

Acknowledgments

This investigation would not be possible without the understanding and support of the Law, Justice or Attorney General's Department in each State, the Coroners and police when they are approached for assistance.

Project Stickybeak

Readers are asked to assist this safety project by contacting the author with information, however tenuous, of serious or fatal incidents involving persons using a snorkel, scuba, hose supply or any form or rebreather apparatus. All communications are treated as being medically confidential. The information is essential if such incidents are to be identified.

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ACHILLES TENDON RUPTURE AS A DIVING INJURY

Jim Marwood

Key Words

Accidents, case report, first aid, injury, treatment.

Abstract

A case of ruptured Achilles Tendon, occurring during "giant stride" entry, is described with discussion of cause and symptoms, and notes on diagnosis and treatment.

Case report

As the diver stepped off the left foot, to make a "giant stride" entry, he felt a blow on the back of the left ankle. He began finning, but the ankle felt powerless. When, after a few minutes, there was no improvement he decided to surface and return to the boat.

The dive boat was an open "shark cat" type with a side-entry port over a low step. Conditions were calm, but a low swell caused the boat to roll. The diver recalled that as he strode off, his left heel was unsupported, being over the back of the step, and he was unbalanced by the motion of the boat. He believed he had been struck by a falling plank or dive-weight, but this the boat handler strenuously denied.

At 65 the diver was well over the usual age of diving patients, but apart from age he had no factors pre-disposing to injury. He was reasonably fit and accustomed to manual

work. He had logged 55 dives in the preceding twelve months, with some 35 giant stride entries loaded, as he was on this occasion, with cold-water gear and heavy photographic equipment.

On return to shore removal of the left drysuit boot was painful. The diver could walk with a limp, but extreme pain on ankle flexion prevented walking on soft sand. There was a little posterior swelling but no bruising. He had full active ankle movement but was unable to rise up on the left forefoot.

Two days later, as weakness persisted, the diver sought medical advice and with the diagnosis of ruptured Achilles tendon (AT) was referred to an orthopaedic surgeon. Open repair was carried out, followed by six weeks in a non-weight bearing below-knee cast. The patient was impatient about mobilisation and this stretched the repair. The tendon healed with residual muscle weakness. At the time of writing, a year later, he can just support his weight on the left forefoot.

Discussion

A direct blow may break the AT, but about 60% of injuries occur in amateur athletes pushing off with a straight leg.¹ This group usually tears close to the tendo-muscular junction, with better healing prospects than those of older, debilitated subjects, whose tear is usually in the distal, avascular part of the tendon.² The patient was gratified to learn he had joined the former group.

At the time of injury the left ankle was carrying a static load of about 125 kg, increased by the forward thrust and perhaps by the boat motion. Clearly a loaded diver making a stride entry is a candidate for injury. A broad platform for a diver's take off would avoid over-extension of the tendon and seems a reasonable recommendation. When heavily laden, entry from a sitting position may be less stylish, but removes the risk of ankle injury.

Diagnosis

Symptoms may be misleadingly minor. A false positive diagnosis of AT rupture may be reached with pain and weakness from a torn Gastrocnemius or Plantaris, or occasionally with acute inflammation of an accessory Soleus muscle lying between AT and tibia.³ Sometimes a patient may report an audible pop as the tendon breaks, but often, as in this case, there is neither sound nor much pain. There is always weakness of ankle extension, though full action remains thanks to intact Plantaris and long toe flexors. This residual action may encourage an element of denial. Sometimes there is a palpable gap in the tendon, but this may be masked by local swelling.⁴ These factors explain the reported 20-30% of missed diagnoses.⁵

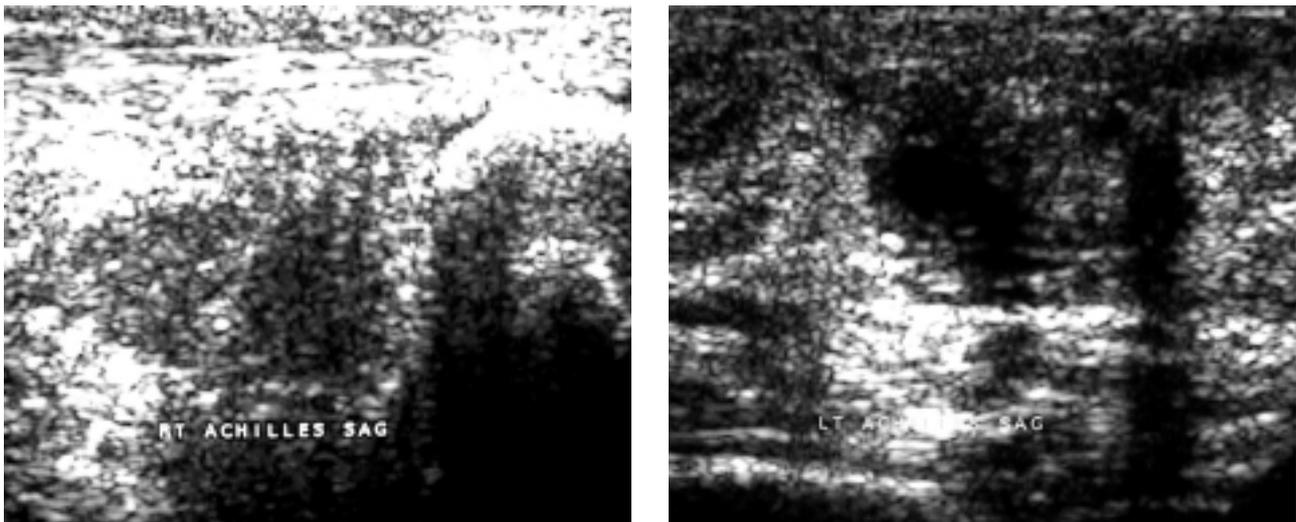


Figure 1. Ultrasound scans of the right intact Achilles tendon and of the ruptured left tendon.
Scans and reproductions by Dr R Jones.

Early diagnosis is very desirable, since four weeks' delay in treatment may leave a 20% loss in muscle power.^{5,6} Imaging by a skilled ultrasonographer can show the tendon gap, and on ankle extension the small tendons may be seen to slide past the static AT. Magnetic Resonance Imaging is sometimes available for those who can afford it, though luckily there is a reliable and less expensive test that has been available on every dive boat since it was first described thirty-six years ago.⁷ This, the Thompson test, requires the patient to lie prone with the knee up at right-angles. When the calf is squeezed firmly an intact TA extends the ankle against gravity. There is no movement from a broken tendon.

Treatment

Tendon healing is by migration of tendoblasts from damaged fibres and laying down of new collagen, but also by in-growth of vessels and fibroblasts from surrounding connective tissue.⁸ Treatment is aimed at minimising the latter, gap-filling process by early apposition of the broken ends. Inactive patients may be offered conservative treatment, with the foot immobilised in equinus, though at the cost of a weakened union. Open repair, using heavy, non-absorbable sutures, is preferred, either with or without fascial graft reinforcement. After removal of the cast a brace with dorsiflexion stop will curb over-enthusiastic mobilisation.⁹

Conclusion

Amateur athletes are a recognised at-risk group for TA rupture. No doubt the diving fraternity will be pleased to be counted among them, though other pre-disposing factors, obesity and sub-optimal fitness are, regrettably, always with us. Gout is said to make the injury more likely,

as is previous, well-meant, injection of steroid.¹⁰ In these enlightened days of diving for the disabled perhaps we should be prepared also for other listed factors, rheumatoid arthritis, subacute lupus erythematosus, diabetes mellitus, renal failure and hyper-parathyroidism.

The rarity of TA rupture as a dive injury is hard to explain. Neither the SPUMS Journal Index (covering the years 1972-1998) nor Dr Douglas Walker, Collator of Project Stickybeak, has a reported case. This rarity, plus the undeserved nature of many ruptured TA injuries are clearly factors in the common diagnostic delay. A denial factor and a low index of suspicion play a part as well. The take-home message must be that rapid referral will minimise morbidity. Finally, as illustrated by the case described, our more obsessive patients have to be impressed with the need for patience to achieve firm healing before they return to full activity.

References

- 1 Jozsa L, Kvist M, Balint B et al. The role of recreational sport activity in Achilles tendon rupture. *Am J Sports Med* 1989; 17: 338-343
- 2 Morris PJ and Malt RA. Eds. *Oxford Textbook of Surgery*. Oxford : Oxford University Press, 1994; 2305
- 3 Berquist TH. *Imaging Sports Injuries*. Gaithersburg, Maryland: Aspen, 1995
- 4 Ralston EL and Schmidt ER. Repair of ruptured Achilles tendon. *J Trauma* 1971; 11: 15
- 5 Inglis AE, Scott WN et al. Rupture of the tendo achilles. *J Bone Joint Surg* 1976; 58A : 990-993
- 6 Reynolds IS. Trauma to the Os Calcis and the heel cord. In *Disorders of the Foot* Jahss MH. Ed. Philadelphia: W B Saunders 1982; 1497-1542
- 7 Thompson TC and Doherty JH. Spontaneous rupture

of the tendon of Achilles: a new clinical diagnostic test. *J Trauma* 1962; 2: 126-129

8 Bullough PG and Vigorita VJ. Eds. *Atlas of Orthopaedic Pathology. 2nd edition.* London: Gower, 1992

9 Campbell MW. Ed. *Operative Orthopaedics.* Philadelphia; Lippincott Co, 1988

10 Kleinman M and Gross AE. Achilles tendon rupture following steroid injection. *J Bone Joint Surg* 1983; 65A: 1345-1387

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THE WORLD AS IT IS

**WHY DID DAN
SUSPEND COVER FOR VANUATU ?**

John Lippmann

Key Words

Accident, decompression illness, insurance, rescue, transport.

Over the past two years, DAN has been involved in the evacuation of around 15 divers from Vanuatu. We are also aware of a substantial number of divers who were not evacuated but who required treatment for decompression illness after returning home from Vanuatu.

Many of these divers had been diving on the *President Coolidge*, off Santo, to depths from around 20 m to approaching 70 m. DAN has expressed concern for some time about the amount of deep diving conducted on the *Coolidge*. In particular we have been concerned about:

- 1 The depth and number of dives conducted;
- 2 the minimal experience of many of the divers;
- 3 the incidence and severity of decompression illness occurring;
- 4 the lack of appropriate medical facilities for treating divers in Vanuatu;
- 5 the general lack of appropriate oxygen equipment and trained personnel;
- 6 the difficulty and delays sometimes associated with evacuating a person from Vanuatu;
- 7 the cost of evacuating a person from Vanuatu (around \$40,000).

Many divers believe that DAN is little more than an insurance company. **DAN is not an insurance company.** DAN buys insurance for its members from insurance companies. DAN is a non-profit, membership-based organisation dedicated to improving dive safety through a variety of activities that include:

- 1 Regular dive safety journals; educational programs and seminars;
- 2 funding diving emergency hotlines (e.g. the DES in Australia);
- 3 providing evacuation cover;
- 4 providing very economical dive injury insurance;
- 5 providing economical and effective oxygen equipment;
- 6 the provision of advisory services for diving health and safety;
- 7 providing support for the establishment of recompression chambers;
- 8 donation of safety equipment;
- 9 collection, analysis and reporting of dive accident data.

Over the past 12 months or so, DAN SEAP has expressed its concern to several dive operators in Vanuatu, pointing out that some insurers were considering placing restrictions on cover for certain dive destinations known to produce DCI. We warned that it was possible that some insurers might cease to offer cover for diving accidents in certain places. Despite our expressions of concern, we observed no reduction in the number of cases.

DAN believes that the best solution would be to have a suitable recompression facility established in Vanuatu. To this end, we approached some organisations and requested that they consider establishing such a facility. DAN offered to make a substantial initial contribution to the chamber and has offered to provide some funds to cover the on-going training and supervision requirements. One of the organisations we approached has spent considerable effort investigating establishing a facility in Vanuatu. The essential condition is that chamber is financially supported by the dive operators, who would have to put a small levy on the cost of each dive to cover the ongoing maintenance and operational costs of the chamber. There was some initial reluctance of some dive operators to support the levy concept and the potential chamber installer has notified us that he is now unwilling to commit himself to installing a chamber in Vanuatu.