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Scapholunate instability: why are the surgical outcomes still so far from ideal?

Gregory I. Bain[1,2] and Melanie Amarasooriya[2]

Abstract

The wrist is a universal joint with intrinsic and extrinsic ligaments that function and fail as ligamentous complexes. Those related to scapholunate instability (SLI) include the dorsal scapholunate complex (DSLC), volar radiolunate complex and scaphotrapeziotrapezoid complex. Together the DSLC, scaphoid and lunate create an 'acetabulum' for the capitate, with the dorsal intercarpal ligament being a labrum to contain the capitate. SLI results from failure of the DSLC, typically from its scaphoid attachments. Failure of the lunate and or triquetral attachments increases the instability. DSLC failure leads to radioscaphoid instability, which is the symptomatic clinical problem. SLI reconstruction with open surgery and trans-osseous tendon graft techniques have been challenging. We discuss a biological arthroscopic approach to identify, mobilize and debride the disrupted DSLC. This ligament/capsular/periosteum sheet is then advanced and secured to the debrided footprint. Thereby reconstituting the acetabulum, labrum and scaphoid stability.

Keywords

Scapholunate instability, scapholunate ligament injury, carpal instability, scapholunate reconstruction

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Introduction

The understanding of anatomical and imaging of scapholunate instability (SLI) have evolved over the last few decades. Despite being the most common carpal instability, and even with evolution of diagnostic and treatment options in wrist surgery, the ideal treatment of SLI remains an unresolved problem. There have been many new techniques, however, the results are inconsistent and the complications remain a concern. In this manuscript we will discuss newer concepts of anatomy and kinematics, review the reasons for the high complication rate and present developments in surgical stabilization of the wrist.

The wonder of the wrist

The hand is the most functional organ of the body that is responsible for grasping, pinching, feeding, lifting, nurturing, writing, hammering and dart-throwing. The wrist is the universal joint that is critical for the position of the hand in space. The long wrist extensors and flexors extend past the universal joint and insert into the metacarpal bases. The metacarpals are tightly bound to the distal carpal arch. Controlled contraction of these wrist tendons directs the metacarpals and the distal carpal row to the desired position. The position of the hand is effectively defined by the orientation of the capitate.

The proximal carpal row is the intercalated segment positioned between the forearm and distal carpal arch (Figure 1). The three bones of the proximal carpal row are linked together to form an acetabulum for the distal carpal row, and a condyle for the radius and ulna. The proximal row swivels to facilitate the required alignment of the distal carpal row. As the proximal carpal row is an intercalated

[1]Department of Orthopaedic Surgery, Flinders University and Flinders Medical Centre, Adelaide, South Australia, Australia
[2]Flinders University, Adelaide, South Australia, Australia

Corresponding Author:
Gregory I. Bain, Department of Orthopaedic Surgery, Flinders Medical Centre, Flinders Drive, Bedford Park, South Australia, 5042, Australia.
Email: admin@gregbain.com.au

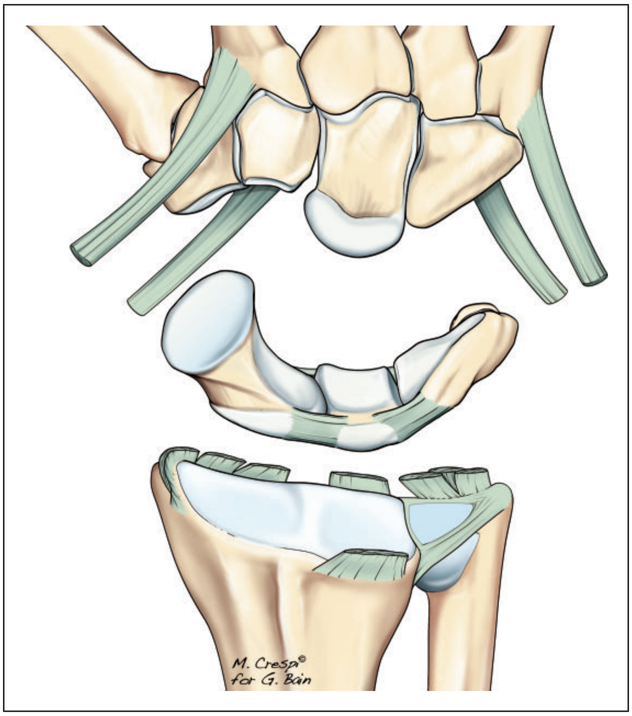

Figure 1. All of the wrist tendons extend past the distal carpal row and attach to the bases of the metacarpals. The tendons tilt the distal row to direct the hand to any position of circumduction. The proximal carpal row is the intercalated segment that swivels between the forearm and distal carpal row. It is all but a miracle that this universal joint can maintain digit grip, precision pinch and grasp, with power and dexterity, with the wrist in any degree of circumduction.

segment with no tendon attachments, it is controlled only by the moments created by the wrist (and finger) tendons, its own articulations and the associated ligaments.

There are many ligaments that stabilize the wrist. They are arranged in bundles and function as ligament complexes. Understanding these different complexes makes it easier to interpret how each component of the wrist functions. These include:

- Dorsal scapholunate complex (DSLC)
- Volar radiolunate complex (VRLC)
- Scaphotrapeziotrapezoid complex (STTC)

Dorsal scapholunate complex (DSLC)

The primary intrinsic stabilizers of the proximal carpal row are the scapholunate interosseous ligament (SLIL) and lunotriquetral interosseous ligament (LTIL) (Elsaidi et al., 2004; Short et al., 2002, 2005). These intrinsic ligaments are supported by the extrinsic ligaments. The dorsal intercarpal ligament (DIC) spans across the entire proximal carpal row (Berger, 2001; Viegas et al., 1999) (Figure 2). Historically thought to be a secondary scapholunate stabilizer, DIC is now recognized to be equally if not more, important in scapholunate stability (Badida et al., 2021; Pérez et al., 2019; Raja et al., 2022).

Dorsal capsule scapholunate septum (DCSS) is thought to be an important structure that stabilizes the scapholunate articulation (Mathoulin et al., 2021; Overstraeten et al., 2013) (Figure 2). The term 'scapholunate ligament complex' (SLLC) is widely used to describe the entire complex of carpal ligaments, capsuled together with the DCSS that stabilizes the scapholunate interval (Mathoulin, 2013; Slutsky, 2013).

Also, of importance is the volar SLLC, which consists of the volar scaphotriquetral ligament (extrinsic), which reinforces the volar SLIL and LTIL (intrinsic ligaments) (Sennwald et al., 1994).

Volar radiolunate complex (VRLC)

VRLC tightly tethers the lunate to the radius, on the volar side (Figure 3). The complex includes the radiolunate ligaments, triquetrum and the volar lunotriquetral ligament. The ulnar carpal ligaments also contribute to this volar ligament complex. This complex is critical as the lunate is in the unenviable position of being the intercalated bone of the intercalated row. To make it even more susceptible, it has spherical proximal and distal articulations, and it is responsible for transmission of significant loads in all wrist positions. The VRLC is critical to wrist function as it accommodates these considerable complexities.

Scaphotrapeziotrapezoid complex (STTC)

The scaphoid is a proximal carpal bone but extends well further than the lunate or triquetrum. The STTC tightly tethers the distal pole of the scaphoid to the distal carpal row. It includes the scaphotrapeziotrapezoid (STT) and scaphocapitate (SC) ligaments (Figure 3)

Radioscaphocapitate ligament (RSCL)

The RSCL is the radial limb of the arcuate ligament complex that wraps around the volar radial aspect of the scaphoid waist (Berger and Blair, 1984), and has a variable attachment to the scaphoid (Fogg, 2004). The scaphoid see-saws over the RSC ligament, and in part acts more as a pulley around which the scaphoid flexes and rotates.

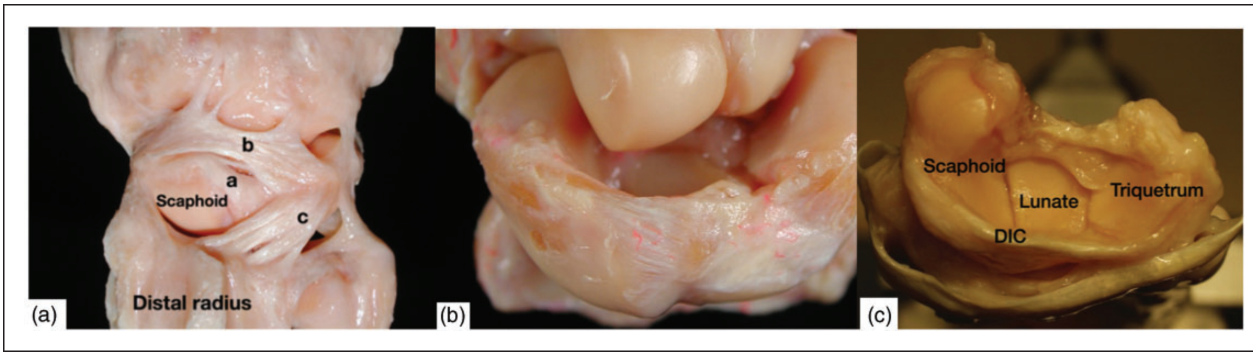

Figure 2. Dorsal scapholunate complex (DSLC) and the proximal row acetabulum. (a) The complex includes the (a) dorsal scapholunate interosseous ligament; (b) dorsal intercarpal ligament (DIC) is an extensive ligament that spans from triquetrum – lunate – dorsal ridge of the scaphoid; (c) dorsal radio-triquetral ligament. (b) The proximal row together forms a composite acetabulum. The DSLC holds the three bones together and creates a labrum to contain the capitate and hamate. (c) Looking into the proximal row acetabulum form the midcarpal joint. Note the DIC provides a dorsal labrum for the capitate.
Images courtesy of Dr Amit Gupta.

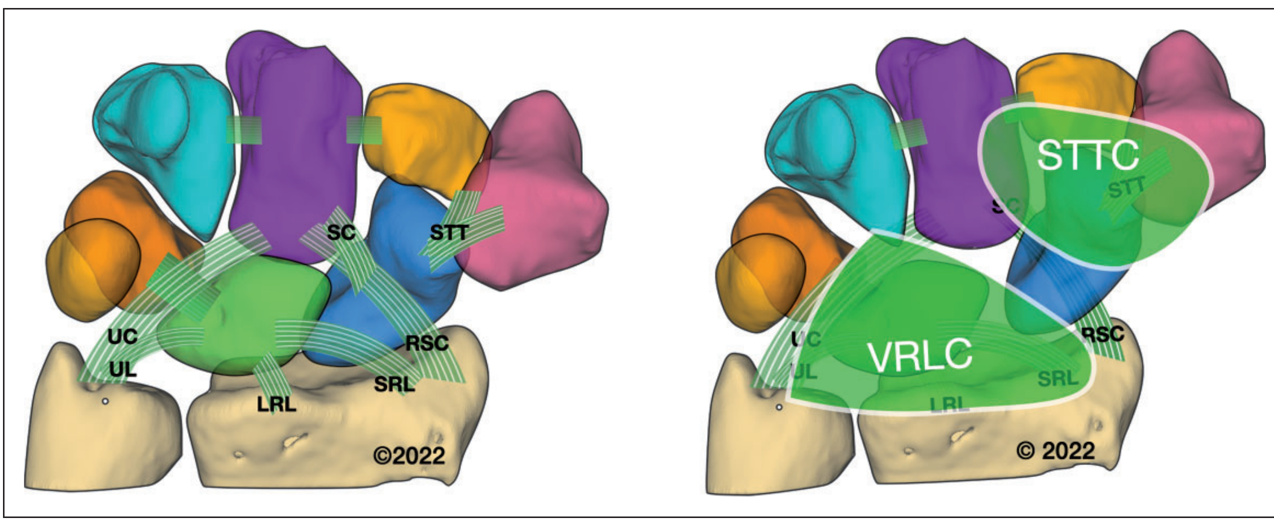

Figure 3. Volar wrist ligaments. The volar radiocarpal ligament complex (VRLC) stabilizes the lunate and triquetrum to the radius. It includes the long radiolunate (LRL) and short radiolunate (SRL) ligaments. It is reinforced by the ulnar carpal (UC and UL) ligaments. The scaphotrapeziotrapezoid complex (STTC) includes the scaphotrapeziotrapezoid (STT) ligaments, and the scaphocapitate (SC) ligament. The radioscaphocapitate (RSC) ligament is the radial limb of the arcuate ligament, which spans from the radial styloid to the capitate. It is the fulcrum over which the scaphoid flexes.
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On the dorsal aspect, the proximal scaphoid is stabilized within the proximal carpal row (SLL) (Figure 2). However, there are NO dorsal ligaments from the scaphoid directly to the radius, other than the indirect support from the dorsal radiocarpal (DRC) ligament. It is amazing that the proximal pole of the scaphoid is basically bare, and unsupported, especially when the wrist is flexed (Figure 2).

Triquetrum

The triquetrum is also important, but for different reasons. Elisabet Hagert has highlighted that the ligaments that insert into the triquetrum are highly innervated (Hagert et al., 2007). The triquetrum is the sensory bone of the wrist. It is strategically positioned at the end of the straight ulna to receive sensory feedback from almost the entire wrist during its various motions and functions (Figure 4).

How is the wrist loaded?

The majority of the load across the proximal carpal row is shared between the scaphoid and lunate. The dominant loading will depend upon the position of the wrist. In radial deviation the radial column will

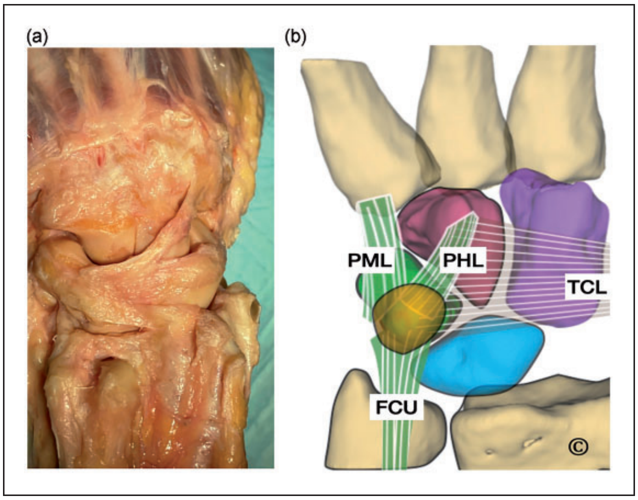

Figure 4. The triquetrum is the sensory bone of the wrist. (a) Dorsal wrist – the triquetrum is the 'smart bone', has ligament connections to the ulna, radius, proximal carpal row, distal carpal row and extensor retinaculum. This image shows extension also to the 2nd metacarpal. (Image courtesy of Dr Elisabet Hagert.) (b) Volar wrist – the triquetrum articulates with the pisiform, which interfaces with the flexor carpi ulnaris (FCU), transverse carpal ligament (TCL) and hypothenar muscles.
PML: piso-metacarpal ligament; PHL: piso-hamate ligament.
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have greater loading, through the scaphoid and scaphoid fossa. In ulnar deviation, the central column takes most of the load, some is shared with the triquetrum, and the scaphoid is unloaded (Figure 5). So, the three columns share the load, depending upon the position of the wrist.

An interesting observation is that each carpal bone tends to load two bones from the adjacent row (Figure 5). For example, the capitate and hamate load the lunate, which then loads the radius and ulna. Therefore, the wrist is more akin to rows of bricks, and that the columns of bricks load the radius and ulna.

How does the wrist move?

As the distal carpal row is deviated to position the hand, the proximal carpal row swivels and twists. With radial deviation the STT complex forces the radial column to shorten, which it does by flexing and pronating the scaphoid over the RSC ligament. The engineers use the term out of plane motion, as the scaphoid is moving in a completely different direction to the hand. It is the DSLC that tethers the scaphoid to the lunate and triquetrum, maintaining integrity of the proximal carpal row and its acetabulum.

Scaphoid stability ensures that scaphoid and scaphoid fossa remain congruent throughout motion. This is important for the smooth motion and loading of the radial column, which is critical to the overall wrist stability and maintenance of precision and grip strength throughout circumduction.

The injured wrist

An isolated disruption of just the intrinsic ligament – SLIL – will only cause a minimal opening of the scapholunate interval. Following sequential sectioning of the entire SLIL and DIC off the scaphoid and loading, the scaphoid becomes unstable before the wrist shows signs of dorsal intercalated segmental instability (DISI) (Mitsuyasu et al., 2004). Elsaidi et al. reported that, when the palmer extrinsic ligaments, SLIL and DIC was sectioned off the scaphoid, the scaphoid significantly flexed. The capitolunate angle remained neutral until the DRC was sectioned off the lunate (Elsaidi et al., 2004). Hence, the scaphoid is the primary bone to be unstable in the early stages of SLI. To achieve SLI with a DISI pattern requires a disruption of the DSLC, which usually includes the dorsal SLL, DIC and DRC ligaments (Pérez et al., 2019).

SLI can be associated with other lesions, including lunotriquetral ligament injuries and fractures of the distal radius, scaphoid and ulnar styloid. Depending on the magnitude and the direction of force transmission, SLI can extend resulting in other variations of instability. Fortunately, involvement of the VRLC with SLI is uncommon. Examples of disruption of the VRLC include radiocarpal dislocations and volar rim fractures of the distal radius (Chiri et al., 2022). These are high-energy injuries, with extensive swelling. In these cases, we must consider that there may be an associated VRLC injury. The hallmark of VRLC disruption is ulnar and/or volar translocation of the carpus. Assessment with MRI, stress fluoroscopy or arthroscopy may unmask the VRLC injury (Chiri et al., 2022; Eardley-Harris et al., 2022).

The STTC is rarely, if ever, injured in SLI. Even in the scaphoid dislocations, the distal pole attachments to trapezium and the trapezoid usually remain intact (Bain et al., 2019).

Pathomechanics

SLI is a dissociative instability of the proximal carpal row (Linscheid et al., 1972). *However, the clinical presentation is of instability between the radius and proximal scaphoid* (Figure 6). We expect that it was for this reason that Brunelli recommended his

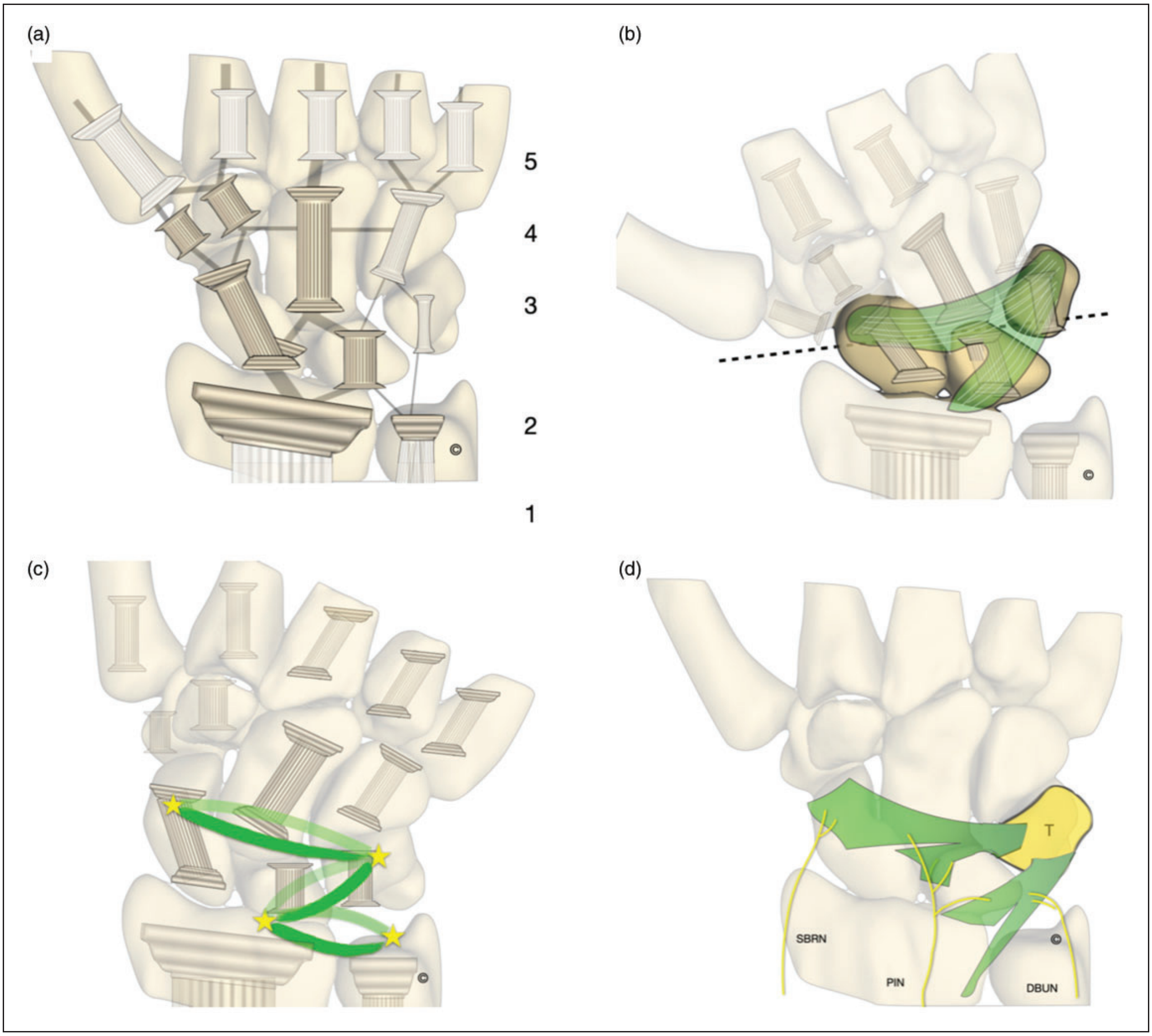

Figure 5. The functions of the wrist – loading, motion, stability and innervation working together. (a) The carpus loads as a composite of bricks, that lead to 3 columns across the radiocarpal joint. Each bone tends to load two bones in the adjacent row. This enables the forces to be shared between the two bones, depending upon the position of the articulation. For example, the lunate loads proximally the radius and ulna, and distally the capitate and hamate. The number of bones per row is on the right of the image and shows the progressively increase from 1 to 5 (humerus – 1 to metacarpals – 5). This explains why scaphoid only loads to the radius. The thickness of the loading lines is defined by the reported loading across each articulation (Garcia-Elias, 2021). (b) The rows of the wrist, highlighting how the proximal row swivels, to enable the distal carpal row to deviate. The DSLC links and stabilises the entire proximal row, ensuring the proximal scaphoid remains congruent during motion and loading. (c) The ligamentous rings provide stability of the wrist throughout motion, allowing the columns to share and distribute the load, depending upon the position of the wrist. The rings are linked, which allows a "flexible stability". Amazingly, in any wrist position, with loading, the wrist is stable, allowing precision grip and grasp. (d) The triquetrum is the sensory bone of the wrist. It is not important for loading but is strategically positioned and interconnected to the remainder of the wrist on the volar and dorsal aspects. During complex hand/wrist functions, the sensory feedback is likely to be important. Image is reproduced from Dr Elisabet Hagert (Hagert et al., 2007).
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tendon graft from the dorsal scaphoid to the radius (Brunelli and Brunelli, 1996).

In SLI, the lunate is extended and supinated as a consequence of the scaphoid not influencing the lunate motion. The radiolunate joint remains congruent, which ensures that radiolunate arthritis is rare, even in late cases. In contrast, the scaphoid is flexed and pronated with the proximal pole dorsally

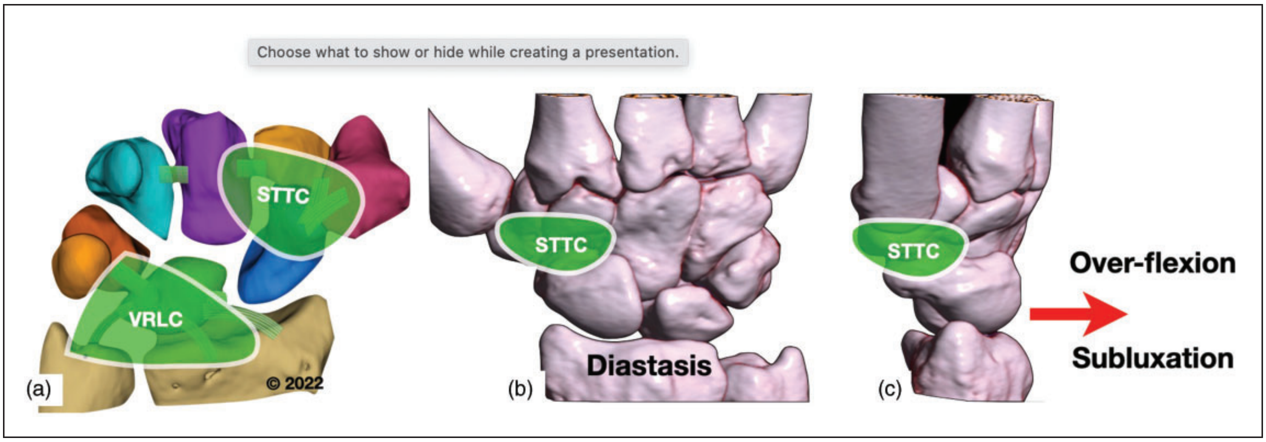

Figure 6. Scapholunate instability is clinically radioscaphoid instability. (a) The volar radiocarpal ligament complex (VRLC) remains tightly bound to the lunate and triquetrum, so that the lunate motion is dictated by the moment arm of the capitate and hamate on the lunate and triquetrum. (b and c) The dorsal scapholunate ligament complex is ruptured, so the scaphoid and lunate motion is dissociated. The scaphoid can translate dorsally. The scaphotrapeziotrapezoid complex (STTC) remains tightly bound to the distal scaphoid, so that the scaphoid motion is dictated by the distal carpal row. The radioscaphocapitate still acts as a fulcrum, and the scaphoid falls into flexion.
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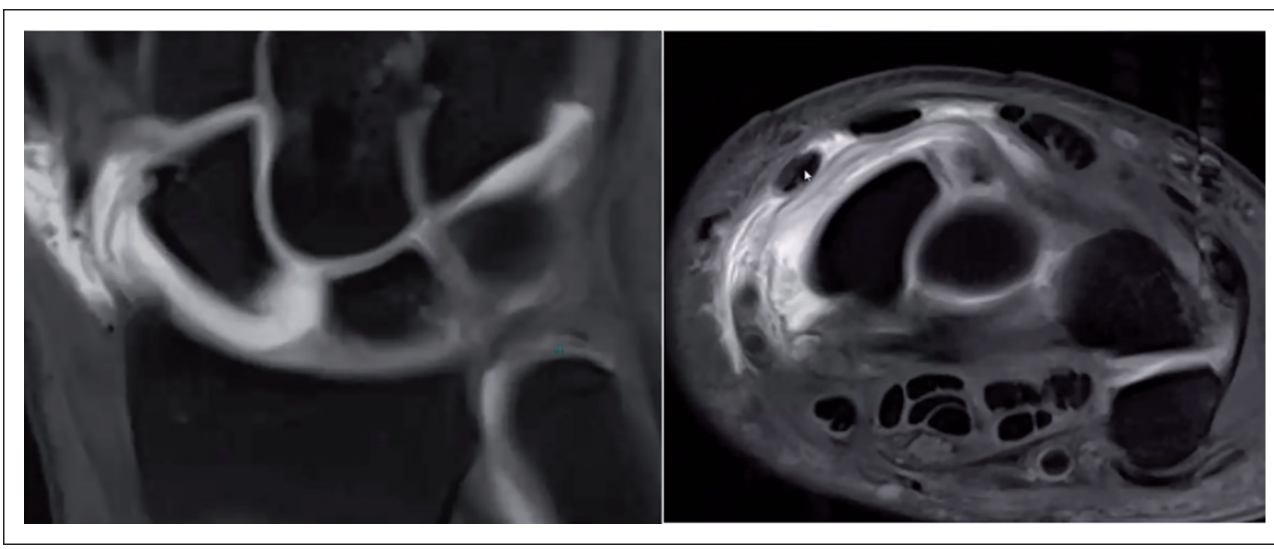

Figure 7. MRI of scapholunate instability with extensive soft tissue injury of the dorsal scapholunate complex from the scaphoid. The scaphotrapeziotrapezoid ligaments are spared.
Image courtesy Dr Nicholas Rhodes, Radiology, Mayo Clinic, Rochester, USA, 2022.

subluxated on the radius. The scaphoid instability is the clinical instability that the patient and clinician can identify (Watson's scaphoid shift test). The radioscaphoid incongruency is associated with abnormal loading and radioscaphoid arthritis. With traction and ulnar deviation, the scaphoid will separate from the scaphoid fossa. The level of instability of the scaphoid is much greater than that of the lunate.

We liken the disruption of the DSLC to the Bankart injury in the anterior glenoid labrum. In this case the DIC is the labrum that is stabilizing the acetabulum of the proximal carpal row, which is containing the capitate.

With this knowledge we need to reduce the scaphoid to the lunate, and then restore the dorsal scapholunate ligament complex. The STT and volar carpal

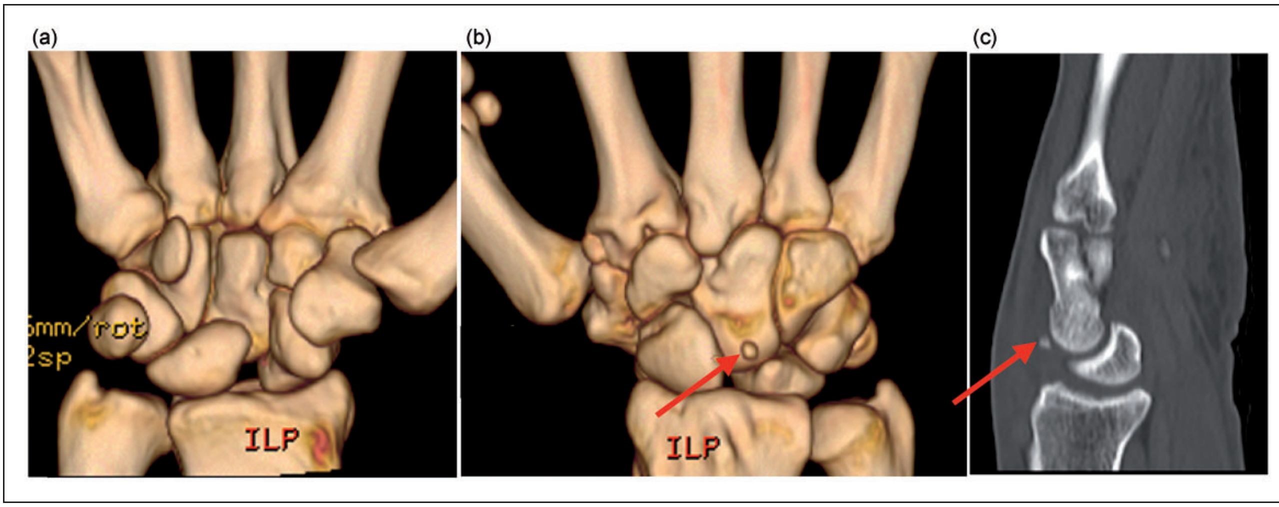

Figure 8. CT scan image of dorsal scapholunate complex disruption. Avulsion of the dorsal lip of the lunate (red arrow), with associated scapholunate instability. (a) Volar view; (b) dorsal view; (c) sagittal section through the lunate.

ligaments are unlikely to be disrupted, and therefore do not require any surgical intervention.

Imaging

When analysing the imaging, it is important to define the SLI and assess the pattern of instability. This includes the SLIL, DIC, DRC, volar carpal ligaments. This information may be important to direct the reduction and stabilization methods.

There are variations in the theme as to how the DSLC is disrupted. Our experience of acute and subacute cases is that the main lesion is an avulsion of the DSLC, typically from the scaphoid (Figure 7).

Fracture of the dorsal lip of the lunate, with disruption of the remainder of the DIC/SLIL is also common (Figure 8). The importance of avulsion of the DSLC from the lunate has recently been described (Loisel et al., 2022; Williams et al., 2022). The key message is that there is a spectrum of these soft tissue injuries, which we should aim to assess with preoperative imaging and arthroscopy. The extent of the ligamentous disruption will dictate the instability of the scaphoid, lunate and remainder of the carpus.

Why scapholunate reconstructions fail?

The outcomes of scapholunate reconstruction remains far from ideal (Daly et al., 2020). Causes include poor patient selection (Athlani et al., 2018), such as contracture or arthritis.

It is timely to review the basic science of ligament reconstruction using tendon grafts. It is well known that anterior cruciate ligament (ACL) tendon grafts have sub-optimum healing, remodelling, load to failure and are challenging to correctly position (Fu et al., 1999). There are associated microfractures and avascular necrosis due to thermal necrosis. Animal studies have demonstrated micromotion between the tendon graft and the endosteal bone, leads to incomplete healing with scarred fibrocartilage (Hjorthaug et al., 2015).The motion creates the 'bungy-cord effect', and osteoclastic tunnel widening (Fu et al., 1999). The healing of the tendon adjacent to the joint is further compromised by the synovial fluid (Bedi et al., 2009). The tendon graft heals best to the periosteum *at the entrance to the osseous tunnel*.

As the graft heals, it progresses through the phases of ligamentization. The de-innervated tendon graft becomes soft, as it is re-vascularized, re-innervated and the fibroblasts develop (Ekdahl et al., 2008). It takes up to 3 years for the tissues and fibroblasts to mature, but the collagen ultrastructure never resembles a normal ligament (Claes et al., 2011; Janssen and Scheffler, 2014; Rougraff et al., 1993). In an animal study, the ultimate tensile load was 25% of the native ACL at 1 year (Blickenstaff et al., 1997).

The normal ACL insertion is board, and different fibre bundles are under stress throughout knee motion (Grood et al., 1992). There are multiple instant centres of rotation that change throughout knee motion. Therefore, the ligament is not a simple isometric structure, but is a multi-bundle structure. This makes graft placement challenging and has led to the development of double bundle techniques aimed at improving the footprint and joint kinematics (Yagi et al., 2002).

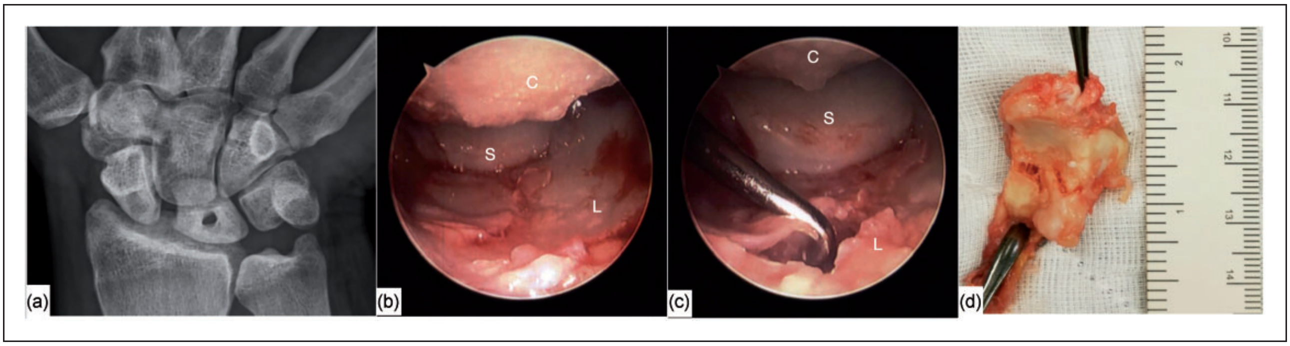

Figure 9. Failed scapholunate reconstruction. (a) Radiograph with scaphoid flexion, persistent scapholunate diastasis, lunate avascular necrosis and loss of mid-carpal joint space. (b) Arthroscopic view of midcarpal joint, with a lunate fracture and advanced arthritis of the capitate. (c) Arthroscopic probe in the lunate fracture and (d) Excised sclerotic and fractured lunate. C: capitate; S: scaphoid; L: lunate.
Image courtsey of Dr Nick Smith, Sydney, Australia.

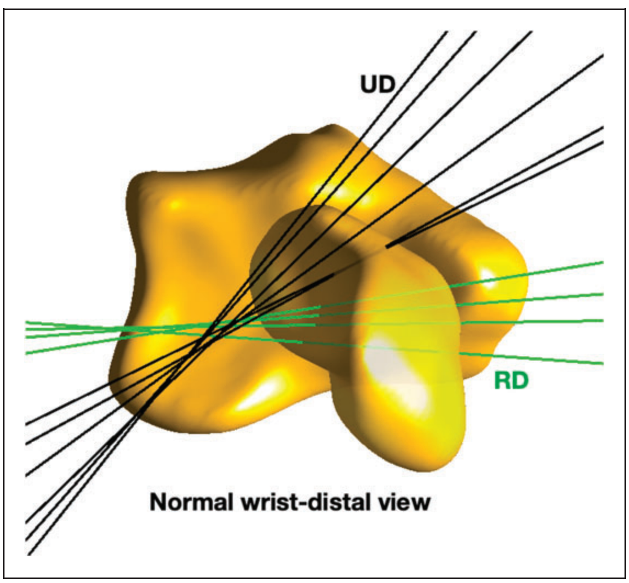

Figure 10. Instantaneous helical axis for the scaphoid during wrist ulnar to radial deviation. The axis for each time point during ulnar deviation is indicated in black and during radial deviation is indicated by green. The image is of a single representative normal wrist.

The most common technical failure of an ACL reconstruction is malposition of the graft (femoral 80%, tibia 37%) (Fu et al., 1999; Wright et al., 2010).

How does this apply to the wrist?

Many authors have recommended a flexor carpi radialis (FCR) tendon graft that is passed through a drill hole in the scaphoid, and then to the radius, lunate or triquetrum. Based on the knee experience, we could expect compromised endosteal healing, especially adjacent to an articulation. We have seen fractures, avascular necrosis and failures of the tendon graft to heal to the endosteal scaphoid (Figure 9).

The normal DSLC has a broad insertion into the dorsal ridge of the scaphoid (Viegas et al., 1999) and some of our preliminary research demonstrates that the normal scaphoid and lunate have multiple instantaneous axes of rotation (Figure 10).

The ligaments/capsule/periosteum is a single anatomical layer. Following debridement, this layer can be mobilized and draped over the dorsal ridge of the scaphoid. This takes advantage of the *periosteum, that has the best potential to heal* to the debrided dorsal ridge of the scaphoid.

Strategies for management of SLI

Based on these multiple factors, our strategy of managing SLI is the following.

- Define the pathology based on history, examination, imaging and arthroscopy. This includes instability, fractures, contractures and arthritis.
- Use arthroscopy or a minimally invasive capsular window technique (Loisel et al., 2021).
- Arthroscopically debride the tears, granulation tissue and osseous footprints.
- Mobilize the ligaments/capsule/periosteum as a continuous anatomical layer.
- Define the extent of the DSLC disruption (e.g., scaphoid, lunate, triquetrum or combined).
- Stabilize the DSLC to the proximal row, typically dorsal ridge of the scaphoid. Ulnar side DSLC stabilization may also be required.
- Ensure the proximal row acetabulum is reduced and stabilized.

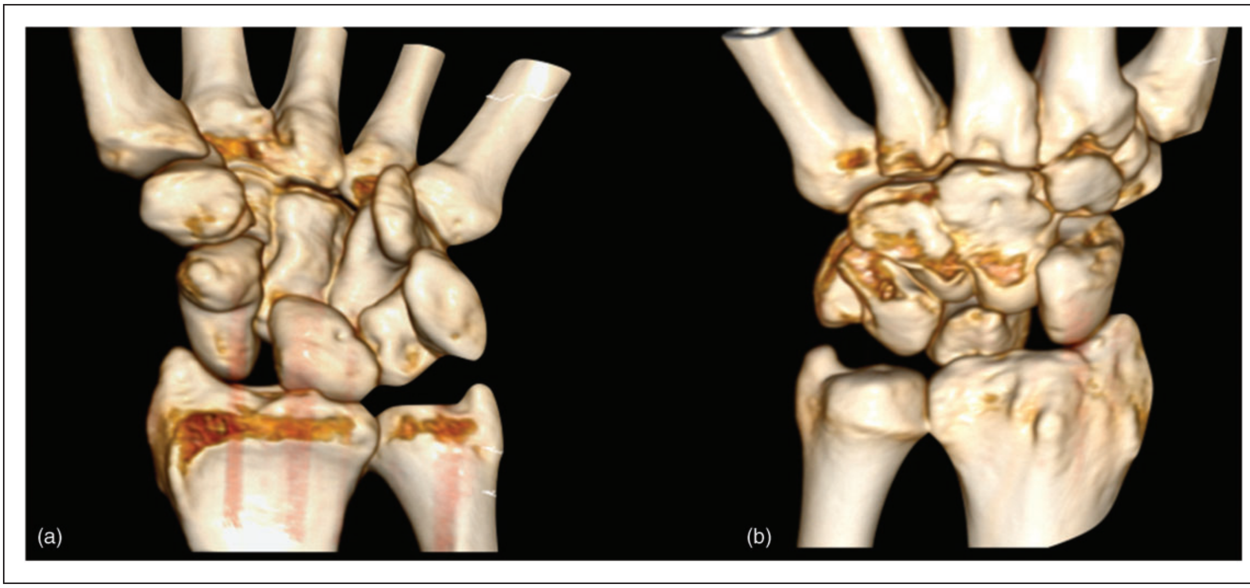

Figure 11. Imaging of 49-year-old man, 6 months after injury. Three-dimensional CT scans (a) volar and (b) dorsal projections. Obvious diastasis, with the scaphoid hyper-flexed, pronated and dorsally subluxated over the rim the radial styloid. The lunate is extended and supinated. The capitate is perched between the lunate and scaphoid. The lunate does not have ulnar translocation.

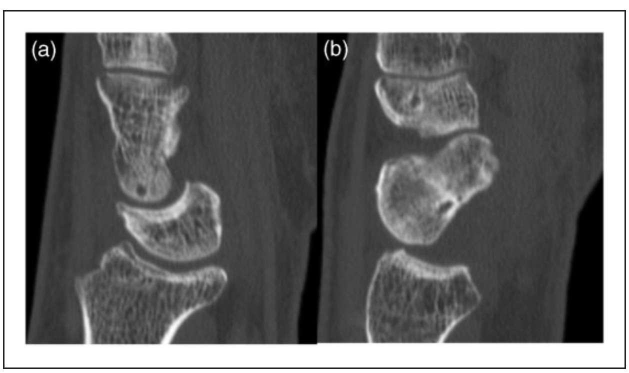

Figure 12. The sagittal CT images. (a) The lunate is extended (DISI) and takes with it the capitate. The carpus is shortened but, the proximal and distal lunate articulations are congruent and (b) The scaphoid is flexed, and the proximal pole is subluxated dorsally.

We avoid the more destructive open techniques and intraosseous tendon grafts in the carpus. If there is volar or ulnar translocation of the proximal carpal row, other options may need to be considered (Del Pinal, 2013; Sandow and Fisher, 2020).

Case history

A 49-year-old man presented with ongoing dorsal wrist pain 6 months following a wrist injury at the workplace. Imaging demonstrated SLI (Figure 11)

There was marked subluxation of the proximal pole of the scaphoid and DISI (Figure 12). So, it likely there is disruption of the dorsal SLLC, including the SLL, DIC and probably the DRC. It is unlikely that there is disruption of the STTC or the VRLC.

With our patient, the primary aim was anatomic restoration of articular congruence of the radiocarpal and midcarpal joints. While reducing the diastasis, correcting scaphoid flexion and the lunate extension. The ultimate goal was to recreate a functional proximal row acetabulum and labrum for the capitate.

Technique

A diagnostic wrist arthroscopy was performed, which identified an obvious drive through sign. Using a probe, a rent in the dorsal capsule/DIC attachment to the scaphoid was identified (Figure 13). The ligament disruption, granulation tissue and dorsal scaphoid ridge is debrided. This can be arthroscopically stabilized to the dorsal ridge of the scaphoid (Figure 13). Alternatively use a mini-open dorsal skin incision, with a radial midcarpal window, which preserves the capsulo-ligamentous structures (Loisel et al., 2021). Grasping sutures were placed in the dorsal capsular sheet, which includes the DIC, SLL and adjacent capsule and periosteum. These sutures were introduced into a 2.9 mm tensionable anchor (Mini-magnum™, Smith and

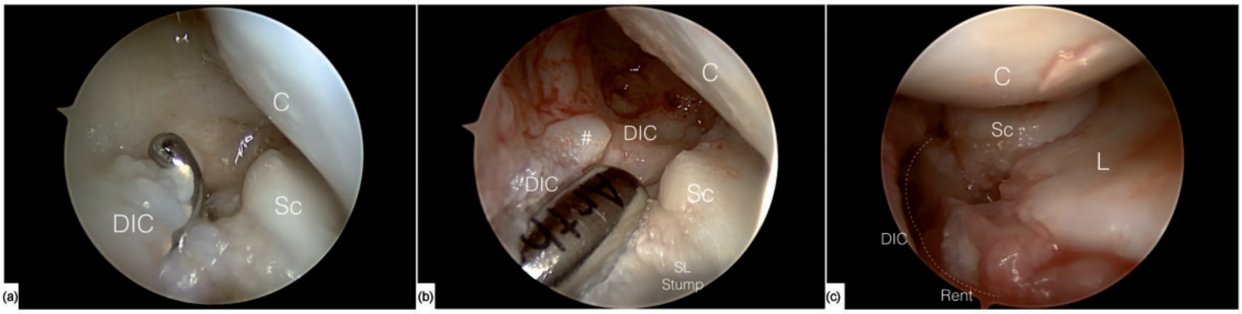

Figure 13. Arthroscopic scapholunate stabilization. Scope in ulnar midcarpal portal, instruments in radial midcarpal portal. (a) Avulsed dorsal scapholunate complex (DSLC) from the dorsal scaphoid and lunate. (b) Arthroscopic debridement of the torn dorsal intercarpal ligament, granulation tissue, dorsal scaphoid ridge and scapholunate ligament stump and (c) Following debridement, the entire sheet of DSLC was mobilized, as if it was the labrum in the shoulder. Arthroscopic sutures were placed into the DSLS and advanced and secured into a suture anchor introduced into the dorsal ridge of the scaphoid. The anchor had been introduced via a mini-open approach.
Images courtesy of Jan-Ragnar Haugstvedt, Gregory Bain and Istvan Rigo.

Figure 14. Postoperative outcome. (a) Initial radiographs and at (b and c) 10 months. The scapholunate interval and alignment are well reduced, using only a single tensionable suture anchor and (d) The range of motion at 18 months.

Nephew, Andover, MA, USA), which is placed into the dorsal ridge of the scaphoid. The tensionable anchor is tightened, to close the disruption of the proximal carpal row. The strategic placement of the scaphoid anchor more radially and distally, restores the DIC, which closes the acetabulum, contains the capitate, reduces the scaphotriquetral interval, extends the scaphoid and indirectly the scapholunate interval. If the DSLC disruption extends to the triquetrum, then an ulnar-based repair/plication is also required.

We reserve the use of K-wires to those cases where we believe extra stability is required. The wrist is immobilized to allow soft tissue healing, followed by a slow graduated exercise programme. The patient has a good clinical outcome with restoration of hand and wrist function (Figure 14).

Summary

SLI is the result of compromised dorsal SLLC. The clinical syndrome of pain and instability is principally proximal scaphoid instability, as the scaphoid is dissociated from the proximal row, and driven by the distal row. The principles we adhere to in managing SLI include the following.

1. Precise anatomical ligament diagnosis based on imaging and arthroscopy.
2. Debridement of the torn DSLC and its anatomic footprint.
3. Mobilization of the common sheet of ligaments, capsule and periosteum.
4. Reduction of the proximal carpal row acetabulum.
5. Fixation of the DIC labrum

The pathoanatomical principles presented in this invited manuscript are an extension of the pathoanatomical concepts and techniques presented in our previous publication (Bain et al., 2015).

Each case of SLI is different and poses a unique challenge to a wrist surgeon. The understanding of enigma of carpal stability and instability may continue to evolve. Needless to say, there is a wealth of knowledge on ACL reconstruction of the knee, which we can learn from. We believe adhering to the principles with a biological approach, with minimally invasive techniques and preservation of native anatomy, will help improve the outcome of SLI reconstruction.

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ORCID iDs Gregory I. Bain https://orcid.org/0000-0002-3258-996X
Melanie Amarasooriya https://orcid.org/0000-0002-5629-543X

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