The Brunelli's Tenodesis

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1 Introduction

Of the many patterns of wrist osteoarthrosis, the SLAC wrist (scapholunate advanced collapse pattern) is one of the commonest. It was described in 1948 by Watson and Ballet [20] who studied the radiological progression of chondral degeneration in 210 patients. These authors described three stages of increasing severity, with the osteoarthrosis progressively affecting more joints. The term SLAC wrist is derived from what the authors thought to be the aetiology, namely, the rupture of the scapholunate (SL) ligament, leading to dorsal flexion of the lunate (the so-called DISI – dorsal intercalated segment deformity) and, more importantly, to pathological palmar flexion and dorsal subluxation of the scaphoid. These anomalies, initially dynamic, become over time fixed (Fig. 1). The malposition of the scaphoid leads to a decrease in the joint contacts between the scaphoid and the radius. The resulting excessive articular stresses cause the osteoarthrosis, first involving the radioscaphoid joint. The lunate dorsal flexion seems to have little consequences at the level of the radiolunate joint.

Experimentally, the isolated section of the SL membrane in a cadaveric wrist does not cause any kinematic alteration [3], except in some special radioscaphoid morphotypes [21]. Distal radius fractures are frequently complicated by intrinsic wrist ligament lesions, especially affecting the SL membrane, yet SLAC wrist is a rare occurrence after distal radius fractures. In fact, the SL ligament may have more a proprioceptive than a mechanical role [9]. As early as 1989, Jantea believed that the said SL dissociative instability resulted initially from insufficiency of the ligaments stabilizing the distal pole of the scaphoid at the scaphotrapeziotrapezoid

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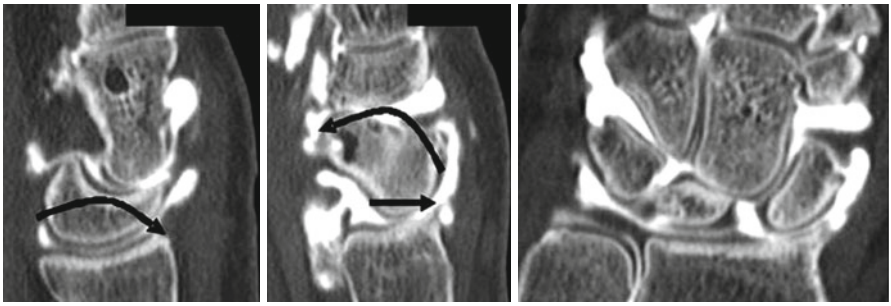

Fig. 1 SLAC wrist with dorsal flexion of the lunate (*left*), palmar flexion and dorsal subluxation of the proximal pole of the scaphoid (*centre*) and SL diastasis (*right*). Note the presence of radioscaphoid and lunocapitate chondral lesions

(STT) level, followed by distension and ultimately secondary rupture of the SL ligament (Jantea C., Mayo Clinic, Rochester, MN, USA, 1989, Personal communication). Brunelli considered the deep part of the flexor carpi radialis (FCR) sheath to be the principle stabilizer of the STT complex [2]. Garcia-Elias believed that the primary stabilizer of the scaphoid was the SL ligament, especially its dorsal component, the STT ligament complex and the scaphocapitate and radioscaphocapitate ligaments being secondary stabilizers [7]. Short reported that the secondary stabilizers were the scaphocapitate and scaphotrapezial ligaments [16, 17].

It is worthy of note that the term instability is incorrect; in fact, the new equilibrium reached in a fixed DISI deformity is quite stable and thus difficult to correct. We proposed in 1996 the term 'carpal dyskinetic syndrome' [14]. Garcia-Elias defined carpal instability as carpal kinetic dysfunction (load transmission) and/or dyskinematic (osseous alignment), but proposed keeping the term instability by right of use [7].

The results of repair of chronic SL lesions remain disappointing, probably owing to the difficulty of correcting scaphoid malposition by these reconstructions. We have abandoned our 1995 original technique of SL repair using a vascularized transfer of the interosseous membrane [13, 15], when in 1995 Brunelli described his technique of ligamentoplasty where a band of the FCR tendon, still attached to the second metacarpal, is tunnelled through the distal pole of the scaphoid and anchored to the dorsoulnar radius, thereby reducing the pathological scaphoid flexion, the dorsal subluxation of the proximal pole as well as the SL diastasis (Fig. 2). The lunate dorsiflexion tends to autocorrect spontaneously, following scaphoid reduction [2, 3].

2 Surgical Technique

The surgery is usually performed under regional anaesthesia. We like the approach through a dorsal radio-scapho-lunate incision parallel to the distal rim of the radius [6]. The dorsal sensory radial nerve branches are identified and spared. The third

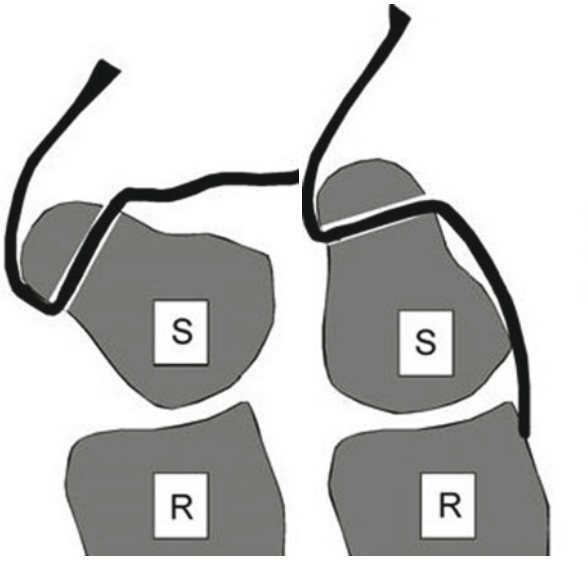

Fig. 2 The Brunelli's tenodesis using a band of the FCR tendon

compartment is incised and the extensor pollicis longus (EPL) tendon palmarly retracted. It is usually unnecessary to open the fourth compartment; it can be 'en bloc' dissected off the distal radius over several millimetres. The dissection proceeds on either side of the extensors carpi radialis, taking care not to damage distally the radial pedicle. The ligament lesions are thus exposed. There is usually an abnormal diastasis between the scaphoid and lunate, with extensive synovitis. There is often little left of the SL ligament, and any attempt at its direct suture is doomed to fail. There is evident dorsal subluxation of the proximal pole of the scaphoid, and the lunate, in DISI, is practically invisible under the capitate head which is situated very close to the radius glenoid. The SL synovitis is resected. Distally, the surgeon approaches the STT interval, which is not so easy to open due to the scaphoid malposition; the synovitis present at this level is as well resected. The reducibility of the scaphoid is now evaluated. A second 4-cm incision is then made along the FCR, centred over the scaphoid tubercle, easily palpable due to the malposition of that bone. The tendon sheath is opened, dividing some thenar muscle fibres. Through another transverse incision, 7 cm higher, a third (about one-half according to Brunelli [2]) of the FCR tendon is harvested, preserving its distal attachment to the trapezium, trapezoid and second metacarpal. At this level, the tendon sheath is not opened. The STT joint is approached, and a spatula is introduced in this joint, giving its orientation. A 2.8- or 3.2-mm tunnel is made through the distal pole of the scaphoid, parallel to this joint, and the tendon band is passed through it. By pulling on the ligamentoplasty, one can usually observe the 'automatic' reduction of the scaphoid and lunatum with disappearance of the SL diastasis. If this is not the case, the surgeon can use K-wires temporarily inserted in both bones as 'joysticks' to assist the reduction. The scaphoid is fixed in the reduced position using one scaphocapitate K-wire; in many cases, a second K-wire is used to transfix the SL joint. The

wires are bent and buried subcutaneously. The tendon graft is fixed under tension using an anchor in the distal radius, at the floor of the third compartment. After meticulous capsular closure, the EPL is left subcutaneous. The wire(s) is(are) removed as a secondary minor procedure, after 6 weeks of immobilization in a plaster cast. Physiotherapy is then instituted. Return to heavy manual work is not allowed before 3 months, and return to high-level sports before 6 months.

3 Results

In his original 1995 publications, Brunelli reported 11 and then 13 cases of satisfactory reduction of the scaphoid and of the lunate, with restoration of the carpal height, the results being maintained over time (follow-up between 6 months and 2 years [2, 3]). Other publications reported results using modifications of the original Brunelli technique [4, 5, 8, 11, 12, 18].

4 Discussion

The natural evolution of the 'scapholunate dissociation instability' syndrome is delayed radiocarpal and midcarpal osteoarthrosis. It is especially the scaphoid subluxation which causes damage to the hyaline cartilage, at least in the first stages. The different types of SL ligamentoplasty described in the 1980s have been abandoned by most authors. Many patients operated during that era had to be reoperated by partial or total wrist arthrodesis. These failures discouraged attempting ligament reconstruction and favoured scaphoid reduction, followed by fixation of the reduced scaphoid by partial carpal arthrodesis, either STT or scaphocapitate fusion. However, these interventions caused substantial wrist stiffness. Watson proposed a technique for SLAC wrist reconstruction involving scaphoidectomy and 'four-corner' fusion of the capitate, lunate, hamate and triquetrum [20]. Other authors did not hesitate to proceed directly to first carpal row resection, especially when the lunocapitate joint was still normal. These different techniques were relatively aggressive, their complication rate was not negligible and their long-term results not well known. This is why the Brunelli technique, which durably corrects the scaphoid malposition, avoiding the evolution towards osteoarthrosis, is now favoured by many wrist surgeons. For us, it is the treatment of choice for treatment of SL dissociative instability without osteoarthrosis.

In order to avoid postoperative reduction of palmar wrist flexion, several authors have proposed to avoid to fix the tendon ligamentoplasty to the distal radius. In the technique of Van Den Abbeele, the graft was fixed to the dorsal radio-triquetral ligament [19]. Garcia-Elias and Stanley described the '3LT' technique (3-ligament tenodesis : STT complex, SL and luno-triquetral ligaments) where the trans-scaphoid tunnel is not any more parallel to the STT joint, but rather oblique, ending dorsally

and proximally, adjacent to the SL joint – at the level of the strongest part of the SL ligament. The tendon band then follows a path transverse and dorsal to the previously reduced lunate, to which it is anchored. The tendon is finally passed around the dorsal radio-triquetral ligament (the ligament had been preserved throughout the Berger approach to the carpus [1]) and sutured to itself [8, 18]. This technique would have the advantage of reconstructing the most mechanically important portion of the SL ligament, of better reducing the gap between the two bones, as well as avoiding radial insertion and therefore wrist stiffness. It does not however allow the same reducing moment on the scaphoid. Howlett showed that the scaphoid tunnel must be distal to ensure the best SL correction [10]. We have ultimately returned to the original Brunelli procedure.

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