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Original Research Article

A prospective study of iatrogenic lateral wall fracture (ILWF) in intertrochanteric (IT) fracture femur patients, treated with dynamic hip screw (DHS) and its effect on stability of fracture

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ABSTRACT

Intertrochanteric fractures accounts for nearly more than half of the fractures involving the proximal femur and the hip joint. This type of fracture is fairly common among the older strata of the population, due to the reduction of the skeletal mass and osteoporosis characteristically seen as age advances. There are a number of devices/implants that can be used for internal fixation of these fractures among them the Dynamic Hip Screw (DHS) with sliding plate is one such device.

The lateral wall of the proximal femoral region plays a key role in the stability of this fracture. The intact wall stabilizes the fracture. Thus a high level of attention and precaution should be taken to preserve the lateral wall during this procedure. In cases of iatrogenic lateral wall fractures, that happens intra operatively, the plan of the surgery changes as the presence of the lateral wall is vital for the stability and proper functioning of this device.

This study deals with measuring circumference of the proximal femoral shaft and checking for the presence of the iatrogenic lateral wall fracture post operatively and to check if the occurrence can be predicted thus avoiding surgeries with the DHS device thus preventing disastrous complications.

1. Introduction

Intertrochanteric fractures accounts for nearly more than half of the fractures involving the proximal femur and the hip joint. This type of fracture is fairly common among the older strata of the population, due to the reduction of the skeletal mass and osteoporosis characteristically seen as age advances. In such people it can be precipitated by a simple fall or trivial trauma.

In younger healthy individuals this type of fracture morphology is commonly produced by some kind of violent injury such as a vehicular accident or a fall from height. In general the frequencies of these fractures have increased to a great fold due to the increased life span and the lifestyle being sedentary.

As compared to the Western World hip fractures of the hip in Indians present at an earlier age peaking in the sixties.[1] This is most probably due to a shorter life span. 34% of Indian women in the postmenopausal group, aged below 60 years were found to be osteoporotic[2] Intertrochanteric fractures if left untreated lead to significant change in the quality of life of the individual. Due to the location of the fracture in the weight bearing region of the body the individual tends to remain immobile for a prolonged amount of time, which further leads to consequences and complications which further deteriorates the condition of the individual and thereby raises the morbidity and in due course, mortality.

Union of these types of fractures occurs readily due to the wide and broad surfaces of the involved are and the presence of adequate blood supply. Hence very rarely do they go into nonunion. But the ideal and proper union of

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these is premeditated on the fact that immobilization of the affected limb is maintained Hence fixation of these fractures are imperative to ensure early mobilization and reduce the morbidity and thereby improving the quality of life of the individual.

There are a number of devices/implants that can be used for internal fixation of these fractures among them the Sliding Hip Screw (SHS) also known as the Dynamic Hip Screw (DHS) with sliding plate is one such device. Historically it is one of the mostly commonly used implants for the fixation of this fracture. It uses the principle of controlled collapse of the proximal fragment thereby maintaining the bone-bone apposition maintaining the stability and thereby promoting union.

The lateral wall of the proximal femoral region plays a key role in the stability of this fracture. The intact wall stabilizes the fracture. Thus a high level of attention and precaution should be taken to preserve the lateral wall during this procedure.

In cases of iatrogenic lateral wall fractures, that happens intra operatively, the plan of the surgery changes as the presence of the lateral wall is vital for the stability and proper functioning of this device.

2. Aims

To study Iatrogenic Lateral wall fracture (ILWF) in intertrochanteric fracture femur patients, treated with Dynamic hip screw (DHS) and its effect on stability of fracture.

3. Objectives

1. To study about ILWF in inter trochanteric fracture femur patients.
2. Effect on stability of patients treated with DHS who developed ILWF.
3. If the occurrence of ILWF can be predicted.

4. Materials and Methods

The cases for this study were collected from patients who were admitted in the Orthopaedics wards who were diagnosed with intertrochanteric fractures. 30 such cases were selected from August 2018 to October 2020.

The patients and their relatives were explained about the condition of the patient and informed consent was obtained along with all details of the patients. Along with the standard routine investigations required for the pre anaesthetic checkup a preoperative X-ray and CT scan of the pelvis and bilateral hip joints was done. This is done to rule out the presence of any lateral wall fracture before the procedure.

The parameters that were recorded initially include age/sex, side of fracture, type of fracture according to AO/OTA system. AO/OTA 31 A1 and 31 A2 were selected for this study. A measurement of the circumference of the proximal femoral shaft was taken at the level of the lesser trochanter. These observations were tabulated. Medical comorbidities were addressed simultaneously.

They were performed under regional or general anaesthesia on a fracture table after a closed reduction of the fracture under an image intensifier (IITV) control. Iatrogenic fracture of the lateral wall was identified intra-operatively on the operating table. This was also confirmed post-operatively using X-rays and CT, done on day 3.

The duration taken to return to weight bearing with assistance and duration for full weight bearing along with the pain score was also noted and tabulated. All investigations and procedures were done only because they were clinically indicated. No specific or additional investigation were be done for the purpose of study. Most of the investigations/procedures were done free of cost or at the minimal possible rate. All investigation/procedure/implant which were indicated clinically were borne by the patient as per hospitals policy.

4.1. Inclusion criteria

1. Patients with intertrochanteric fracture (AO/OTA 31A1, A2 and A3) femur who are operated using the Dynamic Hip Screw (DHS).

4.2. Exclusion criteria

1. Inter trochanteric with subtrochanteric extension laterally
2. Open fractures
3. Pathological fracture
4. Preoperative lateral wall fractures

4.3. Preoperative

Patients who were admitted with intertrochanteric fractures were examined and their X-rays of the pelvis bone and hip joints were obtained and classified according to the AO/OTA classification. A preoperative CT scan of bilateral hip joints with proximal femur region is obtained, to rule out the presence of lateral wall fracture preoperatively.

The level of the lesser trochanter is confirmed in sagittal and coronal cut sections of the preoperative CT scan on virtual reality software. At this point a transverse section is taken and the circumference of the femoral shaft using a freehand ruler is measured and tabulated. The software used was picture archiving and communication system (PACS).

Injectable painkillers, for example Tramadol, Diclofenac which were available in the hospital were used for pain relief. Routine haematological parameters and Echocardiography was done as per the cardiologists' opinion if required. Pre Anaesthetic checkup was done for all the cases and 2nd generation cephalosporin were administered intravenously 30 minutes before the surgery.

4.4. Intraoperative

Anaesthesia: Appropriate anaesthesia given.

4.4.1. Patient positioning

A fracture table with the perineal post in place is used. The C-arm unit should be on the contra lateral side or between the legs of the patient.

4.4.2. Reduction

It is obtained with traction and internal rotation. Once optimum reduction is obtained it is confirmed using the C-arm (fluoroscopy) unit.

4.5. Exposure

Adequate draping is done and the lateral portion of proximal femur is prepared for the incision. Incision is taken at the vastus ridge and carried on dismally as per the length of the implant being used. The dissection is continued through the ITB until the vastus lateralis fascia is reached, which is then split longitudinally. The vastus lateral is lifted anteriorly from the lateral inter muscular septum.

4.6. Stabilization

Guide pin is inserted midway between anterior and posterior proximal femoral cortices laterally. It is made sure that the joint isn't penetrated. Triple reamer which is set at 5 mm shorter than the length of the pin is used which is followed by reaming. The length of the lag screw is same as that of the measure of the triple reamer and is inserted using a wrench. The Tip Apex Distance was checked in AP and Lateral c-arm shoots. The sum should be <25mm to minimize the risk of cutout of the lag screw. A 130/135 degrees barrel plate is slid onto the lateral surface of the femur. The plate is fixed using bicortical screws. The traction is released and the compression screw is inserted. Final images checked on the c-arm unit (fluoroscopy). Thorough washing of the wound is done and the wound is closed in layers and aseptic dressing done using sterile dressing material.

4.7. Postoperative

Postoperative check X-rays are obtained. Postoperative CT scan was obtained on day 3 postoperatively to check for the presence of iatrogenic lateral wall fracture Partial assisted bearing of weight using a walker was encouraged from immediate postoperative period and full weight bearing from day 5-7 both done as per the pain and convenience of the patient. The duration for weight bearing (in days) and the pain score (Visual analogue scoring system was used). These results were then tabulated.

Fig. 1: Showing the localization of the level of lesser trochanter in the CT scans (from left to right: transverse, coronal and sagittal sections) on the unaffected side

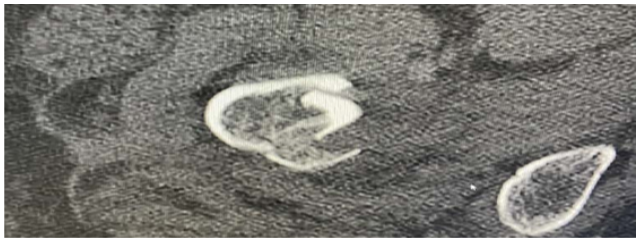

Fig. 2: Showing the fracture site seen in transverse section at the level of the lesser Trochanter

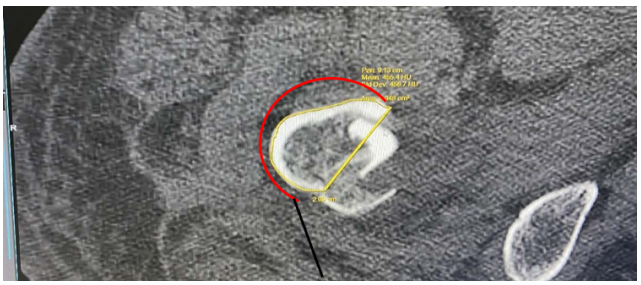

Fig. 3: Showing the measure of the circumference at the fracture site (shown in red)

5. Results

The Table 1 shows the mean distribution of age groups of individuals in the study. This study shows that the mean age of the people in whom this kind of fractures are common i.e. age groups between 60 and 70.

Table 1: Age distribution

Age groups (years)	Number	Percentage
≤60 years	7	23.3
>60 years	23	76.7
Mean age	67.4 years	-
Median Age	69 years	-
Minimum	39 years	-
Maximum	81 years	-
Total	30	100.0

The Table 2 shows the distribution of the Singh Index (which grades osteoporosis) of the individuals involved in

the study. There's a predominance Grade III (46.7% of the total) in the subjects.

Table 2: Singh index

Singh Index	Number	Percentage
GRADE I	2	6.7
GRADE II	4	13.3
GRADE III	14	46.7
GRADE IV	6	20.0
GRADE V	3	10.0
GRADE VI	1	3.3
Total	30	100.0

The Table 3 describes the incidence of iatrogenic lateral wall fractures (ILWF) in the postoperative computed tomography (CT) scan. We see that among the 30 patients studied 6 have developed this kind of a fracture (20%).

Table 3: ILWF in post-op CT

ILWF in Post-op CT	Number	Percentage
Yes	6	20.0
No	24	80.0
Total	30	100.0

This Table 4 deals with the mean pain score and its comparison to the presence of the fracture in the postoperative CT scan. It shows that the individuals who didn't develop an ILWF, on an average, had a lower pain score (VAS) as compared to the individuals who developed the fracture postoperatively. With a P value of <0.001 (using the independent t-test) the result is highly significant.

Table 4: Pain score (Vas) to start weight bearing and IlWF in post-op CT

ILWF in Post-op CT	Number	Mean	SD	P value
No	24	4.4	1.2	<0.001
Yes	6	7.5	0.5	

Independent t-test, p value- Highly significant

This Table 5 deals with the duration to full weight bearing of the individual and its comparison to the presence of the fracture in the postoperative CT scan. It shows that the individuals who didn't develop an ILWF, on an average, started weight bearing earlier as compared to the individuals who developed the fracture postoperatively. With a P value of <0.001 (using the independent t-test) the result is highly significant.

This Table 9 shows the presence of ILWF with respect to a specific circumference (i.e. 8.47 cms, below this circumference an ILWF occurs)

6. Discussion

In the fixation of per trochanteric fractures with a sliding hip screw, a vital role is played by the lateral wall and thus ensuring the continuity of the lateral part of the proximal femoral wall is of prime importance. This was stressed by Gotfried.[3]

There is an 8 fold increase in the need for a resurgery when there is a lateral wall fracture when sliding hip screw was used as an implant, as proved by Palm et al.[4]

Palm et al.[4] proposed that it is mandatory to subdivide intertrochanteric fractures into the following two subtypes, which are, A1 to A2.1 and A2.2 to A3, as the line of management changes according to the stability of the fractures. But because of the presence of large amounts of intra and inter observer bias the classification is not simple, especially between A2.1 and A2.2 pattern of fracture.[5] Palm et al.,[4] in his study, concluded that fracture types A2.2 – 2.3 are vulnerable to a lateral wall fracture. They suggested that stable intertrochanteric fractures like A1 - A2.1 should be stabilized with Sliding hip screw with a side plate and more unstable fractures like those seen in types A2.2 - A3 should be stabilized using a SHS attached to an intramedullary implant.

A study was conducted by Langford which compared the occurrence of perioperative lateral wall fracture in IT fractures when fixed with DHS as to those fixed by percutaneous compression plate. They came to the conclusion that in cases of intertrochanteric fracture, which have a very thin lateral proximal femoral wall, the DHS isn't the ideal device for fixation.[6] He, in his study found that almost one third of the A2 type of fractures had a lateral proximal femoral wall fracture when fixed with Dynamic Hip Screw (DHS)

Throughout the years, there have been multiple definitions for the term 'thin lateral wall', but it is still ambiguous.

In a retrospective study conducted by Hsu et al.,[7] he described the technique to measure the thickness of lateral wall. He defined it as the measure of the distance (mm), between a reference landmark, situated 3cm distal to the greater trochanteric tubercle, to the line of the fracture at an angle of 135 degrees on anteroposterior x-rays. He stated this measurement as a reliable predictor of the thickness of the lateral wall. But this technique had fallacies namely, the degree of rotation changes the thickness measured on the x-ray and that this thickness also includes the lateral cortex.

Although avoidable, an ILWF is a devastating complication related to the fixation of the DHS with the plate. A lot of these type of IT fractures can be fixed with DHS as it is easier available and cheaper as compared to the proximal femoral nail.[8] If this complication can be predicted pre operatively, the plan of management can be changed well before hand.

Table 5: Full weight bearing (in days) and ILWF in post-op CT

ILWF in Post-op CT	Number	Mean	SD	P value
No	24	7.0	1.6	<0.001
Yes	6	43.5	1.04	

Independent t-test, p value- Highly significant

Table 6: AO/OTA classification and ILWF in post-op CT:

AO/OTA Classification	ILWF in Post-op CT-NO		ILWF in Post-op CT-YES	
	n	%	n	%
31A12	10	41.7	0	0.0
31A13	7	29.2	0	0.0
31A22	7	29.2	1	16.7
31A23	0	0.0	5	83.3
Total	24	100.0	6	100.0

Chi square p value=<0.001 (Significant)

Table 7: Evans classification and ILWF in Post-op C

Evans classification	ILWF in Post-op CT NO		ILWF in Post-op CT YES	
	n	%	n	%
1A	5	20.8	0	0
1B	5	20.8	0	0
1D	14	58.3	1	16.7
1E	0	0	5	83.3
Total	24	100.0	6	100.0

Chi square p value=<0.001 (Significant)

Table 8: Circumference of the proximal femoral shaft (at the level of LT) in the pre-op CT scan and the presence of ILWF in the post op CT

Circumference at the level of LT	ILWF in Post-op CT-NO		ILWF in Post-op CT-YES	
	n	%	n	%
6-7 cms	0	0	2	6.67
7-8 cms	0	0	2	6.67
8-9 cms	5	16.67	2	6.67
9-10 cms	11	36.67	0	0
10-11 cms	8	26.67	0	0

Table 9: Circumference of the proximal femoral shaft (at the level of LT) in the preop CT scan and the presence of ILWF in the post op CT

Circumference at the level of LT	Presence of ILWF in the post op Ct scan	Number of patients
Below 8.50 cms (< 8.50 cms)	Yes	6
Above 8.50 (>8.50 cms)	No	24
Total		30

We, in our study, have used a measurement of the circumference at the level of the Lesser Trochanter. We have found a cut off value of 8.50cms. Measurements below this have shown the presence of an iatrogenic lateral wall fracture (ILWF) when fixed with a Dynamic Hip Screw (DHS). Although a large scale study is required to prove this result strongly, we can conclude that cases with circumference measures of less than 8.50cms should be preferably fixed with another lateral wall stabilizing implant or IM nail. Thus we can roughly say our study helps in predicting the occurrence of an iatrogenic lateral wall fracture preoperatively.

Our study also shows a direct link between iatrogenic lateral wall fracture (ILWF) and the delay in full weight bearing. Due to the presence of the lateral wall fracture the average pain score of these patients is also higher and this pain leads to a delay in weight bearing. (Mean score was 4.4/10 for normal individuals while it was 7.5/10 for the individuals with an ILWF). With an independent t-test, p value of <0.001 this was found to be highly significant statistically.

We discovered that, as to their normal counterparts, individuals with iatrogenic lateral fractures returned to weight bearing at a later date. Mean value for normal individuals was 7 days while it was 43.5 days for those with ILWF. With an independent t-test, p value of <0.001 this was found to be highly significant statistically.

This study shows the presence of iatrogenic lateral wall fracture (ILWF) in 6 of the 30 patients involved in the study. This is close to the result found by Langford in his study.[6] This study with a Chi square p value=<0.001, which is significant has shown that for more complex and unstable fractures, when using the AO/OTA and the Evans classification, the DHS isn't an ideal implant as there is an increased risk of ILWF.

We found the presence of ILWF in 1/7 cases with AO/OTA classification of 31A22 and all the cases (5/5) with classification of 31A23. Similarly, when classified according to Evans classification we discovered that 1/14 cases of type 1D and all 1E (5/5) developed an ILWF. On the basis of this we can conclude that Dynamic Hip Screw (DHS) wouldn't be an ideal implant in such cases which involves an unstable fracture.

In the study there is no established link between the Singh Index for osteoporosis and the presence of iatrogenic lateral wall fracture but, most of the ILWF cases (5/6), in this study, have been seen in lower grades of Singh index (i.e. Grades I and II) and one case with a Singh Index of Grade III. This correlation needs to be studied in detail because there is, in general, an increased low bone density prevalence in India.[9] Also as fractures due to osteoporosis is more common in Indians as to the western population[10] this needs consideration.

Literature has proved [3, 4 and 7] that a very poor outcome should be expected in cases of lateral wall fractures. It leads to a variety of associated problems namely, complete loss of reduction, medialization of the shaft, disruption of the abductor lever arm and most importantly, poor ability to move and start weight bearing. This study has not shown the final outcome of these fractures as it basically dealt with predicting this complication pre operatively

7. Conclusion

Based on the findings of this study it appears that intertrochanteric fractures in which the circumference of the proximal femoral shaft, at the level of the lesser trochanter, is less than 8.50cm (<8.50cms), a lateral wall fracture should be expected if it is planned to be operated using a Dynamic Hip Screw (DHS) as an implant. And DHS should be avoided in complex and unstable intertrochanteric fractures as the propensity of it leading to an iatrogenic lateral wall fractures is very high.

8. Source of Funding

None.

9. Conflict of Interest

The authors declare that there is no conflict of interest.

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