

To Determine the Prevalence of Heterotopic Ossification around Trochanter and its Relation to Complexity of Diaphyseal Femur Fracture after Reamed Intramedullary Interlock Nailing

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ABSTRACT

Introduction: Pathological bone formation into soft tissues around the hip is known as heterotopic ossification. Osteogenic debris deposited while reaming the femur is postulated mechanism. This pathological bone formation may be linked to aggressive tissue handling during operation. The complex femoral diaphyseal fractures are difficult to reduce and this increases the probability of aggressive tissue handling by operating surgeon. So we postulated that complex fractures of femoral diaphysis may possess an increased risk of heterotopic ossification.

Material and Methods: Present retrospective study was done on 45 patients in whom intramedullary interlocking nail was done during the period of 2015 to 2017 at Rohilkhand Medical College. All fractures were diaphyseal in location. All surgeries were done by single orthopaedic surgeon. No preventive measures for heterotopic ossification were given. Evidence of heterotopic ossification around trochanter and their relation with the type of fracture were noted and classified according to Brumback Classification.

Results: We found no ossification in 51% of cases. Mild grade-1 and 2 ossifications were seen in only 36% and 11% patients respectively. Maximum number of grade-2 ossifications (4 out of 5) were seen in patients with comminuted fracture group. Grade-3 ossification was seen in only 1 patient of our sample and that was comminuted fracture. We have not encountered any grade-4 ossification.

Conclusion: The overall incidence of heterotopic ossification in our study sample was 49%. More severe grade ossifications (grade-2 and 3) have more predilection towards comminuted fracture variant.

Keywords: Heterotopic Ossification, Comminuted Fracture.

INTRODUCTION

Pathological bone formation in soft tissues where it is not meant to be physiologically is known as heterotopic ossification.¹ It has been postulated that osteogenic debris during reaming of intra medullary shaft femur fracture can be deposited into soft tissues around hip. Later on it forms pathological bone into soft tissues.¹⁰ Mostly this ossification is very low grade and small in size and causes no problem clinically. At other times it may be so large that it can cause the ankylosis of hip.² This pathological bone formation may be linked to aggressive tissue handling during operation. As the pattern of femoral shaft fracture becomes complex its reduction takes more time and consequently surgical time is enhanced. The surgeon may struggle in reduction of these complex variants and subconsciously the chances of

aggressive tissue handling is increased. So we postulated that complex fractures of femoral diaphysis may possess an increased risk of heterotopic ossification around trochanter. Since the consequences like ankylosis of hip may be grave if there is grade 4 ossification, it is also important to understand the actual prevalence of heterotopic ossification and its related factors.

There are some local and some systemic predisposing factors for heterotopic bone formation. Head injury³, spinal cord injury⁴, prolonged intubation, high injury severity score⁵ are some systemic factors. Local factors include-extensive soft tissue dissection, improper washing, severe local soft tissue injury.

Previous studies on heterotopic ossification had reported the incidence as high as 68%.^{5,6,9} Some studies reported the complication as very mild and has minimal effect on range of motion of hip.^{5,8} We also found that there is limited data to understand the prevalence of heterotopic ossification after closed antegrade intramedullary nailing of diaphyseal femur fractures in relation to the complexity of fracture pattern.

So we conducted this retrograde study to determine the prevalence of heterotopic ossification around trochanter after closed antegrade intra medullary nailing of diaphyseal femur fractures and to find the relation, if any, with complexity of fracture pattern.

MATERIAL AND METHODS

A retrospective study was done on 45 patients in whom antegrade (Pyriformis fossa entry) intramedullary femur interlocking nail was done during the period of 2015 to 2017 at Rohilkhand Medical College and Hospital. All fractures

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were diaphyseal in location (5 cm distal to lesser trochanter till 5 cm proximal to adductor tubercle). There were no intertrochanteric and distal femur fractures. All surgeries were done by single experienced orthopaedic surgeon. 1 litre of normal saline was used to irrigate the operative wound after completion of surgery. The duration of surgery was noted from skin incision to skin closure. Routine post operative follow up protocol was done. No preventive measures for heterotopic ossification like indomethacin or radiation were given. The Radiographs of the patients were evaluated from 1st post operative x ray upto 6 month after operation. Evidence of heterotopic ossification around trochanter and their relation with the type of fracture were noted and classified according to Brumback Classification:

Grade 0 - no evidence of heterotopic ossification

Grade 1 - minimal evidence (small nidus) of heterotopic ossification (< 1 cm)

Grade 2 - heterotopic ossification of 1- 2 cm in length

Grade 3 - Heterotopic ossification > 2 cm in length without extension to pelvis

Grade 4 - Severe heterotopic ossification with extension to pelvis (nearly complete ankylosis)

RESULTS

The data of 45 patients were available for analysis. There were 36 males and 9 females. Their mean age was 34 years (Range 16-65 yrs). Number of comminuted fractures were 20, Transverse 12, Butterfly 7, oblique 4, and spiral fractures were 2. Demographic data of the study population is presented in table-1.

Heterotopic ossification of grade 0 was seen in 23 patients, grade-1 was seen in 16 patients, grade-2 was seen in 5 patients, grade-3 was seen in 1 patient. No cases were seen of grade 4 variety (table-2).

Demographic data of patients (n=45)		
Age (years)	Mean Age	34 Years
	Range	16-65 Years
Gender	Male	36
	Female	9
Type of fracture	Comminuted	20
	Transverse	12
	Butterfly	7
	Oblique	4
	Spiral	2

Table-1

Classification of heterotopic ossification		
Grading of ossification	Number of Patients (Total 45)	Percentage of Total sample(45)
Grade—0	23	51%
Grade—1	16	36%
Grade—2	5	11%
Grade—3	1	2%
Grade—4	0	0%

Table-2:

We also evaluated the occurrence of heterotopic ossification in relation to the Type of Fracture. 16 (80%) out of 20 comminuted fracture patients suffered heterotopic ossification. Of these 16 patients, 11 are of grade 1 variety, 4 of grade 2 and 1 of grade 3 variety. Of 12 Transverse fractures only 2 (17%) patients suffered heterotopic ossification and all are grade 1 variety. In The 7 butterfly pattern group only 2 (29%) patients seen with heterotopic ossification. In these two patients, one is grade 1 and the other one is grade 2 variety. Of the 4 oblique fracture variants only 1

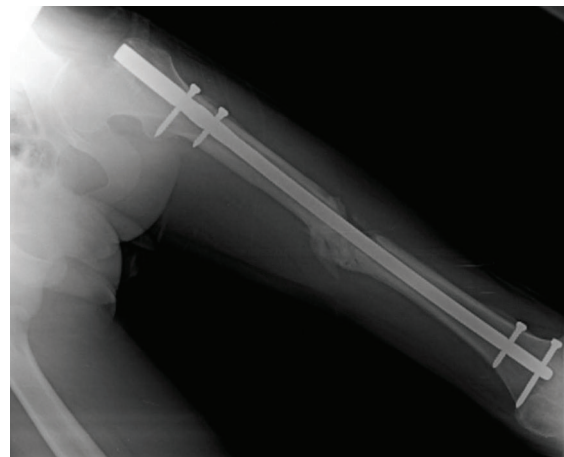


Figure-1: Grade-1 (less than 1 cm) Heterotopic Ossification



Figure-2: Grade-2 (1-2 cm) Heterotopic Ossification



Figure-3: Grade-3 (more than 2 cm) Heterotopic Ossification

Heterotopic Ossification Relative To Type of Fracture				
Type of Fracture	HO Present (Grade1+2+3)	Percentage of HO Present	HO Absent	Total
Comminuted	16 (11+4+1)	80%	4	20
Transverse	2 (2+0+0)	17%	10	12
Butterfly	2 (1+1+0)	29%	5	7
Oblique	1 (1+0+0)	25%	3	4
Spiral	1 (1+0+0)	50%	1	2
Total	22		23	45

Table-3

(25%) patient suffered heterotopic ossification of grade 1. In 2 patients with spiral fracture only 1 (50%) patient is seen with grade-1 heterotopic ossification. We found maximum number of heterotopic ossification seen in patients with comminuted fracture pattern. Transverse fracture pattern saw the least number of cases with heterotopic ossification. 50% of spiral fracture patterns suffered heterotopic ossification (table-3, figure-1,2,3).

DISCUSSION

In majority of the cases heterotopic ossification after intramedullary nailing of femur is asymptomatic. But grade 3 and grade 4 ossification can lead to significant functional limitations and even ankylosis of Hip.² The suggested mechanism of heterotopic ossification is osteogenic debris from femoral canal during reaming form osteoprogenitor cells into soft tissues around trochanter. These osteoprogenitor cells then differentiate into osteoblast which later on form calcified osteoid matrix and organised heterotopic bone.¹⁰ Various systemic and local factors has been linked to predispose the formation of heterotopic ossification. Brain injury³ and increased delay to surgery, high injury severity score (ISS)⁵ are established factors to predispose heterotopic ossification. Major hip surgery like total hip replacement^{1,8}, acetabular reconstruction, fixation of proximal femur fractures and intramedullary nailing of femur fractures^{5,6,9} are well known for incidence of postoperative heterotopic bone formation.

Comparison of heterotopic ossification after reamed and unreamed intramedullary nailing of femur was done by Furlong AJ et al. They found 35.7% incidence in reamed group vs 9.4% in unreamed group.⁷

The hypothesis that thorough irrigation of soft tissues around trochanter may have decreased incidence of heterotopic ossification was not supported by the study done by Brumback.⁶ They found no difference in incidence and severity of heterotopic ossification between the irrigated and control group.

Suthat Juengteerapanich¹⁷ described correlation of heterotopic ossification with respect to location of femur fractures and the implant used for femur fracture fixation. They found significant difference in the prevalence of heterotopic ossification after proximal femoral nailing of trochanteric fracture when compared to intramedullary nailing for femoral diaphyseal fractures (p-value <0.05)

To prevent the formation of heterotopic ossification, early

intervention within 24 hr is important. The strategy to prevent it, is use of indomethacin or meloxicam^{14,15}, limited field radiations (single dose 800 centigray)^{11,12} to the femur. Once the formation of heterotopic ossification begins these interventions have no effect. Surgical removal is considered when symptomatic but surgery should be delayed for about 6 month to permit maturation of ossification. This makes the dissection easy and removal of ossified bone less traumatic.¹⁶ This study shows that in 51% of cases there is no ossification. Mild grade-1 and grade-2 ossification was seen in only 36% and 11% patients respectively. Maximum number of grade-2 ossifications (4 out of 5) were seen in patients with comminuted fracture group. Again to emphasise that Grade-3 ossification was seen in only 1 patient of our sample and that too occurred in comminuted fracture group. We have not encountered any grade-4 ossification.

CONCLUSION

The overall incidence of heterotopic ossification in our study sample was 49%. More severe grade ossifications (grade-2 and grade-3) have more predilection towards comminuted fracture variants probably because these fractures takes more time and manipulation for reduction and are prone for more soft tissue trauma around proximal femur.

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