CASE REPORT

Delayed healing of a navicular stress fracture, following limited weight-bearing activity

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SUMMARY

This report describes a 21-year-old man, a semiprofessional football (soccer) player, with a navicular stress fracture. It highlights the difficulty in diagnosing the condition and the complications arising from inadequate management. The case discusses the optimal management of these stress fractures and the detrimental role of weight-bearing recovery. The diagnosis of navicular stress fractures is challenging, and a high index of suspicion is required. The available literature indicates that limited weightbearing is not an appropriate treatment for navicular stress injuries. Non-weight-bearing (NWB) cast immobilisation for 6–8 weeks appears to be the gold standard treatment; however, open reduction with internal fixation (ORIF) has similar success rates and an equal return-to-play time but should also be followed by a period of NWB. NWB cast immobilisation for 6 weeks remains a good second option at any time following failed limited weight-bearing activity.

BACKGROUND

High-level sports people are at risk of developing bone stress injuries, due to their volume of training and the repetitive use of specific body parts particular to their sport or position. Athletes performing repeated sprinting activities are prone to developing stress fractures of the tarsal navicular bone. These are notoriously difficult to treat, with high failure rates reported. This case illustrates the difficulty in accurately diagnosing navicular stress fractures, due to their vague presentation of diffuse dorsal foot and anterior ankle pain. The case also highlights the potential for ongoing complications and their impact on normal sporting activities, following inadequate treatment. This case and the subsequent discussion emphasise that to allow any weightbearing during the first 6 weeks of treatment would constitute suboptimal management.

CASE PRESENTATION

A 21-year-old semiprofessional soccer player presented to a sports medicine clinic with a 1-month history of diffuse left ankle and foot pain. He reported developing the pain after a forced eversion movement of his ankle. He was initially diagnosed as having a ‘sprained ankle’ and received physiotherapy treatment. He continued to play with pain over the next month. At this point, he saw a physician who arranged plain radiographs. These were unremarkable and his diagnosis was revised to anterior impingement secondary to an ankle sprain. A corticosteroid injection was

administered to the anterior ankle. This gave him some short-lived relief.

After over 2 months of pain, an MRI scan was arranged. This revealed an undisplaced fracture through the proximal navicular bone. The margins of the fracture were reported to be sclerotic. A small longitudinal cleft of peroneus brevis was also noted. He was advised to avoid painful weight-bearing training for a period of 8 weeks. His symptoms improved with this tactic but quickly returned when he resumed running. It was felt that this may be due to the peroneal tendon pathology, and a corticosteroid injection was administered into the peroneal tendon sheath. The patient was advised to continue with light training. The injection did not produce any significant improvement in symptoms. Five months postinjury, the patient’s dorsal foot pain persisted, and a CT scan was obtained to assess the state of the fracture ([figure 1](#)). The fracture line was clearly visible, but it was felt that there was evidence of bony healing. The athlete was encouraged to continue training as he felt able and to use pain relief.

At this point, the patient sought a ‘second opinion’ and was reviewed by another sports physician. This was approximately 5 months after he had developed symptoms. A more detailed history

Figure 1 CT appearance of the navicular stress fracture after 5 months of limited weight-bearing activity.

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was obtained, which highlighted a more gradual onset of initial symptoms, rather than an acute onset. It was felt that further management with restricted weightbearing was not appropriate and that an alternative treatment was required. He was referred for an orthopaedic opinion and an open reduction with internal fixation (ORIF) of the navicular fracture was performed.

This procedure was performed just over 6 months after first developing pain. Postoperatively, the patient was placed in a moonboot for a week of non-weightbearing (NWB). Four weeks after operation, he was encouraged to gradually increase weight-bearing walking activities, and at the 8-week assessment, he was able to walk for 30 min with only a mild and short-lived ache afterwards. He was able to hop without discomfort and no tenderness was felt at the fracture site. He was encouraged to start a walk-jog programme, with a view to returning to soccer training in a further 4 weeks.

OUTCOME AND FOLLOW-UP

A full year following the initial onset of symptoms, the patient continued to experience a mild ache throughout the day with increased time on his feet and continued tenderness with palpation of the dorsal navicular. He had not been able to return to football. A CT scan of the navicular demonstrated a near-complete union of the fracture (figure 2). A further 4-week period of relative rest was advised, as well as the use of low-intensity pulsed ultrasound to the fracture site. At this stage, the athlete was eventually able to return to full play.

DISCUSSION

Stress fractures of the tarsal navicular were first described in the literature in a case study in 1970¹ and were originally thought to be relatively rare. More recent case series have suggested that they are more common—comprising up to 15% of all stress fractures in track and field athletes.² As this case illustrates, the diagnosis of this type of injury can be challenging, as patients typically present with very vague, poorly localised foot and/or ankle pain. Important signs include pain on hopping and tenderness with palpation of the proximal dorsal navicular (the N spot).³ There may also be limited ankle dorsiflexion and subtalar stiffness.³ Due to this vague presentation, as well as its poor visualisation on routine plain radiographs, there is often a delay in diagnosis of up to 7 months or more.⁴

The navicular bone receives its blood supply from vessels entering on the medial, plantar and dorsal aspects and projecting centrally, resulting in a relatively avascular middle third.⁵ It

Figure 2 CT appearance of the navicular stress fracture 3 months after surgery.

is in this region that the majority of stress fractures are located. The fracture typically extends inferiorly from the dorsal cortex into the sagittal plane.³ As a result of the poor blood supply, these fractures are prone to non-union or a delayed union.

Plain films are generally not helpful, with MRI being the investigation of choice for suspected stress injury. Once the diagnosis has been made, CT scans are commonly conducted with a view to guiding treatment and to gain prognostic information. Saxena *et al*⁶ have described a CT-based grading system for navicular stress injuries. This system describes the extent of the fracture and suggests a treatment algorithm and estimates timeframes for returning to sport. Using this classification system, our patient had a grade III stress fracture, and Saxena's system would, therefore, advocate operative management and estimate a 4-month return to sport.

Torg *et al*⁴ were the first to describe a case series of navicular stress injuries. They reported 100% successful outcomes in incomplete or non-displaced complete navicular stress fractures treated with 6 weeks in a NWB cast. This has generally been considered to be the gold standard treatment for these injuries. Clinical experience and a review of the literature suggest that this relatively conservative approach is not often used.⁷ A large variety of conservative and surgical treatment protocols are utilised, with poor or unpredictable outcomes. Limited weight-bearing activity (LWA) remains the most common initial treatment option.³

Numerous studies and meta-analyses have since attempted to further ascertain the optimal management of such stress fractures. Khan *et al*³ reviewed treatment outcomes of 86 confirmed navicular stress fractures in athletes. Eighty-six per cent of patients treated with a NWB cast for 6 weeks returned to play at an average of 5.6 months. Only 69% of those treated with NWB for 2–5 weeks had eventual successful outcomes. Only 5 of 34 patients managed with at least 6 weeks of LWA had returned to play by 6 months, with an additional 4 patients returning to play by 1 year. Ninety per cent of patients with unsuccessful outcomes following LWA (and one case of failed surgery) managed to return to play following subsequent NWB for 6 weeks. This strongly indicates that treatment allowing LWA is inadequate for these injuries.

The surgical management of navicular stress fractures normally involves ORIF with, or without, additional bone grafting. This is often followed by a period of immobilisation and NWB. Surgical management seems to be increasingly seen as a good first-line treatment, as it is viewed by athletes and some clinicians as providing a more 'predictable' outcome. The evidence to support this is, however, lacking. Outcomes following surgical management have, in fact, been described as 'unpredictable'.⁷ While Khan *et al*'s³ case series reported an 83% success rate in those initially treated surgically, the numbers involved were very small (six cases). In addition, two of these six cases simply underwent excision of small ossicles, rather than fixation of a true stress fracture. When surgery was performed on patients with unsuccessful outcomes to LWA, 68% of them were able to return to play by 1 year. If a second operation was required, only 40% of patients were able to return to play by 1 year.

The grading system and treatment algorithm described by Saxena *et al* is widely used and is used to justify early surgical management. There is, however, no convincing evidence to support these treatment recommendations. Using their treatment protocol of NWB for 6 weeks for type I fractures and surgery, followed by 6 weeks' NWB, for type II and III fractures, Saxena *et al*⁸ observed a mean return-to-play time of around

4 months for both treatments. Combining this data with their previous study of 22 navicular fractures, Saxena *et al*⁸ concluded that there was no statistically significant difference in recovery time between conservative and operative treatment of any fracture type. Despite this conclusion, they recommend early surgical fixation for grade II and III fractures. This is on the basis that no refractures, non-unions or surgical complications were observed following ORIF in these groups in their series.

A more recent, and larger, meta-analysis of management outcomes has been published by Torg *et al*⁹. This series includes 251 fractures, and concludes that the response to treatment is independent of fracture type. Patient's age, gender and the time from symptom onset to treatment initiation do not significantly affect the outcome. This casts doubt on the utility of the treatment algorithm suggested by Saxena *et al*. No statistically significant difference was observed between treatment with 6 weeks of NWB and ORIF. A successful outcome, defined as radiographically and/or clinically healed fractures and time to return to play, was reported in 96% and 82% of patients, respectively. Average return-to-play times were 4.9 months for NWB patients and 5.2 months for ORIF patients. There was a statistical trend towards NWB as a more favourable initial treatment option. Both of these treatments were significantly superior to either NWB for less than 6 weeks or LWA. On the basis of this series, it appears that NWB for 6 weeks should be the first treatment considered for all navicular stress fractures and that LWA has no role in the management of these injuries.

After removal of the NWB cast, continued tenderness of the 'N spot' has been suggested as an indication of unsatisfactory bone healing and a further 2 weeks of NWB was recommended.^{3 10} In the authors' experience, however, all patients examined at this stage have a high degree of tenderness, and further immobilisation is generally not useful. Potter *et al*¹¹ also question the value of this finding, as tenderness was often present in some individuals after 2 years or more, despite a successful return to full function. Further pain and disability, despite a graduated return to activity, rather than bony tenderness, is likely to be the best indicator of treatment failure.

The role of imaging modalities in the assessment of clinical fracture healing is unclear. As with fractures in other sites, radiological appearances lag behind clinical improvement⁷ and no obvious CT changes may be observed following several weeks of NWB.³ Somewhat paradoxically, apparent closing of the fracture line may be seen in those managed with LWA. This can be falsely reassuring as these changes have been shown to rapidly reverse after returning to play.³ Persistent fracture lines have been visible in asymptomatic patients for up to 6 years following treatment.⁷ As a result, it has been recommended that serial CT scanning should not be used to monitor recovery. Clinical signs and symptoms are a more useful guide to recovery.³

In the current case, diagnosis was delayed for 2.5 months. A more careful history and a higher index of suspicion may have allowed this diagnosis to have been made more promptly. The initial treatment was not appropriate as there is no role for partial weight-bearing rest for this type of injury. The subsequent surgical treatment, while technically successful, was clearly not a success. At no point in his management was he

treated with NWB for 6 weeks. This is likely to have contributed to his prolonged recovery. Having now reviewed the literature, it is the authors' opinion that if surgery is going to be considered, then it should be followed by a 6-week period of NWB. Fortunately, a full recovery was eventually made, 13 months after the patient first developed pain.

Learning points

- ▶ The diagnosis of navicular stress fractures is challenging, and a high index of suspicion is required.
- ▶ Limited weightbearing is not an appropriate treatment for navicular stress injuries.
- ▶ Non-weight-bearing (NWB) cast immobilisation for 6–8 weeks appears as the gold standard treatment for navicular stress fractures.
- ▶ Open reduction with internal fixation has similar success rates and an equal return-to-play time.
- ▶ NWB cast immobilisation for 6 weeks remains a good second option for failed limited weight-bearing activity.
- ▶ CT does not appear to be a reliable tool for assessing fracture healing in this patient population.

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REFERENCES

- 1 Towne LC, Blazina ME, Cozen LN. Fatigue fracture of the tarsal navicular. *J Bone Joint Surg Am* 1970;52:376–8.
- 2 Bennall KL, Malcolm SA, Thomas SA, *et al*. The incidence and distribution of stress fractures in competitive track and field athletes. A twelve month prospective study. *Am J Sports Med* 1996;24:211–17.
- 3 Khan KM, Fuller PJ, Brukner PD, *et al*. Outcome of conservative and surgical management of navicular stress fracture in athletes. Eighty-six cases proven with computerized tomography. *Am J Sports Med* 1992;20:657–66.
- 4 Torg JS, Pavlov H, Cooley LH, *et al*. Stress fractures of the tarsal navicular. A retrospective review of twenty-one cases. *J Bone Joint Surg Am* 1982;64-A:700–12.
- 5 McCormick JJ, Bray CC, Davis WH, *et al*. Clinical and computed tomography evaluation of surgical outcomes in tarsal navicular stress fractures. *Am J Sports Med* 2011;39:1741–8.
- 6 Saxena A, Fullem B, Hannaford D. Results of treatment of 22 navicular stress fractures and a new proposed radiographic classification system. *J Foot Ankle Surg* 2000;39:96–103.
- 7 Burne SG, Mahoney CM, Forster BB, *et al*. Long-term outcome and clinico-radiological correlation using both computed tomography and magnetic resonance imaging. *Am J Sports Med* 2005;33:1875–81.
- 8 Saxena A, Fullem B. Navicular stress fractures: a prospective study on athletes. *Foot Ankle Int* 2006;27:917–21.
- 9 Torg JS, Moyer J, Gaughan JP, *et al*. Management of tarsal navicular stress fractures: conservative versus surgical treatment: a meta-analysis. *Am J Sports Med* 2010;38:1048–53.
- 10 Khan KM, Brukner PD, Kearney C, *et al*. Tarsal navicular stress fracture in athletes. *Sports Med* 1994;17:65–76.
- 11 Potter NJ, Brukner PD, Makdissi M, *et al*. Navicular stress fractures: outcomes of surgical and conservative management. *Br J Sports Med* 2006;40:692–5.

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