

Femoral neck stress fracture during sport climbing

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Abstract

While the epiphyseal stress fracture of the finger's middle phalanx is a known sport-specific injury occurring only in adolescent climbers, and in other locations it's rare, no femoral neck stress fracture (FNSF) in sports climbing has yet been reported. An experienced female sport climber (37y, 160 cm, 45 kg, BMI 17.5) suffered from pain in the left inguinal region while climbing, and later, also required a stick to walk. Routine radiography missed the FNSF and it was many weeks before a MRI accurately provided that diagnosis. The time between the X-ray and MRI should have been minimized as it resulted in a delayed diagnosis, unnecessary pain and delayed healing. In this situation the initial clinical investigation, the patient's history and the X-ray did not lead to a clear diagnosis, and the initial treatment was ineffective. Further investigation by MRI and / or CT scans should have taken place sooner and would have been essential.

Keywords

- sport climbing
- injury
- diagnosis
- rehabilitation
- physiotherapy
- occult fracture

Contribution

- A – the preparation of the research project
- B – the assembly of data for the research undertaken
- C – the conducting of statistical analysis
- D – interpretation of results
- E – manuscript preparation
- F – literature review
- G – revising the manuscript

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Introduction

Sport climbing has grown in popularity from its beginnings in the early 80's to an Olympic sport in 2020. Participation is accessible at all ages, toddler to pensioner, and is enjoyed by many over lifetime.¹⁻³ Recent studies have established that sport climbing is quite a safe sport with 0.027–0.079 accidents per 1,000 hours of climbing, and the majority of injuries are minor.⁴ Severe injuries and fractures are rare though some specific injuries may harm the athletes (e.g. pulley ruptures). Stress fractures to the fingers do occur, and epiphyseal stress fractures of the middle phalanx are almost exclusively found only in climbers.⁵⁻⁷ However this is the first report of a femoral neck stress fracture occurring during sport climbing.

Clinical findings

An experienced female sport climber [37y, 160 cm, 45 kg, BMI 17.5, active sports climber for about 12 years leading up to UIAA grade VIII, resp. 5.11c (YDS) or 7a (French)] suffered from increasing pain in the left inguinal region while climbing without any acute trauma, and later, also while walking. The symptoms remained relatively constant for several weeks but increased significantly when the climber started climbing a route (UIAA grade IX) whose crux was a 'big roof'. This crux was strenuous and required a technical left 'foothook' move to get on top of this roof from the underside of it. The climber trained on this crux for several days, climbing three times per week. Some days later her symptoms had significantly worsened and it became necessary to use a stick when walking. There was no trauma of the hip or inguinal region in the climber's history.

The climber had initially attended a physician when the symptoms began. The X-ray taken was diagnosed as "normal", but unfortunately only a single anterior-posterior projection was done (Figure 1). The diagnosis at this stage was "strain trauma of the adductor muscles" and physiotherapy was prescribed. Over the next 3 weeks there was no amelioration of the symptoms. Nevertheless, the patient went to Fontainebleau in France for bouldering. Here she climbed, but was in significant pain. She was unable to jump down from the boulders as is typically done at Fontainebleau when the climb is finished. Instead, she had to be lifted off the respective boulder. She also went mountain biking, though still with pain, and walking was now impossible without a stick.



Figure 1. Initial X-Ray of the stress fracture, diagnosed as "normal / no fracture" (see also Figure 2)



Figure 2. Cut-out of Figure 1 with no clear fracture line visible in the broken Collum femoris. Probably there is an interruption of the cortical bone which may retrospectively be interpreted as the stress fracture (arrow).

This debilitating pain prompted her to contact a physician who specialized in climbing and alpine medicine. An MRI showed an older minimal compressive femoral neck stress fracture with a small fissure, and a minimal edema and bone marrow signal increase in T2-weighted imaging. The earlier recent single X-ray was of one plane only and insufficient to identify this older "hidden" stress fracture, or occult fracture. An occult fracture by definition cannot be detected by standard radiographic examination until several weeks after the injury.

Typically, in the course of investigating a stress fracture, two-thirds of the initial radiographs are normal.⁸

Since there was no trauma, and only heavy and regular loading on her hip from her climbing activity, the finding could be classed as a Kaeding-Miller Grade II stress fracture as it was symptomatic, and had no fracture line. As she had been climbing with this fracture and it didn't disintegrate, the injury was assumed to be stable and did not require surgical fixation. However, she was advised to avoid any sports which put a heavy load on her hips like climbing or running for several weeks until she was pain free. Physiotherapy included mobilization of the hip and sacroiliacal joints, a muscular stabilization program of the hip's surrounding muscles, and complete integration in myofascial front and back lines.⁹ Interestingly the patient did not have any risk factors for stress fractures such as anorexia nervosa, osteoporosis, or steroid therapy. However our patient's BMI was 17.5 and would be classed as 'underweight' as it was less than 18.5. But this may be interpreted physiologically as "anorexia athletica", a common finding in climbers.

Discussion

The etiology for developing stress fractures is multi-factorial. This can include sex, age, race, hormonal status, poor energy, calcium and vitamin D intakes, neuromuscular function, genetic factors, improper technique or biomechanics, and a low BMI.^{8,10} Wentz's (2011) review compared the stress fractures of female athletes and army recruits to their male counterparts found a respective incidence of 9.2% and 3.0%. Some sports have a greater association with stress fractures such as running (69%) versus racket sports (5%), or basketball (4%).⁸ Femoral neck stress fractures account for 3% of all sport-related fractures and occur most commonly in marathon and long-distance runners,¹¹ and are unknown in sport climbing. This may be a consequence of the different impact forces involved: While there is an impulse for every single step while running, there is a longer, but significant lower impact force while climbing. Female athletes with a BMI below 19 were at increased risk of developing stress fractures and also took longer to return to unrestricted training and competition compared to those with a BMI more than 19.^{8,10} Our climber's BMI was low at 17.5. She wasn't a runner, but would regularly hike around 12 km twice weekly in addition to climbing. Her serum vitamin D and calcium levels were not assessed for deficiencies. Such findings are common in sport climbers and may be interpreted

as "anorexia athletica". However, the combination of a very low BMI with a relatively high muscle mass and consequently an even lower body fat can lead to hormonal disturbances in athletes that may have put her at risk for osteoporosis.

As mentioned above, major injuries and fractures are rare events in sports climbing, but stress fractures to the fingers are known. Young and Raasch (1994) published a case study where the proximal phalanx of the right index finger of a 30-years-old climber broke after intensive rock climbing for 10 days.¹² Others published similar findings at characteristic locations, including epiphyseal stress fractures of the middle phalanx which occur almost exclusively in climbing sports.^{5-7,13,14} Stress fractures of the distal radius¹⁵ or os hamatum^{16,17} in climbers are rare. There is only one case reported where a climber suffered from a femoral stress fracture but this was after Sugioka's transtrochanteric rotational osteotomy as a treatment for osteonecrosis of the femoral head.¹⁸

The case presented here is of special interest as it is – to our best knowledge – the first one ever published where a femoral neck fracture happened spontaneously while sport climbing. She had no known risk factors other than being a well-trained female climber with a low BMI whose inguinal pain was in fact a femoral head stress fracture. This fracture was missed by the initial X-ray, and the initial physiotherapy did not ameliorate her symptoms. Fortunately a MRI some weeks later accurately diagnosed her condition after she began repetition of a specific climbing move that intensively loaded her left leg and her symptoms worsened. Of course, the differential diagnosis can be difficult in some cases and may include trauma of the adductor muscles, an inguinal hernia or osteitis pubis as inguinal pain during strain is the main symptom, with gait also affected.¹⁹ The most important differential diagnosis in climbers is femoroacetabular impingement. As a femoral neck stress fracture was simply unknown in sports climbers previously, this delayed the final diagnosis.

The delay in this climber's diagnosis may have led to significant long-term consequences including a complete fracture or non-union that required surgical management and could recur in the same location.⁸ Should the injury recur, as her BMI was low the following tests would be crucial in determining her nutritional status and healing potential to differentiate between an underlying endocrine condition or an energy imbalance that would contribute to a recurrent injury or a decreased bone mineral density. These tests include serum vitamin D, calcium and phosphate levels, parathyroid hormone, thyroid-stimulating hormone, alkaline

phosphatase, albumin, pre-albumin, follicle-stimulating hormone, luteinizing hormone and estriol.⁸

Fortunately the stress fracture was stable and did not disintegrate when the patient continued climbing in Fontainebleau, although she was in significant pain. Since up to 80% of the initial X-rays show negative results in the case of stress fractures further investigations would have been required immediately.²⁰ In any such situation where the clinical investigation, a patient's history and X-ray do not lead to a diagnosis, or if the treatment of the initial diagnosis offered no amelioration, further investigations by MRI or CT scans are the gold standard.^{11,21} In this case, the MRI revealed a new diagnosis of a femoral neck stress fracture which was never described in climbing medicine literature previously. If available, MRI is preferred to a CT scan because the latter may also cause false-negative results within the first 24 hours²¹ and exposes the patient to significant radiation.

This case also highlights several special aspects of athletes and extreme sports: 1) this athlete who continued climbing and mountain biking with her femoral neck stress fracture showed an impressive level of capacity for pain and suffering and; 2) obviously the case was misinterpreted by the doctor who initially treated her probably because of two factors: a) such injuries without trauma were unknown in climbers and; b) this doctor thought it was simply unimaginable that a person would be able to continue climbing and mountain biking with such an injury. Athletes are not normal patients!

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