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Intramedullary Fixation for Unstable Intertrochanteric Fractures

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Abstract

Background: Intertrochanteric fractures of the hip are common fractures in the elderly. While the incidence of these fractures has actually decreased, the absolute increase in the elderly population has led to doubling the number of these fractures over the past three decades and this trend is expected to continue. Intramedullary fixation of these fractures gained popularity in the last few years because of its biomechanical superiority over extramedullary methods moreover less blood loss, operative time, x-ray exposure and hospital stay.

Method: This study was performed on forty patients with unstable intertrochanteric fractures underwent fixation with intramedullary short Gamma nail generation three.

Results: Functional outcome was assessed using Parker mobility score at 6 months and one year postoperative, 31(77.5%) patients had the same score as preoperative at 6 months and increased to 87.5% at one year. The most of cases 29(72.5%) had no complications.

Conclusion: Our results recommend the use of intramedullary nail in the treatment of unstable trochanteric fracture after anatomical reduction.

Keywords: Intertrochanteric fracture; Unstable; Intramedullary fixation

Abbrevations: PMS: Parker Mobility Score; DHS: Dynamic Hip Screw; PFNA: Proximal Femoral Nail Antirotation; DVT: Deep Vein Thrombosis; PE: Pulmonary Embolism; OTA: Orthopaedic Trauma Association

Introduction

Intertrochanteric fractures of the hip are common fractures in the elderly. While the incidence of these fractures has actually decreased in the western world, the absolute increase in the elderly population has led to doubling the number of these fractures over the past three decades and this trend is expected to continue [1]. The fractures tend to be more comminuted with aging due to proportional loss of bone density therefore; they are becoming more challenging for the surgeon [2]. For years Dynamic hip screw (DHS) was the gold stander in the treatment of all trochanteric fractures, although they have been associated with increased incidence of complications that may reach 23% in unstable pattern in the form of cutting out of the lag screw from the femoral head, pulling of the side plate from the femoral shaft, dissociation of the sliding compression hip screw from the barrel and failure of the hip screw itself (rare) [3]. In addition open reduction and internal fixation by DHS may results in substantial blood loss, soft tissue damage and worsening of existing comorbidities in elderly patients [4]. These reasons increased the popularity of intramedullary fixation which offers several advantages because of its location intramedullary

as it provide more efficient load transfer than extramedullary devices, shorten the lever arm between the intramedullary device and the center of rotation in the femoral head expected to decrease tensile strain on the implant that decreasing the risk of implant failure and limits the amount of sliding of hip screw compared to DHS; the fracture can settle until the proximal fragment abuts against the nail [5]. Minimally invasive technique of intramedullary fixation decreases surgical exposure, soft tissue striping, blood loss, surgical time and x-ray exposure compared to extramedullary fixation [6]. The aim of the work is to evaluate the radiological results and the functional outcomes according to Parker mobility score [7] of the patients after anatomical reduction and intramedullary fixation of unstable trochanteric fractures and assess the complications. Comparing different types of design modifications of intramedullary nails used in the fixation of trochanteric hip fractures, no significant differences were seen between implants for fracture healing complications, re-operations and other post-operative complications more over PFNa (plade instead of screw) had longer operation time and fluoroscopic exposure [8]. Moreover one hypothesis that due to different geometry of plade compared to threaded tip screw the plade behave differently under load; this potentially resulted in medial perforation and axial cut-out when inserted too closed to subcondral bone, [9]. Other study shows that Gamma nail had increased risk of complications and reoperation with no significant difference in functional outcome [10]. Zhang et al. [11] reported that the use of long intramedullary nail may not be better methods or provide more effective treatment for intertrochanteric fracture as it gives no advantages over the short nail but increases the operation time and more traumatizing. Intertrochanteric fracture fixation using an InterTAN nail (two screw proximal nail) lead to significant shorter hospital stay, and better function outcomes and less pain at six months compared to Gamma nail (one screw). These differences equilibrated at the five year final follow-up examination. The intramedullary nail used in this study was shot gamma nail (generation three) implant with one proximal lag screw.

Patient and Methods

45 adult patients with un-stable trochanteric fracture (AO/OTA type 31.A2-2 and 31.A2-3subtypes and 31.A3 fracture group) [12] were treated with intramedullary nail (short gamma nail generation three). Stable fracture pattern, open fractures, fractures with subtrochanteric extension and patients unfit for surgery were excluded from the study. Patients' age ranged from 50 years to 95 years with mean± SD=66±10.1 years and median=65years. Most of patients under the study were females 25 (62.5%) and 15 (37.5%) were males. Eleven (27.5%) of patients under the study had no comorbidities and most of who had comorbidities were suffering from diabetes and hypertension 10(25%), 6(15%) had only hypertension and the same number had diabetes, other patients had single comorbidities for each one (HCV, prostatic enlargement, Alzheimer, cardiac disease, peptic ulcer and old DVT). Thirty patients (75%) were osteoporotic and ten (25%) had good bone quality. Fractures were classified according to AO/ OTA classification to (type 31.A2-2(22.5%) and 31.A2-3(50%) subtypes and 31.A3 fracture group (27.5%).This prospective study was originally begun by forty five patients [13]. Five of them were lost during follow up (Three of them died within the first three months, due to unknown causes. The other two we lost contact with them after stitches removal). Routinely all patients in the study had preoperative assessment of level of activity using Parker mobility score [7]. Prophylaxis against DVT, IV fluids, pain control medications were prescribed.

Operative technique

Operation was done under spinal anesthesia, with the patient in the supine position on a traction table. Closed reduction was done under the control of an image intensifier on both views and maintained by traction. Anatomical reduction cannot be achieved by closed reduction in 5 cases, we used mini open anterior as lateral as we can to avoid neurovascular bundle and put instrument to reduce the displaced fragment (Figure 1). One case was not reduced by this technique so we used open reduction with the aid of bone reduction clamp to reduce the fracture. A 5 cm incision is made proximal to the greater trochanter, in line with the shaft, and the tip of the trochanter was entered using the canulated awel to gain access to the medullary canal then guide wire was inserted in to the medulla and the position was confirmed using imaging in the AP and Lat view (Figure 2). Remaining was done over the wire using consecutive reamers to prepare the canal to accommodate the nail (Figure 3). The nail was inserted over the guide wire using the hand force only. Two cases nail failed to advance adequately, imaging was used to detect the source of impingement, additional reaming was sufficient in one case while the other small implant was used. Lag screw guide was inserted under imaging and the position was checked in the AP and Lat views we aim to insert the guide wire in the central position in both views and stop about 5 mm from the articular surface (Figure 4) ream over the wire

by graduated Reamr to take the lag length with the help of x-ray. Insert the measured lag screw then the distal locking screw using guide system and finally the end cap (Figure 5). The wound was closed in layers. Operative time, imaging time, bleeding amount, any eventual technical difficulties as well as adverse events were recorded.

a) b) c)

Figure 1: a) X-ray shows displaced trochanteric fracture and valgus deformity. b) Image shows the use of artery forceps from mini open anteriorly to push the proximal fragment to reduce the displacement. c) X-ray shows reduction of displacement.

Figure 2: Skin incision and awel insertion.

Figure 3: Show consecutive reamers by image and x-ray.

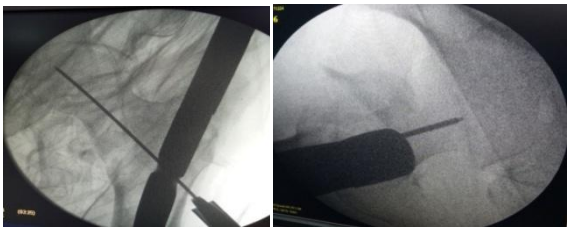

Figure 4: X-rays show position of guide pin in AP and Lat. Views.

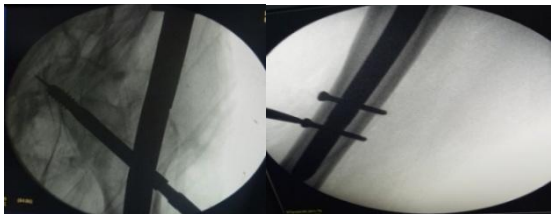

Figure 5: Lag screw and distal locking screws insertion.

Post-operative care

After the operation was finished, all patients were transmitted to the ward where the following protocol was followed:

i. Intra venous broad spectrum antibiotic was given to all patients for 3days and then shifted to oral one.

ii. Low molecular weight heparin was given to all patients and started 12-24 hours postoperative and continued for 14 days postoperative as prophylaxis against DVT & PE.

iii. Postoperative hemoglobin (Hb).

iv. Mobilization: patients started one day to three days after operation to actively move their hips and knees and were mobilized when tolerated using walker or crutches. Partial weight bearing was delayed to 4 weeks in all patients.

v. Discharge from the hospital: all patients were discharged from the hospital on oral broad spectrum antibiotic for 5 days and low molecular weight heparin for 14 days.

Follow up protocol: All patients were followed up in the outpatient clinic as follow:

a. After 2 weeks the wound was examined and the sutures were removed.
b. After 6weeks x-ray was done and mobilization was encouraged.
c. After 3 months x-ray was done to check the union, weight bearing ability was assessed and range of motion was examined.
d. After 6 months x-ray was done to check union and complications, Parker mobility score was calculated to all cases and any complications were assessed and analyzed.
e. After 12 months x-ray was done to check any complications, Parker mobility score was calculated to all cases and any complications were assessed and analyzed.

Radiological evaluation: X-ray was mandatory immediate postoperative, at 6 weeks, 3 months, 6 months and one year postoperatively , by doing anteroposterior view of pelvis and lateral view of the operated hip.

The immediate postoperative images were then assessed for varus or valgus angulation on anteroposterior radiograph and apex anterior or posterior angulation on the lateral radiograph. We then further classified the reduction as good, acceptable, or poor according to Baumgaertner et al. [14] According to Baumgeartner grading of fracture reduction half of patients were good, 16 patients (40%) were accepted and only 4 (10%) were poor. The TAD in most of cases was between 20 to 30 mm, the entry point was from the tip of greater trochanter and the position of screw was in the central position in both AP and Lat views (Figure 6-8).

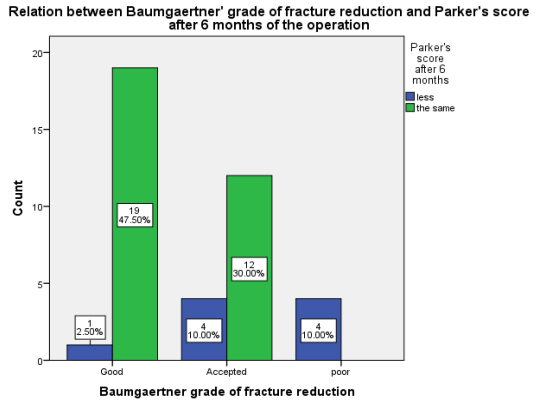

Figure 6: Relation between Baumgaertner grade of fracture reduction and parker's score after 6 months of the operation.

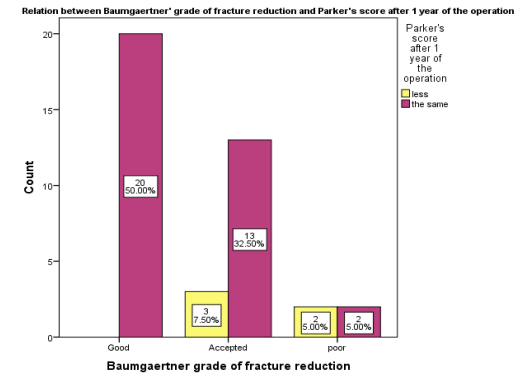

Figure 7: Relation between Baumgaertner grade of fracture reduction and parker's score after 1 year of the operation.

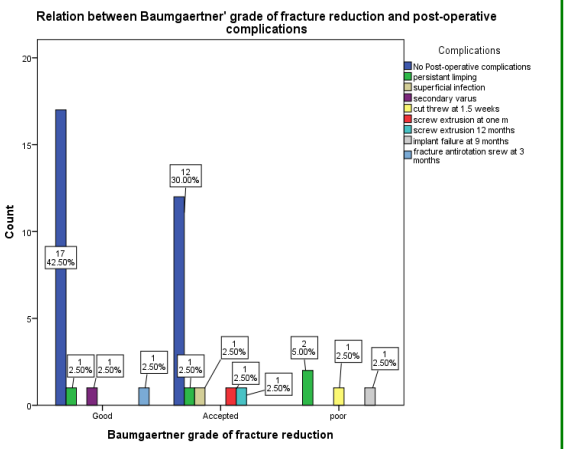

Figure 8: Relation between Baumgaertner grade of fracture reduction and post-operative complications.

Clinical evaluation

After union the visits were scheduled, 3 months, 6 months, and 12 months. Walking, pain and hip function were evaluated at each visit, and the Parker Mobility Score (PMS) [7] at 6 and 12 month was recorded and compared with that recorded preoperative.

Results

This study was conducted on 40 patients from 2/2016 to 2/2018.All cases were done in the same week. The mean time of surgery was 57.8±12.3min and the mean time of radiology exposure was 96.8±31sec. 5 cases (12.5%) had difficult intra operatives reduction, 2case (5%) had fracture lateral cortex and most cases 33 (82.5%) had no intraoperative complications. The mean blood loss to all cases was 148 cc. The mean time of full weight

bearing was 9.3±2.1 weeks and time of radiological full union was 10.9±1.6 weeks. Most of patients under the study kept the same range of motion 34 (85%) and according to Parker mobility score 77.5% of patients kept the same score after 6 months of surgery compared to pre-operative score which increase to 87.5% after one year. The complicated cases represent 27.5% ranging from superficial infections in 7.5 % to implant failure in one case (2.5%), while screw extrusion was encountered in 2 patients at 3 and 6 months, 4 cases (10%) had limping without an obvious cause and one case had secondary varus.

Baumgaertner's score of fracture reduction was highly significant related to Parker score at 6 months (P-value **<0.001*** and chi square=17.3) and 12 months (P-value **=0.01*** and chi square=9.2).

Baumgaertner grade is the only predictor (determinant) of early full weight bearing (less than 10 weeks) (P-value=0.018) and it was associated with age, position of lag screw and absence of intraoperative complications in determining of early full union (p-value 0.03).

There was a highly significant relation between post-operative complications and Baumgeartner grade of reduction (P-value **=0.004*** and chi square=34.9).

Discussion

The most noteworthy finding of the current study is that it recommends routine use of intramedullary nail in treatment of all unstable intertrochanteric fractures after anatomical reduction. The use of DHS in the treatment of unstable trochanteric fractures was associated with high rate of complications, this give chance for the use of intramedullary nails and its popularity. The previous generations of intramedullary nail was associated with high rate of intra-operative and late diaphyseal femoral fractures, this was explained by large diameter of the nail and absence of anteroposterior bowing. The new generation of the nail with small diameter decreases this complication [15].

The most important advantages in intramedullary nail are early active hip and knee exercises, early partial weight bearing and early union [15]. In our study the mean time of active hip and knee exercises was 4 days ranging from 2 to 14 days and the mean time of weight bearing partial and complete was 5.9 weeks and 9,3 week respectively , while full union was achieved from 8 to 14 weeks (mean 10.9+_1.6 w). It was 10.3+_3 weeks according to Soucanye et al. [16]. Several studies report good postoperative outcomes in pertrochanteric fractures treated with intramedullary nailing. Paul et al. [17] described satisfactory functional outcomes in their study of 58 patients that underwent trochanteric entry nailing. Fogagnolo et al. [18] reported that proximal femoral nailing was adequate for the operative treatment of unstable proximal femur fractures with only 2 % patients in that study demonstrating postoperative loss of reduction with varus collapse. Giessauf et al. [15] reported good or excellent results in 67 % of patients in their review of 62 patients. These are comparable with this study as 77.5% had excellent Parker mobility score (the same as pre-trauma PMS) at 6 months that improved to 87.5% at one year and 85% of patients regain their previous range of motion. According to meta-analysis by zhue et al. [19] comparing DHS and intramedullary nail in treatment of 909 patients of unstable intertrochanteric fractures from six randomized control studies.

The results showed that the IMN group was associated with less blood loss, leg length discrepancy, wound infections, hospital stay after operation and time of partial weight bearing with aids and also had Parker mobility score more than other group. No significant difference was seen in other parameter included operative details, fracture fixations complications, postoperative complications and one year mortality. On the other hand the meta-analysis of Li et al. [20] which published in the same year conclude that there were no obvious discrepancies founded regard adverse effect, operative time, blood loss, and hospital stay between intramedullary and extramedullary fixation of unstable trochanteric fracture. However there was increased body of evidence to indicate that unstable trochanteric fracture best treated by intramedullary nail. The review article by Kregor et al. [21] published in 2014 concluded that: "Failure rate of treatment of unstable trochanteric fracture with a DHS are too high to recommend its use". The complicated cases represent 27.5% which was higher than reported. This may be explained by the wide range of our definition to complications. The complicated cases ranging from superficial infections in 7.5 % to implant failure in one case (2.5%), while screw extrusion was encountered in 2 patients at 3 and 6 months, 4 cases (10%) had limping without an obvious cause and one case had secondary varus. The infected cases were treated by repeated dressing and antibiotic.

The two cases with extruded lag were treated conservatively till full union then removed. The cases with limping and secondary varus keeping the function of walking and two of them improved after physiotherapy. Reoperation was only encountered in the case of implant failure and treated by prosthetic replacement. Complications were highly significant related to anatomical reduction, most of Patients with no postoperative complications had a good **Baumgaertner's** score of fracture reduction 17 (42.5%) and only one case who had persistent limping 1 (2.5%) and another one who had secondary varus (2.5%) but still these two cases are

keeping the function of walk. Good anatomical reduction according to Baumgeartener grading had statistically significance on clinical outcomes and postoperative complications. Our study had a number of limitations. The small number of cases, relative short time of follow up and the gamma nail device was not compared to other internal fixation systems. However good follow up and focusing on anatomical reduction as a single most important factor in determining of outcomes and complications is our strong points.

Conclusion

Our results recommend the use of intramedullary nail in the treatment of unstable trochanteric fracture after anatomical reduction.

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