What are the structure, function and biomechanics of tendons in the hand?

Structure

Normal tendon is composed of 65–70% water overall. Of its dry weight 80% is extracellular matrix, the majority of which is type I collagen (70%) with 2% elastin and 2–5% ground substance (glycoprotein, proteoglycan and plasma proteins), and the remaining weight is tenocyte fibroblastic cells. The role of these cells is to produce procollagen and remodel the extracellular matrix. Two chains of $\alpha$1(I) procollagen polypeptide coil with one $\alpha$2(I) procollagen forming a right-handed triple helix. This triple helix structure forms partly as a result of the abundance of proline and hydroxyproline amino acids and is stabilised by cross-linking bonds and glycopeptide molecules. The crosslinking, which increases with maturity of the tendon, also increases its tensile strength. Within tendon these structures are organised longitudinally in a staggered pattern to form micro-fibrils, which are visible under electron microscopy. The collagen fibres are arranged in progressively larger bundles to form sub-fibrils and fibrils. These are packed in tight bundles with proteoglycans to form fascicles bound by endotenon, which also provides conduits for vessels and nerve fibres. In contrast, the arrangements of collagen fibres in ligament are not strictly parallel. Several fascicles form a tendon with a synovial epitenon membrane, which allows it to glide smoothly (see Figure 1).

The epitenon layer continues at the musculo-tendinous junction with the perimysium, providing continuity with muscle. At the tendon–bone interface the epitenon continues onto periosteum with perforating fibres of Sharpey. There are four zones at a tendon insertion (see Table 1). These zones are separated by the stiffness of tissue so reducing the stress concentrated at the insertion site.

*Corresponding author.
E-mail address: philipparust@hotmail.com (P.A. Rust).
Function

Tendons are simply cables by which force produced by muscle contraction is transmitted to bone resulting in joint movement. The power and precision of the hand is a result of organisation of layers of extrinsic tendons and intrinsic muscles within it. The large forearm muscles can generate high tensile loads, as much as 120 N in the index flexor digitorum profundus (FDP) with strong pinch grip.  

Biomechanics

The stress–strain curve for tendon, which is very similar to collagen, is divided into four regions (see Figure 2). Firstly, a toe region where initial loading causes the collagen fibres to un-crimp, straightening the wavy pattern of relaxed fibres. Secondly, a linear region where the extension of the straighten fibres (strain) is proportional to the load (stress), producing its Young’s modulus. This is also called the elastic region, as removal of the load results in return to original tendon length. In the third region the tendon becomes plastic, with failure of some of the most stretched fibres strain is no longer proportional to stress. The point of transmission from elastic to plastic deformation occurs at the yield point. Finally the tendon fails at its maximum strength, the ultimate tensile strength, following which there may be a very low resistance to extension if the connective tissue surrounding the tendon is intact, region 4.

Tendon exhibits rate- and time-dependant properties known as viscoelasticity, which is characterised by creep, stress relaxation and hysteresis. Creep occurs when extension (strain) of the tendon increases over time when it is held at a constant load (stress), this is a property used in the application of serial splinting. Stress relaxation is when a constant length (strain) is maintained by a reduced load over time. With cyclical loading, creep elongates the tendon causing increased extension with each constant load applied. The difference between the upswing and the downswing loop with each cycle is known as hysteresis and represents the energy absorbed by the tendon.

What is the anatomy related to the flexor tendon zones?

In order to prevent bowstringing of the tendons across the finger with flexion, they are held to the phalanges and joints by a system of pulleys. These increase the range of movement of the joints by decreasing the lever arm. However, as the reduced lever arm reduces the power transmitted from the muscle, this has to be overcome by relatively more muscle bulk, contained in the forearm. The tendon sheath is made up of two osseous pulleys A2 and A4. The A2 pulley holds FDP and FDS to the proximal phalanx. The A4 is the next most important, holding the FDP to the middle phalanx. In between these the A1 is at the MCP joint and is involved in trigger fingers and A3 and A5 attach to the volar plates of the PIP and DIP joints, respectively. There are cruciate pulleys between these which compress with flexion. Based on the position of the tendon within the hand, injuries are divided into five zones (see Figure 3).

Tendons receive their blood supply mainly through the vinculae (akin to a mesentery), as there is minimal intratendinous supply and only passive diffusion of nutrients from synovial fluid within the paratenon. The vinculae contain branches from each digital artery, with a superficial and a deep vessel to the dorsal side of each tendon. These are of particular importance in cases of delayed FDP rupture where the tendon has retracted into the palm and thus the vinculae are injured.

How does a tendon heal?

Tendons heal by both intrinsic and extrinsic methods. Although clinically it is impossible to separate the cellular events involved in each method, the degree of each is influenced by injury and treatment. Tender healing is divided into three stages. The first stage is the inflammatory phase characterised by the release of cytokines,
the inflammatory phase the tendon strength reduces by also needs to withstand gap formation, as during the remodelling phase, which occurs from 28 days to 3 months as the scar matures and collagen realigns. In addition to this period of time, return to normal ultimate tensile strength also requires physiological loading.

A higher proportion of extrinsic healing increases scar tissue around the tendon, reducing tendon glide. With the aim of avoiding this, the treatment of cut tendons involves apposing the ends with strong, gap-resistant sutures secure enough to tolerate early controlled mobilisation. Controlled motion reduces adhesions, improves excursion and increases tendon nutrition, as it encourages intrinsic healing and reduces extrinsic healing and scar formation. The suture also needs to withstand gap formation, as during the inflammatory phase the tendon strength reduces by 10–60%5 when the ends are held only by flimsy fibrin and clot. Between 5 and 21 days, therefore, the repair strength is dependant almost entirely on the suture. Active motion rehabilitation should be started before day 5, as starting after this point increases the risk of rupture.

What are the principles of flexor tendon repair?

The technique of tendon repair using a core suture was first described by Kirchmayr in 1917, but was popularised by Kessler.5 Much research is published on the subject, with many different suturing techniques described, including Tajima’s modifications of Kessler, Strickland, cruciate and Tsuge.6,9 However, some general conclusions can be drawn from the literature. Firstly, that the initial strength of the repair is proportional to the number of suture strands that cross the tendon gap. Savage showed that a six strand repair is stronger than a four strand, which is stronger than a two strand.10,11 Since this early work there have been a number of studies correlating the number of suture stands crossing the repair with repair strength.12–16 However, the more complicated the repair, the more difficult the technique and increased chance of tendon damage, or stitch division, with a subsequent pass of the needle. So, based on current evidence, we would suggest that a four strand core suture should be used as a minimum.

The strength of the repair increases with the calibre of the suture, however, quantity of suture increases the bulk of the repair so reducing tendon glide, therefore 3/0 or 4/0 non-absorbable sutures have been suggested for adequate strength and ease of placement balanced with volume of suture material.17 Ruptures usually occur at the knots, but this may be reduced by using braided sutures.17

In addition to a core suture, an epitendinous suture is used to smooth the tendon repair, improve glide, reduce gapping and increase strength by 10–59%,12,18,19 A locking epitendinous suture has been described, which gives greater strength;20 however, it is technically difficult. The aim of the repair is to have a strong enough repair that prevents tendon gapping and allows early active mobilisation, which encourages intrinsic healing and reduces adhesions.

What is the significance of closed zone 1 injuries and its classification?

A closed FDP avulsion is often referred to as rugger jersey finger, as they commonly occur in the ring finger when it gets caught in a fellow player’s jersey. As this is a closed injury a high index of suspicion is needed to avoid delayed diagnosis, especially as the tendon can retract back to the palm with rupture of both vinculae, resulting in loss of blood supply, haematoma in the sheath and subsequent scar formation and joint contracture if untreated.

Leddy and Packer21 classified these injuries depending on the degree of tendon retraction, with type 1 retraction back to the palm (the most severe type), type 2 retraction to the proximal phalanx held at the FDS decussation and type 3 a large bony avulsion holding the tendon at the A4 pulley, preventing retraction past the DIP joint. In type 2, a flake of bone may be seen on the lateral X-ray indicating the level of retraction, otherwise ultrasound is the investigation of choice.

This classification can used to direct treatment, with type 1 requiring urgent surgical reattachment of FDP to distal phalanx, as vinculae to FPD are ruptured. A number of different techniques are described. Our preferred method is...
to expose the tendon ends and sheath through a Bruner incision from the level of the DIPJ to the A1 pulley in the palm. The end of the tendon is passed through the intact flexor sheath using a paediatric feeding tube and reattached to the distal phalanx using a Bunnell suture passed through the phalanx with an eyed needle and tied over a dental roll on the nail. As described by Elliot, if there is difficulty in passing the tendon beneath the A4 pulley then dividing the tendon in half longitudinally along the natural cleavage line can help.\textsuperscript{13} In cases where the diagnosis is delayed more than 3 weeks, tendon reattachment tends to fail due to loss of blood supply and contraction of the tendon. Hence, cases diagnosed late require reconstruction of FDP with a graft, or DIPJ fusion which can be rehabilitated in a shorter time and gives more reliable results. In cases where the FDP end causes a painful nodule in the palm, this can be excised.

Type 2 has a better prognosis, as the long vinculae remain intact and as such can be repaired up to 3 months. In late cases, as described above, the FDP tendon can be reduced in size to get the tendon beneath a collapsed A4 pulley. Type 3 injuries require bony attachment of the fragment with sutures or mini screws.

Why have zone two injuries been called “no man’s land”?

Zone 2 injuries lie between the A1 pulley and the insertion of FDS on the middle phalanx and therefore incorporate two tendons within the flexor sheath. Bunnell named this “no man’s land” after his First World War experience in France, where it was used to describe the strip of devastated land between enemy trenches, as he recognised that restrictive adhesions followed tendon injuries in this area. He advised repair only of FDP and post-operative immobilisation in wrist flexion with “sufficient motion to stimulate growth and lessen adhesions” during healing. However, because of generally unsatisfactory results, up to the 1960s primary tendon repair in zone 2 was not practiced, but rather the tendons were excised and FDP grafted. Following Kienert’s\textsuperscript{22} initial work, much research has been done on tendon repair and healing, especially in zone 2, with improved techniques and suture materials showing reduced gap formation allowing early mobilisation. Current practice is to repair both tendons\textsuperscript{13}, as this allows independent movement of both PIP and DIP joints, encouraging tendon glide and helping to prevent adhesions. An intact FDS also wraps around FDP, acting like a dynamic pulley.

Is examination important?

With careful examination there are various observations that should alert one to a likely flexor tendon injury, including loss of the normal finger cascade, loss of the tenodesis effect, no passive movement in the fingers on squeeze compression of the forearm muscle bulk, as well as loss of individual active movement of PIP and DIP joints by isolated FDP and FDS testing.\textsuperscript{24} With lacerations caused by glass, the wound may be deceptively small and yet the damage done extensive.

When exploring finger lacerations, the position the finger was in at the time of the injury is important as it informs the surgeon as to where the level of the tendon division will lie when the finger is out straight, for example if the tendon laceration occurred when the finger was flexed the tendon laceration will be distal to the skin wound and so the distal end of the tendon cannot be retrieved into the traumatic wound and will have to be exposed by distal exposure and this where the tendon repair will need to be carried out. Conversely, a fall with the hand flat will lead to the tendon division being at the site of the traumatic wound.

What surgical techniques can help with the repair of lacerations in zone 2?

At exploration blood seen within the flexor sheath is an indication of tendon laceration. In those cases where the proximal end of the tendon has retracted away from the wound, flexing the wrist and milking it down can deliver the tendon end. Similar milking can be used to deliver a retracted distal end, but it will only come down if the tendon division occurred with the finger straight. If this fails the ends will need to be found by surgical exposure and then passed it through the flexor sheath. The tendons can be passed through the A2 pulley using a paediatric feeding catheter. The flexor sheath can be opened and reflected as a window between the A2 and A4 pulleys to allow retrieval, passage and repair of tendons.

If the laceration is under the A4 or A2 pulley, in addition to flexing the finger to move the repair site out of the pulley, the end third of these pulleys can be divided to allow access to the tendon end for repair. Following tendon repair, sheath repair has been suggested to act as a barrier to adhesions; however, various studies have not confirmed a clinical advantage.\textsuperscript{2} Therefore, as repair may reduce volume and thus tendon glide we suggest that the sheath should be replaced back but not sutured. Once the tendon has been repaired its excursion through the pulleys is checked with passive range of movement. If the pulleys are too tight for the repaired tendon to pass through they can be dilated. If it is still too tight it is preferable to vent the pulley, by dividing up to a third along its edge either distally or proximally,\textsuperscript{25} rather than risking the repair catching and rupturing.

What are the factors affecting zone 3–5 injuries?

Tendon injuries in zone 3 are prevented from retracting due to the lumbral attachment and lacerations in the carpal tunnel are unusual. When repairing wrist lacerations in zone 5 it is important to be aware that isolated tendon injuries are uncommon. So, as nerve and artery damage should be anticipated, pre-operative assessment includes examination of sensation, motor assessment and an Allen’s test, in addition to testing tendon integrity as described earlier. Exploration with loupe magnification is advisable. Tendon repairs in this area are repaired as elsewhere with a 3/0 or 4/0 non-absorbable core 4-strand suture and a 6/0 non-absorbable epitendinous suture.
What are the principles of treatment of complex injuries?

In more complex injuries skin, tendons, nerves, bone and joints may be damaged. This predicates against a satisfactory outcome. To try and achieve the best result it is important to try and restore immediate tendon function. To enable satisfactory healing and gliding, a tendon needs a well-vascularised bed, stable bony fixation, a functioning flexor sheath (especially the A2 and A4 pulleys) and soft tissue cover. These injuries are best treated by stable internal fixation of fractures to allow early active tendon mobilisation. Flexor sheath reconstruction can be performed either by sacrificing one of the flexor tendons or using extensor retinaculum. Exposed tendon requires immediate cover to prevent desiccation and, as skin grafts will not take directly onto bare tendon, large soft tissue wounds, such as roll-over injuries, usually require flap coverage.

How has flexor tendon rehabilitation evolved to current practice?

Immobilisation was historically used after flexor tendon repair as the fear was of tendon rupture; however, due to the marked adhesions that formed and the severe stiffness that developed following this, mobilisation protocols were developed. There remain a few specific indications for immobilisation, for example children or adults that cannot comprehend or comply with active or passive rehabilitation programmes. Other relative indications are where it is necessary because of associated injuries and disorders that can affect tendon healing e.g. rheumatoid arthritis.

As suture techniques improved gap resistance, early controlled forces were shown to not only increase intrinsic tendon healing and recovery of tensile strength, but also reduced adhesions by allowing tendon excursion. Two basic passive motion programs were subsequently developed Duran–Houser and Kleinert.

In the 1970s, Duran and Houser showed that passive movement would produce 3–5 mm of tendon glide by extending the DIP or PIP joint while the other joint was held flexed, as this moves FDP and FDS independently, moves the repairs away from each other and away from the site of injury, so reducing the formation of adhesions. The patient does these passive exercises with a dorsal blocking splint. This regimen is occasionally used now when tendon repair is such that a full repair is not possible or if the fear was of tendon rupture; however, due to current practice?

What should be expected after tendon repair?

Rupture after a four strand tendon repair technique is uncommon, 4–17% in zone 2 and 3–17% with FPL, however, it is the most significant complication. It may occur with inadvertent strong gripping, lifting or functional use of the hand and so patient education is extremely important. On some occasions, despite commitment to therapy, reduced range of motion with contractures at DIP and PIP joints occur and an estimated 10% of zone 2 injuries require secondary tenolysis or tendon graft.

Outcome can be measured using the total active range of motion (TAM) method by totalling the DIP and PIP joints range in degrees, which was proposed by the American Society of Surgery of the Hand and modified. As an active range over 80% compared to the normal side gives excellent function to the fingers, this is taken into account with this grading method, which divides results into excellent, good, fair and poor. As tendon healing takes time outcome should not be measured before 3 months. In a review of 15 papers’ results over the past 15 years TAM outcome measured excellent or good in three quarters of primary tendon repairs following various rehabilitation regimes.

When is tenolysis indicated?

Flexor tenolysis is performed to release non-gliding adhesions formed on the tendon surface that reduces range of movement. Adhesions form after any tendon injury but the incidence increases with crush injuries, fracture callus, soft tissue injury, infection and immobilisation. Treatment starts with therapy to restore gliding and mobilise stiff joints; however, if progress plateaus and there is a significant difference between passive (full) and active (limited) motion of the finger then tenolysis is indicated. Other prerequisites are that fractures have united, skin is stable.
and supple, there is good muscle strength, mobile joints with a near full passive range, a compliant patient and availability of immediate therapy for active mobilisation and good pain relief post-operatively.

Sometimes it is very hard to know whether the flexor repair is intact despite careful clinical examination. Ultrasound can be helpful. However, all patients undergoing tenolysis should be warned that the tendon may not be intact and that there is a risk of surgical damage leading to rupture. The patient should, therefore, also be consented for insertion of a tendon rod.

**How should delayed flexor tendon lacerations be treated?**

If a flexor tendon repair is delayed beyond a few days certain criteria need to be met for delayed direct repair. These include no segmental loss of tendon, adequate skin and soft tissue cover, good passive range of movement of the joints with no contracture, adequate sensation and vascularity of the finger and skeletal alignment. If these are not fulfilled tendon grafting or transfer should be considered.

If there is a delay of more than 3 weeks the tendon ends degenerate and the gap fills with scar tissue, and direct repair is not possible. In this situation primary tendon grafting can be considered. Other indications for primary tendon grafting are an acute injury with segmental tendon loss and delayed type 1 FDP avulsion. However, in order for a single stage tendon graft to be successful the finger needs to be in good condition. The criteria are the same as for tenolysis (see above) apart from the requirement that the flexor sheath is undamaged and patent.

In a single stage tendon graft palmaris longus, plantaris or a toe extensor can be harvested as tendon graft. Palmaris is absent in 16% of people unilaterally and 9% bilaterally and plantaris is absent in 7%. Ultrasound can be used to identify plantaris. The tendon graft is attached to the distal phalanx as for a FDP reattachment, described earlier, and the proximal graft is weaved through the free tendon end using a Pulvertaft weave with 3–4 weaves, outside the flexor sheath either in the palm or wrist. This is usually strong enough to allow early active mobilisation, in a dorsal blocking splint similar to flexor tendon repair rehabilitation.

The graft should be tensioned by observing the tenodesis effect and the normal cascade of the fingers. Only one graft is done per finger, and when restoring FDP function if there is an intact FDS this should not be sacrificed.

More commonly a two-stage tendon graft reconstruction is necessary, as the criteria for single stage grafting are rarely found. Usually flexor reconstruction is needed as the result of the failure of an acute repair. If a tendon repair ruptures then a further attempt can be made to re-repair the tendon; however, this should only be done if the soft tissues and joints are in a suitable state. More often than not, the soft tissues are thickened and the joints stiff in which case single stage grafting is doomed to failure. Once the finger is in a satisfactory state the flexor sheath will have collapsed and a silicone rod will be needed to create a new synovial sheath. Another indication is the need to reconstruct fibrous pulleys.

The patient needs to be aware that the process requires two operations and regular therapy to get a good result. The alternatives to tendon grafting are a tenodesis or arthrodesis of the DIP joint where just FDP is missing or amputation where both flexor tendons are missing.

The first stage involves inserting a silicone rod through the pulley system, in order to recreate a smooth tunnel for the tendon graft to be inserted at a later date. If A2 and A4 are absent these can be reconstructed and any joint contracture is released. The silicone rod is fixed to the FDP stump distally and the other end is usually left free either in the palm or at the wrist. It is important to achieve and maintain the full passive range of motion during the 8–12 weeks needed for a “sheath” to form around the rod.

At the second stage operation this newly formed “sheath” is not disturbed, as the ends of the rod are exposed proximally and distally. The harvested graft is then attached to the distal end of the rod and pulled through the “sheath” and attached and tensioned as for a one-stage graft. Our preference is to attach the graft distally first and to use the weave proximally to adjust the tension. Early hand therapy to establish tendon glide is essential for a good result.

**When is pulley reconstruction required?**

Successful function of the flexor tendon system requires an intact pulley system and if the A2 or A4 pulleys are destroyed then bowstringing will be a problem and reconstruction of one or both will be necessary. Loss of the A1, A3 or A5 pulleys will not lead to a significant problem. The A2 and A4 pulleys should be reconstructed at the first stage over a silicone rod. The material used to recreate pulleys needs to encourage tendon glide and thus synovial lined graft is preferable, for example one tail of FDS leaving the distal end attached or a strip of extensor retinaculum wrapped around the phalanx. The preservation of the pulleys is important and attention should be paid to retaining as much uninjured pulley and preserving the sheath as possible at primary surgery, by entering the sheath by raising windows between the main annular pulleys, through the cruciate pulleys.

**What are the extensor tendon zones?**

The joints are the odd numbered extensor zones and in between are the even numbered zones. Therefore, zone 1 is over the DIPJ, 2 over the middle phalanx, 3 over the PIPJ, 4 over the proximal phalanx, 5 over the MCPJ, 6 over the metacarpals, 7 over the dorsal reticulum, 8 distal forearm and 9 proximal forearm (see Figure 4).

**How should closed and open mallet injuries be treated?**

The result of an extensor tendon injury in zone 1 is known as a mallet deformity. An X-ray is essential to identify a bony or tendinous mallet and to look for subluxation. Closed injuries are common and 80% will heal with 6 (tendinous)—8 (bony) weeks of splintage with a further 2 weeks at night. If the
tendon does not heal within this period of time further splintage can be successful, but if this fails open repair may be considered. One indication for surgery in a closed injury is the presence is palmar subluxation of the distal phalanx. There may be a large dorsal fracture fragment associated with this subluxation. The fragment can be fixed if large enough, otherwise a simple longitudinal k-wire to hold the joint reduced is adequate.

Open mallet injuries require surgical repair and various methods of this are described. The tendon can be repaired separately from the skin, but as there is little subcutaneous tissue the repair material may be superficial and successful results have been achieved with a mass repair of tendon and skin. A k-wire through the DIP joint is useful to stabilise the repair while the tendon heals. If the tendon ends are damaged a turndown of one lateral band can be used to strengthen the repair and this method may also be useful for chronic mallet injuries.

What is a boutonnière deformity and how should closed and open injuries be treated?

A boutonnière deformity occurs due to disruption of the central slip and subsequent palmar subluxation of the lateral bands. The deformity may not necessarily be apparent at the outset, as it may take time for the palmar subluxation of the lateral bands to occur, which then results in the classic hyperextension of the DIPJ.

Acute closed injuries can be treated by splinting the PIPJ in extension, allowing active flexion of the DIPJ as this draws the lateral bands dorsally, for 6 weeks until the central slip has healed. Others advocate holding the PIPJ in extension with a k-wire for 3 weeks, followed by a further 4 weeks in a splint. Serial casting is sometimes necessary to correct PIPJ flexion if diagnosis is delayed. After immobilisation the PIPJ is often stiff and this can be treated with a dynamic splint for a further few weeks.

Open extensor tendon division in zone 3 require washout of the PIP joint and primary repair of the central slip to restore extension. Sometimes the cut ends are not very substantial and in these cases the repair can be reinforced with splitting and centralising a lateral band or with a central slip turndown. Following repair, immobilisation in full an extension splint for 6 weeks is suggested and additional k-wire support for the first few weeks can be considered. The outcome of boutonnière injuries tends to be less predictable than mallet injuries.

Chronic boutonnière deformities occur following untreated trauma or related to inflammatory or osteoarthritis. These injuries have been staged depending on the passive range of the PIPJ. Type 1 is completely supple, type 2 has a fixed contracture and type 3 there is joint fibrosis. Type 1 can be reconstructed surgically by repair of the central slip; when this is not possible then division of the distal extensor tendon over the middle phalanx can be effective in mild cases. Whereas type 2 involves initial correction of the fixed flexion contracture by serial casting and if this is unsuccessful a volar PIP joint release to achieve a near full passive ROM before reconstruction of the extensor tendon can be considered. Many methods of reconstruction have been described, for example mobilising the volarly displaced lateral bands and suturing them dorsally, and reconstruction of the central slip with a tendon graft if there is insufficient tendon for repair. In type 3 where the joint is arthritic treatment options include fusion, or arthoplasty with extensor tendon reconstruction. However, as boutonnière deformities rarely affects PIPJ flexion or grip strength, non-operative treatment is also an option and this may be preferable to staged reconstruction procedures, which risk finger stiffness.

What is the significance and treatment of a fight-bite injury?

Wounds over the MCP joints (zone 5) should alert one to the possibility of a fight-bite injury and a careful history and hand radiographs should be taken to exclude both fractures and tooth fragments. Oral flora are abundant within normal saliva, which contains 42 different bacteria including Eikenella corrodens, which is not sensitive to penicillin, so such injuries require second or third generation cephalosporins or co-amoxiclav. These injuries should be treated with prompt surgical washout and exploration. The extensor tendon injury is often proximal to the skin wound, as the hand is in a fist at the time of injury, so when the finger is held extended the tendon covers the joint capsule laceration, thereby sealing off the joint and increasing the risk of septic arthritis. The inexperienced examiner will look in the wound and think that there has been no injury to either tendon or joint. Surgery must include a proper exploration of the extensor tendon and washout of MCP joint. In cases of
active infection, tendon repair should be delayed until this is treated.

How should attrition rupture of extensor pollicis longus be treated?

Attrition rupture of extensor pollicis longus (EPL) can occur after a distal radius fracture. The mechanism may be wear over a rough distal radius fracture edge in the third dorsal compartment (zone 7), due to vascular damage or as a complication of dorsal plating. Rupture can also occur as a complication of tenosynovitis and attrition in rheumatoid arthritis. Loss of EPL function presents with sudden loss of ability to raise their thumb off the table inability to do this—ultrasound. The differential diagnosis includes posterior compartment (zone 7), attrition rupture of extensor pollicis longus (EPL) can occur due to vascular damage or as a complication of dorsal plating.

Conclusion

In summary, the treatment of tendon injuries is complex and requires an understanding of the basic principles to achieve good results. Hand therapy plays a key role in both non-operative treatment and post-operative rehabilitation. There is a plethora of literature, especially on flexor tendon injuries, but in this review article we aim at answering some of the important questions on tendon injuries, outlining the salient findings which have influenced current practice.

References