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DORSAL INTERCARPAL LIGAMENT CAPSULODESIS FOR PREDYNAMIC AND DYNAMIC SCAPHOLUNATE INSTABILITY

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We treated a prospective series of 18 patients (nine men and nine women) with a mean age of 35 years (range 15 to 57), with chronic predynamic or dynamic scapholunate instability by a dorsal intercarpal ligament capsulodesis using the modified Mayo technique. All the patients were assessed by the modified Mayo wrist score and DASH questionnaire. Wrist arthroscopy was done in all patients before open surgery in order to grade the scapholunate instability and correlate the findings with the radiographic and MRI results. At an average follow-up of 45 months (range 34 to 60) pain significantly diminished ($P < 0.05$) with improvement in the grip strength ($P < 0.005$) in all 18 cases. Wrist motion remained almost the same. The mean Mayo wrist score improved from 62 to 84 ($P < 0.005$).We recommend dorsal capsulodesis by using the dorsal intercarpal ligament flap for the treatment of scapholunate dissociation, when the ligament is still repairable.

Keywords: dorsal capsulodesis, scapholunate dissociation, ligamentous repair, wrist instability, carpal instability

INTRODUCTION

Scapholunate (SL) dissociation is a common condition that can lead to carpal instability and eventually to wrist disability. Despite present knowledge of this type of injury, it still remains underestimated and misdiagnosed (Walsh et al., 2002).

The consequences of SL ligament injuries vary depending on the severity of the injury. Some acute injuries heal spontaneously, whereas others develop chronic progressive instabilities and collapse associated with involvement of the secondary stabilizing ligaments (scaphotrapezotrapezoid [STT] and scaphocapitate [SC]). More detrimental effects of SL dissociation can be seen when the STT and SC ligaments are damaged along with the SL ligament. Degeneration of the articular surface of the radiocarpal and midcarpal joints leaves the surgeon with the only option of carrying out a salvage procedure. Different treatment and classification algorithms have been proposed in order to provide a simple and unique way for selecting surgical options (Garcia-Elias et al., 2006; Larsen et al., 1995; Stanley and Saffar, 1994). However, despite various efforts by different surgeons, the treatment of SL injuries remains a challenge for hand surgeons.

When treating a SL injury different parameters, such as the status of dorsal SL ligament (partial or complete tear), the cartilage status and the healing potential of the ligament tear, status of the secondary scaphoid stabilizers and the reducibility of carpal malalignment have to be considered (Garcia-Elias et al., 2006). Taking all these parameters into consideration and also using the proposed algorithm of Garcia-Elias et al. (2006), we decided to use the Mayo modified capsulodesis technique (Moran et al., 2005) for our patients who presented with a partial or complete SL tear. (The senior author (R.L.) was aware of the work of Garcia-Elias et al. and the Mayo group before their publications.) 'Capsulodesis' is not an appropriate term to describe this surgical intervention. The term 'augmentation' seems to be more appropriate as the DIC ligament flap which is harvested from the dorsal aspect of the wrist reinforces the damaged SL ligament. However, to avoid any confusion, we shall use the term 'capsulodesis' throughout the description in our study.

PATIENTS AND METHODS

A prospective series of 18 patients with chronic predynamic or dynamic SL instability was treated by a dorsal intercarpal (DIC) ligament capsulodesis using a modified Mayo technique (Moran et al., 2005). All the patients were operated on by the same surgeon (L.R.).

Primary indications for selecting the surgical candidates were based on dorsal wrist pain at rest and during work or sport activities, with associated signs of SL carpal instability. These patients were clinically assessed by the Watson manoeuvre (Watson et al., 1997). The results of the Watson manoeuvre were somewhat doubtful in the predynamic stage but were clearly evident during the dynamic stage. All the patients presented with an absence of resting scaphoid flexion in anteroposterior radiographs and no features of arthritis. MRI was routinely done in all patients.

Exclusion criteria for this study were: wide static SL diastasis; SL angle greater than 60°; DISI deformity; and presence of signs of arthritis in radiographs.

The study was done between 2001 and 2006 and included nine men and nine women with a mean age of 35 years (range 15 to 57). The right and left hands were affected in nine cases each. The dominant hand was involved in six cases. The mechanism of injury was by hyperextension of the wrist in all but one case, in which the mechanism was hyperflexion.

Method of assessment

All patients had preoperative and postoperative radiographs. Preoperative and postoperative clinical evaluation included quantification of pain, wrist ROM and grip strength. Pain was evaluated by a visual analogue scale (VAS) ranging from 0 to 10 points, 10 being the most severe. Wrist ROM included flexion–extension, pronosupination and radioulnar deviation, all of which were measured with a goniometer. Grip strength was measured in kilograms using a dynamometer (Jamar, Preston, Jackson, MI) set at all five positions of which the mean value was based on three trials for each grip strength position.

Each patient was clinically evaluated by the Mayo wrist score (0–100 points) as modified by Cooney et al. (1987) and Krimmer (2000). The results were graded as excellent (90 to 100); good (80 to 90); fair (65 to 79) and <65 as poor.

The Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire was also included: the best rating being closest to 0 points (Hudak et al., 1996).

Statistical analysis

Preoperative and postoperative data for pain, wrist ROM, grip strength, Mayo score and DASH questionnaire were compared statistically in 18 cases by use of the two-tailed matched pair Student's *t*-test. Differences were considered significant when the *P* value was <0.05.

Surgical procedure

Wrist arthroscopy was done in all patients before open surgery to assess the status of the radiocarpal joint and to grade the SL instability according to the Geissler classification (Geissler et al., 1996). Wrist arthroscopy immediately before surgery was done without water infusion (Atzei et al., 2006; del Piñal et al., 2007). A dorsal approach (a zig-zag skin incision) was used and the incision was centred along the long finger ulnar to Lister's tubercle. During blunt dissection, the dorsal sensory branches of both the radial and ulnar nerves were carefully retracted and secured. The extensor retinaculum was sectioned between the third and the fourth compartments and a dorsal ligament splitting capsulotomy was done as in the dorsal exposure proposed by Berger et al. (1995). Neurectomy of the dorsal interosseous nerve was done to prevent neuroma formation and subsequent dorsal wrist pain (Haerle et al., 2002; Wilhelm, 2001). After exposing the radiocarpal joint, the SL ligament was assessed. Before repairing the SL ligament, two Kirschner wires were positioned in the scaphoid and in the lunate bones, and used as joysticks to manipulate the bones and to derotate the lunate in a neutral position. Both in the dynamic and predynamic stages the scaphoid and the lunate were temporarily stabilized with two Kirschner wires, one across the scaphocapitate and the other across the SL joint. The SL ligament was then repaired, depending on to the type of tear (complete or partial tear, reparable or irreparable). The proximal half of the dorsal intercarpal ligament (DIC) (Fig 1) was detached from the triquetrum and its radial insertion left attached to the scaphoid. The detached part of the ligament was used as augmentation for the SL ligament tear (Fig 2). The partially dissected DIC ligament was then transferred proximally to cover the SL ligament and sutured to the dorsal part of the lunate by using a suture anchor (FASTak Suture Anchor, FiberWire, Arthrex, Naples, FL, USA).

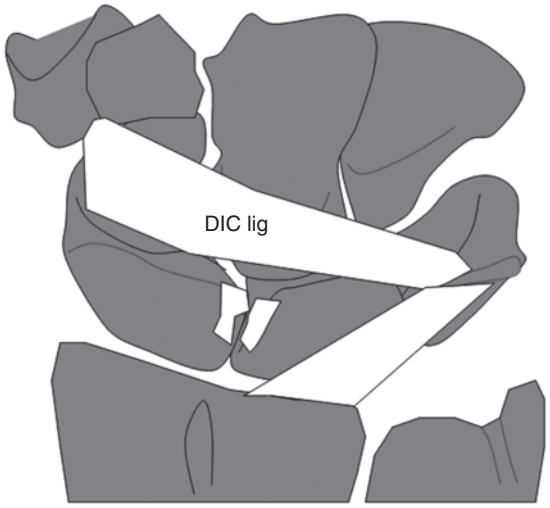

Fig 1 Illustration showing the DIC ligament.

The capsular flap, extensor retinaculum and skin were closed with a drain in place.

The wrist was immobilized in a palmar thermoplastic splint or a fibre cast for 4 weeks. An antioedema lymph drainage program was started by the hand therapist in the immediate postoperative period.

The Kirschner wires were removed after 4 weeks and passive and active mobilization of the wrist was started. The splint was used to protect the wrist for an additional 4 weeks. During this time, graded resistive hand/wrist and forearm strengthening exercises and wrist/hand

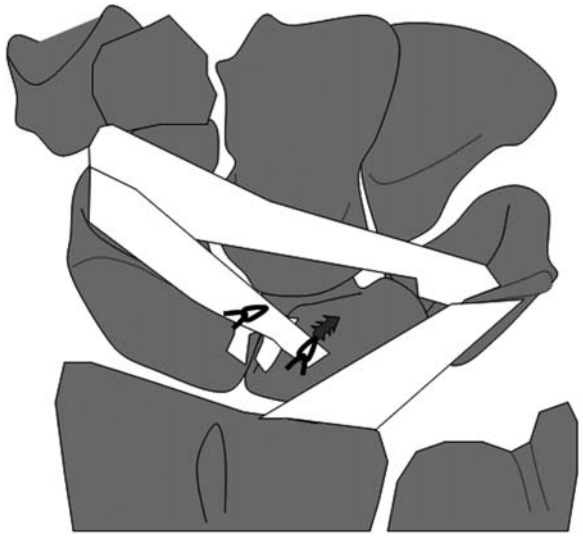

Fig 2 Illustration showing the proximal half part of the DIC ligament rotated proximally to reinforce the scapholunate ligament tear.

proprioceptive exercises were integrated into the physical therapy program, gradually preparing the patient to return to work after 3 months and to free sports activities after 6 months.

RESULTS

The average time from injury to surgery was 10 months (range 2 to 24). The average follow up was 45 months (range 34 to 60). Static X-ray films were always negative for SL diastasis with the SL angle being less than 60°. An SL gap became evident by a stress test (clenched fist) in four cases and another six more cases were doubtful. Arthroscopic results, in all 18 cases, demonstrated stage 3 SL instability according to the Geissler classification (Geissler et al., 1996). Preoperative assessment of SL instability and dissociative signs by MRI and X-rays were considered to be positive only in 87% and 56% of the cases, respectively. Arthroscopy was confirmed to be the gold standard in the evaluation of the SL lesion.

An incomplete dorsal SL ligament tear was found in 14 patients at surgery and a complete tear in four patients. SL ligament tears in the latter group were always repaired by using a suture anchor (Arthrex, Naples, FL, USA).

Postoperative complications, such as K-wire infection or complex regional pain syndrome, did not occur in any case. Nor did any patients develop arthritis. All were able to return to their previous work or sport activity.

In all cases pain significantly diminished and grip strength improved (Table 1).

Wrist ROM decreased without reaching statistical significance. The mean Mayo wrist score improved from 62 to 84 using the method of Cooney et al. (1987) and from 72 to 90 using the method of Krimmer (2000). The DASH questionnaire showed an average improvement from 38 to 20, but this was not significant.

Table 1—Results

Parameters	*Preoperative*	*Postoperative*	*P value*
Pain (VAS)	8	5	<0.005
Flexion–Extension (°)	127	123	NS
Grip strength (kg/%)	24/75	27/87	NS
MWS* (Cooney)	62	84	<0.005
MWS* (Krimmer)	72	90	<0.005
DASH	38	20	NS

*Mayo Wrist Score.

A typical case is shown in Fig 3.

DISCUSSION

The purpose of repairing an SL tear is to avoid the onset of secondary arthritic wrist changes, to restore normal ROM and to decrease painful wrist symptoms.

SL ligament repair can be performed according to the severity of the SL tear. When STT and SC ligaments tears are associated with SL ligament tears, SL repair or capsulodesis are not sufficient to restore normal SL joint function. The secondary stabilizer ligaments must also be repaired in order to recover normal scaphoid extension (Garcia-Elias et al., 2006).

Different techniques have been proposed to treat the SL ligament tear, such as direct ligament repair in acute conditions with or without capsulodesis (Baxamusa and Williams, 2005; Kobayashi and Terrono, 2003; Lavernia et al., 1992; Szabo et al., 2002), reconstruction by bone–ligament–bone graft (Wolf and Weiss, 2001) reconstruction by FCR tendon (Brunelli and Brunelli, 1995a; 1995b; Van den Abbeele et al., 1998), tendon transfer (Brunelli et al., 2004) or partial wrist arthrodesis (Kleinmann and Carrol, 1990; Watson et al., 2003).

A treatment algorithm for SL ligament tear was proposed by Garcia-Elias et al. (2006) according to the status and the potential reparability of the SL ligament, the cartilage condition, the status of secondary scaphoid stabilizer ligaments (STT and SC ligaments) and the possibility of correcting the carpal malalignment. In this series, we did dorsal capsulodesis by using the DIC ligament transfer only in the presence of dynamic and predynamic SL ligament instability and in accordance with the treatment protocol proposed by Garcia-Elias et al. (2006).

The first capsulodesis was reported by Blatt (1987), who used a flap of the dorsal capsule to reduce scaphoid flexion. Anatomical studies and research led to modifications in capsulodesis techniques to avoid the limitation of wrist flexion, so commonly seen with Blatt's procedure. Szabo et al. (2002) used the DIC ligament to

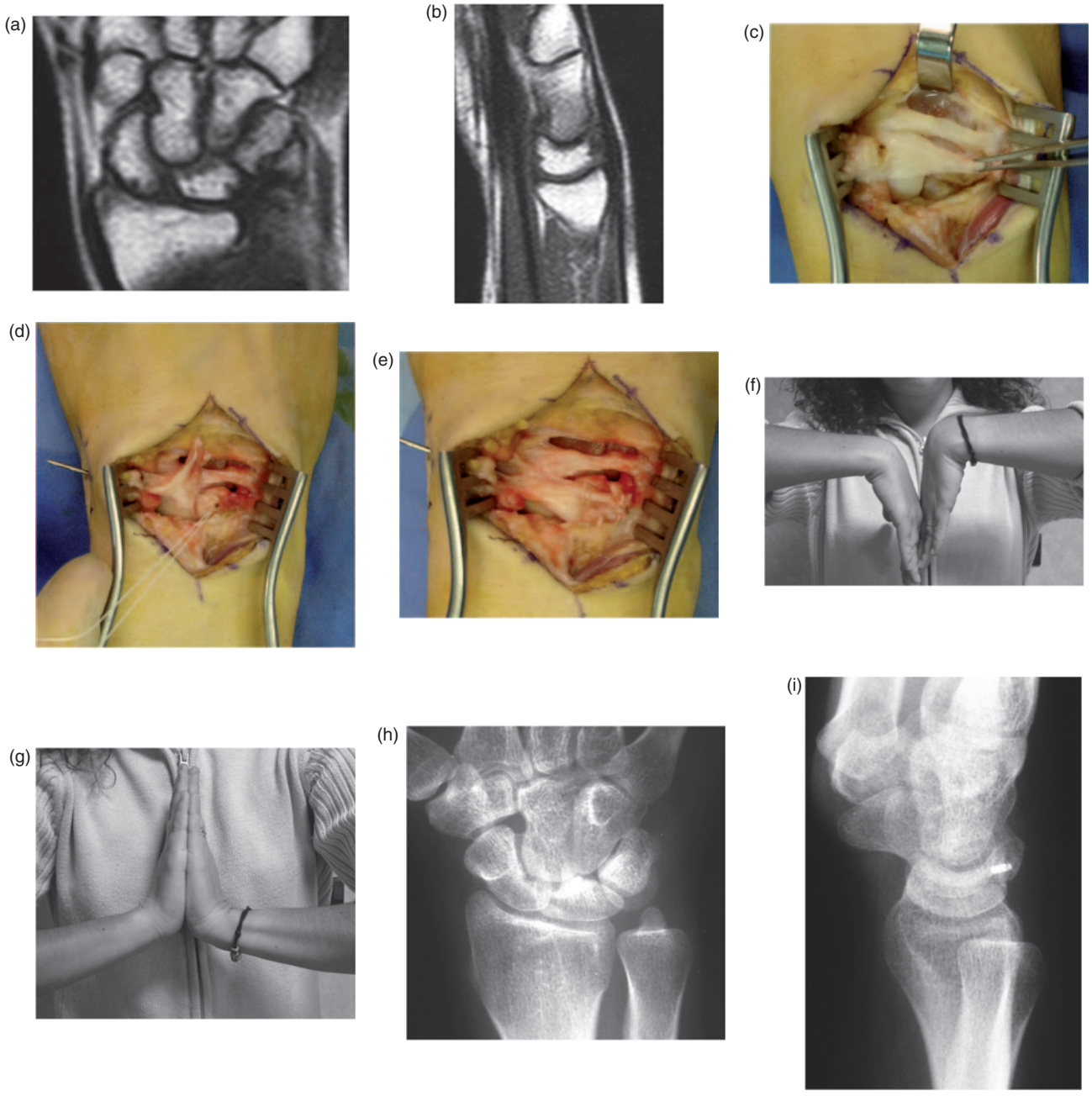

Fig 3 Clinical case: a 35-year-old woman with right hand hyperextension trauma. (a,b) MRI of right wrist: the SL ligament lesion is evident without DISI deformity. Wrist arthroscopy done before surgery demonstrated a Geissler stage 3 lesion of the SL ligament. (c,d,e) Surgical treatment of the SL lesion with capsulodesis by using proximal half of the DIC ligament. Carpal bones were temporary stabilized using 2 K-wires. (f,g) Clinical result and (h,i) radiographs at 6 months follow-up.

correct the SL malalignment. Berger et al. (1995) proposed a modification of this technique reversing the DIC ligament flap harvest. Moran et al. (2005) reported improvement in pain relief using the Blatt or Mayo techniques, but with a decrease in wrist ROM. Minami et al. (2001) treated 17 patients with dorsal capsulodesis and recommended early wrist rehabilitation to achieve better results in wrist ROM.

Comparison between the results of these studies is not feasible because different capsulodesis techniques were used and most of these techniques reduced wrist flexion (Dagum et al., 1997). Moreover, the same techniques were used both for static (reducible) and dynamic SL ligament tears and in acute or chronic conditions.

The outcomes from our series demonstrated a good agreement with other studies (Table 2). Furthermore, the

Table 2—Comparison with other studies

Authors	*No*	*Follow-up (months)*	*Pain (VAS)*	*F/E (%)*	*Grip strength (%)*	*MWS*
Moran et al. (2004)	31	54	↓	83	70	73
Minami et al. (2005)	17	49	↓	87	93	83
Kobayashi and Terrono (2003)	21	14	↓	?	81	?
Present study	18	45	↓	80	87	84

patients reported a significant improvement in pain and wrist function (Table 1). Pain did not disappear completely; however, it decreased enough to allow return to previous work and sporting activities along with improvement in grip strength. Recovery in wrist ROM was not always complete and wrist extension and flexion was less than in the contralateral wrist. Patients must be informed before surgery about this loss of range of motion of the wrist, which may be more important for heavy workers and sportspersons.

Based on the present study we conclude that dorsal capsulodesis by using the DIC ligament flap is a good surgical option in the treatment of SL dissociation. We recommend this procedure for partial or complete SL ligament tears, when the ligament is still reparable. In such conditions, the dorsal capsulodesis reinforces and stabilizes the repaired or stretched SL ligament and works in conjunction with the STT and SC ligaments to prevent palmar scaphoid flexion, thereby restoring wrist stability.

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CONFLICT OF INTERESTS

None declared.

References

Atzei A, Luchetti R, Sgarbossa A, Carita E, Llusa M. Set-up, portals and normal exploration in wrist arthroscopy. Chir Main. 2006, 25(Suppl. 1): 131–44.

Baxamusa TH, Williams CS. Capsulodesis of the wrist for scapholunate dissociation. Tech Hand Upper Extrem Surg. 2005, 9: 35–41.

Berger RA, Bishop AT, Bettinger PC. New dorsal capsulotomy for the surgical exposure of the wrist. Ann Plast Surg. 1995, 35: 54–9.

Blatt G. Capsulodesis in reconstructive hand surgery. Dorsal capsulodesis for unstable scaphoid and volar capsulodesis following excision of the distal ulna. Hand Clin. 1987, 3: 81–102.

Brunelli GA, Brunelli GR. A new surgical technique for carpal instability with scapholunate dislocation. Eleven cases. Ann Chir Main. 1995a, 14: 207–13.

Brunelli GA, Brunelli GR. A new technique to correct instability with scaphoid rotatory subluxation: a preliminary report. J Hand Surg Am. 1995b, 20: S82–5.

Brunelli F, Spalvieri C, Bremner-Smith A, Papalia I, Pivato G. Dynamic correction of static scapholunate instability using an active tendon transfer of extensor carpi radialis: preliminary report. Chir Main. 2004, 23: 249–53.

Cooney WP, Bussey R, Dobyns JH, Linscheid RL. Difficult wrist fractures. Perilunate fracture-dislocations of the wrist. Clin Orthop Relat Res. 1987, 214: 136–47.

Dagum AB, Hurst LC, Finzel KC. Scapholunate dissociation: an experimental kinematic study of two types of indirect soft tissue repairs. J Hand Surg Am. 1997, 22: 714–19.

del Piñal F, Garcia-Bernal FJ, Pisani D, Regalado J, Ayala H, Studer A. Dry arthroscopy of the wrist: surgical technique. J Hand Surg Am. 2007, 32: 119–23.

Garcia-Elias M, Lluch AL, Stanley JK. Three-ligament tenodesis for treatment of scapholunate dissociation: indications and surgical technique. J Hand Surg Am. 2006, 31: 125–34.

Geissler WB, Freeland AE, Savie FH, McIntyre LW, Whipple TL. Intracarpal soft-tissue lesions associated with intra-articular fracture of the distal end of the radium. J Bone Joint Surg Am. 1996, 78: 357–65.

Haerle M, Tonagel T, Schmidt G, Schaller HE. Long-term results of total wrist denervation. J Hand Surg Br. 2002, 27(Suppl.): 36–7.

Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (Disability of the Arm, Shoulder and Hand). The Upper Extremity Collaborative Group (UECG). Am J Ind Med. 1996, 29: 602–8.

Kleinmann WB, Carrol C. Scapho-trapezio-trapezoid arthrodesis for treatment of chronic static and dynamic scapho-lunate instability: a 10 year perspective on pitfalls and complications. J Hand Surg Am. 1990, 15: 408–14.

Kobayashi K, Terrono AL. Dorsal intercarpal augmentation ligamentoplasty for scapholunate dissociation. Tech Hand Upper Extrem Surg. 2003, 7: 151–6.

Krimmer H. Gegenuberstellung der mediokarpalen Teilarthrodese und der totalarthrodese des Handgelenkes durch Scorebewertung. In: Krimmer H (Ed.) *Der posttraumatische karpale Kollaps*. Berlin, Springer, 2000: 48–57.

Larsen CF, Amadio PC, Gilula LA, Hodge JC. Analysis of carpal instability: I. Description of the scheme. J Hand Surg Am. 1995, 20: 757–64.

Lavernia CJ, Cohen MS, Talesnik J. Treatment of scapholunate dissociation by ligamentous repair and capsulodesis. J Hand Surg Am. 1992, 17: 354–9.

Minami A, Kato H, Iwasaki N. Treatment of scapholunate dissociation: ligamentous repair associated with modified dorsal capsulodesis. Hand Surg. 2001, 8: 1–6.

Moran S, Cooney WP, Berger RA, Strickland J. Capsulodesis for the treatment of chronic scapholunate instability. J Hand Surg Am. 2005, 30: 16–23.

Stanley J, Saffar P. Abnormal findings. In: Stanley J, Saffar P (Eds.) *Wrist arthroscopy*. London, Martin Dunitz, 1994: 106–7.

Szabo RM, Slater RR, Palumbo CF et al. Dorsal intercarpal ligament capsulodesis for chronic, static scapholunate dissociation: clinical results. J Hand Surg Am. 2002, 27: 978–84.

Van den Abbeele KLS, Loh YC, Stanley JK, Trail IA. Early results of a modified Brunelli procedure for scapholunate instability. J Hand Surg Br. 1998, 23: 258–61.

Walsh JJ, Berger RA, Cooney WP. Current status of scapholunate interosseous ligament injuries. J Am Acad Orthop Surg. 2002, 10: 32–42.

Watson HK, Weinzweig J, Zeppieri J. The natural progression of scaphoid instability. Hand Clin. 1997, 13: 39–49.

Watson HK, Wollestien R, Joseph E et al. Scaphotrapezoid arthrodesis: a follow-up study. J Hand Surg Am. 2003, 28: 397–404.

Wilhelm A. Denervation of the wrist. Tech Hand Upper Extrem Surg. 2001, 5: 14–30.

Wolf JF, Weiss AP. Bone–ligament–bone reconstruction of scapholunate ligament injuries. Orthop Clin North Am. 2001, 32: 241–6.

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