Chapter 22
Scaphoid Nonunion Advanced Collapse: Denervation

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Case Presentation

A 50-year-old right-hand dominant architect complained about increasing pain in his left wrist over the past couple of years. At first, the pain manifested only during dumbbell workouts, especially when the wrist was loaded in dorsiflexion. The patient described a condition of moderate rest pain (VAS 2-3). Under minor load sudden severe pain (VAS 8-9) appeared. His functional impairment consisted of a decrease in grip and pinch strength and a progressive limitation of range of motion in his left wrist. The current symptoms did not appear to be related to trauma, but the patient reported a sports accident 20 years before with wrist pain for several weeks at that time. No care was provided at that time.

Physical Assessment

On our clinical examination of the left wrist, we found normal skin and soft tissue. The assessed range of motion was decreased for palmar flexion/dorsiflexion (25/25°), as well as for radial/

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ulnar deviation (20/30°). Pain was produced in the radiocarpal joint during wrist motion, mostly when forcing dorsiflexion; less during radial deviation. The scaphoid-shift test was positive. Tenderness was elicited in the anatomic snuffbox. Neither pain nor tenderness was found in the scaphotrapezio-trapezoidal joint or in the thumb basal joint. A stable condition was found in the distal radioulnar joint (DRUJ), and TFCC stress tests were negative.

Diagnostic Studies

The radiographs (Figs. 22.1 and 22.2) reveal an unstable nonunion of the left scaphoid with dorsal intercalated segmental instability (DISI) deformity and a degenerative osteoarthritis (OA) between the scaphoid and the radial styloid process with concomitant marginal osteophytes. Overall, there is a decrease in carpal height with advanced OA between the head of the capitate and the lunate. Signs of OA are barely found in the lunate fossa.

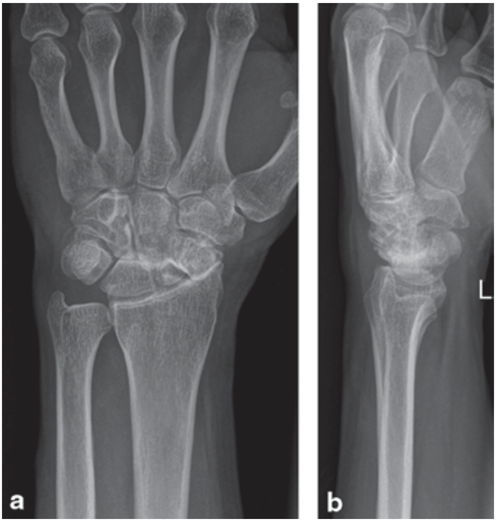

Fig. 22.1 Left wrist in two planes. (Published with kind permission of ©M. Haerle and T. Del Gaudio, 2015. All Rights Reserved)

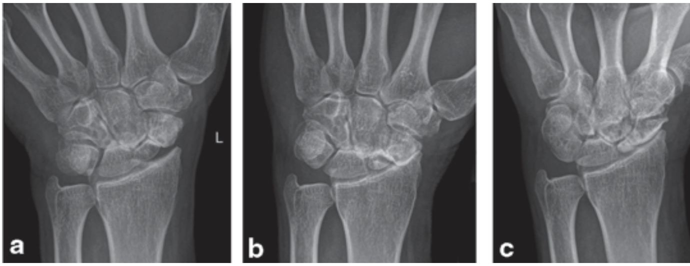

Fig. 22.2 Functional X-rays of the left wrist. (Published with kind permission of ©M. Haerle and T. Del Gaudio, 2015. All Rights Reserved)

Diagnosis

The conducted clinical and radiographical examinations (Figs. 22.1 and 22.2) were consistent with Stage III scaphoid nonunion advanced collapse (SNAC), mostly ascribable to a scaphoid fracture related to the previous sports accident.

Management Options and Management Chosen

Therapeutic decision-making in patients with SNAC wrist is based on a careful assessment of both the case history (taking account of patients age, profession, and dominant hand), as well as on the bone and cartilage status of the wrist, ascertained by radiographs and if indicated, by arthroscopy of the wrist, respectively. This allows a meaningful restriction of different conservative and surgical treatment approaches, such as nonunion repair, partial fusions of the carpus (e.g., four-corner fusion), proximal row carpectomy, wrist arthrodesis, radial styloidectomy, and wrist denervation[1].

In this specific case, we discussed in detail the clinical and radiological findings with the patient. Because of a radiological evident OA in the radiocarpal joint, no strategy of scaphoid repair was proposed. Proximal row carpectomy was contraindicated because of radiographic evidence of OA of the head of the capitate and in the midcarpal compartment. Since signs of OA between the lunate and the lunate fossa in the radiographs were scarce, we proposed to evaluate the intra-articular situation of the cartilage in the different joints by wrist arthroscopy. In case of intact cartilage layers between the lunate and lunate fossa, a four-corner fusion is alternatively proposed to wrist denervation as a salvage procedure. In case of cartilage damage in the lunate fossa, wrist denervation is more often chosen by patients before going to wrist arthrodesis.

Surgical Technique

Arthroscopy

The arthroscopy was performed with an upper-arm tourniquet. The hand was placed in stiff finger traps. 5 kg vertical traction was applied through a traction tower. First, the radiocarpal compartment was inspected through the 6R portal. Synovitis pervaded the radiocarpal compartment. The cartilage surface of the scaphoid and lunate fossa revealed grade IV chondromalacia, and the adjacent proximal articular surface of the lunate revealed grade II-III chondromalacia (Fig. 22.3).

Thereafter, the midcarpal compartment was inspected through the MCR portal which revealed grade II-III chondromalacia in the whole compartment, especially of the proximal pole of the capitate and the tip of the hamate (Fig. 22.4). It revealed OA with complete loss of cartilage due to the scaphoid nonunion.

Wrist Denervation in the Same Setting

Based on the arthroscopic findings and the assessed radiocarpal and midcarpal damages, we opted for complete wrist denervation as proposed by Wilhelm [2]. After removing the traction, the hand was placed on hand table for wrist denervation. A curved incision was performed on the dorsal distal forearm just proximal to the DRUJ (Figs. 22.5 and 22.6). Thereafter, the cutane-

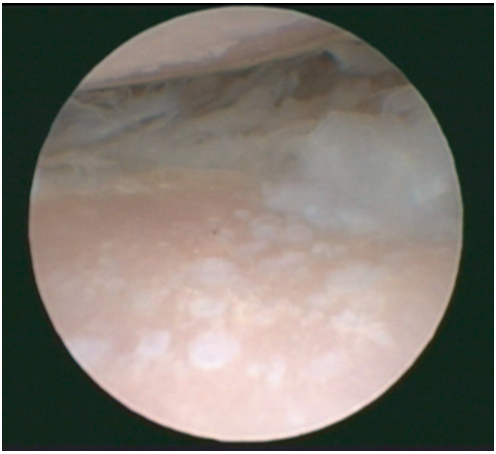

Fig. 22.3 Lunate fossa and counterfacing lunate. (Published with kind permission of ©M. Haerle and T. Del Gaudio, 2015. All Rights Reserved)

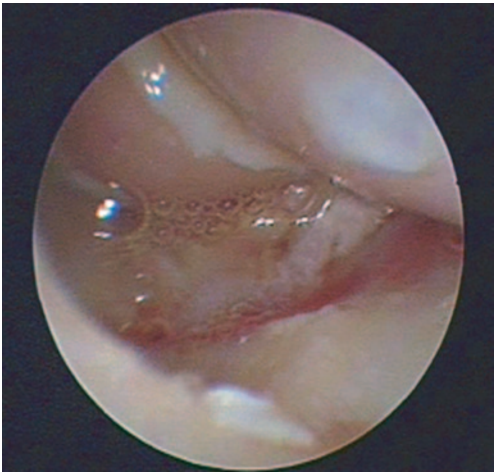

Fig. 22.4 Chondromalacia of capitate and hamate. (Published with kind permission of ©M. Haerle and T. Del Gaudio, 2015. All Rights Reserved)

Fig. 22.5 Dorsal incision for denervation. (Published with kind permission of ©M. Haerle and T. Del Gaudio, 2015. All Rights Reserved)

Fig. 22.6 Palmar incision for denervation. (Published with kind permission of ©M. Haerle and T. Del Gaudio, 2015. All Rights Reserved)

ous and subcutaneous layers are separated from the fascia layer. Perforating nerve branches were coagulated and transected. By doing so in proximal, distal, radial, and ulnar directions, the totality of the dorsal fascia was exposed like in a degloving injury. The fascia was incised in the area next to the muscle belly of the extensor pollicis longus. The muscle belly is retracted radially and the tissues lying on the interosseous membrane are exposed. A 2-cm segment of the posterior interosseous nerve (PIN) was coagulated and resected (Fig. 22.7). Next, a dorsoradial incision corresponding to the level of the trapeziometacarpal joint was made. The perforating branches originating from the superficial radial nerve and innervating the radial wrist capsule were coagulated and transected, protecting the cutaneous branches (Fig. 22.8). Another longitudinal incision was made just above the radial artery. The surrounding tissue was prepared in radio-

Fig. 22.7 Exposed posterior interosseus nerve. (Published with kind permission of ©M. Haerle and T. Del Gaudio, 2015. All Rights Reserved)

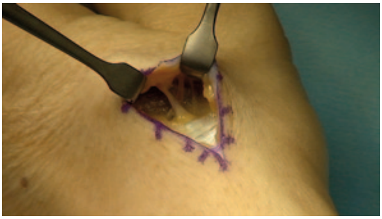

Fig. 22.8 Perforating branches of the superficial radial nerve. (Published with kind permission of ©M. Haerle and T. Del Gaudio, 2015. All Rights Reserved)

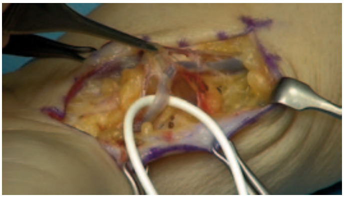

Fig. 22.9 Radial artery surrounded by periarterial tissue. (Published with kind permission of ©M. Haerle and T. Del Gaudio, 2015. All Rights Reserved)

dorsal direction in order to create a communication with the previously prepared area on the dorsal side and to again interrupt the perforating branches of the superficial radial nerve. The radial artery was exposed using microsurgical technique and the periarterial tissue was coagulated and also resected (Fig. 22.9). Subsequently, the final volar incision was made. The palmar fascia was opened and the pronator quadratus muscle was lifted at the distal edge. Thereafter, the periosteum on the palmar aspect of the distal radius was removed under extensive coagulation. Branches of the anterior interosseous nerve (AIN) were intensively coagulated volar to the DRUJ. Following wound closure, postoperative immobilization was not necessary.

Clinical Course and Outcome

Four years following this procedure, the patient returned for a long-term follow-up. He reported to be free of complaints. The hand is used in everyday life, as well as in working life without any difficulties. In the clinical examination, the patient showed a range of motion of 25/30° for the palmarflexion/dorsiflexion and of 20/25° for radial/ulnar deviation. Upon loading the wrist, little pain was reported (VAS 1-2). DASH score was 5, compared to 70 preoperative.

Clinical Pearls/Pitfalls

- Denervation is indicated in painful wrist OA, preserving mobility.
- Wrist denervation represents a simple, low-risk surgical procedure. This procedure does not burn bridges and when compared to other wrist salvage procedures, it gives at least as good results.
- Preoperative testing gives results with little reproducibility and consequently low predictability. We therefore no longer perform these tests routinely.
- The PIN should be resected 1.5–2 cm proximal to the wrist, before it branches.
- The AIN may be dissected close to the distal rim of the pronator quadratus muscle and therefore just distal to the DRUJ.
- Resection of the AIN via a posterior approach, through the interosseous membrane following resection of the PIN, gives equivalent results. No patient to date has complained about the loss of function of the pronator quadratus.

- A meticulous dissection, coagulation, and interruption of as many perforating dorsal branches as possible by separating the superficial layers from the fascia on the complete dorsal aspect of the wrist helps the results of the denervation.

Literature Review and Discussion

Osteoarthritis (OA) of the wrist represents a relatively common painful condition with an overall prevalence of 1.7 % in men and 1.0 % in women [3]. If symptoms of OA persist or worsen despite of a conservative pain management (including NSAIDS, immobilization in a splint, or intra-articular injection of corticosteroids), surgical management for pain relief is taken into consideration. Apart from different salvage procedures described for patients with SNAC/SLAC wrist (e.g., partial midcarpal fusion and proximal row carpectomy), wrist denervation should be considered as an effective palliative surgical intervention, although it must be clear that the original pathology is not addressed. The best surgical indication is the patient with wrist pain in the presence of OA while there is still some preservation of wrist motion.

In fact, in terms of range of motion (ROM) none or minimal long-term postoperative impairment was reported after total wrist denervation only [4,5]. In contrast, partial carpal fusions and proximal row carpectomy are both associated with decreased ROM, ranging between 47–56 % [6,7] and 43–63 % [8,9] respectively, when compared to the contralateral wrist. Total wrist denervation has also been shown to provide a significant increase in grip strength. Rothe et al. showed in a collective of 46 patients (36 SNAC and 10 SLAC- wrists at stage II/III) an increase of 51 % in grip strength after an average follow-up of 6.2 years [5].

In the literature, the reported overall pain relief after wrist denervation ranges between 56 and 85 % [10,11]. In a study among 195 partial and total wrist denervations, 35 % of patients achieved freedom from symptoms after a mean follow-up time of 4.1 years, and good results were achieved in 66 % of cases [12]. Total wrist denervation, including AIN and PIN transection, seems to provide significantly higher pain reduction (76 %) compared to PIN transection only (57 %) [13, 14]. Interestingly, results of preoperative nerve blocking with local anaesthetics do not correlate with the postoperative degree of pain relief [13].

In summary, wrist denervation leads to significant pain reduction, preserving postoperative wrist mobility and improvement of grip strength. It therefore should be taken into account as a valid alternative to other salvage strategies such as (partial) fusions or PRC, when good wrist mobility is demonstrated preoperatively. Of course, denervation is not performed if any repair strategy can potentially delay or halt the progression of the disease. Also the interruption of afferent fibres can theoretically interrupt proprioceptive protective mechanisms, which are of relevance especially in younger patients, although this has not been shown in any clinical studies to date. In any case, these considerations may be neglected in cases of frank OA.

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