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.² 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 chance 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 heterotrophic ossification and its related factors.

There are some local and some systemic predisposing factors for heteropic bone formation. Head injury¹, spinal cord injury¹, prolonged intubation, high injury severity score³ 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%.⁴ Some studies reported the complication as very mild and has minimal effect on range of motion of hip.⁵ We also found that there is limited data to understand the prevalence of heterotopic ossification after closed antegrade intermedullary nailing of diaphysial 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 diaphysial 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 inter locking nail was done during the period of 2015 to 2017 at Rohilkhand Medical College and Hospital. All fractures 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.

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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).

### Table-1: Demographic data of patients (n=45)

| Age (years) | Mean Age | Range |
|-------------|----------|-------|
| Male        | 36       | 16-65 Years |
| Female      | 9        |       |

| Type of fracture | Number of Patients (Total 45) |
|------------------|-------------------------------|
| Comminuted       | 20                             |
| Transverse       | 12                             |
| Butterfly        | 7                              |
| Oblique          | 4                              |
| Spiral           | 2                              |

### Table-2: 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%                              |

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
(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 injury\(^1\) and increased delay to surgery, high injury severity score (ISS)\(^4\) are established factors to predispose heterotopic ossification. Major hip surgery like total hip replacement\(^13\), 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.\(^8\) They found no difference in incidence and severity of heterotopic ossification between the irrigated and control group.

Suthat Juengteerapanich\(^17\) 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)\(^16,17\) 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.

**REFERENCES**

1. Stoltny T, Koczy B, Wawrzynek W, Miszczyk L. Heterotopic ossification in patients after total hip replacement. Ortop Traumatol Rehabil 2007; 9:264-72.
2. Balboni TA, Gobeze R, Mamon HJ. Heterotopic ossification: pathophysiology, clinical features, and the role of radiotherapy for prophylaxis. Int J Radiate Oncol Biol Phys 2006; 65:1289-99
3. Garland DE, Blum CE, Waters RL. Periarticular heterotopic ossification in head injured adults. Incidence and location. J Bone Joint Surg Am 1980; 62: 1143-6.
4. Maier D. Heterotopic ossification spinal cord injury. Management through early diagnosis and therapy. Orthopade 2005;34:120, 122-7.
5. Marks PH, Paley D, Kellam JF. Heterotopic ossification around the hip with intramedullary nailing of the femur. J Trauma. 1988;28:1207-13.
6. Brumback RJ, Wells JD, Lakatos R, Poka A, Bathon GH, Burgess AR. Heterotopic ossification after the hip after intra-medullary nailing for fractures of the femur. J Bone Joint Surg Am 1990;72:1067-73.
7. Furlong AJ, Giannoudis PV, Smith RM. Heterotopic ossification: a comparison between reamed and

| 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**
unreamed femoral nailing. Injury. 1997;28: 9-14.
8. Brooker AF, Bowerman JW, Robinson RA, Riley LH Jr. Ectopic ossification following total hip replacement. Incidence and a method of classification. J Bone Joint Surg Am. 1973; 55(8):1629-32.
9. Steinberg GG, Hubbard C. Heterotopic ossification after femoral intramedullary nailing. J Orthop Trauma 1993; 7: 536-42.
10. Rumi MN, Deol GS, Singapuri KP, Pellegrini VD Jr. The origin of osteoprogenitor cells responsible for heterotopic ossification following hip surgery: an animal model in the rabbit. J Orthop Res 2005; 23: 34-40.
11. Andreu Martinez FJ, Martinez Mateu JM, Tormo Ferrero V. The role of radiotherapy for prevention of heterotopic ossification after major hip surgery. Clin Transl Oncol 2007; 9: 28-31.
12. Chao ST, Lee SY, Borden LS, Joyce MJ, Krebs VE, Suh JH. External beam radiation helps prevent heterotopic bone formation in patients with a history of heterotopic ossification. J Arthroplasty 2006; 21: 731-6.
13. Seegenschmiedt MH, Keilholz L, Martus P, Goldmann A, Wolfel R, Henning F, et al. Prevention of heterotopic ossification about the hip: final results of two randomized trials in 410 patients using either preoperative or postoperative radiation therapy. Int J Radiat Oncol Biol Phys 1997; 39: 161-71.
14. Legenstein R, Bosch P, Ungersbock A. Indomethacin versus meloxicam for prevention of heterotopic ossification after total hip arthroplasty. Arch Orthop Trauma Surg 2003; 123: 91-4.
15. Amstutz HC, Fowble VA, Schmalzried TP, Dorey FJ. Short-course indomethacin prevents heterotopic ossification in a high-risk population following total hip arthroplasty. J Arthroplasty 1997; 12: 126-32.
16. Van Ooij A, Van Kollenburg JA, Pons C, Walenkamp GH. Surgical removal of debilitating neurogenic heterotopic ossifications of the hip. Ned Tijdschr Geneeskd 2005; 149: 37-41.
17. Suthat Juengteerapanich, Pacharapol Udomkiat, Banchong Mahaisavariya. Heterotopic Ossification after Closed Femoral Nailing. J Med Assoc Thai 2012; 95: S99-S103

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