Scaphoid Safety Scapholunate Ligament Reconstruction for Unrepairable Scapholunate Ligament Injury: A Case Report

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This case study describes a scaphoid safety procedure for scapholunate [SL] ligament reconstruction in a 33 year old woman diagnosed with SL injury. She presented with wrist pain and discomfort for 3 months after a wrist injury. Arthroscopic diagnosis confirmed an SL injury, Geissler's classification grade 3. Due to poor ligamentous quality, the authors decided to perform a scaphoid safety SL reconstruction using a double anchor technique which avoids the requirement to make a tunnel through the scaphoid. Her symptoms improved after the operation and she returned to normal activity within 3 months. At the 1 year follow-up, grip strength at the operated side was close to the normal hand.

Keywords: Scapholunate ligament injury, Scapholunate ligament reconstruction

J Med Assoc Thai 2018; 101 [Suppl. 3]: S269-S274
Website: http://www.jmatonline.com

Rupture of the scapholunate ligament is a common traumatic wrist injury. That ligament plays an important role in maintaining carpal alignment. Instability of the scapholunate structure may be the result of either injury of the primary SL stabilizer, i.e., the SL ligament and/or disruption of the secondary stabilizers including the STT, RSC and DIC ligaments. Alteration of the carpal alignment may lead to degenerative changes in the wrist. Geissler et al proposed a treatment for the static SL injury based on classification using radiographic images. It is suggested that in repairable cases (Geissler stage II) repair of the SL ligament should be combined with augmented dorsal intercarpal capsulodesis to protect the repaired site and to prevent scaphoid flexion. SL reconstruction is recommended in unrepairable cases (Geissler stage III)(1).

Tri-ligament reconstruction(2) is a common procedure to correct SL instability. This technique requires a bone tunnel which may result in an iatrogenic scaphoid fracture(3). The present case report describes a new procedure for SL reconstruction developed by the authors which uses suture anchors. This new SL reconstruction technique with anchor sutures avoids the risk of scaphoid fracture resulting from the bone tunnel. SL reconstruction using an anchor technique has not been reported in the literature, despite this being the era of the anchor suture.

In this case report, we describe scaphoid safety procedure for unrepairable scapholunate injuries with normal carpal alignment which uses a modified tri-ligament reconstruction technique employing double suture anchors without a bone tunnel. A review of the relevant literature on surgical techniques for SL injuries is included as well.

Case Report

A 33-year-old female labour worker presented at orthopedic clinic for treatment with a three-month history of pain in the wrist following a fall on her outstretched hand. The pain did not subside and was aggravated when she turned a door knob.

Physical examination revealed pain on active motion of the wrist. The range of motion of the wrist was normal, with flexion of 50° and extension of 70°. Pronation and supination of the forearm were within

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How to cite this article: Tawonsawatruk T, Tuntiyatorn P, Kanchanathepsak T. Scaphoid Safety Scapholunate Ligament Reconstruction for Unrepairable Scapholunate Ligament Injury: A Case Report. J Med Assoc Thai 2018;101;Suppl.3:

normal limits.

There was mild swelling at the wrist and tenderness at the scapholunate interval. The pain was severely aggravated by Watson's test (Scaphoid shift test), but no abnormal motion between scaphoid and lunate were observed. The scapholunate ballottement test showed normal scaphoid and lunate translation. Grip strength of the injured hand was a half that of the contralateral side. Radiographic images of the right wrist showed evidence of scapholunate instability with a clenched fist scapholunate interval of 4 mm (stress view). There was no dorsal intercalated segment instability [DISI] deformity and the scapholunate angle was 55° (Figure 1).

The injury was initially diagnosed as a dynamic scapholunate dissociation and dynamic SL injury. The suitability of the ligament for direct repair was uncertain, so we performed a dry arthroscopic diagnosis to determine the condition and pathology of the scapholunate ligament.

Visualization of the radiocarpal space through the 3 to 4 portal with a probe in the 4 to 5 portal showed marked bulging and partial torn of scapholunate ligament from the scaphoid attachment (Figure 2). The probe could be passed through the SL interval from the midcarpal joint portal.

After obtaining the arthroscopic finding of SL ligament, we determined the injury to be a Greissler arthroscopic grade III[4] and decided to performed open reduction and primary ligament repair.

Surgical technique

The approach was through a dorsal longitudinal incision. The extensor retinaculum was divided in a Z fashion and preserved for later repair. The wrist capsule was approached between the third (extensor pollicis longus) and fourth (extensor digitorum communis) extensor compartments. The dorsal capsule was identified and both the dorsal radiocarpal ligament [DRC] and the dorsal intercarpal ligament [DIC] were found to be intact. A capsulotomy was performed with a radially based V cut incision to preserve the dorsal radiocarpal and intercarpal ligaments. The normal carpal alignment was maintained, but the scapholunate joint was unstable. The scapholunate interosseous ligament [SLIL] appeared to be disrupted with a remnant of the ligament still remaining (Figure 3). We initially performed primary repair, but the quality of the ligament was very poor and subsequently completely detached from the scaphoid. It was impossible to repair the ligament due to the poor quality of the tissue.

We therefore decided to substitute SL ligament reconstruction. The scapholunate joint was accurately reduced using Kirschner wires as a joystick for maintaining reduction. The Kirschner wires were inserted through the scapholunate and scaphocapitate ligaments. The position of the wires and carpal alignment were checked using a fluoroscope. Then a half-slip of the flexor carpi radialis [FCR] tendon was harvested using the volar approach while the distal insertion of the FCR was maintained. The FCR tendon graft was passed from volar to dorsal through the radial aspect of the scaphoid tubercle. The first 1.5 mm. bioabsorbable suture anchor was applied to the roughened dorsal part of the scaphoid and the FCR

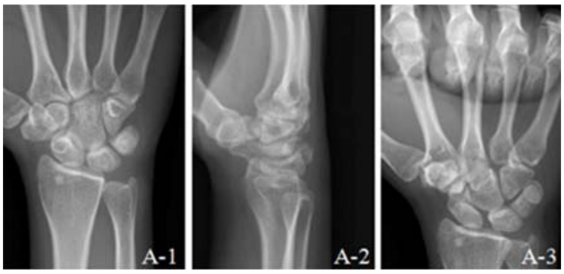

Figure 1. Radiograph of the PA and lateral view of the wrist (1, 2) and the 4 mm SL gap in stress view (3).

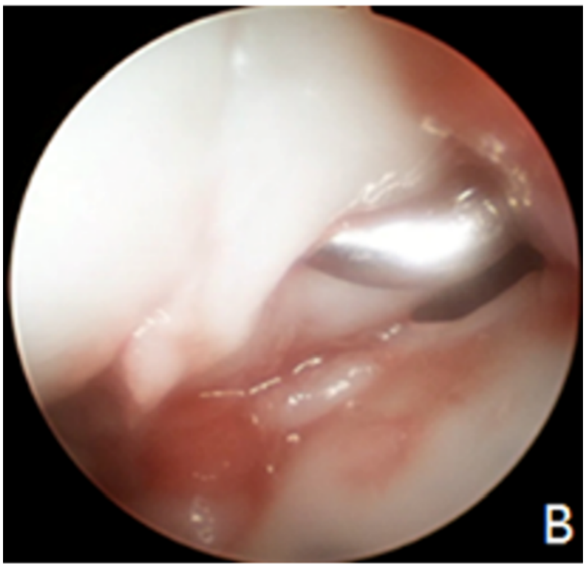

Figure 2. Arthroscopic view of the torn SL ligaments.

tendon graft was securely sutured to the scaphoid under tension. The FCR graft was sutured to the dorsal intercarpal ligament to augment the graft tension and to prevent subluxation into the wrist joint (Figure 4). After that, a second 1.5 mm bioabsorbable anchor suture was applied to the roughened surface of the lunate and the FCR graft was sutured (Figure 5). The remnant of the FCR tail was looped through the radiotriquetral (RT) ligament and sutured into itself (Figure 6).

Finally, the capsule, retinaculum, and skin were repaired and the wrist was immobilized in a neutral position. A post-operative radiograph of the wrist was obtained. (Figure 7) Four weeks later, the slab was removed and limited wrist motion was allowed with a removable splint. The Kirschner wires were removed at 4 weeks after operation and range of motion exercises were encouraged. Sport activities were allowed at 3 months after the operation.

Three months after the surgery, the patient was satisfied with the outcome of the operation. Her daily activities resulted in no aggravated pain. Physical examination of the wrist found no tenderness at the scapholunate joint. The Watson's shift test and the scapholunate ballottement test were negative and without pain. The range of motion of the wrist was 70^{o}/85^{o} in flexion/extension and 90^{o}/90^{o} in supination/pronation which was slightly limited compared to the normal side (80^{o}/90^{o} in flexion/extension and 90^{o}/90^{o} in supination/pronation). Grip strength was improved to

Figure 3. Unrepairable torn SL ligament.

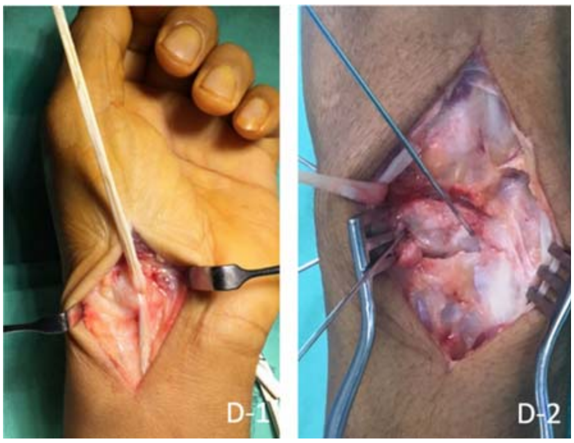

Figure 4. Half-slip of FCR harvested and passed from volar to dorsal side (D-1, D-2).

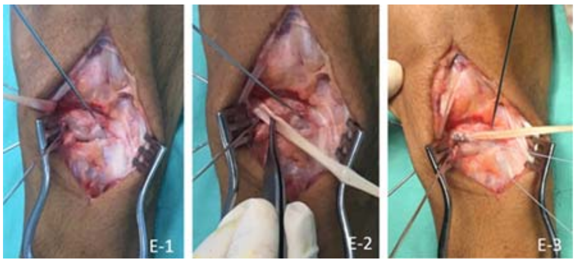

Figure 5. FCR was anchored to the scaphoid under tension (E-1, E-2, E-3).

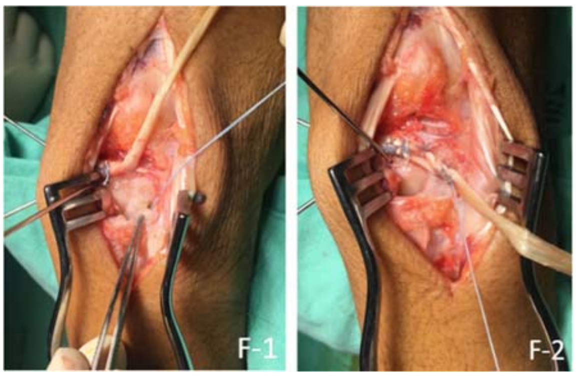

Figure 6. Dorsal surface of lunate was prepared (F-1) and anchor suture was applied (F-2).

87% of that of the contralateral normal hand. The Disabilities of the Arm, Shoulder, and Hand [DASH] score was 4.2 compared to preoperative score of 32.5. Radiographs at 12 months after the operation (Figure 8) showed normal scapholunate alignment with 1.5 mm of scapholunate interval in AP view and 2.5 mm in stress view.

Discussion and Literature review

In this case, the patient presented with a symptomatic subacute SL injury with dynamic SL injury diagnosed from stress radiographs. The dry arthroscopic assessment indicated a defini decided to perform open ligament repair. The quality of the ligament remnant was poor, however, and it and might not have been possible to achieve a satisfactory outcome. For that reason, the authors decided to change the procedure and perform a reconstruction using a multiple tendon weave.

Multiple tendon weave procedures were popularized by the Brunelli technique[5,6]. In that procedure, a portion of the flexor carpi radialis tendon is passed through a bone tunnel in a distal scaphoid and fixed to the distal radius. Van Den Abeele et al[7] reported a modification of the Brunelli technique, changing the attachment of the flexor carpi radialis tendon to the lunate itself instead of to the distal radius. That modification avoids crossing the radiocarpal joint, thus preventing post-operative wrist stiffness. The latest technique, tri-ligament tenodesis, reported by Marc Garcia-Elias[2] is a modification of the Brunelli technique in which the flexor carpi radialis tendon is passed through a bone tunnel in the scaphoid and is then used to create the dorsal scaphotrapeziotrapezoid, dorsal radiotriquetral, and scapholunate ligaments. However, all of these procedures depend on a bone tunnel at the scaphoid which involves risk of an iatrogenic scaphoid fracture from the drilling or graft passing step[1,3], particularly when performed by a less experienced surgeon.

Chopra et al[8] suggested a technique for reconstruction of the scapholunate ligament using a slip of FCR in which the FCR slip at the distal and lateral aspect of the scaphoid is passed around the tuberosity level, then across the dorsal side of the scaphoid at the distal pole to buttress the scaphoid, securing tension at the posterolateral wrist capsule by an anchor suture. The remaining FCR is then attached to the lunate with another anchor. However, this technique cannot create adequate ligament tension to close the SL gap.

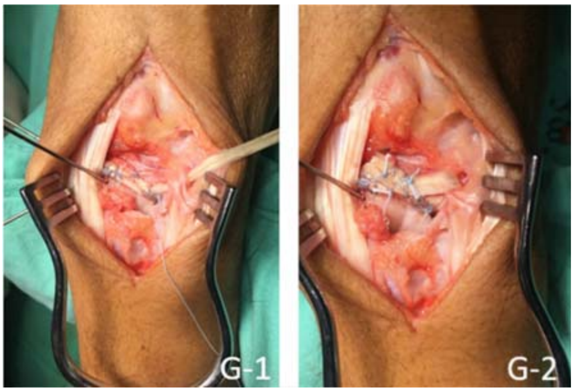

Figure 7. FCR was anchored to the dorsal side of the lunate, passed through the RT ligament (G-1) and then turned back and sutured into itself (G-2).

Figure 8. Immediate post-operative radiograph of wrist.

Figure 9. Post-operative radiograph 12 months after surgery. AP (I-1), Lateral (I-2), and Stress view (I-3).

In this case report, the authors introduced a simple modification of a tri-ligament tenodesis based on Chopra's technique. The same technique with the

FCR tendon portion is introduced from volar to dorsal, avoiding the need for a bone tunnel in the distal scaphoid. The graft is passed through the radial aspect of the scaphoid and securely sutured under tension to the scaphoid using an anchor suture. In this additional step, we believe that the FCR slip attached to the scaphoid with an anchor suture can maintain sufficient tension to prevent scaphoid flexion. The FCR tendon slip is then pulled under tension and fixed to the dorsal surface of the lunate by means of an anchor suture, creating tension between the two anchors. The remaining graft is looped through the radiotriquetral ligament, the tension is adjusted, and then the graft is sutured to itself. No bone tunneling procedure is required with this procedure.

Our method of ligament reconstruction is based on the principle of tri-ligament tenodesis which creates the scaphotrapeziotrapezoid (only augmentation in this case), radiotriquetral, and scapholunate ligaments. These ligaments can be restored quickly by anchor sutures. The SL gap can be reduced by creating tension between "Anchor-Ligament-Anchor". We suggest that the dorsoradial part of the scaphoid should be carefully identified in order to avoid any injury to the main arterial supply. The ligament attachment site at the lunate should be debugged at the distal half to prevent impingement of redundant ligament on the dorsal lip of the distal radius.

The authors believe this method of tri-ligament tenodesis without bone tunnel can restore carpal alignment and reconstruct key ligaments. In this patient, there were no complications and good clinical results and radiological parameters were achieved. However, the carpal bone is composed primarily of cartilage, and cancellous bone, compared to the other bones of the body. The potential for tendon healing to bone and the tolerable degree of dislocation of the anchor suture due to cyclic loading will require long term follow-up to validate this technique. The results were satisfactory in this case, so a large cohort study of the "Safe scaphoid SL reconstruction technique" and to determine long term clinical outcomes to evaluate the effectiveness of this surgical procedure before recommending adoption of the technique for SL reconstruction.

Conclusion

This study introduces a novel technique of scaphoid safety procedure for scapholunate ligament reconstruction using a double anchor suture technique and multiple tendon weave an alternative to the bone tunnel technique

What is already known on this topic?

The current bone tunnel technique for scapholunate ligament reconstruction requires a drilling procedure which involves the risk of the serious complication of an iatrogenic scaphoid fracture.

What this study adds?

The new modified technique of Scapholunate ligament reconstruction without bone tunnel uses the "Anchor-Ligament-Anchor" technique. This technique can reduce the risk of the iatrogenic scaphoid fracture from the drilling procedure and can create sufficient tension between the ligament and the anchors to prevent scaphoid flexion deformity.

Acknowledgements

The present study was supported by Hand and Reconstructive Microsurgery Unit, Department of Orthopaedics, Faculty of Medicine, Ramathibodi Hospital, Mahidol University.

Potential conflicts of interest

The authors declare no conflict of interest.

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