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ORIGINAL STUDY

Does the "three-ligament tenodesis" procedure restore carpal architecture in static chronic scapholunate dissociation ?

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The effect of the three-ligament tenodesis on the scapholunate angle and scapholunate gap was studied. A comparison was made between these angles preoperatively and postoperatively in 12 patients. There was a significant decrease in the scapholunate angle from 77 to 68°, and the scapholunate gap was reduced from 4.25 mm to 3.29 mm. We also studied the correlation between scapholunate angle and scapholunate gap postoperatively in a cohort of 25 patients and found a significant correlation.
This suggests that the principle of the procedure is correct, but the aims are not fully achieved, and that the procedure has a similar effect on SL gap and SL angle.

Keywords : wrist ; scapholunate ; carpus ; instability ; ligamentoplasty ; Brunelli ; DISI.

INTRODUCTION

Scapholunate (SL) instability is the most frequent type of carpal instability (*12*). The intrinsic (interosseous) scapholunate ligament is the main stabilizer of the carpus.

Ruptures of the SL ligament create a pattern of collapse of the carpus called DISI (dorsal intercalated segment instability) with flexion of the scaphoid, extension of the lunate, and dissociation of the lunate and scaphoid bones. On radiographs this results in an increased scapholunate distance (normally less than 2 mm) and an increased scapholunate angle on the lateral view (normally between 45 and 60°). Both parameters assess the SL malalignment in patients before surgery. Procedures such as scaphotrapeziotrapezoid (STT) arthrodesis (*15*) and the original Brunelli procedure (*3*) concentrate on reducing the SL angle without addressing the SL gap.

When rotatory disassociation is seen, some attenuation of extrinsic ligaments must have occurred. This was the rationale for the flexor carpi radialis (FCR) tenodesis described by Brunelli and Brunelli (*3*). A distally based strip of the FCR is passed through a drill hole through the scaphoid and fixed on the dorsal rim of the distal radius. Later Van den Abbeele *et al* (*14*) and Garcia-Elias *et al* (*8*) modified this procedure and fixed the tendon strip onto the dorsal aspect of the lunate (Fig. 1). Brunelli (*4*) explicitly requested not to call this modification "modified Brunelli". Following these suggestions the term "three-ligament tenodesis" should be used.

Good clinical outcomes were reported but there is limited radiological data. Before evaluating the clinical outcome it is important to see if the

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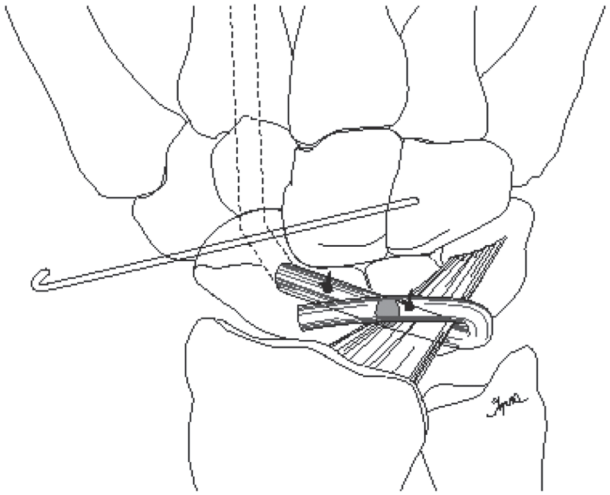

Fig. 1. — Drawing of the procedure

technique does what it was supposed to do : correct the DISI.

The aim of this study was to evaluate the effect of the three-ligament tenodesis procedure on the SL angle and SL gap and to to investigate the correlation between these measurements after the surgery.

MATERIAL AND METHODS

We performed two investigations.

In our first study, there were 12 patients, 10 males, 2 females with a mean age of 43 years (range : 35 to 57). With a chronic, static DISI, treated with the three-ligament tenodesis, the SL angle greater than 60° and the SL gap greater than 2 mm. Patients who had osteoarthritis, inflammatory disorders and severe (post)traumatic deformities other than that caused by the SL injury were excluded. The preoperative and postoperative radiographs had to be available and to have been taken in the correct (zero) position. We excluded those patients who subsequently had a salvage procedure because none of these had radiographs we could use at one year after surgery.

We also wanted to investigate carpal alignment in patients in which we were confident that stabilisation was completely achieved and the indication for surgery had been correct. The preoperative and postoperative radiographs had to be available and to have been taken in the correct position with the wrist in neutral. In this cohort we studied the changes of the SL angle and SL gap after three-ligament tenodesis.

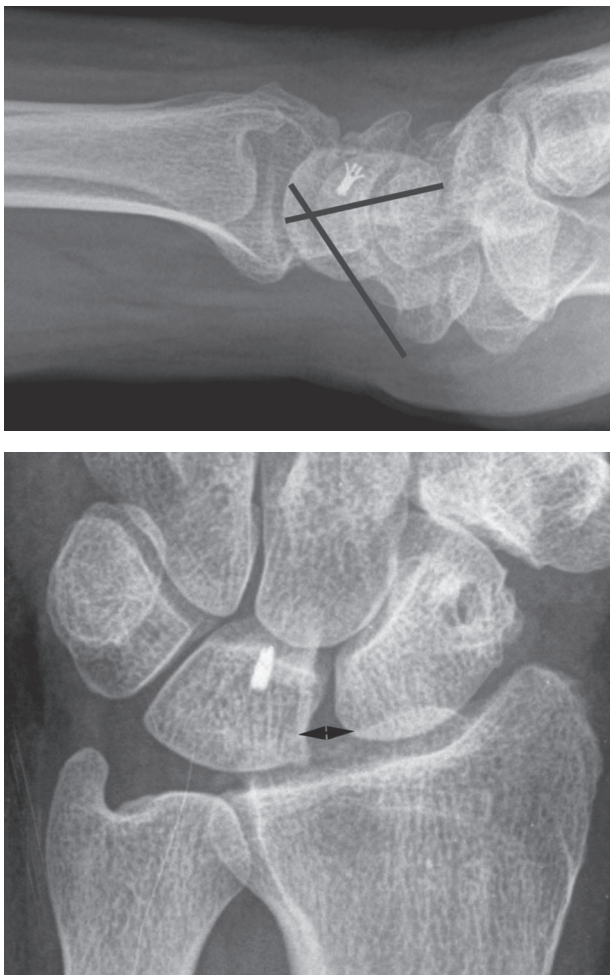

Fig. 2. — Schematic measurements on the radiographs

Secondly we investigated the correlation between the SL angle and the SL gap after ligamentoplasty in 25 consecutive patients with chronic, static SL dissociation treated with the three-ligament tenodesis, with or without preoperative radiographs and regardless of whether a salvage procedure subsequently had been done or not. There were 18 men and 7 women with a mean age of 40.2 years (range : 26 to 59).

All measurements were done electronically (Fig. 2) with the measuring device available in the

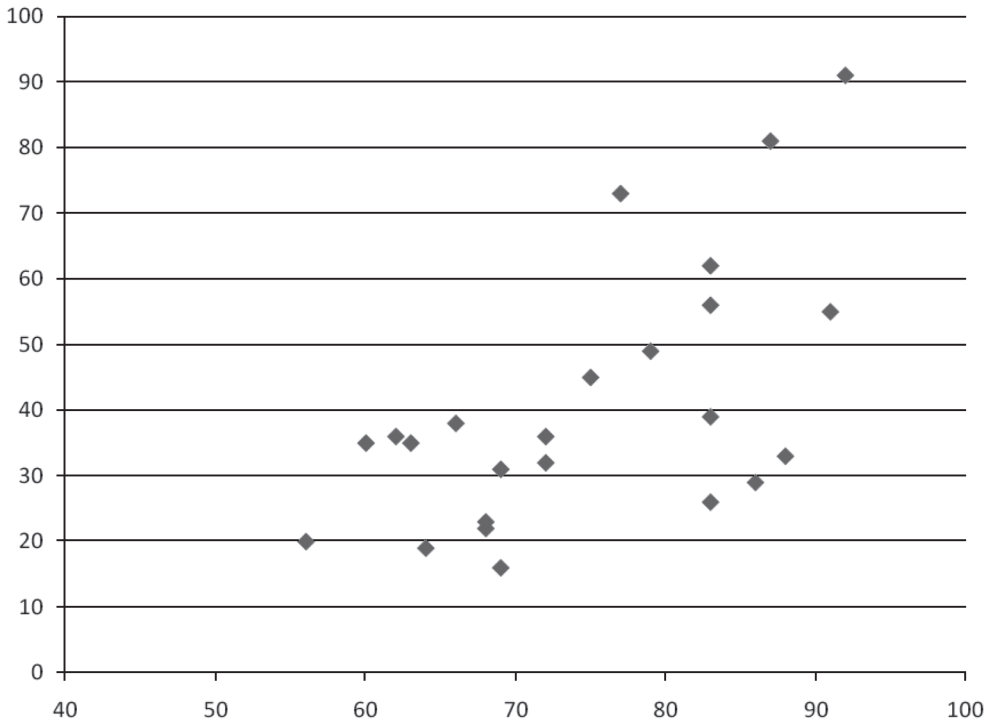

Fig. 3. — Scatter plot of data : X-axis = SL-angle, Y-axis = SL-gap

radiology software package. The interval between operation and evaluation was at least 12 months. We analysed the data using the paired t-test to evaluate the change in measurements before surgery and over 12 months later. Correlation was assessed with the Spearman correlation coefficient. Significance was set at $p < 0.05$.

RESULTS

The SL angle on the lateral radiographs was 77° preoperatively (SD 9.04) and was found to be reduced to 68° (SD 14.90). This decrease was significant ($p = 0.026$, paired t-test) However the angle became normal with a value of 60° or less in only three wrists.

The SL gap decreased from 4.3 mm (SD 1.72) preoperatively to 3.3 mm (SD 1.88). This difference was also significant ($p = 0.002$, paired t-test). The gap was normal (less than 2 mm) in only four cases.

In the second study of 25 patients, the mean SL angle was 47° (SD 11.1) and the SL gap was 5.3 mm (SD 2.03). The correlation coefficient between the two measurements was high ($r = 0.7$) and was significant ($p = 0.036$) (Fig. 3).

DISCUSSION

The choice of treatment for chronic scapholunate dissociation remains controversial. Blatt (*2*) described a dorsal capsulodesis, with which a good outcome has been reported, mostly for dynamic SL instability (*10,17,18*). When the deformity becomes static, more aggressive reconstruction procedures may be required and there is still no consensus whether soft tissue reconstruction or a limited arthrodesis should be done (*1,3,5,11,13-18*).

Brunelli and Brunelli (*3*) based their procedure on reconstructing the palmar ligaments and reducing the scaphoid tilt, without any effort to close the SL gap. The three-ligament tenodesis (*8*) reinforces the palmar STT ligaments, closes the SL gap and reduces the scaphoid rotation.

Most reported case series focus on the clinical outcomes (*5,7,11,13*) but include wrists with dynamic and static DISI. One report (*13*) did not present radiographic data on 23 patients with static DISI who were retrieved and evaluated. Another study (*14*) reported no improvement in patients with static DISI. Garcia-Elias *et al* (*8*) mentioned a carpal collapse pattern but did not provide radiological data. Chabas *et al* (*5*) reported the radiographic outcome and found the SL angle was improved from 63° to 54°, but had relapsed to 62° at 37 months follow-up. We found that the SL angle and SL gap improved, but full correction was uncommon. A moderate to strong correlation was found between these two parameters, indicating that the procedure probably affects both the SL gap and the SL angle.

REFERENCES

1. **Almquist E, Bach A, Sack J, Fuhs S, Newman D.** Four-bone ligament reconstruction for treatment of chronic complete scapholunate separation. *J Hand Surg* 1991 ; 16-A : 322-327.
2. **Blatt G.** Dorsal capsulodesis for the unstable scaphoid and volar capsulodesis following excision of the distal ulna. *Hand Clin* 1987 ; 3 : 81-102.
3. **Brunelli GA, Brunelli GR.** [A new surgical technique for carpal instability with scapho-lunar dislocation (Eleven cases).] (in French). *Ann Chir Main* 1995 ; 14 : 207-213.
4. **Brunelli G.** Letter to the editor. *J Hand Surg* 2009 ; 34E : 139-140.
5. **Chabas JF, Gay A, Valenti D, Guinard D, Legre R.** Results of the modified Brunelli for treatment of chronic scapholunate instability. *J Hand Surg* 2008 ; 33-A : 1469-1477.
6. **Cuenod P.** Osteoligamentoplasty and limited dorsal capsulodesis for chronic scapholunate dissociation. *Ann Chir Main* 1999 ; 18 : 38-53.
7. **De Smet L, Van Hoonacker P.** Treatment of chronic, static scapholunate dissociation with the modified Brunelli technique : preliminary results. *Act Orthop Belg* 2007 ; 73 : 188-191.
8. **Garcia-Elias M, Lluch A, Stanley J.** Three-ligament tenodesis for the treatment of scapholunate dissociation : indications and surgical technique. *J Hand Surg* 2006 ; 31-A : 125-133.
9. **Kleinmann WB, Carroll C.** Scapho-trapezio-trapezoid arthrodesis for treatment of static and dynamic scapholunate instability. A ten-year perspective on pitfalls and complications. *J Hand Surg* 1990 ; 15-A : 408-415.
10. **Lavernia CL, Cohen MS, Taleisnik J.** Treatment of scapholunate dissociation by ligamentous repair and capsulodesis. *J Hand Surg* 1992 ; 17-A : 354-359.
11. **Links A, Chin S, Waitayawinyu T, Trumble T.** Scapholunate interosseous ligament reconstruction ; results with a modified Brunelli technique versus four-bone weave. *J Hand Surg* 2008 ; 33-A : 850-856.
12. **Linscheid R, Dobyns J, Beabout J, Bryan R.** Traumatic instability of the wrist, diagnosis, classification and pathomechanics. *J Bone Joint Surg* 1972 ; 54-A : 1612-1632.
13. **Talwalkar S, Edwards A, Hayton M *et al.*** Results of four-ligament tenodesis : a modified Brunelli procedure in the management of scapholunate instability. *J Hand Surg* 2006 ; 31B : 110-117.
14. **Van Den Abbeele KL, Loh YC, Stanley JK, Trail IA.** Early results of a modified Brunelli procedure for scapholunate instability. *J Hand Surg* 1998 ; 23B : 258-261.
15. **Watson HK, Ryu J, Akelman E.** Limited triscaphoid intercarpal arthrodesis for rotatory subluxation of the scaphoid. *J Bone Joint Surg* 1986 ; 68-A : 345-349.
16. **Weiss A**. Scapholunate ligament reconstruction using a bone-retinaculum-bone autograft. *J Hand Surg* 1998 ; 23-A : 205-215.
17. **Wintman B, Gelberman R, Katz R.** Dynamic scapholunate instability : results of treatment with dorsal capsulodesis. *J Hand Surg* 1995 ; 20-A : 971-979.
18. **Wyrick J, Youse B, Kiefhaber T.** Scapholunate ligament repair and capsulodesis for the treatment of static scapholunate dissociation. *J Hand Surg* 1998 ; 23-B : 776-780.