CASE REPORT

Sesamoid osteonecrosis treated with radial extracorporeal shock wave therapy

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SUMMARY

Sesamoid osteonecrosis is a disabling condition resulting in severe forefoot pain, for which there are limited treatment options. We present a 52-year-old man with 1-year history of pain, aggravated by walking and playing tennis. On examination, pain was localised to plantar aspect of the first metatarsophalangeal joint. Imaging revealed evolving end-stage avascular necrosis of lateral sesamoid with early secondary degenerative changes. Previous exhaustive conservative treatment had been unsuccessful in alleviating his pain. As an alternative to surgery, radial extracorporeal shock wave therapy (rESWT) was proposed. Treatment protocol was 2000 pulses at frequency of 5 Hz, and pressure was varied from 1.2 to 1.8 bar according to patient tolerance. A total of eight sessions were delivered. At completion of treatment, the patient reported minimal discomfort to no pain and was able to return to playing tennis with no recurrence. We propose rESWT to be an effective novel conservative treatment for sesamoid osteonecrosis.

BACKGROUND

Hallucal sesamoid osteonecrosis is an uncommon disabling condition, which often results in surgical extraction of the affected sesamoid bone, when conservative treatment has failed.[1 2] We describe a case of sesamoid osteonecrosis successfully treated with radial extracorporeal shock wave therapy (rESWT), a novel conservative treatment for this condition.

CASE PRESENTATION

A 52-year-old keen, club tennis player presented to a London Sports Medicine Clinic with a 1-year history of left forefoot pain, which was aggravated by walking and playing recreational tennis. There was no history of trauma or injury even though the onset of pain was acute.

On examination, he was found to have pain on palpation, precisely in the region of the lateral sesamoid. There was some swelling localised to this anatomical site. The first metatarsophalangeal joint (MTPJt) demonstrated features of early osteoarthritis with palpable dorsal osteophytes/exostosis, reduced range of movement and painful active/passive dorsiflexion and plantar flexion of first MTPJt. He had pain and disability with walking for more than 30 min. In addition, playing recreational tennis aggravated his pain, which measured six on the Visual Analogue Scale (VAS).

The initial diagnosis was sesamoiditis/severe synovitis with differential diagnosis of sesamoid stress fracture based on clinical history and later, confirmed on scanning as osteonecrosis of the lateral sesamoid.

He was otherwise fit and well with no prior medical or surgical history.

INVESTIGATIONS

Ultrasound scan was readily available in the clinic, and initial review revealed plantar plate tear which was felt not to be in keeping with the clinical findings. Sesamoids were degenerate and irregular in shape, especially the lateral sesamoid. Stress fracture of the sesamoids was not obvious. There was evidence of osteoarthritis of the first MTPJt with synovitis. Due to availability of on-site CT scanner and a condition unresponsive to treatment, this was subsequently organised. High-resolution CT revealed probable end-stage avascular necrosis of lateral sesamoid (figure 1) with early degenerative change, fragmentation and sclerosis of the lateral sesamoid. These findings were later confirmed on MRI scan. Figure 2 is a short time of relaxation & excitation weighted (T1W) image with low signal of the bone marrow of the lateral sesamoid, and figure 3, is a fat suppressed/short tau inversion recovery (STIR) sequence showing high signal of the same bone, thus confirming an evolving osteonecrosis of the lateral sesamoid.

TREATMENT

During the acute phase, he was immobilised in a pneumatic walker for 4–6 weeks. This was followed by non-steroidal anti-inflammatories (NSAIDs), customised orthotics to offload the first MTPJt and physiotherapy, which incorporated gentle manipulation, taping, acupuncture and therapeutic ultrasound treatment. Despite these interventions, the patient failed to improve and was not able to return to sport. He subsequently underwent image-guided arthrogram and high-volume injection with primary aim to reduce adhesions and pain. Surgical excision of the sesamoid was discussed and considered including risk factors, complications and possible poor outcome.

His case was presented at a multidisciplinary team meeting where rESWT was discussed as an alternative treatment. Although evidence for its use in osteonecrosis of the bone was weak, rESWT has been used in tibial stress injury, mainly medial tibial stress syndrome, stress fractures (fifth metatarsal and tibia) and osteonecrosis of the femoral head.[3 4] After detailed discussion and having followed the

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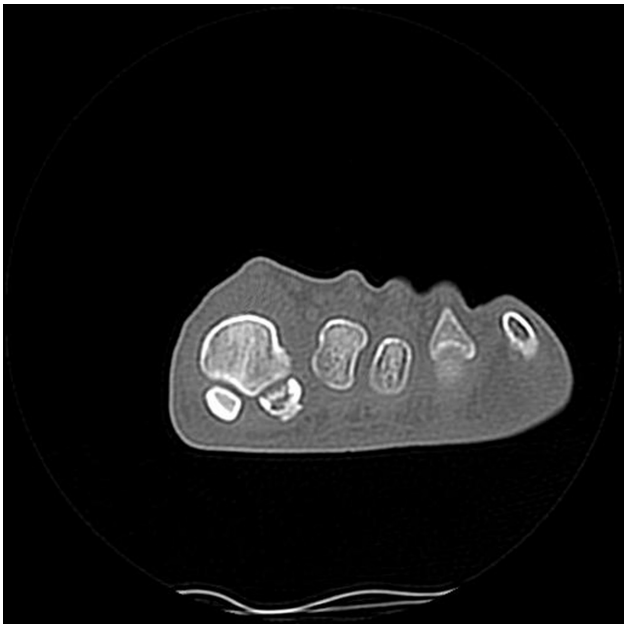

Figure 1 High-resolution CT of axial view of the foot.

process of informed consent, the patient agreed to a trial of rESWT as an alternative to surgery.

The EMS Swiss DolorClast device was used. The patient received an individualised protocol based on severity of symptoms, tolerance of the procedure and response to treatment. The pressure was set according to pain tolerance. Treatment was considered complete once VAS was less than or equal to 2 and the patient reported marked improvement in symptoms with activity. There is no definitive prescription for rESWT for various musculoskeletal conditions but evidence is emerging for individualised protocols for conditions treated with rESWT.[5 6]

In total, eight sessions of rESWT were administered, at a frequency of 5 Hz, 2000 pulses per session and pressure of 1.2–1.8 according to patient's ability to tolerate.

Figure 2 Short time of relaxation & excitation weighted (T1W) MRI sequence of the axial view of the foot.

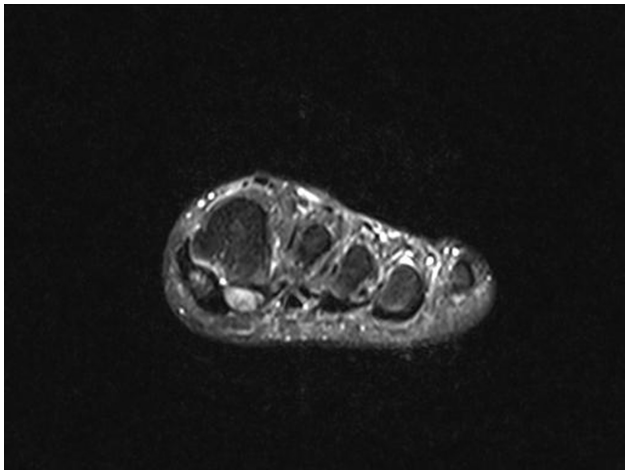

Figure 3 Short tau inversion recovery (STIR) MRI sequence of axial view of the foot.

OUTCOME AND FOLLOW-UP

During early treatment sessions, there was little or no change in pain reported; however, by the sixth session, the patient reported noticeable reduction in pain with activity. The patient was able to complete treatment with no reported side effects. Following completion of rESWT, VAS was reported as 2. The patient underwent a 12-week sport-specific rehabilitation programme and he returned to preinjury level of playing tennis, 6 weeks after completing rESWT treatment. At 1-year follow-up, VAS was 0. The patient remains pain-free and continues to play tennis.

DISCUSSION

The first MTPJt plays a key role in normal gait by allowing for forward propulsion during the toe off phase.[7] An important component of this joint are the sesamoid bones—two small accessory bones located within the tendons of flexor hallucis brevis, one medially and one laterally.[8] The sesamoids are able to improve function of the first metatarsal by acting to protect the tendon, stabilise the joint during propulsion and absorb weight bearing. Due to its increased role in weight bearing, the tibial (or medial) sesamoid bone is more prone to developing pathology.[8] It was unusual that in this patient, the affected sesamoid was the lateral side; however, this is not unique and either bone can be affected.

A number of conditions can cause pain in the forefoot including those affecting the hallucal sesamoid bone, making a diagnosis for patients presenting with pain and tenderness in this region challenging. Differentials include but are not limited to infection, bursitis, inflammatory conditions, stress or traumatic fracture, osteoarthritis, subluxation or dislocation of the sesamoids, sprain of a bipartite sesamoid, sesamoiditis and osteonecrosis.[1 8]

Sesamoid osteonecrosis is a condition first described in 1924 by Axel Reander.[9] Despite this, it is relatively uncommon with descriptions in the literature mostly confined to case reports or small case series.[1 2] The condition typically affects young adult females who present with plantar pain during the toe-off phase of gait. Often patients will be seen to supinate the foot during walking to relieve symptoms. Examination reveals point tenderness over the head of the first metatarsal, which is worse on forced dorsiflexion.[1 2] In the early stages, the condition is rarely painful but later progresses to disabling pain which can be career ending in the professional athlete.

The aetiology is unclear and it is often not suspected at the initial presentation, as there is rarely a history of trauma or injury, even though the presentation is often of acute onset. However, the condition is more commonly seen in sports such as dance and athletics where there is repeated trauma to the joint. The sesamoid bones have a tenuous circulation and it is thought that chronic microtrauma over time may cause disruption of blood flow.[1] The resulting oxygen depletion results in ischaemia and cell death ultimately leading to osteonecrosis.[2] This theory would in part explain why the condition is more common in females who have a higher incidence of single vessel supply to the hallucal sesamoids, compared with men. Additionally, hind foot alignment disorders such as pes valgus and pes cavus have also been named as risk factors for development of sesamoid osteonecrosis.

History and examination is an important component of diagnosis; however, due to the significant overlap in pathologies, imaging is a useful tool in differentiating causes of pain in this region.[8] Radiograph and isotope bone scanning have been used to diagnose osteonecrosis but MRI is now overtaking these as the preferred imaging modality due to its high sensitivity in this area.[8 10] In the case of osteonecrosis, signal abnormalities can be seen in the first few days of pathology, with T1-weighted and T2-weighted sequences showing low signal. On T1 sequences, evidence of fibrosis can be seen as fat and haematopoetic tissue is replaced.[11] It has been suggested that due to high sensitivity and early signal changes, a normal T1 bone marrow signal can rule out osteonecrosis.[1]

Treatment strategies to date are limited with the main stay of treatment involving the elimination of weight bearing via activity modification, orthotics and splinting.[1 12] Physiotherapy (taping, manipulation, therapeutic ultrasound and acupuncture) and NSAIDs also play a role in reducing pain. Conservative treatment is typically trialled for a period of 6 months after which surgical extraction is often recommended in refractory cases.[2] Excision involves partial or total sesamoidectomy with removal of the necrotic area. Reports exist of postsurgical pain in the contralateral sesamoid and patients may develop hallux valgus or varus dependant on sesamoid removed.[2]

Extracorporeal shock wave therapy (ESWT) is an increasingly popular treatment for a range of musculoskeletal conditions such as patella tendinopathy, plantar fasciitis, trigger finger and calcific shoulder tendinopathy.[5 6 13] Studies exist for the use of ESWT in osteonecrosis of other areas, such as the hip as an alternative to surgery.[14]

Valchanou and Michailov were the first to use ESWT to treat musculoskeletal conditions in 1991.[15] They applied a high-energy ESWT to treat delayed union or non-union of long bone fractures in humans.[15] Radiological examination showed that shock waves can break up the sclerotic bone ends and produce numerous small detached or partly attached fragments of bone. This stimulates osteogenesis and speeds up the union of the fracture, in addition to promoting bone healing.[16]

The biological mechanisms by which rESWT induces therapeutic effects on pathological tissue are not completely elucidated, although it is suggested that shock waves may facilitate the healing process through the disruption of avascular, damaged tissues, stimulation of growth factor release, stem cell recruitment and neovascularisation.[17 18] rESWT has been shown to have few side effects and given its success in hip osteonecrosis, in our patient who had already exhausted conventional non-surgical treatment, decision was made to trial rESWT as an alternative to proceeding to surgery.[19]

This case showed positive results with the use of rESWT in sesamoid osteonecrosis. Literature is deplete for use of shock wave therapy in osteonecrosis of the sesamoid bone. A study by Saxena *et al*[20] was a pilot study using radial shock wave therapy in 10 patients with sesamoid pathology, of which one patient had avascular necrosis. However, response to treatment was not reported according to disease pathology and, therefore, it is difficult to assess the individual response in the patient with osteonecrosis.

We propose that rESWT is a good non-surgical option for treatment of this disabling condition, where other conservative treatments have failed and as an alternative to surgery. Longer follow-up and additional trials are needed to ensure reproducibility and lack of recurrence.

Learning points

- Sesamoid osteonecrosis of the first metatarsal is a relatively uncommon but disabling cause of forefoot pain.
- Treatment options to date are limited and often result in surgery.
- We present a patient who was successfully treated with radial extracorporeal shock wave therapy and was able to return to premorbid activity levels.
- Shock wave therapy should be considered in those patients who have failed other conservative measures as an alternative to surgery.

Contributors All authors made a significant contribution to the writing of the submitted paper and approved the final version. DT was responsible for literature review and write-up of the case report in question, including preparing the report for submission. Both NM and NP were involved in patient investigation, diagnosis and treatment. They provided the patient images and assisted in writing up the case report. In addition, NM provided important patient information and case history. NP assisted in literature review and description of the more technical aspects of the report.

Competing interests None declared.

Patient consent Obtained.

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