

Case Report

Digital Heterotopic Ossification After Groin Flap for Crush Injury of the Hand: A Case Report

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We report a case of heterotopic ossification in a 60-year-old woman after crush injury with significant skin defects along the right middle, ring, and small fingers, managed with groin flap 38 years previously. Digital heterotopic ossification is extremely rare. As such, case reports of digital heterotopic ossification after trauma and flap reconstruction are few. Over a period of three decades, this patient became symptomatic with palpable bony protrusions of the digits, in addition to pain, swelling, and chronic wounds. The diagnosis was established with plain radiography and computed tomography, which revealed soft tissue ossification adjacent to the distal phalanx of the right ring finger. She underwent surgical excision due to lack of significant improvement after conservative treatment. This case report demonstrates that, although uncommon, heterotopic ossification can occur in a digit after groin flap reconstruction following crush injury of the hand.

Keywords: Heterotopic ossification, Hand, Crush injury, Flap reconstruction

1. Introduction

Heterotopic ossification (HO) is the abnormal formation of mature lamellar bone within soft tissue.¹⁻⁵ It generally results from trauma and neurologic injury¹ and involves large joints such as the hips, knees, shoulders, and elbows but rarely the hands.^{2,3,5,6} HO is typically asymptomatic but can cause pain and impaired range of motion, leading to decreased quality of life. To date, the pathophysiology and etiology of HO have not been completely elucidated. Radiography is the most common diagnostic tool for musculoskeletal disorders and is recommended in all patients with suspected HO. In addition, computed tomography (CT) can provide detailed images of HO. Prophylactic management to successfully prevent post-operative

HO includes administration of non-steroidal anti-inflammatory drugs (NSAIDs) and external beam irradiation therapy.⁴ Surgery is indicated for symptomatic HO. The objective of this case report is to highlight unusual clinical ossification to avoid incorrect diagnoses and treatments.

2. Case report

A previously healthy, right-handed, 60-year-old, female maintenance worker had suffered injury to her right hand from a metal bar falling onto it in 1978. At that time, her right middle, ring, and little fingers were crushed with degloving injury and significant skin defects. She underwent several surgeries including debridement, groin flap, and division of the flap, followed by extensive physiotherapy and occupational therapy. Although there was decreased range of motion in her injured fingers, she was able to manage daily activities and do light work. There were no significant sensory deficits in these fingers.

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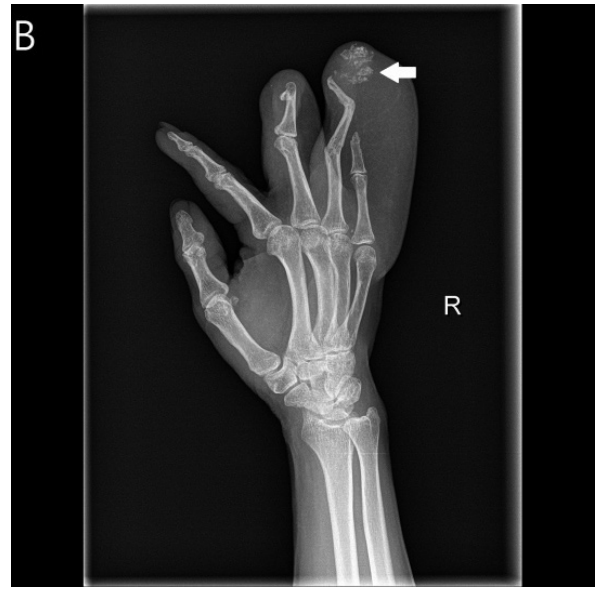


Fig.1A, Fig. 1B. Anteroposterior and lateral views of the right hand. (Arrow) An ectopic bony lesion is adjacent to the dorsal distal phalanx of the ring finger.

Fig.1C. Gross image. (Triangle) Bony tissue is seen emerging from the chronic wound at the tip of the groin flap.

Ten years ago, she came to our hospital due to palpable mass with mild pain at the tips of the fingers that had been reconstructed with groin flap. Radiographs of her right hand showed bone-like fragments at the distal phalanx of the ring finger (Fig.1A, Fig.1B). She underwent conservative treatment and observation.

Four years ago, she came to our outpatient department due to another injury to the area of the reconstruction flap. This injury resulted in a poorly healed wound, with gradual emergence of tiny bony protrusions. She removed the protruding bony fragments herself, but the wound did not heal. Clinical examination revealed a 3 mm open wound that was firm on palpation with mild swelling over the right ring fingertip (Fig. 1C). Laboratory data included white blood cell count 5530/ul (normal range: 4000-11000/ul), percentage of neutrophils 52% (normal range: 40-75%), and high sensitivity C-reactive protein 0.044 mg/dl (normal range: < 0.748). In addition, liver enzymes and renal function were within normal range, with no hyperuricemia, hypercalcemia, or hyperphosphatemia. Dual-energy computed tomography of the right hand revealed ossification near the distal phalanx of the right ring finger with no evidence of gout (Fig. 2). Our clinical diagnosis was HO post-groin flap surgery on right



Fig. 2 Dual energy computed tomography. There is ossification adjacent to the distal phalanx of the right ring finger.

hand. Initial management included pain control and wound therapy. However, the wound, mild swelling, and bony protrusions at the right ring and small finger reconstruction area persisted. Hence, surgical removal was scheduled after confirming maturation. Intraoperatively, the ossified bony fragments were treated by partial excision through a 5 mm incision over the previous scar on the ring finger and small finger reconstruction flap. To reduce tissue damage and risk of further recurrence, the bone fragments were removed through the smaller wound and gentle tissue dissection. There was no continuity between the ossified portion and the distal phalanx bone of

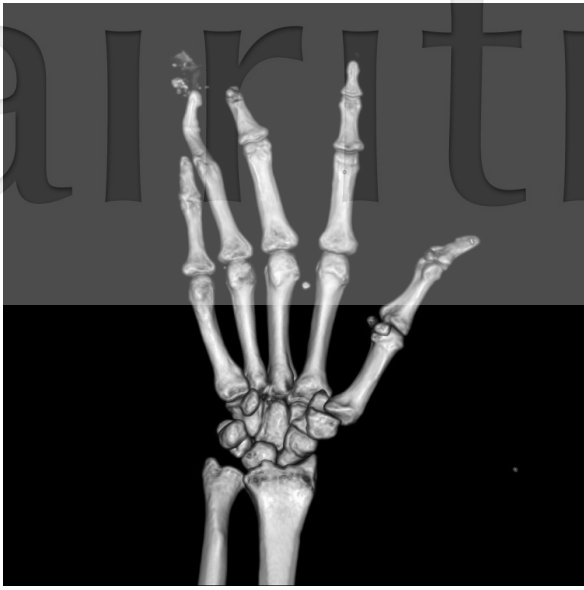
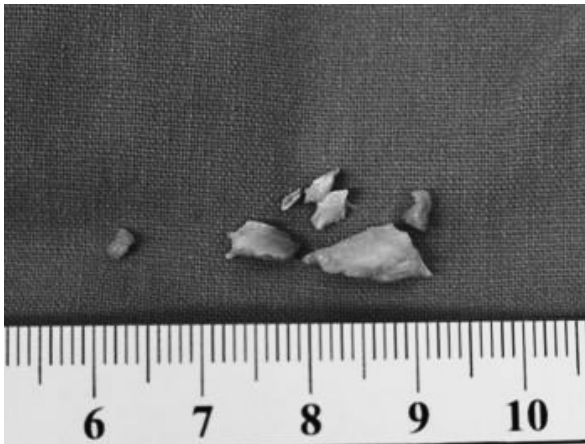


Fig. 3 Surgical specimens. White calcifications with irregular margins measured up to 12 mm x 5 mm x 5 mm.



her right ring finger. The firm mass was composed of several white calcifications with irregular margins measuring up to 12 mm x 5 mm x 5 mm (Fig. 3). No NSAID or external beam irradiation therapy was administered due to the patient's concerns about their side effects. During subsequent visits, she reported reduction in pain and tenderness in the affected areas.

3. Discussion

In this patient with crush injury to the right hand, treated with groin flap 38 years previously, HO developed in a very uncommon location. HO

has rarely been found in the digits of the hand or reconstruction flap.^{2,5,7} There are no reports on HO in fingers after crush injury treated with flap reconstruction. HO refers to the formation of mature lamellar bone in (redundant) soft tissues where bone does not usually occur.¹⁻⁴ The most common areas of involvement are large joints such as hips, knees, shoulders, and elbows.^{2,3,5,6} It is not known to occur below the knees or below the elbows.

The etiology of HO can be divided into traumatic, neurologic, and genetic.⁵ The definitive mechanism of HO is not yet understood. However, it may be a result of inflammatory and traumatic processes.⁴ Bone morphogenic protein 2 (BMP2), which is most likely released upon injury, triggers the transformation of perivascular mesenchymal cells into osteoblasts,¹ which are then stimulated in an environment of increased inflammation after trauma, leading to the formation of ectopic bone. Risk factors for HO include head trauma, spinal cord injury, and hip arthroplasty.² Small to medium-sized areas of HO are usually asymptomatic, but functional impairment, pain, and swelling can be found in large areas of HO.^{4,6} Imaging plays a crucial role in the diagnosis of HO.^{1,2,4} Plain radiography is the most common and reliable method for evaluating ossification foci and computed tomography is essential for surgical planning and visualization of the shape and sagittal location of ectopic bone.^{1,4} In addition, alkaline phosphatase values are often elevated in early HO¹ and may return to normal 18 weeks after injury.⁴

Conservative management includes physiotherapy and occupational therapy during the maturation phase and post-operatively to limit long-term stiffness.^{2,5} Long periods of immobilization are also associated with the formation of HO. Additional therapies, such as NSAIDs and low-dose radiation, have been found to successfully prevent HO,^{1,2,4,5} as they may suppress migration and proliferation of inducible mesenchymal cells.² Depending on the severity of pain, range of motion restriction, and entrapment of nerves, surgical excision may be considered if conservative treatment fails.^{1,4} Garland recommends delaying operative treatment until the bony mass reaches radiological maturation and biological silence.⁸ External beam irradiation or a

2-week course of indomethacin after removal of HO can decrease risk of recurrence. This patient decided to withdraw from preventive therapy because of gastrointestinal upset and potential risk of cancer from irradiation.

This patient with right hand reconstruction flap presented with digital bony mass with pain, swelling, and small chronic wound. Her serum levels of high sensitivity C- reactive protein, calcium, phosphate, and uric acid were all within normal range. Plain films of the right hand showed a small lesion measuring around 1 cm in diameter and composed of numerous small deposits adjacent to the distal phalanx of the right ring finger. This bony lesion was unlike tumoral calcinosis and myositis ossificans due to normal serum levels, small size, and location.⁹⁻¹¹ Dual energy CT revealed several small ectopic bony lesions around the distal phalanx of the right ring finger without abnormal signal intensity of gouty tophi. The possibility of calcified tophaceous gout was low due to mature ossification^{12,13}. Therefore, she received conservative treatment under the impression of HO of the right hand and eventually underwent surgical excision due to small chronic wound with persistent pain and swelling.

In this case, tissue damage from a crush injury and groin flap with increased inflammation may have led to the development of HO. Physicians should consider HO, even if it is in an uncommon location. In addition, surgical treatment might be beneficial when symptoms are refractory to conservative management. Surgical removal of HO with prophylactic treatment has been shown to improve outcomes and lower recurrence rates.

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