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# Extensive Post-Traumatic Heterotopic Ossification with Multi-joint Involvement: A Case Report

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**Learning Point of the Article:**

Extensive heterotopic ossification with significant functional limitation can occur in polytrauma patients; early ultrasound screening and NSAID prophylaxis can be key strategies for timely detection and prevention.


## Abstract

**Introduction:** Heterotopic ossification (HO) is a recognized complication following severe trauma, but simultaneous involvement of multiple joints is rare. This case highlights the diagnostic and management challenges posed by extensive HO and proposes potential screening and prophylaxis strategies applicable to polytrauma patients.

**Case Report:** A male in his mid-twenties sustained severe polytrauma from a motor vehicle accident, resulting in multiple fractures, requiring several surgeries and prolonged mechanical ventilation. After initial improvement in joint mobility in the intensive care unit, he developed progressive joint stiffness and pain across multiple limbs. HO was confirmed by radiographic and ultrasound imaging. Treatment included non-steroidal anti-inflammatory drugs (NSAIDs) and months of intensive multidisciplinary rehabilitation, which slowly improved function but left significant mobility deficits. The patient declined surgical intervention for mobility enhancement due to perceived adequate functional capability. At 11 months, the patient achieved near-normal ambulation without assistive devices. However, significant knee mobility deficits persisted bilaterally.

**Conclusion:** Extensive multi-joint HO can occur in polytrauma patients and poses significant diagnostic and therapeutic challenges. Early detection with ultrasound and early prophylaxis with NSAIDs may help reduce long-term morbidity.


**Keywords:** Heterotopic ossification, polytrauma, rehabilitation, non-steroidal anti-inflammatory drug prophylaxis, ultrasound.

## Introduction

Heterotopic ossification (HO) is a benign ossification of soft tissues, categorized into three types: genetic, traumatic, and neurogenic HO [1,2,3].

HO is a frequent complication following trauma, occurring in 10–20% of patients with traumatic brain injury (TBI) or spinal cord injury (SCI), and up to 30–50% in patients with fractures [4,5]. Prolonged mechanical ventilation has additionally been identified as a risk factor for severe HO [6]. Underlying mechanisms include a pro-inflammatory environment with overexpression of osteogenic mediators like bone morphogenetic protein (BMP)-2 and BMP-4, which can cause pathological endochondral ossification in HO-susceptible locations [5]. The most commonly affected joints include the hip, elbow and knee, although HO can develop almost anywhere in the body [7,8]. HO presenting specifically within muscle tissue is classified as myositis ossificans [9,10,11].

HO typically presents 3 to 12 weeks after an inciting event with

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tissue injury. Clinical signs include increased joint stiffness, limited range of motion, warmth, swelling, and erythema [2,12]. As these clinical signs are often non-specific, diagnosis is commonly made with plain radiographs and computed tomography, showing ectopic bone fragments with peripheral ossification zones.

Other imaging techniques include ultrasound and bone scintigraphy [5,8]. Early ultrasound findings include a hypoechoic core with an outer hyperechoic rim, while bone scintigraphy typically shows increased uptake in the injured area [2,13]. Due to the initial lack of bone formation, plain radiographs may not show any abnormalities in the first 2 weeks after injury, with ultrasound and bone scintigraphy having a higher sensitivity in the early stages [2,8]. Despite this, early diagnosis remains challenging due to the initial non-specific symptoms, and the lack of reliable tools or methods to predict which patients are likely to develop HO [14].

Evidence for the non-surgical treatment of HO is limited. Non-surgical care usually consists of physical therapy management and non-steroidal anti-inflammatory drugs (NSAIDs). This evidence is extrapolated from the effectiveness of NSAIDs in the prophylactic treatment after hip surgery [2]. Gentle mobilization of the joint within a pain-free range is recommended; forcible manipulation is contraindicated. It remains uncertain if physical therapy has a significant role in the development or reduction of HO [5,12].

Treatment with bisphosphonates is controversial, but they have been shown to be effective in some causes of HO, i.e., burn injuries and SCI [3,7,15].

Surgery should be considered in patients with functional deficits that failed conservative management. The timing for surgical excision is under discussion and is guided by the etiology and bone maturation. A waiting time of 6 months for maturation seems to be adequate in the post-traumatic setting without TBI or SCI. In SCI, HO is considered mature after 12 months and 18 months for TBI [2,4,8,12]. Recurrence rates remain high after surgery, making secondary prevention with NSAIDs and/or radiotherapy essential to reduce the risk of recurrence.

## Case Report

We present the case of a male patient in his mid-twenties who was involved in a motor vehicle accident resulting in numerous fractures (left humerus, radius, ulna, ribs II-VII, femur condyle, patella; right mandible, ribs I-II-III, femur) and severe blunt abdominal trauma. Orthopedic surgical management encompassed osteosynthesis of the mandible, radius, ulna, intramedullary nail of the right femur, left humerus, and screw fixation of the left femoral condyle. The abdominal trauma required multiple laparotomies. The patient required 7 weeks of invasive mechanical ventilation in the intensive care unit.

Passive mobilization was started postoperatively with initial clinical improvement while the patient was still intubated. However, 4 weeks postoperatively, the patient presented with an increase in pain during mobilization and severe mobility regression in both knees and the right hip, alongside mild mobility loss in the left shoulder and elbow compared to 2 weeks beforehand.


**Figure 1:** Radiographs and ultrasound at 1-month post-trauma demonstrating heterotopic ossification. Radiographs at 1-month post-trauma demonstrating heterotopic ossification of the left shoulder, humerus and forearm, right hip, both quadriceps muscles (left image) and ultrasound of the right anterior femur with hyperechoic fragments within the quadriceps muscle and associated posterior shadowing (right image).

### Investigations

Plain radiographs and ultrasound revealed extensive HO in the left shoulder, forearm, and distal quadriceps muscles bilaterally (Fig. 1). In addition, the radiographs excluded displacement of the fractures or the orthopedic material.

### Treatment

NSAIDs were initiated (naproxen 500 mg twice daily for 3 weeks) and further rehabilitation with progressive slow mobilization of the limbs.

After recovering sufficiently from his abdominal injuries, the patient commenced intensive inpatient rehabilitation consisting of five sessions per week of physical therapy and occupational therapy, each of at least 1 h/day,

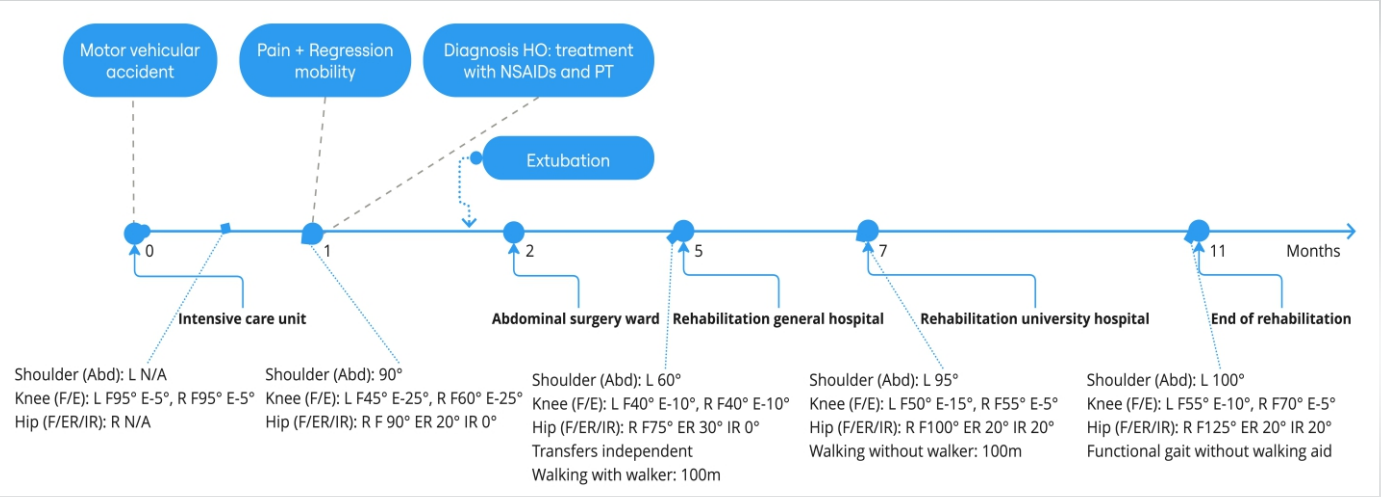


**Figure 2:** Timeline from initial trauma to completion of rehabilitation. Timeline illustrating the clinical course from initial trauma through intensive care unit stay, surgical management, and multidisciplinary rehabilitation. Serial measurements demonstrate progression of joint mobility in the left shoulder, right hip, and both knees over time. The figure highlights initial improvement, followed by functional deterioration associated with the development of heterotopic ossification, and subsequent gradual recovery during rehabilitation. R: Right, L: Left, N/A: Not available, HO: Heterotopic ossification, PT: Physical therapy, Abd: Abduction, F: Flexion, E: Extension, ER: External rotation, IR: Internal rotation.

aimed at improving function, mobility and strength. This was coordinated by a multidisciplinary team including occupational therapists, physiotherapists, and physical medicine and rehabilitation physicians.

The option of surgical excision of the HO in combination with radiotherapy was offered at 8 months post-injury to increase mobility in the knees. Due to the extensiveness of the HO in both quadriceps muscles, surgery would result in significant muscle loss. The patient declined, reporting adequate functional recovery in activities of daily living despite the persistent mobility restrictions.

## Outcome

In total, the patient received 6 months of multidisciplinary rehabilitation which focused on mobility, strength, proprioception, functional training, and gait rehabilitation. An overview of the timeline is shown in Fig. 2.

At 8 months follow-up, imaging with radiographs, ultrasound, and single-photon emission computed tomography scan revealed minimal bone turnover in the ossifications of the quadriceps with only mild tracer uptake distal anteriorly (Figs. 3 and 4). These signs of maturation supported the option to consider surgery.

After rehabilitation, the patient was able to regain near-normal walking speed without assistive devices; however, significant range of motion deficits persisted in both knees, with flexion limited to 55° (left) and 70° (right), and extension deficits of −10° (left) and −5° (right).


**Figure 3:** Follow-up radiographs at 8-month post-trauma of the left humerus, knee, and right femur. Follow-up radiographs at 8-month post-trauma of the left humerus and knee (upper panels) and right femur and hip (lower panels), demonstrating mature heterotopic ossification with defined cortical margins.

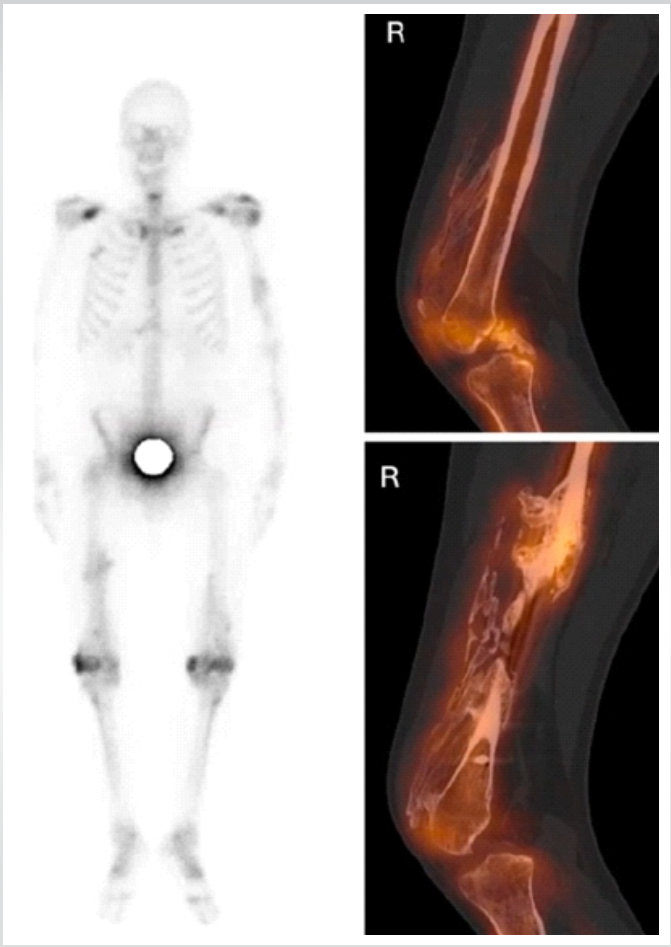


**Figure 4:** Single photon emission computed tomography (SPECT) at 8-month post-trauma demonstrating low-level tracer uptake indicating mature lesions. SPECT combined with computed tomography imaging performed 8 months after trauma. The images demonstrate low metabolic activity within the heterotopic ossifications, with only minimal residual tracer uptake in the distal anterior thigh region, consistent with mature and metabolically inactive lesions.

## Discussion

HO is a known complication in polytrauma patients, though the incidence of multi-joint involvement without TBI or SCI is not well established. Older literature suggests that multi-joint involvement is seen in approximately 6% of head-injured patients [16]. HO with simultaneous involvement of the shoulder, forearm, hip, and both quadriceps, as seen in this case, is rare. To our knowledge, only one other case report of extensive multi-joint HO without head trauma has been reported, in a patient subjected to prolonged ventilation due to COVID-19 infection [17].

The pathophysiology of HO is still not fully understood. In traumatic HO, it is hypothesized that trauma causes inflammation, vascularization, and tissue ischemia at the site of injury. Through complex signaling pathways (including BMP-2, BMP-4), this leads to endochondral ossification, a process where cartilage is replaced by bone [5,7,8,18]. This is likely amplified by systemic factors. Wollner et al. [19] compared the epidemiology of HO in femur fractures treated with an intramedullary nail among polytrauma patients versus isolated femur fractures. HO was apparent in 75% of the polytrauma patients compared to 20% in the isolated fracture group. They hypothesized that the difference could be due to the hyperinflammatory state of the polytrauma patient and long immobilization. In addition, in polytrauma, there is frequent association with TBI and SCI, which are hypothesized to trigger osteogenic mediators (like Substance P, interleukin-6, BMPs, and fibroblast growth factors) [20]. Trauma type and energy also influence the risk, as the prevalence of HO in high-energy war trauma is far greater than in civilian injuries [21]. In our patient, prolonged mechanical ventilation likely further amplified the risk and extent of HO, consistent with previously reported cases [6,17].

There is limited evidence for the conservative management of HO. In this case, NSAIDs were administered as they have demonstrated significant efficacy in the prophylaxis of HO, as they inhibit Cyclooxygenase-2 which is required for endochondral ossification [4,5,22]. No direct therapeutic evidence for NSAIDs in established HO exists. Their use here aimed to limit further ossification. No consensus exists on optimal type, dosage or duration, and both selective and non-selective NSAIDs appear comparably effective for prophylaxis [8]. In patients with no contraindications to NSAIDs, the complication rates are relatively low, although an increased risk of non-union in acetabular fractures has been reported [23].

Given the high morbidity and rehabilitation burden associated with HO and lack of strong evidence for conservative management once HO has developed, early recognition and prophylaxis are crucial. In our case, HO necessitated multiple months of rehabilitation to improve function, but significant mobility restrictions persisted. It is our view that NSAID prophylaxis for a minimum of 2 weeks can be considered in polytrauma patients if there are no contraindications [22]. If NSAIDs are contraindicated, prophylaxis with radiotherapy, a single dose of 700 cGy from 24 h pre- to 72 h postoperatively, can be considered at high-risk locations, though this evidence is extrapolated from the arthroplasty setting [8,19,24].

Ultrasound can aid screening and early detection, as it is a cost-effective tool with higher sensitivity than plain radiographs in the early stage of HO [21]. Early recognition might be achieved using ultrasound screening at 1–2 weeks at high-risk HO locations (e.g., hips and knees) [25].

## Conclusion

This case documents a rare presentation of extensive post-traumatic HO with simultaneous involvement of the left

shoulder, forearm, right hip, and bilateral quadriceps, in a polytrauma patient without TBI or SCI. Prolonged mechanical ventilation likely contributed to the severity and distribution of ossification. Although 6 months of multidisciplinary rehabilitation enabled the patient to achieve near-normal ambulation, clinically significant knee range-of-motion deficits persisted at follow-up. This case underscores that early ultrasound screening at high-risk locations and timely NSAID prophylaxis or radiotherapy when NSAIDs are contraindicated can be considered to reduce the significant functional morbidity associated with extensive HO in high-risk polytrauma patients.

**Clinical Message**

Consider heterotopic ossification prophylaxis with non-steroidal anti-inflammatory drug in high-risk polytrauma patients. Screening with ultrasound at high-risk HO locations may aid early detection at 1–2-week post-trauma.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil **Source of support:** None

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