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Comparative Study of Gamma Nail versus Dynamic Hip Screw in Treatment of Unstable Proximal Femoral Fracture

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Abstract

The second leading cause of hospitalization among older individuals is hip fracture. We aimed to compare between Gamma nail and dynamic hip screw (DHS) in treating unstable proximal femoral fractures, regarding operative time, intra-operative blood loss, radiological exposure, union time and functional outcome. This prospective randomized clinical study was performed on sixty cases with unstable proximal femoral fractures. They were treated with internal fixation, either by a gamma nail, or by a DHS. The patients were randomly allocated into 2 groups; the cases in Group 1 were treated with gamma nail, and the cases in group 2 were treated with DHS. Mechanism of injury intraoperative blood loss, time of surgery, duration of surgery, irradiation exposure, time of union and complication rate were assessed. In group I, we didn't have any case complicated with lag screw cut out. The lag screw position in the AP view was central in 21 cases, inferior in 5 cases, and superior in 4 cases. In the lateral view, it was central in 12 cases, posterior in 16 cases, and anterior in 2 cases. In group II, we did not have lag screw cut-out in 26 cases. In these cases, the position of the lag screw in the AP view was central in 17 cases, inferior in 7 cases, and superior in 2 cases. In the lateral view, it was central in 14 cases, posterior in 10 cases, and anterior in 2 cases. Greater than 1 cm. No malrotation, late union, or non-union has been seen clinically. While enabling early mobility and weight bearing, the gamma nail also provides biological indirect reduction, better functional results, and significantly fewer complications than DHS.

Keywords: intertrochanteric fracture; gamma nail; dynamic hip screw; unstable; elderly

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1. Introduction

Inter-trochanteric fractures are prevalent among the elderly. A simple fall causes ninety percent of trochanteric fractures in older people. Age-related increases in incidence were exponential, doubling every six years. Decreased physical activity, which adds to the bone loss, is the cause of this increase [1]. The conventional therapy for patients should consist of rigid fixation followed by early mobility; this substantially improves the patient's capacity to walk upon hospital discharge and facilitates a more rapid return to daily activities [2]. Intramedullary or extra medullary fixation are frequently used to treat trochanteric fractures nowadays. Surgical options include reduction and internal fixation with intramedullary fixation devices, dynamic condylar screws, and dynamic hip screws (DHS) [3]. The occurrence rate of proximal femoral fractures in females is two to three times greater than in males [4]. Sub-trochanteric fractures of the proximal femur are those that occur in the region between the isthmus of the femur and the lesser trochanter. A plethora of intra-and extra-medullary devices have been proposed for the surgical fixing of sub-trochanteric fractures, but the optimal implant for internal fixation remains a matter of debate [5]. We aimed to compare between Gamma nail and DHS in treating unstable proximal femoral fractures, regarding operative time, intra-operative blood loss, radiological exposure, union time and functional outcome.

2. Materials and Methods

This prospective randomized clinical study was done on sixty cases with unstable proximal femoral fractures. The study received ethical approval, and informed consent was obtained from all patients studied. Inclusion criteria, any patient with unstable trochanteric or sub trochanteric fracture, more than 50 years old, and isolated hip fractures. Exclusion criteria, any patient who is less than 50 years old, fractures in a poly-traumatized patient, Patients with prior injuries involving the ipsilateral hip or femur, Medical co-morbidities (e.g., restrictive or obstructive lung diseases, heart disease) that can increase the patient's surgical risk.

2.1. Randomization

They were treated with internal fixation, either by a gamma nail, or by a DHS. The patients were randomly allocated into 2 groups; the cases in Group 1 were treated with gamma nail, and the cases in group 2 were treated with DHS. Cases with unstable proximal femoral fractures were prospective randomized into two treatment groups either GAMMA nail or DHS. Patients were randomly assigned to either GAMM nail or DHS by a sealed envelope. Baseline characteristics as age, sex, Mechanism of injury intraoperative blood loss, time of surgery, duration of surgery, irradiation exposure, time of union and complication rate were assessed. All patients enrolled in the study were informed the type of the study and by the type of procedure, possible complications, consent was signed. Detailed medical history, General examination for head, chest, abdomen, and other injuries, Assessment of vascular status of affected limb, and Motor and sensory examinations were done to exclude associated nerve injury. Evaluating the soft tissue envelope appropriately regarding swelling, skin bullae, abrasions, and wounds was also performed. A lateral and anterior-posterior radiographic examination of the femur, illustrative of the knee and hip joints were done. Routine preoperative laboratory investigations were performed. Singh's approach was employed to evaluate the condition of the trabecular bone in the proximal femur. Fracture classification: Boyd and Griffin's approach, as modified by Kyle et al., was utilised to classify fracture patterns [6].

2.2. Operative techniques

Spinal anesthesia was given in accordance with the overall state of the patient and the preference of the anesthesiologist. The patient was positioned supine on a fracture table, with both lower extremities supported by foot holders, for the most effective execution of the operation. Ipsilateral to the groin, a cushioned perineal post was positioned, taking care to avoid impingement on the labia or scrotum. By applying modest longitudinal tension while the leg was externally rotated, then internally rotated, the fracture was reduced. In order to make room for C-arm image intensifier, the uninvolved leg was then flexed, abducted, and externally rotated. Also, an alternative approach involved extending the hip and knee while abducting the contralateral extremity; this modification, meanwhile, exerted more pressure on the perineum due to the perineal post. The fracture should be reduced or be reducible before preparation and draping the patient. Biplanar non-obstructive radiography viewing of the whole proximal femur, including the hip joint, should be facilitated by the image intensifier. A posterior sag or residual varus angulation may render centering the lag screw in the head and neck of the femur difficult. Malalignment of the varus is often corrected by disengaging the fracture fragments with more longitudinal traction, then re-reducing the fracture. Posterior sag is usually the result of posterior comminution and requires manual correction with upward pressure applied to the buttock. Pressure must be reapplied during each passage of the instrument across the fracture to prevent jamming of the instrument on the guide-pin. To ascertain if the fracture fragments are in motion as a unified entity, the lower extremity is rotated under fluoroscopic control after reduction. Excessive internal rotation of the leg should be avoided in individuals whose femoral shaft motion is independent from the proximal fragment. We position the lower extremity in neutral rotation in such cases. The patient is draped after the reduction of the fracture. Technique of gamma nail (group I) 3 to 8 cm incision is made proximal to the greater trochanter, in line with the shaft, and the tip of the trochanter is entered using an awl to gain access to the medullary canal. Entry portal location and guide pin insertion. Position the tissue protector containing the guide pin centering sleeve such that it contacts the greater trochanter's medial apex. The 3.2mm guide pin is introduced 2-3 cm into the greater trochanter through the guide pin centering sleeve, with the canal centred in the AP and ML views. The nail is advanced into the fracture by hand alone, as it passes over the guiding rod. Nail entry should always be effortless. To ascertain the origin of the impingement if the nail fails to progress enough, employ bi-planar imaging of the fracture zone and the nail tip.

2.3. Technique of DHS (group II)

A 3.2mm drill hole is created at the level of the lesser trochanter in the lateral cortex of the proximal femur. Following this, a guide wire is introduced while the image is intensified utilising the 135° guide. Adjustments are made to the guide wire until it is centred between the head and neck of the femur; a slightly postero-inferior position also is acceptable. The estimation of the tip apex can be achieved by employing an image intensifier subsequent to the guide-pin installation but before to the drilling and insertion of the screw. Surgeons must have clear lateral and antero-posterior views of the image intensifier in order to confidently determine the distance between the tip of the guiding pin and the apex of the femoral head. In general, the tip apex distance will be less than 25 millimetres if the distance from the guiding pin to the apex looks to be less than one and one and a half times the length of the threaded section of the pin from both views. Directly read the length of the pin within the bone by passing the direct measurement instrument over the guiding pin. In order to optimise screw and barrel interaction, the screw length is selected to permit an approximate 5 mm of impaction. Reaming is performed under image intensification over the guide wire to 5 mm from the sub-chondral bone. It is important to monitor the location of the guide wire during the reaming process in order to identify any binding that may occur within the reamer and potentially lead to penetration of the femoral-head. The DHS triple reamer provides 3 functions in 1 operation: reaming for the plate; for the screw; and for the plate barrel junction. Even in senior individuals, the proximal femur is tapped to avoid femoral head rotation during the insertion of the lag-screw. A coupling screw, a guide shaft, and a hip screw must be assembled before to inserting the screw into bone. To accomplish this, insert the coupling screw into the hip screw via the hollow guide shaft. Interdigitation is required between the ridge and slot of the guiding shaft and the screw. Initially, the longer centering sleeve is threaded using the wrench. It should be noted that the distal portion of the lag screw fits well into the wrench end and is grooved exactly into the plate barrel. Then, the guide shaft, assembled coupling screw, and selected screw are threaded into the wrench and this assembly is then slipped over the guiding pin, followed by the insertion of the centering sleeve into the predrilled hole. The screw is inserted into the femoral neck by the rotation of the wrench until the zero mark aligns with the lateral cortex. At the conclusion of the screw insertion, the T-handle of the wrench must be parallel or perpendicular to the femoral shaft; otherwise, the DHS plate will not lie in alignment with the shaft.

2.4. Post-operative care

A reduction was deemed good when the fracture displacement was below 4mm, the AP view revealed normal or minor valgus alignment, and the lateral view revealed less than 20 degrees of angulation. The reduction was deemed acceptable if either the displacement or alignment conditions were fulfilled, but not both. When both criteria were not fulfilled, the reduction was deemed poor. Patients were given postoperative prophylactic low-molecular weight heparin and parenteral antibiotics (fourth generation cephalosporin: Cefipime 1 gm twice daily) for 72 hours. Patients are permitted to engage in weight bearing and mobility as soon as they are able to do so while using a walker. Cases were discharged by the fifth day from the hospital and attended the outpatient clinic on a biweekly basis for the initial two months, and subsequently on a monthly basis for the next four months. At each appointment, the patients had clinical and radiological examinations. Weight bearing was permitted four to six weeks following the operation. During the clinical examination, pain, range of motion, and walking abilities were assessed. X rays were checked for the lag screw position, fracture fragment position, union, malunion or fixation failure. Average follow up was 12 months.

3. Results and discussion

The patients in the study group included thirty-six females, and twenty-four males. The average age was sixty-five years (range: from sixty to seventy years). The duration of follow up averaged six months (range: from five to eight months). The mean age in group I was 68 years where in group II, it was 65.9 years. There were 16 males and 14 females in group I. In group II, there were 10 males and 20 females. The average follows up for the group I ranged from 5 to 8 months. For group II, the average follow up ranged from 5 to 7 months. There was an insignificant difference between both groups as regard co morbidities. (P value = 0.065 – clinically insignificant difference). A clinically significant variation was reported in the position of the lag screw between patients complicated with cut-out and those without cut-out. (P= 0.048). Table (1) A clinically significant variation was reported in the TAD of the lag screw between both groups. (P Value= 0.001). In group II, A clinically significant variation was reported in the TAD of the lag screw between patients complicated with cut-out and those without cut-out. (P Value= 0.035). Table (2) Regarding walking ability; in group I, there were 17 cases with good walking ability, 6 cases were walking with an aid, 5 cases were not able of walking, and 2 cases dropped off during follow-up. In group II, there were 16 cases with good walking ability, 5 cases were walking with an aid, 6 cases were not able of walking, and 3 cases dropped off during follow-up. (P value=0.021 – clinically significant difference). Table (3). Gamma Nail group had significantly more Flexion, External rotation, Internal rotation, Abduction, Adduction compared to DHS group. Extension was significantly different between both groups. Table (4). No. of re operation was significantly different between both groups. (P value=0.043 – clinically significant difference). Table (5).

3.1. Case presentation

3.1.1. Case presentation of group I

Case (1)

Male patient, 72 years old, fell to the ground while in home, and developed right sided unstable trochanteric fracture. Figure (1) He had no co morbidity. The operative duration was 75 minutes. The estimated blood loss was 300 ml, and didn’t need blood transfusion. The number of C-arm images was 42. The estimated time for union was 5 months. The patient was able to fully bear weight 6 months after operation. The postoperative walking ability was good. Figure (2-4).

3.1.2. Case presentation of group II

Case (1)

Female patient, 68 years old, fell to the ground while in home, and developed left sided unstable trochanteric fracture. Figure (5) she had no co morbidity. The operative time was 55 minutes. The estimated blood loss was 800 ml, and needed transfusion of 1 unit of packed RBCs. The number of C-arm images was 39. The estimated time for union was 5 months. The patient was able to fully bear weight 6 months after operation. The preoperative walking ability was good. The postoperative walking ability was good. Figure (6-7). The management of unstable fractures is challenging due to the substantial mechanical strains experienced in the proximal femur. Enhancing functional outcomes while ensuring and maintaining stable fixation is the objective of all fracture fixations. Most frequently, the DHS was employed for trochanteric fractures stabilization [7]. However, failure rates and complications were reported such as lag screw cut-out through the head and neck, limb shortening, varus collapse and, rarely, lateral pulling out of the side plate [8]. Complications suspected to be implant-design-related have been documented despite the utilisation of gamma nails. Due to postoperative complications such as subsequent shaft fractures in addition to the absence of scientific data supporting intramedullary vs extramedullary procedure, the implant's use has been the subject of extensive dispute. However, various alternatives to this implant have been developed on the basis of the same principle—antegrade intramedullary nailing [9]. Hao et al. [10], studied 24 active-comparative researches involving 3097 cases. They reported that DHS had a relatively longer operation duration (average 85 minutes range from 70to 100minutes) than GAMMA nail (average 65 minutes range from 55 to 75 minutes)(P value 1.00).

Table 1. Distribution of patients of group II according to lag screw position

DHS group		cut out				P value
		yes		NO		
		Count	%	Count	%	
Position of lag screw Antero-posterior view	**Central**	4	100.0%	17	65.4%	0.048
	Inferior	0	0.0%	7	26.9%	
	Superior	0	0.0%	2	7.7%	
Position of lag screw Lateral view	**Central**	0	0.0%	14	53.8%	0.004
	Posterior	1	25.0%	10	38.5%	
	Anterior	3	75.0%	2	7.7%	

Table 2. Comparison of patients of both group according to TAD

	Gamma Nail group				DHS group				P value
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
TAD 1n mm	19.91	3.65	10.80	24.60	24.25	4.27	16.00	35.20	< 0.001

Table 3. Comparison of patients of both groups according to walking ability

		Group I		Group II		P value
		Count	%	Count	%	
Walking ability	**Walking**	17	56.7%	16	53.3%	0.021
	walking with aid	6	20.0%	5	16.7%	
	Not walking	5	16.7%	6	20.0%	
	Lost - dead	2	6.7%	3	10.0%	

Table 4. Comparison of patients of both groups according to range of motion

	Gamma Nail group		DHS group		
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**	**P value**
Flexion	91.40	26.80	76.97	29.57	0.050
Extension	6.87	2.85	4.97	1.77	0.083
External rotation	25.07	7.66	22.63	7.80	0.028
Internal rotation	19.23	6.24	17.30	6.17	0.032
Abduction	24.40	7.29	22.47	7.57	0.031
Adduction	17.07	4.96	15.47	5.35	0.035

Table 5. Comparison of patients of both groups according to re-operations

		Group I		Group II		P value
		Count	**%**	**Count**	**%**	
No. of re operation	**No**	25	83.3%	26	86.7%	0.043
	1st	3	10.0%	4	13.3%	
	2nd	2	6.7%	0	0.0%	

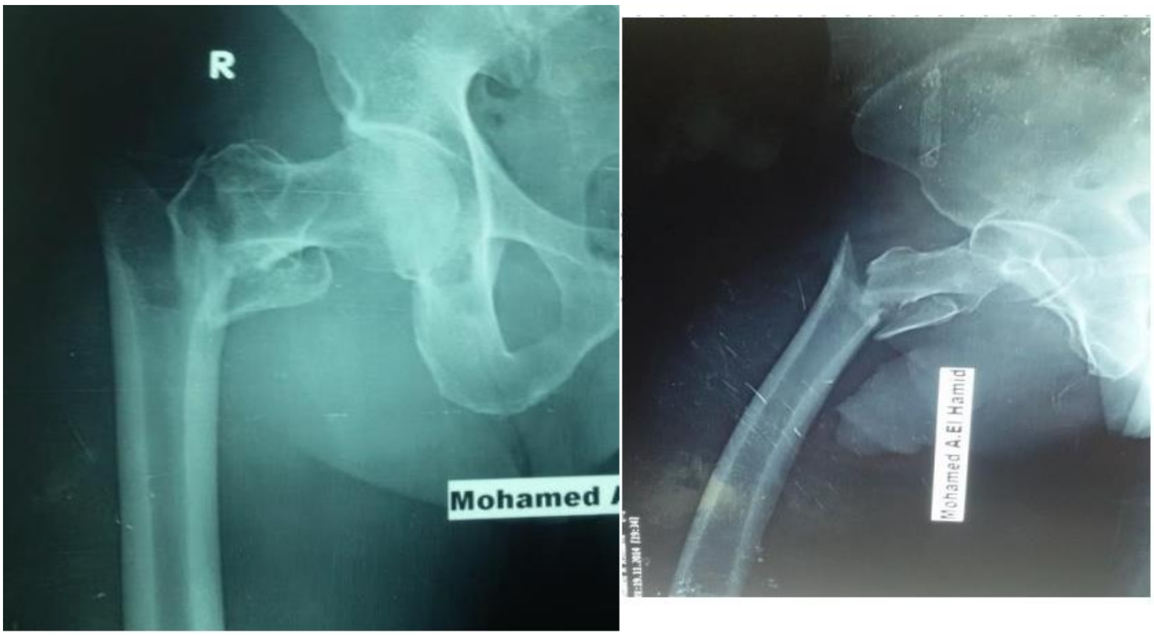

Figure 1. Preoperative x-ray

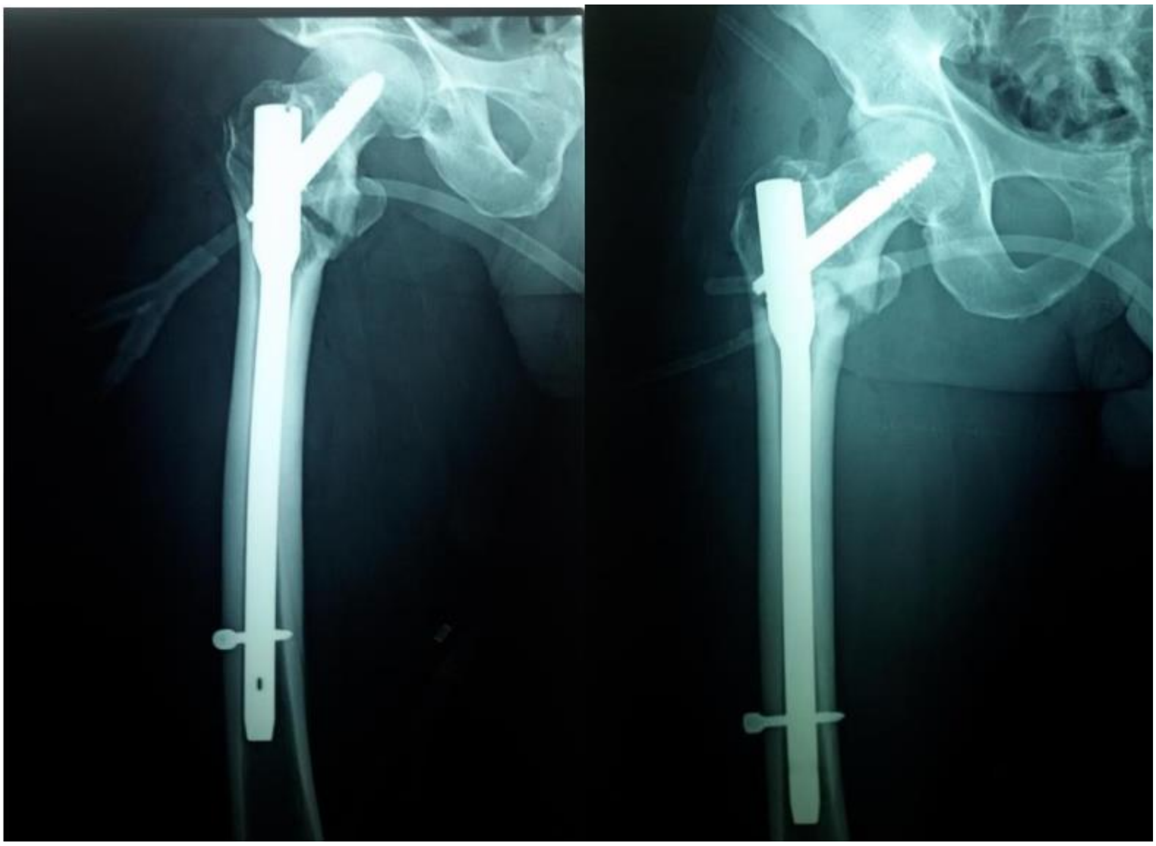

Figure 2. Immediate postoperative x-rays, showing the TAD= 18 mm

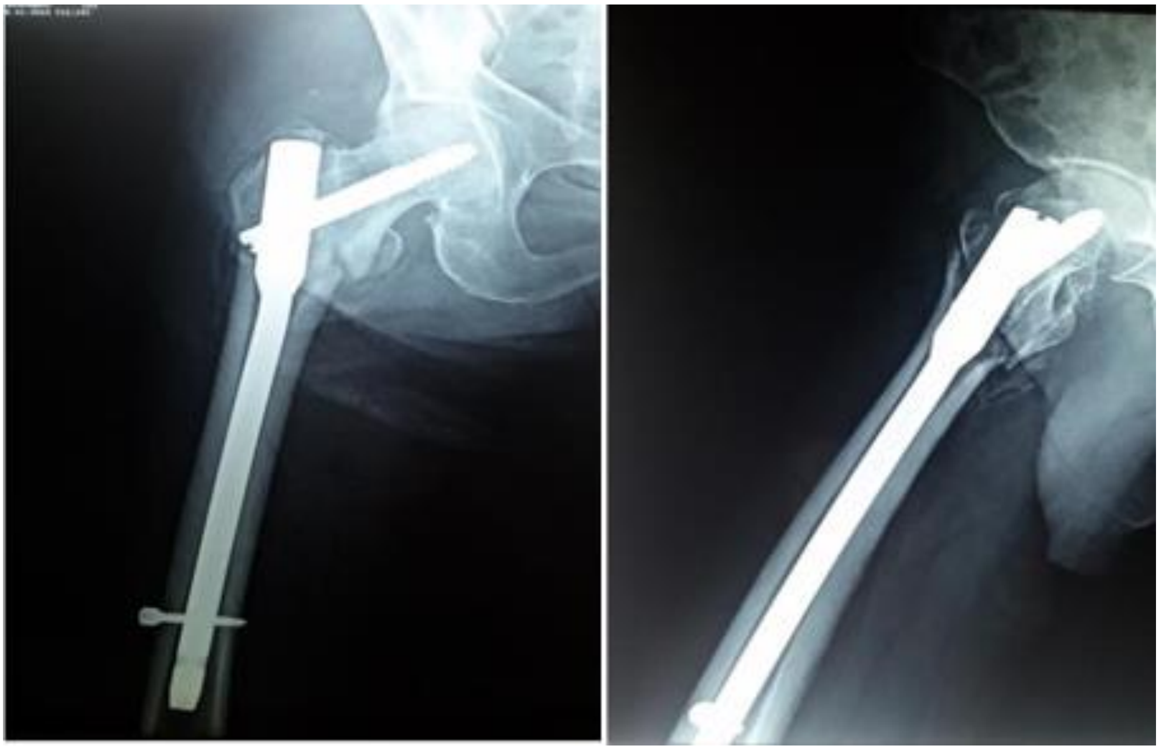

Figure 3. Follow up x-rays: after 1 month

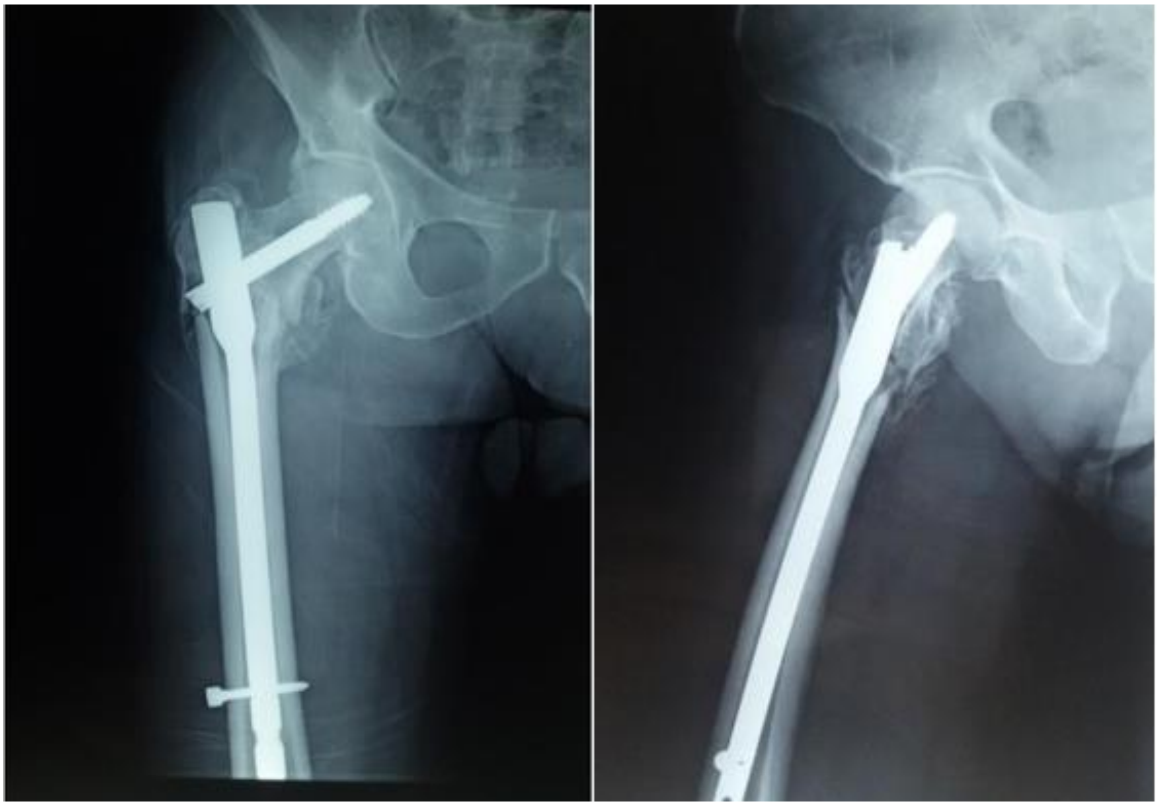

Figure 4. Follow up x-rays: after 5 months

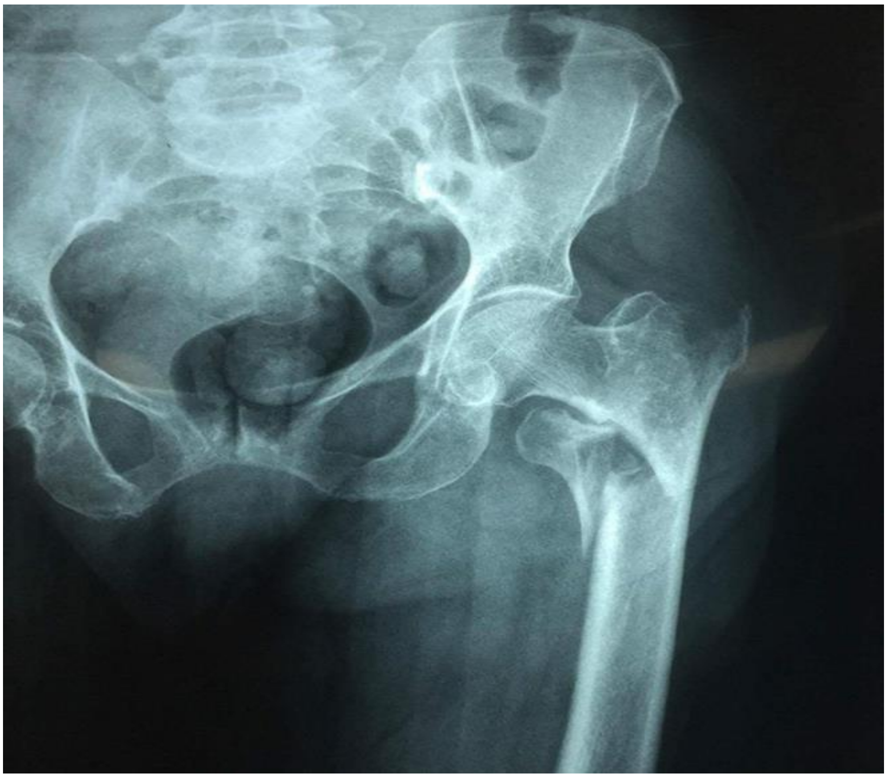

Figure 5. Pre-operative x-ray

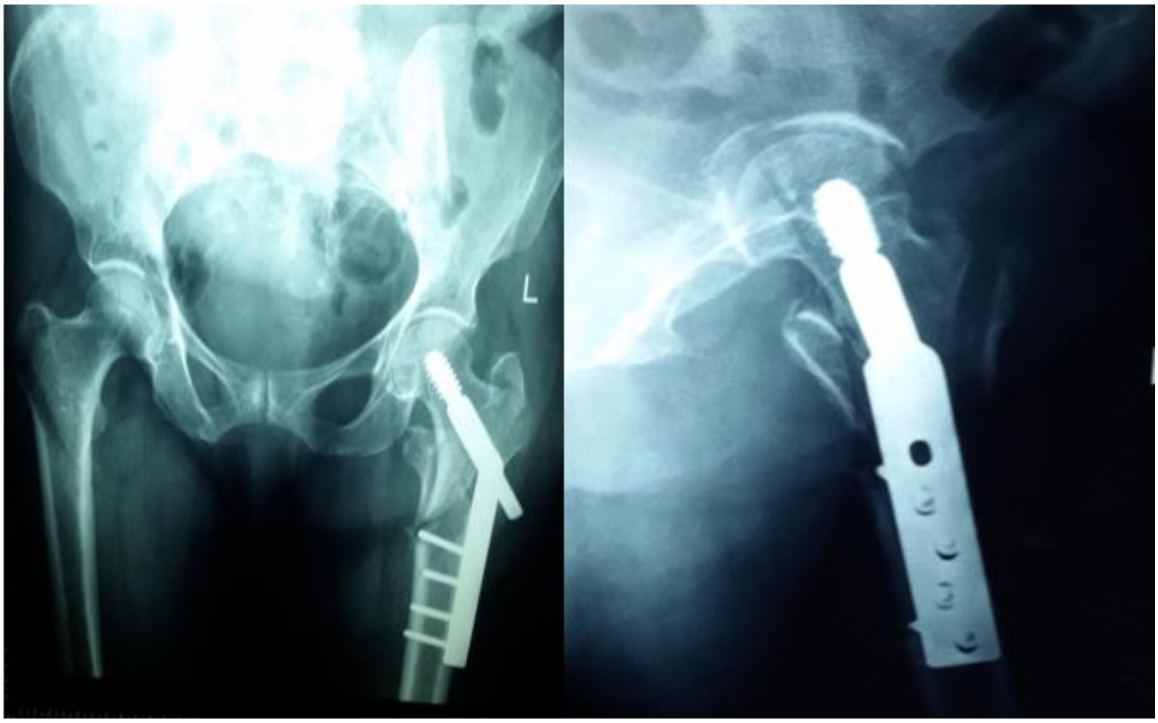

Figure 6. Postoperative x-ray

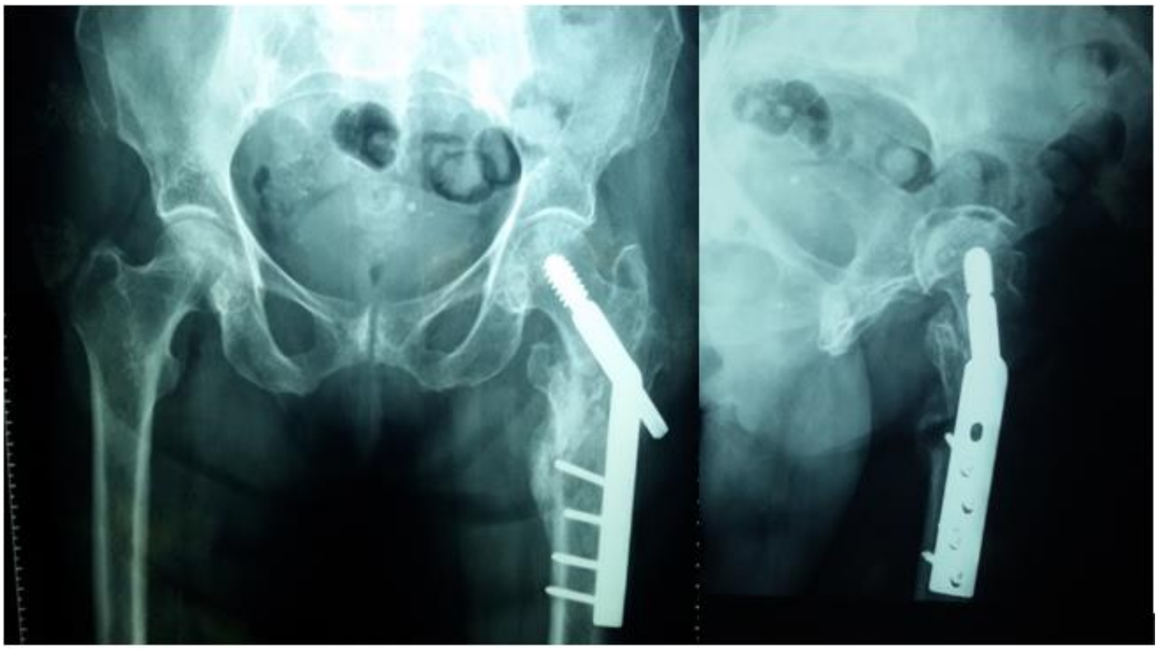

Figure 7. Follow up x-rays: after 5 months

In our study, we compared gamma nail to DHS in treating unstable proximal femoral fractures. In the study, the operative time for the Gamma nail average 60 minutes (ranged from 50 to 75 minutes), and for the DHS was 55 minutes (ranged from 50 to 60 minutes). (P value= 0.010 – clinically significant difference). The difference in operative time duration for Gamma nail insertion between our study and the study of Hao et al. [10], is mainly due to applying a relatively new technique and the initiation of a learning curve. By time, we were able to insert GAMMA nails in shorter operative times. Between 2005 and 2010, Matre et al. [11] utilized information from the Norwegian Hip Fracture Register for 7643 procedures. The 1-year reoperation rate for patients treated with GN (4.2%) was found to be significantly higher (p = 0.001) compared to those treated with DHSs (2.4%). The reoperation rates for IM nails were 7.1% at the 3-year mark, whereas for SHSs they were 4.5%. (p=0.001) Variation in the causes for reoperation and the degree of complications may occur between implant groups. Reoperations due to fractures surrounding the implant and local discomfort emanating from the implant were more prevalent among patients in the GN group. Aside from that, there were no discrepancies in the causes for reoperation between the two groups, suggesting that the incidence of mild and major complications was comparable in both. Although the frequency of most types of reoperations was higher in the IM nail group, "implant removal" was the only significant finding. In the study, the complication and reoperation rates were less in the GAMMA nail group, which is clinically significant different from results of Kjell Matre et al. [11]. There is no significant statistical difference between the GAMMA nail and DHS in terms of wound infection rate, mortality rate, percentage of patients who are able to walk independently following rehabilitation, or re-operation rate for fracture fixation failure according to Ming Liu et al. [12]. Although the GAMMA nail has a shorter period of operation, it has a larger risk of postoperative femoral shaft fracture. The probability of postoperative femoral shaft fracture was definitively found to be larger in the GAMMA nail group compared to the DHS group. Based on the findings, they concluded that DHS fixation is a more reliable and secure method compared to GAMMA nail fixation in terms of postoperative complications. Consequently, they proposed that DHS fixation be the initial choice when treating per trochanteric fractures. In the study, we didn't have postoperative or intra-operative femur fractures. The mean duration to union in group I (GAMMA nail) was 5.97 month (range: 5 to 8 months), while it was 5.07 months in group II (DHS) (range: 5 to 7 months). (P value = 0.065 – clinically insignificant difference). According to the findings of Pajarinenet et al. [13], femoral neck shortening may result from fracture impaction in individuals who are treated with a DHS. Furthermore, the significant compression that takes place may impede the recovery of walking functionality. In contrast to the utilisation of a DHS, this data indicates that the application of GN may yield superior function restoration in trochanteric fractures. In the study, regarding walking ability; in group I (GAMMA nail), there were 17 cases with good walking ability, 6 cases were walking with an aid, 5 cases were not able of walking, and 2 cases dropped off during follow-up. In the study, group II (DHS), there were 16 cases with good walking ability, 5 cases were walking with an aid, 6 cases were not able of walking, and 3 cases dropped off during follow-up. (P value=0.021 – clinically significant difference). Functional result was not significantly impacted by the statement that the GN is more rigid and permits full weight bearing earlier than the DHS, even in cases of extremely complex fractures, or that DHS fixation needs more extensive surgery than GN fixation. Conversely, the DHS group had superior walking ability as measured by the change as compared to the pre-operative state [14]. In the study, results of walking ability were similar to results of Pajarinenet et al. [13] that when comparing trochanteric fractures treated with GN to DHS, the former may result in a more robust restoration of function. YZ XU et al. [15] compared the outcomes of 55 cases treated with DHS to 51 cases treated with GN. They observed that individuals treated with PFNA experienced a higher rate of walking ability restoration than those treated with DHS. Despite the fact that all fractures in both groups had fused by the one-year follow-up in this research, patients who had PFNA treatment exhibited much more mobility compared to those who underwent DHS. In addition, six months following surgery, 67.5% of patients in the GN group had resumed their prior level of walking activity, in comparison to 44.2% in the DHS group. In our study, regarding walking ability results were better in GAMMA nail than DHS which were similar to results of YZ XU et al. [15]. Regarding the strength of our research, we assert that it extended our understanding of the significance of functional outcome evaluation in relation to the use of gamma nails or DHS to repair unstable trochanteric fractures. We assessed our patients by many aspects for evaluation of the functional outcome, as; walking ability and return to ore-fracture activity range of motion, radiological assessment of stability of fixation.

3.2. Limitations

First, a limited number of patients were included in the study. Second, the range of follow-up lasted from six to eight months, which is relatively brief period. Our study recommends that a more comprehensive study than ours, with a larger number of patients, be recommended to assess the functional outcome of fixation of the unstable trochanteric fractures with gamma nails or DHS. Extended lengths of follow-up are required in order to evaluate the long-term effects. Recommendation for further addressing functional outcome of fixation of the unstable trochanteric fractures with gamma nails or DHS.

4. Conclusions

While enabling early mobility and weight bearing, the gamma nail also provides biological indirect reduction, better functional results, and significantly fewer complications than DHS, especially in unstable trochanteric fractures among elderly with osteoporosis.

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