Novel stress radiography technique for avulsion fracture of the lateral malleolus in children: a report of three cases

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ABSTRACT

This study reports a novel stress radiography technique to evaluate an avulsion fracture at the lateral malleolus in children. Radiographs in the stress anteroposterior view or the Haraguchi calcaneofibular ligament or anterior tarotibular ligament (ATFL) projection could not detect any fracture; only manual inversion stress radiography in the Haraguchi ATFL projection could identify the avulsion fracture.

Key words: ankle fractures; child; radiography

INTRODUCTION

Anterior tarotibular ligament (ATFL) injury is rare; most such cases are avulsion fractures of the lateral malleolus.1 Cartilaginous or bony fragments have been found in 13 of 14 cases of acute ankle injuries in children aged ≤10 years.2 Haraguchi et al.3 proposed 2 novel radiographic projections for evaluation of avulsion fractures at the lateral malleolus. This paper reports three 6-year-old children with an avulsion fracture of the lateral malleolus that could not be detected by radiographs in the anteroposterior (AP) or stress AP view or the Haraguchi calcaneofibular ligament (CFL) projection (in which the leg and foot are rotated 45° medially from the position with the foot in a neutral position and the beam directed vertically through the lateral malleolus to the cassette) or ATFL projection (in which the medial border of the foot is elevated to 15° and the ankle is at 45° of plantar flexion and the beam is directed vertically through the lateral malleolus to the cassette). The fractures were only detected by manual inversion stress radiography in the Haraguchi ATFL projection (Fig. 1).

CASE REPORTS

Patient 1
In June 2012, a 6-year-old girl presented with pain on the lateral malleolus of the left ankle joint after
twisting it 2 days earlier. Physical examination revealed tenderness and swelling at the ATFL insertion of the lateral malleolus. Radiographs in the AP view, stress AP view, and Haraguchi CFL and ATFL projections did not reveal any fracture, but manual inversion stress radiography in the Haraguchi ATFL projection showed a very small fragment (Fig. 2). After 4 weeks in a short leg cast, there was evidence of union on the stress ATFL view.

Patient 2

In October 2012, a 6-year-old girl presented with pain on the lateral malleolus of the left ankle joint after twisting it that day. Physical examination revealed tenderness at the ATFL insertion of the lateral malleolus. Radiographs of the AP view, stress AP view, and Haraguchi CFL and ATFL projections did not reveal any fracture, but manual inversion stress is applied manually at the position in which the medial border of the foot is elevated to 15° and the ankle is at 45° of plantar flexion.

Figure 1

Figure 2

Radiographs in the (a) Haraguchi calcaneofibular ligament projection, (b) Haraguchi anterior tarofibular ligament (ATFL) projection, or (c) stress anteroposterior view do not reveal any fracture in the lateral malleolus. (d) Only the manual inversion stress radiograph in the Haraguchi ATFL projection shows a fracture and (e) its union after 4 weeks in a short leg cast.
stress radiography in the Haraguchi ATFL projection showed a fracture (Fig. 2). After 4 weeks in a short leg cast, the fracture was united on the stress ATFL view.

**Patient 3**

In December 2012, a 6-year-old girl presented with pain on the lateral malleolus of the right ankle joint after twisting it the day before. Physical examination revealed swelling and tenderness at the ATFL insertion of the lateral malleolus. Radiographs of the AP view, stress AP view, and Haraguchi CFL and ATFL projections did not reveal any fracture, but manual inversion stress radiography in the Haraguchi ATFL projection showed a fracture (Fig. 2). After 4 weeks in a short leg cast, the fracture was united on the stress ATFL view.

**DISCUSSION**

In children, most ankle sprains are reported to be avulsion fractures of the lateral malleolus. In some skeletally immature patients, physical examination indicates an avulsion injury yet radiographs show no evidence of an osseous avulsion fragment. Haraguchi et al. proposed 2 novel radiographic projections for evaluation of avulsion fractures at the lateral malleolus. Nonetheless, in our patients, the avulsion fracture of the lateral malleolus as a result of the traction force of the ATFL could not be detected by these radiographic techniques; only manual inversion stress radiography in the Haraguchi ATFL projection that places more traction force on the ATFL could identify the fracture. The avulsion fragment was pulled distally by the ATFL, and the fragment appeared to return to the original position of the lateral malleolus when the traction force was removed. The ATFL runs from the anteroinferior aspect of the lateral malleolus to the talus, and the position of ankle plantar flexion places increasing strain on the ATFL. This inversion stress did not lead to additional ATFL injury because the ATFL was not injured. It was easily and quickly performed without general anaesthesia; the children experienced slight but tolerable pain. Magnetic resonance imaging (MRI) is not suitable for patients aged <6 years as they cannot maintain the same position and may need sedation to reduce anxiety. MRI for acute ankle distortion injuries in children does not have any additional therapeutic value. If the avulsion fracture is not diagnosed and the patient is not treated with cast immobilisation, non-union of osteochondral fractures may result in chronic ankle instability and ankle joint pain. It is important to diagnose the avulsion fracture and treat with cast immobilisation and weight bearing to achieve more rigid fixation of the ankle joint. This is preferable to applying an ankle brace or a removable cast boot, both of which frequently result in pseudoarthrosis.

**DISCLOSURE**

No conflicts of interest were declared by the authors.

**REFERENCES**