Heterotopic Ossification after Closed Femoral Nailing

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Background: *Heterotopic ossification is defined as pathological bone formation in soft tissue, it usually occurs postoperatively and varies in amount from faint to massive ossification, which are frequently asymptomatic. The cause of heterotopic ossification is unknown, but it occurs more commonly after the procedure, in which considerable bone and soft tissue are dissected extensively. The heterotopic ossification in the abductor region of the hip following closed femoral nailing has rarely been documented.*

Objective: *To assess the prevalence and type of heterotopic ossification after closed antegrade femoral nailing.*

Material and Method: *A retrospective study was performed in patients who underwent closed antegrade femoral nailing. The occurrence of heterotopic bone was assessed by reviewing of the series of the follow-up films in this group of patients with sufficient duration of at least after 6 months post-operation. The size and extent of the heterotopic ossification were measured and graded according to Brumback classification.*

Results: *From 100 patients who were completely followed-up. There were 54 cases (54%) presented with heterotopic ossification. The heterotopic ossification are classified as grade I in 16 cases (16%), grade II in 13 cases (13%), grade III in 24 cases (24%) and grade IV in 1 case (1%). There was a significant different between the prevelence of heterotopic ossification in patients with trochnateric fractures when compared to patients with femoral shaft fractures (p-value < 0.05).*

Keywords: *Ossification, Nailing, Femur, Fracture*

J Med Assoc Thai 2012; 95 (Suppl. 9): S99-S103
Full text. e-Journal: *http://jmat.mat.or.th*

Heterotopic ossification is defined as pathological bone formation in soft tissues, for example in muscles, where physiologically there is no osseous tissue present[1]. It usually occurs postoperatively and varies in amount from faint, indistinct density to massive ossification on radiographic findings. Heterotopic ossification is frequently asymptomatic, however when it is more severe, it typically manifests by the decrease in range of motion at a nearby joint[2]. The cause of heterotopic ossification is unknown, but it occurs more commonly after the procedure which considerable bone and soft tissue are dissected extensively. Factors predisposing in the formation of heterotopic ossification can be divided into local and systemic factors.

Systemic factors implicated in the formation of heterotopic ossification are head injury[3], spinal cord injury[4], prolong intubation, male sex, delay time from injury to surgery, high injury severity score (ISS)[5]. Local factors are including; soft tissue damage at gluteal region during reaming, osteogenic reaming debris. However, in the present study of Brumback[6] using pulsatile irrigation at surgical wound with 3 liters of normal saline solution to irrigate the reaming debris, the incidence and severity of heterotopic ossification were not different to the control group without irrigation. In the present study of Furlong[7] which compare between reamed and unreamed nailing also found no significant difference of the occurrence of the heterotopic ossification.

Although extensive heterotopic ossification may decrease the range of motion of the hip after total hip arthroplasty or fixation of acetabular fractures, heterotopic ossification after intramedullary nailing of the femur are mild to moderate degree which minimal effect on range of motion of the hip[5,8]. The heterotopic ossification in the abductor region of the hip following intramedullary nailing of femur has rarely been documented and may not be identified as the complication in many series but some studies defined as the complication of the procedure which has been previously reported as high as 68%[5,6,9].

The information of prevalence and severity of heterotopic ossification after closed femoral nailing

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has been very limited especially in Asian population. The authors therefore, conducted the present study to determine the prevalence and severity of heterotopic ossification at the entry point around the hip in patients underwent closed antegrade femoral nailing. This included patients with fractures of trochanter, subtrochanteric and femoral shaft fractures.

Material and Method

A retrospective study was performed in 155 patients who underwent closed antegrade femoral nailing between December 2002 and December 2004 by one senior staff at Siriraj Hospital. Radiographs during the follow-up time from early post-operation until at least 6 months post surgery were evaluated. The occurrence and the extent of the heterotopic ossification were assessed and were graded according to Brumback classification (5 grades, from 0-IV)[6].

Fifty-five of 155 patients were excluded from the present study because the radiographs of the hip were not available or sufficient for review due to the follow-up time was shorter than 6 months post surgery. Only 100 patients remained for the present study. All fractures were treated by closed antegrade femoral nailing with reaming. The heterotopic ossification was assessed from the series of radiographs at the time of follow-up with sufficient duration of more than 6 months post operation and most often until one year post operation. The time to union of the fracture in the present study group was between 4-8 months after injury. All heterotopic ossifications were classified to five grade according to Brumback classification[6]: grade 0-no evidence of heterotopic ossification, grade I-a small nidus of heterotopic ossification, not more than 1.0 centimeter in length, grade II-heterotopic ossification between 1.0 and 2.0 centimeters in length, grade III-heterotopic ossification more than 2.0 centimeters in length without extension to pelvis, grade IV-severe heterotopic ossification, with evidence of nearly complete or complete osseous ankylosis of the hip.

Results

There were 100 patients who were completely followed-up. There were 76 males and 24 females with average age of 38.6 years (range, 7-94). The locations of fracture were intertrochanteric in 18 (18%), subtrochanteric 15 (15%) and shaft of femur 67 (67%). The implants for fixation were Kuntscher nail 52 (52%), modified tibial nail 2 (2%), Grosse-Kempf nail 16 (16%), trochanteric gamma nail 21 (21%) and long gamma nail 9 (9%) (Table 1).

The heterotopic ossification were classified as grade 0 (none) 46 cases, grade I 16 cases, grade II 13 cases, grade III 24 cases, grade IV 1 case (Table 2). The prevalence of heterotopic ossification in relation to the sites of fractures and the implants being used are shown in Table 3, 4.

There was a positive correlation between the formation of heterotopic bone and the locations of the fracture when compared intertrochanteric fracture and

Table 1. Demographic data on the patients

Parameter	n = 100
Age (years)	
Mean	38.6
Range	7-94
Gender	
Male	76
Female	24
Male:Female ratio	3.16: 1
Fracture level	
Intertrochanteric	18
Subtrochanteric	15
Shaft of femur	67
Implant	
Kuntscher nail	52
Tibial nail	2
Grosse-Kempf nail	16
Trochanteric gamma nail	21
Long gamma nail	9

Table 2. Classification of heterotopic ossification

Ossification	n = 100
Grade 0	46
Grade I	16
Grade II	13
Grade III	24
Grade IV	1

Table 3. Heterotopic ossification (HO) relative to type of fracture

Type of fracture	Present HO	No HO	Total
Intertrochanteric	14	4	18
Subtrochanteric	10	5	15
Femoral shaft	30	37	67
Total	54	46	100

femoral shaft fracture (p-value < 0.05), but there was no correlation between the formation of heterotopic ossification and intertrochanteric fracture-subtrochanteric fracture, subtrochanteric-femoral shaft fracture. No significant difference was found for type of implant that was inserted.

Discussion

The term heterotopic ossification is different from myositis ossification that myositis ossification is occurred as a result of inflammation in muscle following trauma, result in amorphous deposit of calcium and necrotic tissue rather than true cartilage or new bone formation. The mechanism of heterotopic ossification had been proposed that primodial mesenchymal cell from femoral canal[10] was differentiated into osteoprogenitor cell then moderate into osteoblastic tissue and then osteoblast lay down and produced osteoid matrix and calcified to formed osteocyte and heterotopic bone. The mesenchymal cell may had hematopoitic origin from medullary canal and diffierentiated to osteoblast early as 16 hours after operation and peak response was approximately 32 hours.

The authors did not attempt to correlate the range of motion of the hip and the severity of

Table 4. Heterotopic ossification (HO) relative to type of implant

Type of implant	Present HO	No HO	Total
Kuntscher nail	23	29	52
Grosse-Kempf nail	6	10	16
Trochanteric gamma nail	16	5	21
Long gamma nail	7	2	9
Tibial nail	2	0	2
Total	54	46	100

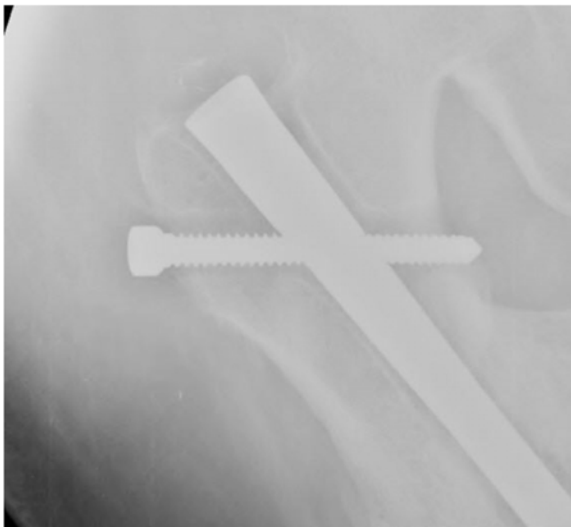

Fig. 2 Grade II 1.0 to 2.0 centrimeters of heterotopic ossification

Fig. 1 Grade I 1.0 centrmeter or less of heterotopic ossification

Fig. 3 Grade III more than 2.0 centrimeters of heterotopic ossification

Fig. 4 Grade IV nearly complete or complete osseous ankylosis of the hip

heterotopic ossification, because this has been done previously[5,8]. The heterotopic ossification must be severe to limit the range of motion and that mild to moderate amount of heterotopic ossification is compatible with excellent functional result.

However, prevention of heterotopic ossification may be important, removal of nail might be lessened if heterotopic ossification at the site of insertion could be prevented. The intervention to prevent formation of heterotopic ossification should be applied within 24 hours after surgical procedure. There were many strategies to prevention heterotopic ossification formation such as limited field radiation in a single dose 800 centigray[11,12], but there was the resent study compare pre- and post-operative radiotherapy that result equally effective to prevent heterotopic ossification[13]. Some medication as indomethacin, meloxicam can prevent the formation of heterotopic ossification[14,15]. All of these cannot change the quantity of heterotopic ossification once it had been fully formed. Surgical resection of heterotopic ossification can be considered but should delay for 6 months to permitted maturation of bone and easy dissection to distinct fibrous capsule[16].

The present study demonstrates the prevalence of heterotopic ossification was 54% (grade I- IV) and most were classified into grade I-II (29%) but usually asymptomatic and have no any disturbance to daily living. There was significant difference of prevalence of heterotopic ossification between cases underwent nailing of trochanteric fractures and cases underwent nailing of femoral shaft fracture (p-value < 0.05). This finding may suggest that nailing of trochanteric fractures with special trochanteric femoral nail may have certain predisposing effect for the formation of heterotopic ossification.

Conclusion

The overall incidence of heterotopic ossification after intramedullary nailing of femoral fracture is 54%. Almost half of the positive group was grade III (24%) and most severe grade (grade IV) was only 1%. There was significant difference of the prevalence of heterotopic ossification occurred after proximal femoral nailing of trochanteric fracture and femoral nailing for femoral shaft fractures (p-value < 0.05).

Potential conflicts of interest

None.

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การสร้างเนื้อกระดูกนอกโครงกระดูกบริเวณข้อสะโพกภายหลังการผ่าตัดสอดแกนดามกระดูกฟีเมอร์โดยไม่เปิดแผลตรงรอยหัก

สุทัศน์ จึงธีรพาณิช, พัชรพล อุดมเกียติ, บรรจง มไหสวริยะ

การสร้างเนื้อกระดูกนอกโครงกระดูก (heterotopic ossification) เป็นภาวะแทรกซ้อนที่พบเห็นเกิดขึ้นภายหลังการผ่าตัดบริเวณข้อสะโพกได้บ่อย โดยมีปริมาณ และอาการทางคลินิกมากหรือน้อยแตกต่างกันโดยการเกิด heterotopic ossification บริเวณข้อสะโพกภายหลังการผ่าตัดสอดแกนดามกระดูกฟีเมอร์ โดยไม่เปิดแผลตรงรอยหักยังมีข้อมูลจำกัด

วัตถุประสงค์*: เพื่อศึกษาความชุกของการเกิด heterotopic ossification บริเวณข้อสะโพกภายหลังการผ่าตัดสอดแกนดามกระดูกฟีเมอร์ โดยไม่เปิดแผลตรงรอยหัก*

วัตถุและวิธีการ*: ทำการศึกษาความชุกของการเกิด heterotopic ossification บริเวณข้อสะโพกภายหลังการผ่าตัดสอดแกนดามกระดูกฟีเมอร์ โดยไม่เปิดแผลตรงรอยหักในผู้ป่วย 100 ราย ที่ได้รับการติดตามอย่างน้อย 6 เดือนหลังการผ่าตัด*

ผลการศึกษา*: พบการเกิด heterotopic ossification ใน54 ราย (ร้อยละ 54) โดยแบ่งเป็น เกรด 1 16 ราย (ร้อยละ 16) เกรด 2 13 ราย (ร้อยละ 12) เกรด 3 24 ราย (ร้อยละ 24) และเกรด 4 1 ราย (ร้อยละ 1) ความชุกของการเกิด heterotopic ossification ในกลุ่มผู้ป่วยกระดูกหักที่ trochanter แตกต่างจากกลุ่มผู้ป่วยกระดูกหักที่บริเวณลำกระดูกฟีเมอร์อย่างมีนัยสำคัญ*