A New Surgical Technique for Carpal Instability with Scapholunate Dissociation

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The most common carpal instability is the scapholunate dissociation (carpal instability dissociative: C.I.D.) with dorsal intercalated segment instability (D.I.S.I.), with the most significant element being the flexion of the scaphoid bone (rotary subluxation). Rupture of the scapholunate ligament was formerly believed to be the prerequisite for the dissociation.[1-3] However, three findings contradict this theory[4,5]:

1. By experimentally cutting the scapholunate ligament (SLL), the scaphoid did not flex. The authors performed this experiment on cadavers, as have other research groups.
2. The SL ligament is very lax, normally allowing wide freedom of flexion-extension movement of the scaphoid as related to the lunate. It is not a stabilizing structure for the scaphoid.
3. The intact scaphotrapezio-trapezoid ligament complex does not allow the rotary flexion of the distal pole of the scaphoid.

An indirect confirmation of these is the use of STT arthrodesis to correct scapholunate CID.

The scaphotrapezio-trapezoid ligament complex is peculiar. On the radial aspect, it consists of the continuation of the collateral radial ligament of the wrist. On the dorsal aspect, it is made up of two fibrous branches from scaphoid to trapezium and trapezoid and by the distal band of the dorsal belt from triquetrum to trapezium and trapezoid.

The strongest component of the STT ligament complex, however, is located on the volar aspect and is constituted by the thick fibrous apparatus made up of the volar STT ligaments fused with the deep layer of the sheath of the FCR (Fig. 1).

In cadaveric research, the severance of the STT ligaments and especially of the volar component permitted the scaphoid to rotate and flex.

On the other hand, the reduction of the scaphoid in situ and the maintenance of this reduction are difficult and often unsuccessful. Various surgical techniques which do not include surgical removal of the scar formed in the space (which has been left open dorsally by the rotation of the scaphoid) may be responsible for failure.

Therefore, we think that the rupture of the (volar) STT ligament is the essential prerequisite for the scaphoid rotary dislocation and that it is constant in the SL dissociation.

DISI is the consequence of the rotary subluxation[6] of the scaphoid which allows recession of the capitate. This in turn presses the lunate and brings about its gliding in order to leave the thinner dorsal bone between radius and capitate. The proximal movement of the capitate starts the carpal collapse which can reach the SLAC (Scapholunate Advanced Collapse) with arthritic changes (Fig. 2).[7,8]

The ligamentoplasties which have been proposed are currently difficult to perform and their results are generally unpredictable. The best known procedure of this type is the Dobyns and Linsheid ligamentoplasty.[1-3] A ECRL strip is used that is left distally inserted and is passed by various means into the scaphoid, the lunate, and the radius.

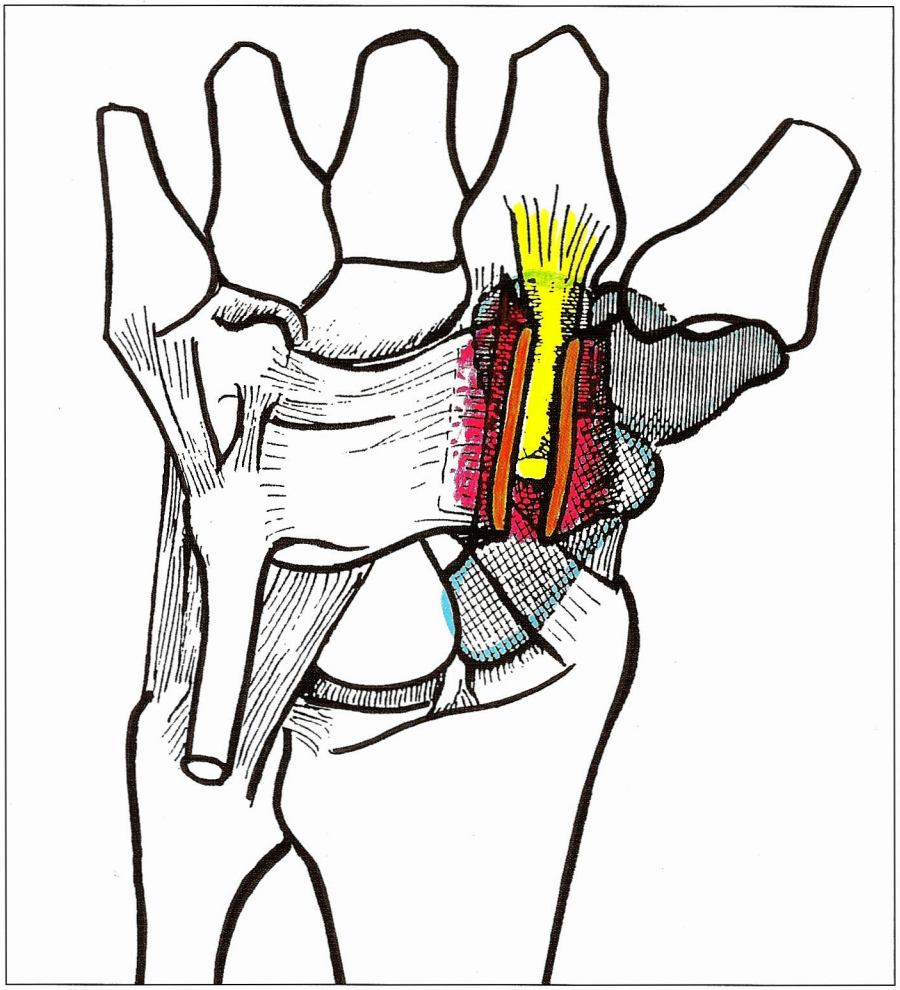

Figure 1. The deep part of the sheath of the flexor carpi radialis is the most important element of the ligamentous complex which ties the scaphoid to the trapezium and trapezoid bones.

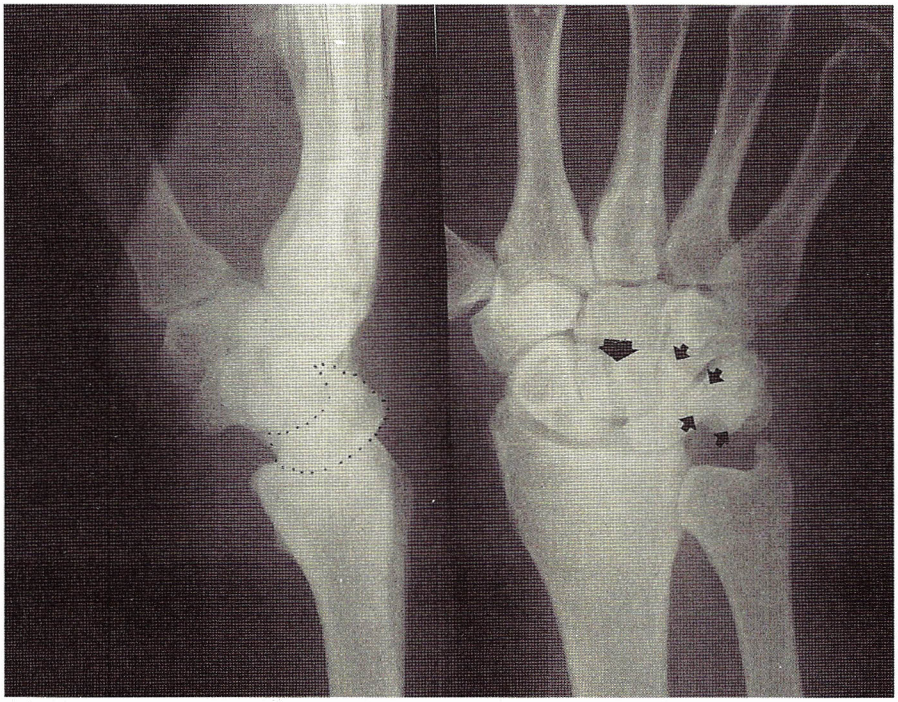

Figure 2. Example of SLAC. Right panel: recession of the capitate with collapse of the carpus (wide arrow) and disarrangement (small arrows) of almost all the carpal bones.

These intraosseous passages have been modified during the years. Taleisnik takes a strip of FCR and passes it dorsally in the lunate, then throughout the scaphoid in a volar direction, and eventually in the volar edge of the radius.

Other techniques aim to tie together the carpal bones or to bind the scaphoid with the lunate and the radius.[9,10]

These capsuloplasties demand a perfect reduction of the position of the two bones which is generally obtained by transferring them by means of K-wires and by manipulation of these wires. The scar formed between scaphoid and trapezium and trapezoid may often prevent a good reduction. No importance has been given to this fact as yet. Due to the inadequate results of these ligament reconstructions, many surgeons abandoned this technique in favor of partial arthrodesis in order to correct the rotary subluxation of the scaphoid. These arthrodeses, especially the STT type, however, reduce carpal mobility, modify the carpal kinetics, and worsen the pressure against the radial glenoid with arthritic changes at short-term follow-up (as has been demonstrated by numerous recent reports).[14-19]

MATERIALS AND METHODS

We have searched for a more effective and simple type of ligamentoplasty, while bearing in mind that the scapholunate CID is always associated with the following:

- a scar between the scaphoid and the lunate;
- dorsal subluxation of the proximal pole of the scaphoid;
- rupture or detachment of the fibrous sheath of the FCR;
- invasion of scar into the dorsal angle formed by the volar displacement of the distal pole of the scaphoid.

By careful examination of anatomic specimens after having tried various combinations of ligament sections and various types of tentative ligamentous reconstructive techniques, we have selected a surgical technique able to reduce the scaphoid into its normal position, to correct the SL dissociation, to reestablish the height of the carpus, and to maintain the correction (Figs. 3, 4).

A dual approach is necessary. By a longitudinal, dorsal approach 4 cm long, the retinaculum of the extensor tendons is cut at the level of the dissociation. By passing between the tendons of the extensor carpi radialis brevis and of the extensor pollicis

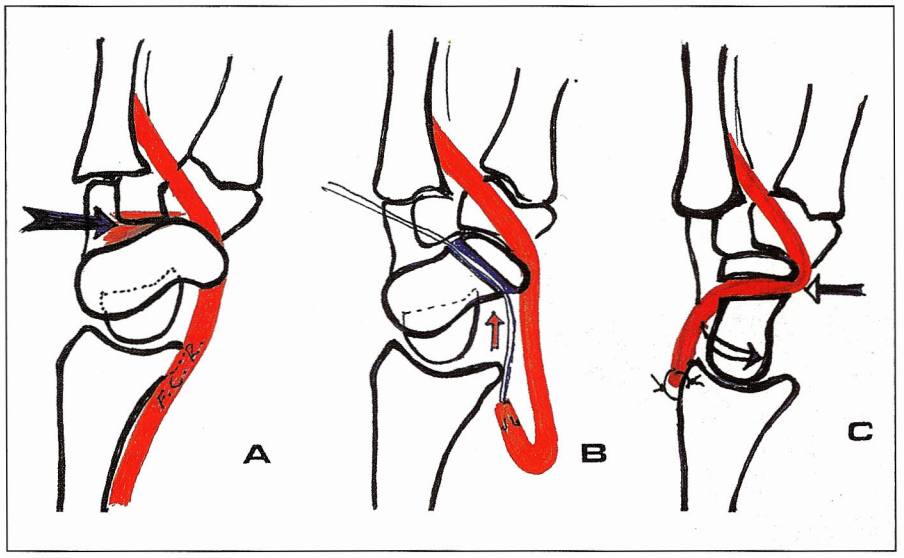

Figure 3. Scheme of the operation, lateral view. (A) The rotary subluxation of the scaphoid. (B) The flexor carpi radialis has been divided and is to be passed in a tunnel pierced in the distal pole of the scaphoid, parallel to its distal articular surface. (C) The tendon slip has been passed through the tunnel, pulled to reduce the rotary subluxation and sutured to the radius.

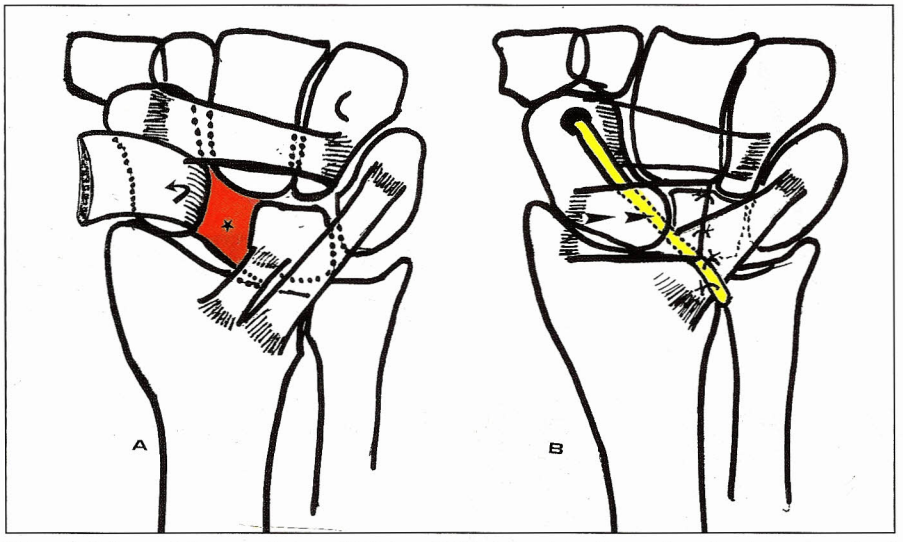

Figure 4. Scheme of the operation, sagittal view. (A) The capsulotendineous layer has been opened and reflected, giving access to the dissociation (star) in order to remove the scar. (B) After reduction of the scaphoid's rotary subluxation, the tendon slip is sutured to the dorsal-ulnar edge of the radius, and the capsule is sutured back to its place.

longus, the deep fibrous layer (capsule and ligaments or their remnants) is also open. All the scar tissue formed between the scaphoid and the lunate is removed, taking care to spare the cartilage of these two bones. Following the scaphoid distally, the STT joint is reached, and the scar formed in the angle produced by the scaphoid flexion is removed.

On the volar aspect, the skin incision follows the FCR tendon. The remains of the scar between scaphoid and lunate are removed to facilitate visualization throughout the space from dorsal to volar. The fibrous sheath of the tendon is opened up to the trapezium and trapezoid.

The tendon is longitudinally severed and a 7-cm-long tendon slip is prepared which remains attached distally.

A tunnel with a diameter of 2.5 mm is pierced throughout the distal pole of the scaphoid, parallel to the distal articular surface. The tendon slip is taken with a nylon slip knot and passed throughout the tunnel from volar to dorsal.

By pulling the tendon slip dorsally, the scaphoid is reduced to its place, the proximal pole subluxation disappears, as does the SL dissociation. The latter is almost automatic and does not require any effort.

The reduction is temporarily fixed by means of one (or two) K-wires including the scaphoid and the capitate. The K-wires will be removed after 30 days (Fig. 5).

The tendon slip is then sutured to the fibrous tissue at the dorsal and the ulnar edge of the distal radius. If there are some remains of SL ligaments, these will be sutured to the tendon slip which overlies them obliquely, crossing the SL joint.

Then the capsule remnants are sutured and the flap of the dorsal retinaculum is sutured back to its place. A plaster cast is worn for 30 days.

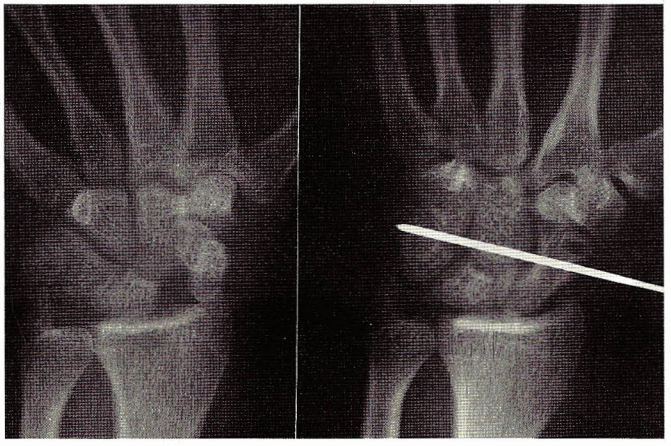

Figure 5. After the reduction, a temporary fixation of the scaphoid is obtained by means of a K-wire securing the distal part of the scaphoid to the capitate.

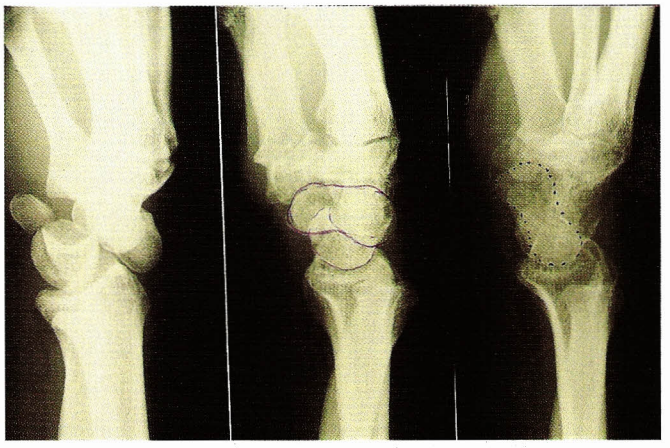

Figure 6. (left) Dislocation of the wrist. (center) After reduction (at 3 months): severe rotary luxation of the scaphoid. (right) Result at 7 months after the operation.

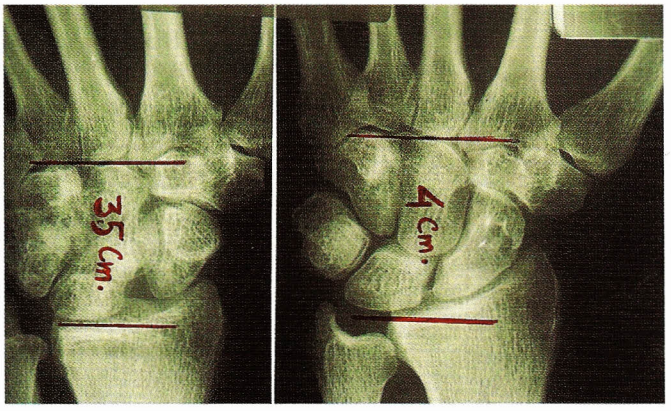

Figure 7. The height of the carpus (after the correction of the scaphoid rotary subluxation) is restituted and maintained.

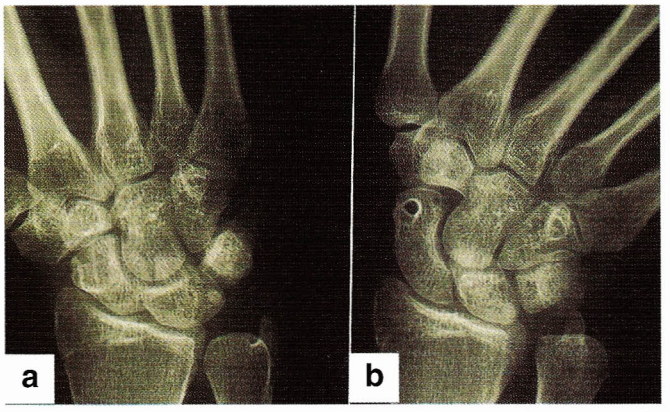

Figure 8. After the operation, the independent movements of the scaphoid are restored. In radial deviation (a), the scaphoid flexes; in ulnar deviation (b), it extends.

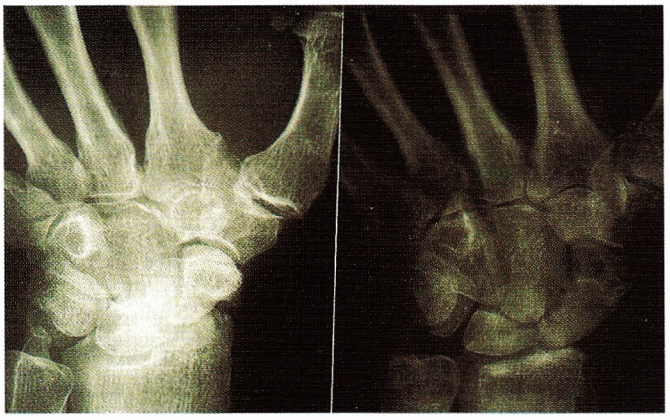

Figure 9. Preoperative and postoperative result of a case with radioscaphoid arthritic changes operated on by ligamentoplasty plus styloidectomy.

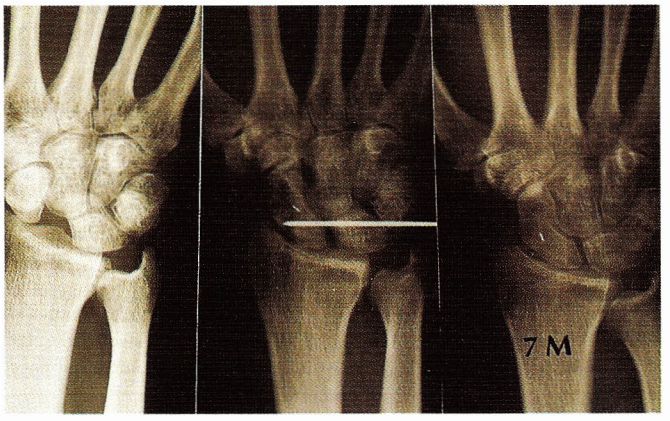

Figure 10. Carpal instability with scapholunate dissociation, anteroposterior view. (left) Before the operation. (center) Immediately after. (right) The result at 7 months is perfectly maintained.

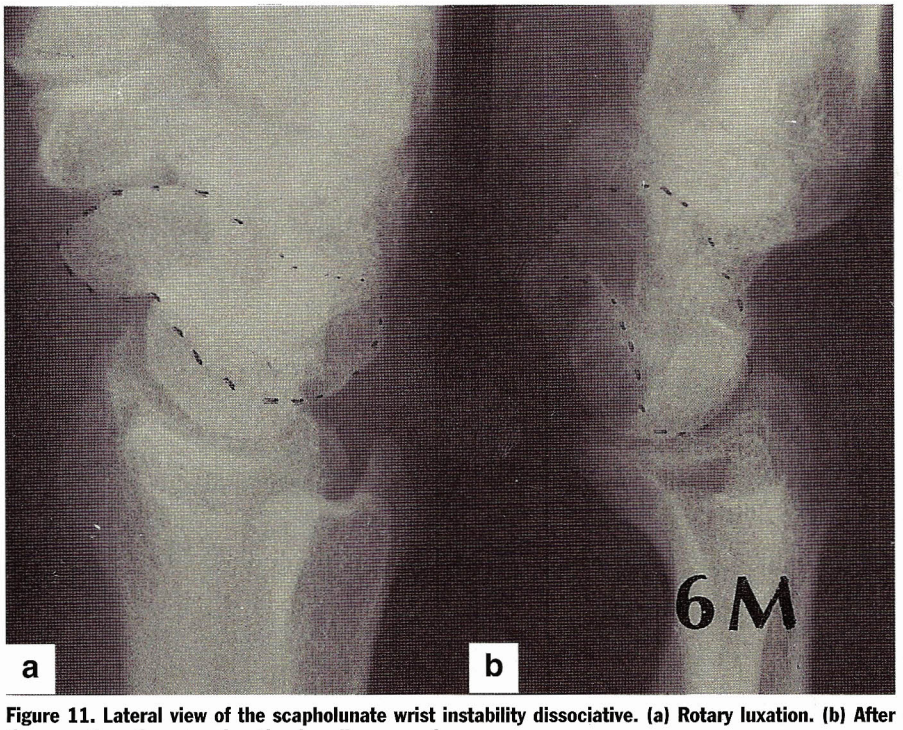

Figure 11. Lateral view of the scapholunate wrist instability dissociative. (a) Rotary luxation. (b) After the operation, the rotary luxation has disappeared.

RESULTS

We first operated on a small series of seven patients and stopped to check the mid- and short-term results. Finding very good results and full patient satisfaction, we have since applied this technique routinely (Fig. 6)

Our series includes 15 cases operated on starting in 1992 with a follow-up of 6 months to 3 years. This follow-up is clearly still short. No recurrence has thus far been observed. The scaphoid always maintains its reduction. The carpal height is restored and restoration maintained (Fig. 7). The scaphoid ROM was preserved with flexion during radial deviation of the hand and extension in ulnar deviation. The scaphoid keeps its independence of movements as related to the lunate (Fig. 8). The ROM of the wrist is on average slightly reduced in flexion.

Extension is more or less normal. The strength is reduced 35% compared to the controlateral hand but, compared to the

preoperatory status, it has improved 50%.

The average absence from work was 100 days. In 2 cases in which arthritic changes had already occurred in between distal radius and scaphoid, styloidectomy was concurrently performed. In these cases the result was evidently less satisfactory.

Eleven patients are completely pain-free and very satisfied. Two still suffer from slight pain at work (patients with styloidectomy), and two are still under re-education (Figs. 9, 10, 11).

DISCUSSION

It is the opening of the STT joint and the removal of the scar formed dorsally which allows (1) the mobilization of the scaphoid and (2) its rather easy reduction in situ with concomitant disappearance of the SL dissociation. In addition, the scar between the scaphoid and the lunate has to be previously removed. This confirms the importance of the STT ligaments, the most important of which is the deep fibrous sheath of FCR tendon. The technique we are suggesting is easy to perform—easier than any other ligamentoplasty proposed to date. Even if present literature is skeptical about the possibility of ligamentoplasties, our results (at short and mid-term follow-up) are very encouraging.

If results at long-term follow-up confirm the present expectations, this technique will probably replace partial arthrodesis, the results of which appear less satisfactory and enduring. STI

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