bone-holding forceps, reduction clamps) were used to help the inadequate open reduction.

Operational actions were performed as per C-arm fluoroscopy to gain the correct reduction. One to two cerclages were stitched to hold the fractured bone blocks in the small cuts of the fracture. During intramedullary fixation the intramedullary nail (IM) is inserted into the canal of femur as per its procedure by insuring it that this process is done after the reduction. Making the greater trochanter as a center near about 3.5-centimeter skin cut was on the soft tissue to take apart it up to the greater trochanter. The point for the insertion of IM nail situated in the vertex (or situated in medial part of greater trochanter) and lateral projection was made on the one third of the greater trochanter. At the insertion point of the IM nail made a cut by using scalpel and

then inserts the needle. For adjusting and ensuring the proper position and insertion angle of the needle we had used the C-arm fluoroscopy in anteroposterior and lateral planes. After that reamed a little by using the reamer and reamed up to place where IM nail can be inserted in a proper way and used the soft tissue protection sleeve to make sure the position of the needle and keep away from lateral derivation and then placed the antegrade intramedullary IM nailing of the right width and length. In the meantime, maintained the position of the fracture properly and also maintained the force line of the limbs in proper way. Inserted the IM nail by using the guide wire up to the correct depth and inserted both distal and proximal locking screws to get better stability. Made the confirmation of the fracture position by the using the C-arm fluoroscopy. Subsequently fixed the tail cap and clean the incision area. For the purpose of safety tightened the screws. Managed the surgical drain and incisions were closed with sutures.

Postoperative treatment of all the cases was done by giving the prophylactic anti-infective treatment for 3 days. In the postoperative treatment of hospital stay to stay away from intense vein thrombosis all the patients were treated with low molecular heparin's subcutaneous injection. After the discharge from the hospital all the patients advised for the oral management of the clotting factor Xa inhibitors. Just after the surgical operation the different exercises was started and these exercises were as an exercise for the lower limbs to strengthen the muscles of lower limbs and different functional exercises for the hip joint. The patients were advised not to lift the weight for the next 8 to 12 weeks. We also advised

the patients with the timing of the weight lifting exercises by keeping in view the results of postoperative radiographic as assessed by the physicians. Carried out the inspection of the hip in pelvic anterior-posterior and lateral planes to observe the recovery of the fracture, morphology of hip joint and the implant status for the postoperative visits of three, six and twelve months. When the fracture of all patients cured, the Harris Hip Scoring HHS system was utilized to check the functional effectiveness of the hip joint.

In the statistical analysis of our study we expressed the data in statistical terms of mean and standard deviation SD and also enlisted the max and min values. We used the SPSS 20.0 software to carry out the statistical analysis.

RESULTS:

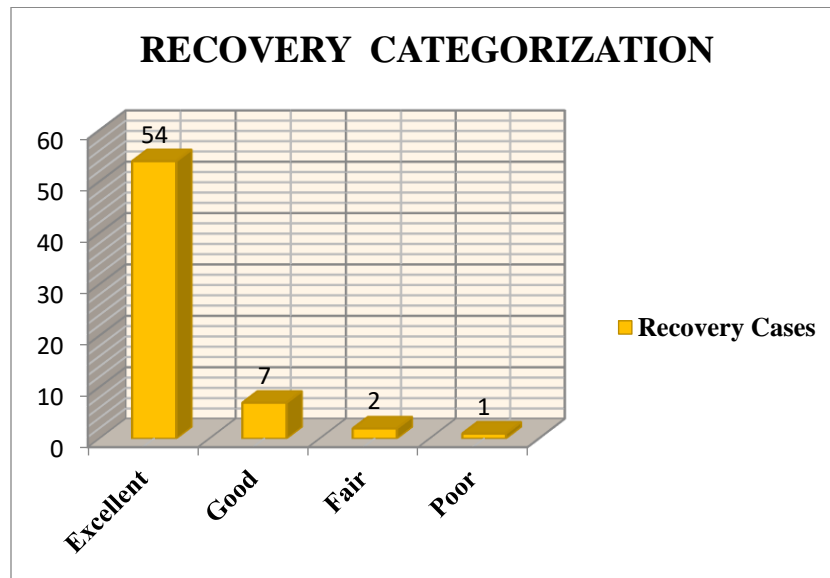
The follow up of each case of subtrochanteric femoral fracture among the 63 cases was comprised on six to 24 months. Almost all subtrochanteric femoral fractures were recovered with the exception of only one case that was not cured in time and got long time recovery. The average recovery time of bone union was 4.1 months. The functional recovery ratio as per the reference of Harris Hip Scoring HHS system was categorized as 54, 7, 2, and 1 case with categories of Excellent, Good, Fair and Poor respectively. Functional recovery ratio of the first three categories in contrast with poor had the percentage of 98.41%.

Table-1 and graphical representation show recovery categorization

Table-1 Recovery Categorization

<i>Category</i>	<i>Recovery Cases</i>
<i>Excellent</i>	54
<i>Good</i>	7
<i>Fair</i>	2
<i>Poor</i>	1

Bar Chart-1 Recovery Categorization



Closed reduction of the all fracture is in the management of C-arm fluoroscopy. In our study cases of ideal closed reduction was observed in one case of type-I and the two cases of type-III and treated by internal fixation. Limited open reduction was observed in rest 60 cases as the adverse closed reduction resulted by using the C-arm fluoroscopy. Pointed clamp-assisted reduction was being experienced in 56 cases and the treatment of these

patients was done by intramedullary fixation while in other four cases faced some complications in the fixation of fractured bones by using the clamps. So why, cerclages were stitched to hold the fractured bone blocks in the small cuts of the fracture and then done the intramedullary fixation. Management of cases is shown in the Fig-1 and Fig-2.



Fig.1. A, B: Subtrochanteric Fracture of Left Femur Treated by Limited Open Reduction and Intramedullary Fixation



Fig.1.C: Postoperative 4 Weeks

Fig.1.D: Postoperative 12 Weeks

**Fig.1.E: Intraoperative Macroscopic View of The Incisions****Fig. 2. Subtrochanteric Femur Fracture Treated by Limited Open Reduction and Cerclage-Assisted Intramedullary Fixation****Fig.2.A: Preoperative X-Ray and CT**



Fig.2.B: Postoperative 6 Weeks

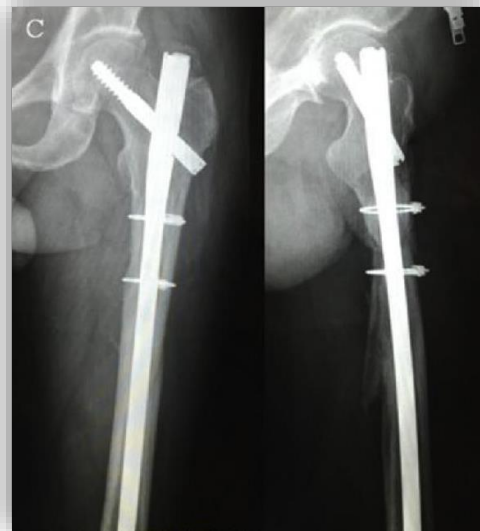


Fig.2.C: Fracture Healing at Postoperative 12 Weeks

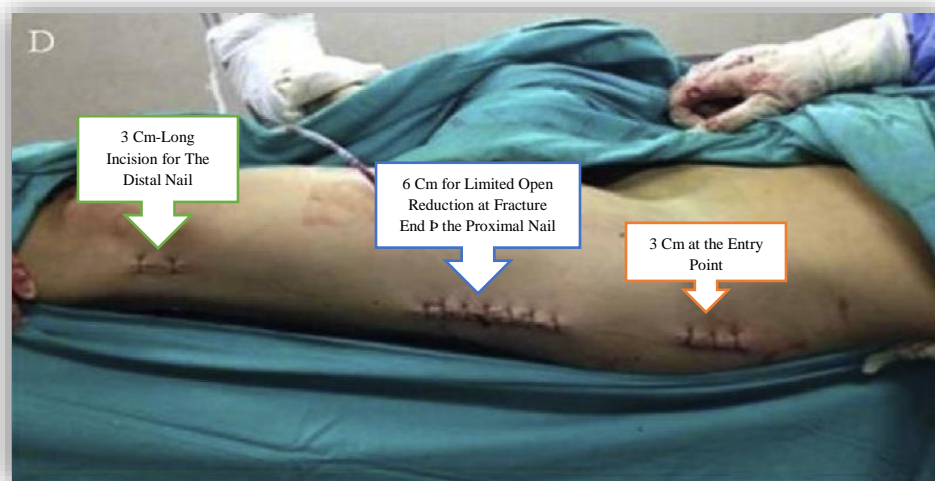


Fig.2.D: Intraoperative Macroscopic View of the Incisions

DISCUSSION:

Traditional treatment is not preferable in the cases of subtrochanteric femur fractures because of its anatomy. Generally, the long-term bed traction creates the complications for the patients but especially, it can create the complications for the patients of old age that comprises on deep vein thrombosis, hypostatic pneumonia and pressure ulcers. Those cases which have no absolute contraindications, surgical treatments are best option as long as the patients can tolerate surgery. With the reason of a little percentage of the patients whose

case is dealt with the traditional treatment we found the small amount of journals and books about the effectiveness of traditional treatment and also about the comparison b/w internal fixation and traditional treatment. In this context the study of Vlasco et al in 1978 is quoted here according to Vlasco et al when 82 patients retrospectively considered and made the study on them. In accordance with this study adverse results came from the patients which were treated congenitally management with percentage of 50 of 32 cases. These adverse results comprised on the shortening of limbs, rotational deformity and Varus

hip whereas reporting poor results in surgery had only the proportion of 21 percent [5].

Abstracting from the retrospective study with reference of Seinsheimer et al the calculations was as; the total reported patients was 56 and 47 patients treated with surgery. Out from these 47 patients; nine cases had internal fixation failure and three cases of non-union with failure rate of 26 percent, nine cases healed with traditional treatment but 5 cases had hip Varus deformity [6].

Which one is a preferable treatment method either it is intramedullary or extramedullary? In the cases of subtrochanteric fractures, surgery is the normal treatment of the subtrochanteric fractures by using the advance techniques of intramedullary fixation. In all this scenario, a troublesome issue was arising that is the selection of the fixation method. Intramedullary fixation gives distinctive privilege of short force arm that can enhance the distribution of the stress where as extramedullary fixation has a disadvantage of load the stress [7].

Several researchers made their researches and studies on the comparison of the intramedullary and extramedullary fixation. At end their studies they finalized that the best option among these two is intramedullary fixation. Obviously, biomechanical benefits of intramedullary fixation are depending on stable fracture patterns. On the other hand, for the unstable fracture cases, which are linked with palpable comminuted fractures, the stress can precede to the distal screw rather it can make bone defect it will bypass bone defect. And consequently, the chances of the breakage of the distal screws might be present there in spite of this what kind of fixation method is used either it is intramedullary or extramedullary.

According to the studies of the Roberts et al. appraised four types of 2nd-generation intramedullary IM nails in the biomechanical experiment. These different types of IM nails can be simulated for the management of the subtrochanteric fractures. The study outcomes illustrated that it is not critical which type of IM nail is selected for the simple fracture patterns. The main issue is the selection of suitable IM nails of right form, length and angle when the fracture is deteriorated especially when having the comminution and defects with itself. This might be suitably selected with exact measurements to decrease the disposition of fracture ends. The chance of failure in the intramedullary fixation is very little against the failure rate of extramedullary fixation. The reason behind this is intramedullary fixation can give the prevention from the medial displacement of distal segment particularly in those cases who has medial cortex defects. Even though intramedullary fixation has strong anti-bending impact and also has

strong anti-compression capability, it has good antiglide capability [8].

Regardless of the advantages of the intramedullary fixation, some researches disagree with the preference of the intramedullary fixation on extramedullary fixation (extramedullary fixation is done with the use of DHS and Steel plate. In this perspective there are few references can be made from these studies. One of them is the retrospective study made by Cook et al in which 244 patients of subtrochanteric fractures are dealt with the intramedullary fixation and extramedullary fixation. The clinical findings of this study reflect no considerable differentiation between these two methods [9].

Some other studies also have the findings of such type which show the no remarkable distinctions. In latest times, the researchers get focused on the biological fixation and indirect fixation. A number of researchers get better findings by doing the fixation with the locking plate in simply persistent perspective. According to the prospective study of Lee et al, which was made on total 66 patients of subtrochanteric femoral fracture with younger age, there are same therapeutical consequences of DCS and Russel Taylor reconstruction nail [10,11].

Another study made on 32 cases of subtrochanteric fractures with Seinsheimer classification of type-III to type-V. All cases dealt with indirect reduction and PF-LCP internal fixation. Outcomes reflect that all the patients recovered the fracture with the recovery period of 15.62 weeks. The results comprised as the two-infection case, two external rotation deformity cases, one case of 1-centimeter limb shortening and two delayed union cases but there was no case of failure of internal fixation in observational results [12].

According to the findings of study of Zhong et al, it discovered in cases of subtrochanteric femoral fractures that Proximal Femoral Locking Compression Plate (PF-LCP) operation had less bleeding, shorter operation time, rapid fracture recovery, better hip joint function (Sanders score), and lesser complication rate than the Dynamic hip screw (DHS) operation. The reason behind this in the DHS operation there would be great cut, wider injury if soft tissue, maximum loss of blood and the adverse damage to blood of supply [13].

In a study of 26 cases by the Li et al all cases recovered with none of any complication up to the follow up of 28 months and the method used for treatment was Less Invasive Stable System (LISS). Radiographic and clinical facts of the study of Riehl et al revealed less than ten deformity in any plane of the bone would enhance the chance of union delay or nonunion. It is obvious that intramedullary fixation

has biomechanical advantages but it has no preference of clinical superiority. It may be due to the following factors which influenced in the follow up and these are comprises on implants, age, reduction method, results of reduction, fracture pattern, postoperative function exercise and such others [14, 15, 16].

Keep in view the findings of all abovementioned studies by catering the advantages, disadvantages, preferences and short-comings of different methods for treatment of the subtrochanteric femoral fractures cases abstracted from these studies, it is very obvious that subtrochanteric femoral fractures' treatment can't rely only on intramedullary fixation treatment. According to surgeons, expert of the extramedullary fixation, it is also a valid treatment with closed reduction in conjunction with minimally invasive extramedullary fixation. The ultimate conclusion of surgical treatments may not possibly rely on the selection of implants for intramedullary and extramedullary fixation. The main features of success of any surgical operation are minimum damage to the blood supply of fracture segments and get the exact reduction influence.

When we talked about the reduction it may be closed reduction, open reduction and limited open reduction. In the initial treatment of cases the subtrochanteric femoral fractures emphasis is given to the anatomical reduction. DCS and the angular steel plate were utilized only one time in the internal fixation. For this type of treatment, the surgeon requires the dissection of soft tissues in a large quantity for the purpose of getting the adequate reduction by visualizing directly. However, in this management the nonunion rate was recorded with high percentage of almost 20 percent [17].

Extra medullary fixation may minimize the injury of soft tissue to a great extent and keep the remaining unharmed soft tissue around the ends of the fracture therefore nonunion rate will decrease. However, some complications are still exist there comprising on the adduction, deformation of the flexion, external rotation in proximal femur, the reduction of subtrochanteric femoral fracture. These may be a great challenge to resolve them. Basically 2 kinds of reductions are present, firstly reduction in the lateral position from distal to proximal and second one reduction is due to the force of traction in traction table. In some cases, it may be unsuccessful. When reduction becomes unsuccessful it may create the problems of nonunion of fractures yet it further leads to internal fixation failure. Contradiction may appear in the treatment of subtrochanteric femoral fractures while preserving the blood supply in fracture ends and gaining the exact reduction level. To resolve this conflict some researchers gave the suggestion that

limited open reduction has advantage minimization of the intrusion on the fracture ends at same time it preserves stability and correctness of reduction [18, 19, 20].

In another study of subtrochanteric femoral fractures, the 56 cases are dealt with the open reduction and intramedullary fixation. According to this all patients had bone union with no reduction loss, 55 patients was recorded with coronal and sagittal plane deformity. On the other hand, for the cases of unstable subtrochanteric femoral fractures, in operation it was hard to keep the reduction maintained by using pointed clamps [21].

Several studies have reported the proposal of using the wire cerclage of fracture ends to keep the correct reduction and force line for the subsequent intramedullary IM nailing. The treatment of subtrochanteric femoral fractures is done by using percutaneous cerclage in addition with intramedullary fixation. All the cases are recovered and there was not any complication is observed [22 to 26].

In another study the researcher introduces another technique in which pointed clamp-assisted reduction is used. Unfortunately, there were also some restrictions so due to the constraint of some tools and methods there were the requirement to strip ample array of soft tissues for the early cerclage placement. This stripping was harmful for the blood supply of fracture ends furthermore there were use of the cerclage wires increased and resultantly occurrence rate of nonunion of bone increased [27, 28].

Some researchers have arguments that the main reason which affects the blood supply of fracture ends is the cerclage itself. While in several histological and anatomical researches it is proved that periosteal blood supply not longitudinal. But it is circular. Therefore, Nather et al raised the query on the supposition that cerclage would harm the blood supply of periosteal vessels. In the innovation of technology, presently percutaneous cerclage is used. It can conserve the blood supply by stabilizing the fracture ends. And as a result, it causes the very small harm on the soft tissues that surround the fracture ends [29 to 32].

According to the summary of study by Kennedy et al cerclage is not harmful for the recovery of fracture with a supplementary precaution of controlling the quantity of nails. There is also the impact of the quantity and spacing of cerclage wires on the recovery of fracture. So, the surgeons have to comprise b/w advantages and disadvantages of effects of different treatment methods [33].

CONCLUSION:

The Intramedullary fixation is effectively practicable the treatment of subtrochanteric femoral fractures but

with the follow up of long-time frame. For the clinical outcomes the expertise in surgery and the accuracy of intra-operative reduction is necessary. Our study provides the evidences of the feasibility and effectiveness of the intra-medullary fixation in conjunction with limited open reduction for the treatment of subtrochanteric femoral fractures with short come of follow-up of long-term follow-up.

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