SPECIAL ARTICLE

Missed tendon injuries

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INTRODUCTION

The timing of the repair of divided tendons may be debated but in most cases a clearly divided tendon should be repaired primarily and, whether or not primary repair is indicated, 'the ideal treatment programme is immediate surgery performed by an experienced surgeon' (McGrouther *et al.*, 1990). If a tendon injury is missed, deformity may occur, the patient may need further surgical procedures, the period of disability between injury and normal use will be longer and the long term result may be less good.

Unfortunately it is well recognized that such injuries can be missed. There is very little written about the incidence of missed tendon injuries but two series of flexor tendon repairs describe late diagnosis occurring in 15% (Early & Milward, 1982) and 20% (Morgan & Palmer, 1989) of cases. Honner in 1975 described his treatment of 44 patients with late diagnosed flexor digitorum profundus injuries.

There is even less written on the incidence of missed extensor tendon injuries but the numerous procedures available for the management of the chronic boutonnière deformity (Froelich *et al.*, 1988) indicates how commonly this injury is missed.

The problem is therefore a significant one and although numerous review articles on tendon injury recognize the problem of late diagnosis and the difficulties of diagnosis, the question of why and how these injuries are missed which is so important if the problem is to be avoided, has not been addressed.

Over several years and in more than one hospital, I have seen 25 patients with 26 open tendon injuries missed at a first attendance to the Accident & Emergency (A&E) department. These I investigated and in this report I seek to show how and why these occurred.

The injuries missed are shown in Table 1 and the mechanisms of injury are shown in Table 2. One patient has an associated nerve injury missed and on five occasions the tendon injury was missed at two visits to the A&E Department.

Table 1 Site of tendon injury

Hand	
Extensor tendon distal to P-I-P joint	7
Extensor tendon central slip	1
Extensor tendon over M-C-P joint or more proximal	4
Flexor digitorum profundus in hand	4
Flexor digitorum superficialis at wrist	2
Extensor pollicis longus	2
Extensor pollicis longus and extensor digitorum on dorsum of hand	1
Foot	
Extensor hallucis longus	3
Flexor tendon in foot	1

Table 2 Mechanism of injury

Glass	9
Knife	3
Sharp metal	3
Crush/blunt force	3
Penetrating injury with drill	1
Unknown	1
Not stated	4

The most obvious way to miss a tendon injury is to fail to examine for it and this was probably the reason in 13 patients in whom there was no record that tendon function had been examined. One patient had a severe abdominal stab wound which had taken precedence over seemingly minor defensive wounds of the fingers and two others had injuries sustained in road accidents which had also diverted attention away from wounds of the hands. One patient had a penetrating injury with a small drill that was not expected to divide a tendon and in most of the patients with a crush injury it was clear that the doctors has sought to exclude a fracture and had not considered the possibility of a tendon injury. In some of the patients with glass injuries, the exclusion of a glass foreign body seemed to be a priority rather than the exclusion of an underlying injury. One patient was said to have superficial skin loss over the distal interphalangeal (DIP) joint but the later finding of a tendon injury and the behaviour of the wound indicated that the wound was full thickness. In the remaining patients, the failure to examine for a tendon injury was inexplicable and was probably caused by feeling that the wound was too superficial to have divided a tendon, by taking short cuts when busy or by simply forgetting to do it in individual cases.

Of more worry is that in 11 cases the records made some reference to the tendons having been tested. In a few it stated 'tendons intact' and in others there were more vague statements such as 'tendons seem intact', 'no obvious tendon

involved' or even 'movement ✓'. In at least three patients this statement seemed to be based on an examination of the wound rather than an examination of tendon function distal to the wound. In no case did it state which tendon had been examined.

The most likely explanation is that these injuries occurred at the time of the injury and were missed by the doctor who examined the wound at the time. Other possibilities, however, do exist: a tendon may be partially divided or crushed, formal testing will demonstrate that the tendon is intact but it may then rupture later. I believe, however, that the majority, and possibly all, of the patients described had a missed tendon injury and not a delayed rupture. When the tendon injury was diagnosed, many patients were asked when they had first noticed a problem and they all replied that it had been immediately after the injury.

The examination for tendon injury in the hand is well described in textbooks of orthopaedics and hand surgery but it is my experience and that of many senior A&E medical staff that most doctors, on starting work in an Accident & Emergency Department are unable to test tendon function properly and almost certainly these injuries were missed because the examination was inadequate. It must be acknowledged that a proper examination for tendon injuries in children may be very difficult, if not impossible.

To casually observe a patient making a fist and then extending their fingers and thumb does not exclude a tendon injury. Looking into a wound and seeing an intact tendon does not exclude a tendon injury either as if a wound is sustained with the finger flexed and the finger is then examined while it is extended, the level of the tendon injury will not correspond to the level of the skin laceration.

Flexor digitorum profundus (FDP) flexes the DIP joint. If the tendon is divided in the finger and flexor digitorum superficialis (FDS) remains intact, when the patient makes a fist the DIP joint will not flex. This is easily overlooked.

Injuries of an FDP tendon at the wrist may be even more difficult to diagnose as there may be weak flexion of the DIP joint provided by the interconnections between the four profundus tendons (Flatt, 1979.)

Injuries of FDS are even easier to overlook as the patient can flex both finger joints using the profundus tendon and only formal testing will demonstrate it.

The interconnections between the extensor tendons on the dorsum of the hand mean that even if the tendon to one finger is completely divided proximal to the interconnections it is possible for there to be extension of the finger by the extensor tendons to adjacent fingers. However, this extension will be weak and the patient will be unable to hyperextend the finger. These injuries, too, are easily missed if a proper examination is not performed.

The index and little fingers each have two extensor tendons and if one is intact then the patient will still be able to extend the finger.

If there is a wound over the dorsum of the proximal phalanx extension of the proximal interphalangeal joint should be examined with the metacarpophalangeal (MCP) joint in extension as if the MCP joint is flexed, the PIP joint may be extended by the lumbrical muscles even if the extensor digitorum tendon is completely divided.

An injury to the central slip of the extensor tendon over the PIP joint will initially cause only minor or no loss of active extension at the PIP joints as extension is still provided by the lateral slips of the extensor tendon. Even when there is loss of extension this may be overlooked or attributed to pain. It is not until later when the lateral slips of the tendon move anteriorly that the bountonière deformity of flexion at the PIP joint and hyperextension at the DIP joint becomes obvious. Flatt (1979) describes all tests for this injury as unreliable, but Elson (1986) has described a test in which the PIP joint is held flexed over the edge of a table. In this position the patient is asked to extend the middle phalanx against resistance. If the central slip is intact all the extension occurs through this and the DIP joint remains fail but if the central slip is divided extension is provided by the lateral bands and the DIP joint extends. This test is not, however, in general use.

Division of the extensor tendon distal to the PIP joint will cause a mallet deformity but this may not be obvious immediately if there are adhesions between the tendon and the oblique retinacular ligament (Lister 1981).

Extensor pollicis longus (EPL) extends the interphalangeal joint of the thumb. This should be examined with the thumb abducted when the bowstringing of the tendon where it forms the posterior border of the anatomical snuff box is additional evidence that the tendon is intact. If the thumb is held adducted then extension of the IP joint can be provided by extensor pollicis brevis and an EPL tendon injury can be missed.

Tendon injuries of the ankle and foot are much less common than those in the wrist and hand with the consequence that they may not be considered. Missed tendon injuries do occur (Citron, 1985; Crosby *et al.*, 1988.)

CONCLUSIONS

In hand injuries 'errors in diagnosis can occur only because of errors of omission or commission in the examination' (Flatt, 1979).

My conclusions are not original but the rules of good clinical practice obviously need to be restated.

(1) All doctors seeing injured patients should be properly taught to examine the hand for tendon injuries. Consultants in charge of Accident & Emergency Departments should ensure that their staff are able to do this.

(2) All patients with wounds, no matter how superficial they seem and even if caused by a blunt force or penetrating injury should have tendon (and nerve) function tested distal to that wound no matter what other injuries the patient has. If there are multiple wounds this should be done for every wound. Looking into a wound and seeing an intact tendon does not exclude its injury.

(3) Because of the difficulties of excluding extensor tendon injuries all wounds which from their position might have divided an extensor tendon should be explored in addition to tendon function being tested distally.

(4) Words such as 'tendons intact' are easily written but do not signify what examination has been performed to justify the statement. The tendons tested

should be noted. For example, if a patient has a wound on the front of the wrist, the examination note should read:

'FDP √√√√ FDS √√√√ FPL √ FCR √ FCU √ median n √ ulnar n √'

(5) Patients with wounds of the foot and ankle should also be examined for tendon and nerve injury.

(6) When patients with wounds return for review or for their sutures to be removed, tendon and nerve function should be re-examined.

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