

Chapter 25

Scaphoid Nonunion Advanced Collapse: Scaphoid Excision and 4-Corner Arthrodesis

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Case Presentation

A 45-year-old male CEO of a financial firm presented with a 3 year history of gradually worsening wrist pain. He recalled injuring his wrist in his 20's. A physician told him he had broken a "wrist bone" and he had worn a cast for 2 months. He had not had much pain until 3 years ago when he first noticed pain with exercise and weightlifting progressing to pain with most activities of daily living at present. He noticed that he has lost range of wrist motion and also noticed a "hard bump" on the dorsal-radial aspect of the wrist. He has tried a wrist splint, anti-inflammatory medicines and has had a corticosteroid injection into the wrist, all only providing short term relief of symptoms.

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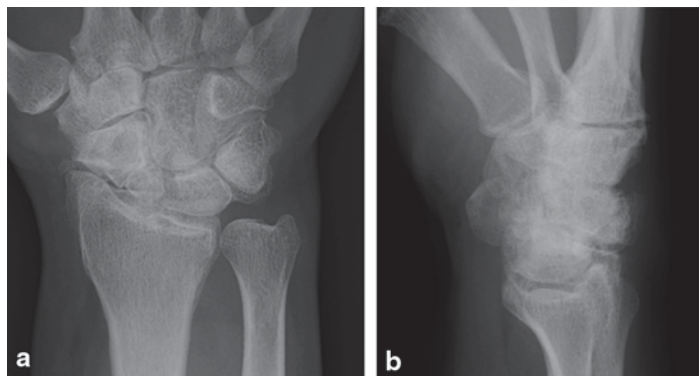


Fig. 25.1 Posteroanterior **a** and lateral **b** radiographs demonstrate an old scaphoid nonunion with findings of advanced collapse. (Published with kind permission of © Nathan T. Morrell and Arnold-Peter C. Weiss, 2015. All rights reserved)

Physical Assessment

On physical examination, there was swelling localized to the dorso-radial aspect of the wrist. There was tenderness to palpation about the scaphoid. Wrist range of motion was limited to extension of 30° and flexion of 35° ; he had minimal radial and ulnar deviation of the wrist. There were no neurologic or vascular deficits. There was no erythema or overt signs of infection. Grip strength was about 30% less than his uninjured wrist.

Diagnostic Studies

Posteroanterior and lateral radiographs were obtained demonstrating a scaphoid nonunion with atrophy of the proximal pole fragment, substantial radioscaphoid arthritis and erosion of the radioscaphoid joint contour. The radiolunate joint appeared intact and there was no significant erosion of the capitoulnate joint articulation. Carpal height was collapsed on the lateral radiograph (Fig. 25.1a, b).

Diagnosis

Based on the history, physical exam, and radiographs, the diagnosis of scaphoid nonunion advanced collapse (SNAC), stage II was made. The development of degenerative changes following scaphoid nonunion progresses in a characteristic manner, much like in chronic scapholunate ligament insufficiency. Stage I SNAC involves the radial styloid-scaphoid articulation; Stage II involves the scaphocapitate interface, as well as progression of degeneration in the radioscapoid articulation; and finally Stage III SNAC involves the capitulate interface with progression of the previously involved joints. Generally, the proximal radioscapoid and radiolunate articulations are preserved in true SNAC wrists [1]. Stage IV represents pan-carpal arthritis.

Management Options

Initial treatment for SNAC wrist should almost always be conservative. Activity modification, splinting, nonsteroidal anti-inflammatory medications, and intra-articular corticosteroid injections may be beneficial. Surgical intervention may be indicated when conservative treatment has failed.

Reasonable surgical treatments for advanced SNAC wrist include proximal row carpectomy, scaphoid excision with four-corner arthrodesis, total wrist arthrodesis, and total wrist arthroplasty, although the latter two options are usually reserved for Stage IV disease. For Stage II disease, either a proximal row carpectomy (PRC) or a scaphoid excision and four corner fusion are appropriate treatment options. In younger (less than 50 years of age) patients, we recommend a four corner fusion as the longevity of the radiolunate joint is quite predictable once a solid fusion occurs. The longevity of the capitate head articulation in younger patients following PRC is less predictable with subsequent arthritis a relatively more common finding. In older patients (more than 60 years of age), we generally recommend a proximal row carpectomy. In between 50 and 60 years of age, we favor four corner fusions

in active individuals and proximal row carpectomies in the more sedentary.

Scaphoid excision with four-corner arthrodesis is contraindicated in the presence of radiolunate degenerative changes or radiolunate instability (e.g., ulnar carpal translocation due to radioscapaphocapitate or long radiolunate ligament insufficiency), as well as in the presence of active infection.

Management Chosen

Scaphoid excision with four-corner arthrodesis, with use of a dorsal four corner fusion specific plate and autologous distal radius cancellous bone graft.

Clinical Course and Outcome

Following cast immobilization for 4 weeks and hand therapy for range of motion and strengthening for another 4 weeks, the patient returned to activities of daily living without restriction. At 3 months postoperative, the patient resumed golfing and tennis. Occasional aching in the wrist was noted for the first 3–4 months which ultimately resolved. Radiographs taken at 4 months demonstrated a solid four corner fusion and excellent plate recession (Fig. 25.4a, b). Follow-up examination at 6 months will generally demonstrate range of motion (ROM) of 35° wrist extension and 30° of wrist flexion. In general, wrist flexion lags wrist extension. By 1 year postoperative, average wrist ROM = extension 45° and flexion 35°. Average grip strength at 1 year is 75 % of the contralateral hand. VAS pain scores at 1.5 out of 10 at 6 months and 0.9 out of 10 at 1 year.

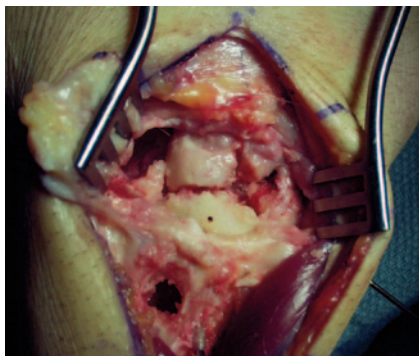


Fig. 25.2 All four joints being fused need to have complete debridement down to good and bleeding cancellous bone at each joint carefully removing all hard subchondral bone and cartilage. (Published with kind permission of © Nathan T. Morrell and Arnold-Peter C. Weiss, 2015. All Rights Reserved)

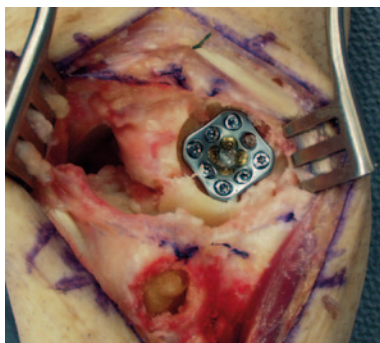


Fig. 25.3 The plate should be recessed below the level of the fusion mass with careful placement of all the screws (lag = gold and locking = blue) into each of the four bones being fused. (Published with kind permission of © Nathan T. Morrell and Arnold-Peter C. Weiss, 2015. All Rights Reserved)

Clinical Pearls/Pitfalls

While a number of different fixation techniques have been described (e.g., K-wires, screws, staples, various plates, etc.), a good functional result following four-corner arthrodesis is likely more due to

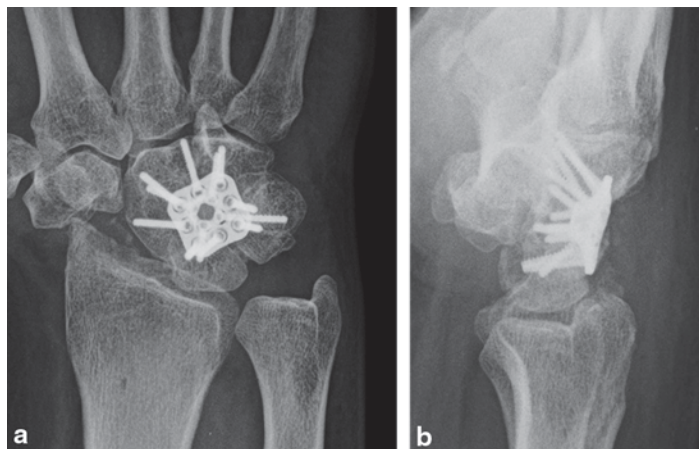


Fig. 25.4 Final posteroanterior **a** and lateral, **b** radiographs should demonstrate excellent consolidation of the fusion mass, carpal alignment and plate recession. (Published with kind permission of © Nathan T. Morrell and Arnold-Peter C. Weiss, 2015. All Rights Reserved)

technical factors than specific implant or fixation technique chosen [2]. We believe that an adequate amount of quality bone graft is critical; we recommend distal radius autogenous cancellous bone. We caution against the use of the morselized scaphoid as bone graft as this poor quality bone may have contributed to previously reported elevated nonunion rates [2].

Additionally, adequate preparation of the articular interfaces is critical. All cartilage from at least the dorsal two thirds of each intercarpal joint must be removed to bleeding, subchondral bone (Fig. 25.2). After reaming or drilling, any debris must be removed from the intercarpal interstices so as to allow for adequate contact and compression of the fusion surfaces.

When using a dorsal plate for fixation, the plate must be appropriately sized and positioned in the appropriate location. All screws must have good purchase and we prefer plates with locking screws for added postoperative stability (Fig. 25.3). Care must be taken to avoid too long of screws in the triquetrum which may penetrate the pisotriquetral joint possibly causing pisotriquetral pain. All four corners of the carpal bones must meet; the triquetrum tends to migrate ulnarly and may need provisional fixation. To avoid dor-

sal impingement of the plate, the preoperative DISI deformity, if present, must be corrected. Provisional Kirschner wire (K-wire) fixation may be helpful [2, 3]. Lastly, careful attention to reaming is paramount. The lunate is often harder bone than the hamate or capitate and may cause the reamer to tilt distally; as such, we recommend keeping the pressure on the lunate while reaming.

Literature Review and Discussion

The primary goal of treatment for SNAC wrists is pain relief while maintaining some wrist range of motion and improving strength. Scaphoid excision with four-corner arthrodesis has proven a reliable treatment for advanced SNAC [4].

A systematic review of outcomes indicates that good pain relief can be expected with scaphoid excision and four-corner arthrodesis with approximately 90% of patients being satisfied with the procedure [4]. Postoperative grip strength averages approximately 75% of the uninvolved contralateral side [4].

Regarding wrist range of motion, *in vitro* analysis of wrists suggested that approximately 36% of wrist flexion-extension would be lost with a four corner fusion due to the loss of mid-carpal motion[5]. In practice, approximately 40–55% of wrist flexion-extension is typically lost when compared to the uninvolved, contralateral wrist [1, 2]

The overall complication rate with four-corner arthrodesis is approximately 13% [3]. The most common complication is nonunion. The historical nonunion rate is around 8%, however with recent techniques and particular attention to detail, this rate has approached zero [2]. Other complications include: dorsal radiocarpal impingement; superficial or deep infection; reflex sympathetic dystrophy; injury to the superficial branch of the radial nerve; and others [3].

References

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Suggested Reading

Weiss KE, Rodner CM: Osteoarthritis of the Wrist. *J Hand Surg Am.* 2007;32:725–46.