

# Case Report and Review of the Literature of Anterior Thigh Heterotopic Ossification in a U.S. Air Force Special Operations Parachutist

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## ABSTRACT

The development of heterotopic ossification (HO), also known as myositis ossificans, after blunt trauma to the quadriceps muscles is a well-described disease in athletes. It is a disease with an interesting and predictable course; it is the unusual case that leads to chronic morbidity or requires surgery.

This report describes a case of HO in a U.S. Air Force Special Operations parachutist following a routine parachute landing fall (PLF) after performing a high-altitude-low-opening (HALO) jump. The literature was reviewed; however, no other reports of HO in the parachutist occupation were identified. The work-up to rule out other diseases, particularly sarcoma of the thigh is reviewed, as well as the recommended management and expected course of the disease.

An interesting exacerbating factor and contributor to this parachutist's injury was the placement of his sunglasses in his anterior distal thigh pocket of his flight suit. While performing his PLF, the parachutist's sunglasses bluntly traumatized the area that subsequently developed HO.

The military parachutist population as well as civilian skydivers are particularly at risk for HO. The third point of contact of every PLF after the feet and lateral calf is the lateral aspect of the thigh. Strong effort to avoid exacerbating the force vectored into the thighs of parachutists by leaving pockets empty should be emphasized prior to any jump.

Delaying surgical intervention until six months is also advised due to the risk of recurrence and exacerbation of the disease if surgery is performed at an earlier time. The majority of those with HO of the anterior thigh simply require supportive care and watchful waiting.

## CASE REPORT

A 29 year-old healthy male U.S. Air Force Special Operations pararescueman presented to the flight surgeon's office three weeks after he sustained trauma to his left distal thigh during a PLF following a HALO jump. He complained of left knee swelling and pain, as well as a hard mass in the soft tissue near the superior lateral patella. He reported that he broke his sunglasses, which were in his left thigh pocket of his flight suit when his knee crushed the sunglasses into the ground during his PLF. He remembered that the impact of his sun-

glasses into his thigh was exactly over the area that developed the mass.

He denied any penetrating trauma or laceration of the skin over the area of impact. He complained of 2/10 knee pain intensity with swelling that intermittently became more severe. At the time of initial exam, he reported that his swelling was not at its worst. He denied any limitation to range of motion. He denied fevers, redness to the knee, chills, weight loss, or other constitutional symptoms. There was no parasthesias, weakness, or other injury.

His past medical history was unremarkable except for a remote history of pneumomediastinum sustained during military dive operations. He had an appendectomy as a child, took no medications, and had no drug allergies.

The patient remained active in the weeks after his injury up until several days prior to arrival for initial evaluation. He continued to train with his team and to participate in athletics to include rock-climbing, but denied further injuries. He requested medical authorization to attend hyperbaric chamber refresher training the day after his initial presentation.

On exam he was afebrile with normal vital signs. He was well-appearing, ambulatory without a limp, in no acute distress. His physical exam was unremarkable except for his left knee exam. The overlying skin was intact; he had full range of motion (ROM) with mild pain at maximum flexion. A moderate, ballottable knee effusion was present without redness. Mild increased

warmth was present. No tenderness to palpation of any of the bony structures, joint spaces, or soft tissue structures was elicited. A hard mass was palpable at the superior lateral aspect of the patella. The mass was nontender, subcutaneous, and mobile, not well delineated but measured at 2x4cm. The remainder of the knee exam was unremarkable. His distal neurovascular exam was intact, and no lesions to the distal leg, feet, or interphalangeal areas were present.

Lab studies were unremarkable:

WBC 4.9, Hgb 14.9, Plt 271, 50.5% neut., 31.3% lymph, 0% mono.

Na 137, K 4.5, Cl 102, CO<sub>2</sub> 30, Glucose 71, BUN 15.0, Creat 0.9, CA 9.5

ESR 2, Alk Phos 61

Synovial fluid aspirate was without organisms or crystals, gram stain was negative, with only occasional WBCs, and culture was negative.

Plain films showed the left knee with small joint effusion, 2 to 3mm soft tissue calcification, superior to the patella without a connecting stalk. The mass was slightly less dense than adjacent bone.

CT, at five weeks post-date of injury, showed soft tissue edema, a small joint effusion, and no evidence of calcification in or around the knee.

After initial evaluation, HO was suspected given the mechanism of injury, exam, and plain radiograph findings. His risk factors for HO versus other disease included; (1) a history of trauma to the affected site, (2) patient age of younger than 30 years, (3) location of the lesion (anterior thigh), (4) the presence of an intact cortex, and (5) a negative alkaline phosphatase level.<sup>1</sup> Joint sepsis or other infection was unlikely. Osteosarcoma was unlikely although this diagnosis required close attention with further evaluation and radiography at several months post-date of injury.

He was prescribed Celebrex<sup>®</sup> as needed for pain and instructed to resume activities as tolerated. Specifically regarding his planned dive in the hyperbaric chamber, he was instructed not to dive until resolution of his joint pain. Although the hyperbaric environment is not expected to adversely affect patients with HO, it may be difficult to ascertain if knee pain after a dive is secondary to decompression sickness (DCS) or simply pain from HO.

The patient used Celebrex<sup>®</sup> three to four times a week for the first week, and then declined further analgesia. He successfully completed his hyperbaric chamber dive one week after diagnosis. At two months post-date of injury, the patient reported 0/10 pain. Serial

re-examinations showed his effusion to improve but persist, with no redness or warmth. The mass was no longer palpated. A repeat CT scan showed no soft tissue calcification, minimal edema, and no mass.

## DISCUSSION

HO is well described in athletes. A three-year study of 117 West Point cadets with quadriceps contusions acquired during athletics showed a 9% rate of HO development. Risk factors thought to contribute to HO were: (1) knee motion less than 120 degrees, (2) injury occurring during football, (3) previous quadriceps injury, (4) delay in treatment greater than three days, and (5) ipsilateral knee effusion.<sup>2</sup> Other studies of cadets have found a 20% rate of HO development after quadriceps contusions. Another risk factor well-identified in HO patients is a concomitant spinal cord injury.

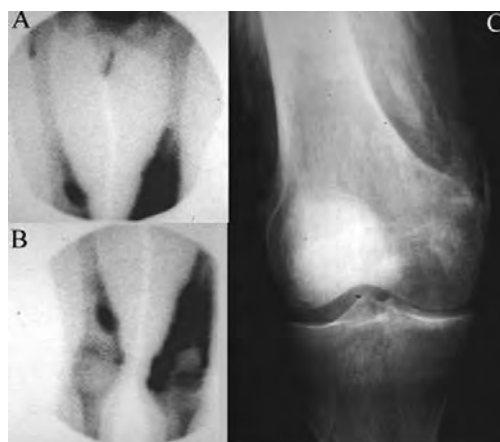


Figure 1. HO in left knee as seen on bone scintigraphy and plain radiography.

HOs prevalence in parachutists is unknown. The case of HO after a normal PLF in this U.S. Air Force Special Operations pararescueman was exacerbated by the impact of his sunglasses into his distal thigh. This patient's risk factors included a delay in treatment greater than three days and an ipsilateral knee effusion. The radiograph in Figure 1 shows soft tissue calcification similar to the subject patient's radiograph.

The course of the patient in this case was typical. He developed no complications or chronic morbidity. He required no surgery. Follow-up evaluations showed nearly complete resolution of symptoms and pseudo-normalized radiographs at eight weeks post injury.

Unfortunately initial evaluation of this patient occurred three weeks after the date of injury. The early treatment of simple quadriceps contusions is thought to be beneficial in order to prevent complications such as HO and to provide for an early return of patients to nor-

mal activities. Early efforts to reduce thigh hematoma formation with the RICE regimen (rest, ice, compression, and elevation) are advised. Non-contact activities should be prescribed. Other treatments for quadriceps contusions and strains include several days of immobilization in 100 to 120 degrees of flexion, followed by closely observed range of motion exercises and heat therapy. Athletes may return to normal activities in two to three weeks after quadriceps contusions if their evaluation and management begin in the early stages.<sup>2,3</sup>

Other important diagnoses to consider in a patient with suspected HO include: (1) osteosarcoma, (2) chronic osteomyelitis, (3) deep venous thrombosis, (4) diabetic muscle infarct, (5) hydroxyapatite deposition disease, (6) pyomyositis, and 7) tumoral calcinosis. In this patient, a lab study that was not performed but which may be helpful to exclude infection is a serum C-reactive protein (CRP) level. An initial ultrasound was also not performed but these can help identify early HO. The ultrasound will show a disorganized pattern typical of early HO. Both CRP level and ultrasound can be followed serially to advance or exclude the diagnosis.

The radiologic modality of choice to diagnose HO and exclude osteosarcoma is not clearly identified in the literature. Options include plain radiograph, ultrasound, bone scan, CT scan, CT-enhanced arteriogram, and MRI. In a patient with a history and physical consistent with HO, a combination of serial radiographs with a CT, MRI, or bone scan at one to two months post injury is advised.<sup>4</sup>

Surgical excision of HO is not advised until 6 months after injury.<sup>1</sup> Earlier surgical intervention may be a disaster in some cases since HO may return in a more aggressive manner and increase the patient's disability.

## SUMMARY

Heterotopic ossification was diagnosed in the distal left lateral thigh of a U.S. Air Force Special Operations Pararescuemen after a PLF which was complicated by blunt trauma to the thigh from sunglasses in his flight suit pocket. HO can occur at a nine to twenty percent rate following quadriceps muscle injuries in athletes. The prevalence of HO in parachutists is unknown at this time, but the disease can be expected given the nature of PLFs.

Risk factors for HO in a suspected case should be elicited. Other important diagnoses such as osteosarcoma must be excluded.

A two to four-month recovery period is predicted in a patient with HO and may be improved with the use of NSAIDs. Occasionally surgical excision is required but is not advised until six months after HO development. Repeat radiography at time of HO maturation is important to exclude other diagnoses and to document disease progression or resolution.

Pre-jump emphasis to parachutists is advised to avoid, if possible, carrying objects in thigh pockets. Soon after a quadriceps injury sustained during parachute operations, a patient should seek medical care to minimize recovery time and the risk of HO complications. After HO develops, restriction of flying and parachute activities may be necessary. Specifically dives in the hyperbaric chamber should be restricted to avoid confusion with DCS.

**Author's Notes:** Permission to include patient's medical report has been secured by the author from the patient.



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## REFERENCES

1. DeLee and Drez. (2003). *Orthopaedic Sports Medicine*, 2nd Ed.; Chapter 26.
2. Ryan JB, Wheller JH, Hopkinson WJ, et al. (1991). Quadriceps contusions. West Point update. *Am J Sports Med*; 19:299-304.
3. Bencardino J.T., Rosenberg Z.S., Brown R.R., et al. (2000). Traumatic musculotendinous injuries of the knee: Diagnosis with MR imaging. *Radiographics*, 20; pp S103-S120.
4. (2006). W.B. Saunders Company. *Clinics in Sports Medicine*; Vol. 25. No. 4.