Technical Note

Arthroscopic Scaphocapitate Fusion: Surgical Technique

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Abstract: Scapholunate fusion appears to be an interesting surgical solution for carpal pathologies, which are sometimes difficult to manage as Kienbock's disease or chronic scapholunate instability. Open intracarpal fusion is notorious for decreasing joint range of motion due to the fusion of several carpal bones and because of the capsulotomy sectioning important ligamentous elements in carpal biomechanics. Wrist arthroscopy has already demonstrated its effectiveness in preserving joint mobility compared with open procedures. In this work, we present a detailed procedure for performing a scaphocapitate fusion under arthroscopy by specifying the key points of this procedure in our experience.

Introduction

Scapholunate fusion appears to be an interesting surgical solution for carpal pathologies, which are sometimes difficult to manage. Indeed, for chronic scapholunate instability lesions, many surgical methods have been proposed, whether they are conservative, such as tendon interposition[1] or denervation,[2] or more definitive, such as intra-carpal fusion.[3] In chronic scapholunate instability, scaphocapitate fusion seems to have good functional results, stopping the arthrosic evolution by eliminating dorsal and rotatory subluxation of the scaphoid.[4] Moreover, this technique has good results in the management of advanced Kienbock's disease without the need for lunate excision.[5] However, intracarpal fusion is not the most effective technique for the management of chronic scapholunate instability. Open intracarpal fusion is notorious for decreasing joint range of motion due to the fusion of several carpal bones and because of the capsulotomy, sectioning important ligamentous elements in carpal biomechanics.

Wrist arthroscopy has already demonstrated its effectiveness in preserving joint mobility compared with open procedures.[6] Scaphocapitate fusion under arthroscopy has already been described, but these articles present only brief descriptions of the surgical technique itself.[7–9] Because of the multiple indications, it seems advisable to provide a detailed and

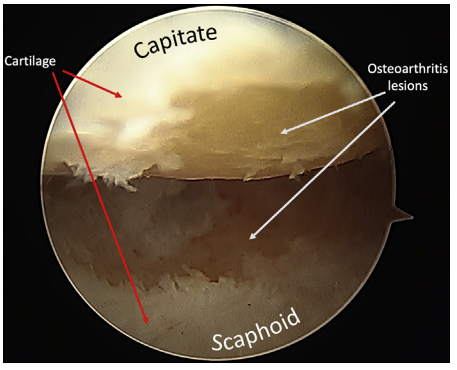

Fig 1. Midcarpal arthroscopic view through the radial midcarpal portal. The patient's arm is secured to the arm board, and Chinese fingers traps are used to apply 5−7 kg (11−15.5 lb) of traction along the arm's axis vertically. This is an arthroscopic view with the optic positioned through the RMC portal. We observe the articular surfaces of the capitate and scaphoid, showing that chondromalacia has already evolved. The head of the capitate (top) appears to be devoid of its cartilage as well as the scaphoid surface (bottom).

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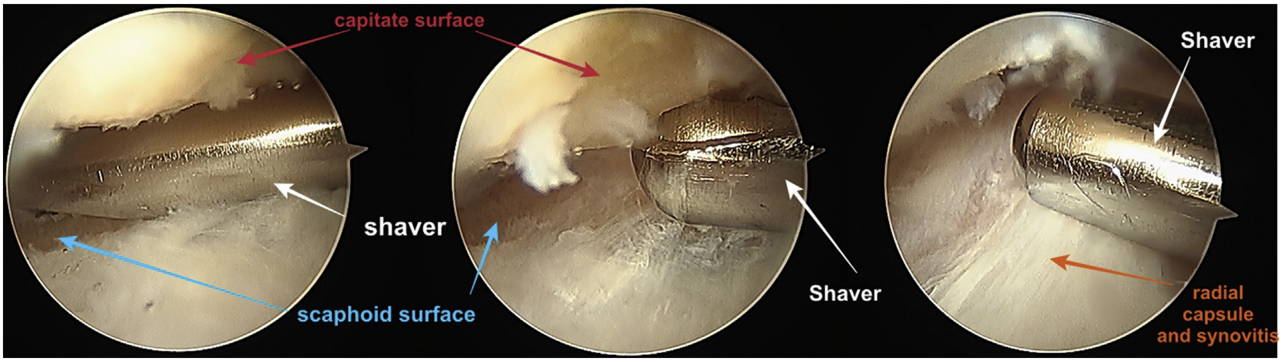

Fig 2. Large synovectomy and superficial bone debridement, arthroscopic view through the radial midcarpal portal (optic) and the use of a shaver through the ulnar midcarpal portal. It is essential to perform the widest possible synovectomy because the scaphocapitate space is narrow (left and center). The space must be cleared and widened (especially at the level of the joint capsule) to allow a better passage of the instruments (right).

reproducible technique for scaphocapitate fusion. In this work, we present a detailed procedure for performing a scaphocapitate fusion under arthroscopy by specifying the key points of this procedure in our experience (Video 1).

Surgical Technique

Installation

The procedure is performed on an outpatient basis under regional anesthesia using a tourniquet. The patient's arm is secured to the arm board, and finger traps are used to apply 5–7 kg (11–15.5 lb) of traction along the arm's axis vertically.

It is necessary to have an X-ray machine that is compatible with the use of arthroscopy available in the room.

Arthroscopic Exploration

The scope (30°, 2.4-mm diameter, Stryker, Bloomington, MN) is introduced via the 3–4 portal and the shaver (2.5 mm; Stryker) via the 6R portal. The first phase of the arthroscopic procedure consists of complete radiocarpal synovectomy with a shaver, reversing the shaver and scope positions. Then, we perform a midcarpal exploration via the ulnar (UMC) and radial midcarpal (RMC) portals by the same process.

The injury assessment differs widely depending on the indication for scaphocapitate fusion. However, it remains essential to ensure that the procedure is effective. In the case of long-standing scapholunate instability with very limited styloscaphoid or radioscaphoid arthrosis, the conflict will be treated by styloidectomy. Occasionally, isolated scaphocapitate osteoarthritis may occur (Fig 1). In Kienbock's disease, the appearance of the lunate is variable depending on the stage of the disease but is often reserved for advanced stages greater than or equal to stage 3A, according to Lichtmann. The scaphocapitate joint may be free of cartilage lesions. The aim here is to modify the carpal axial loads to decompress the lunate.

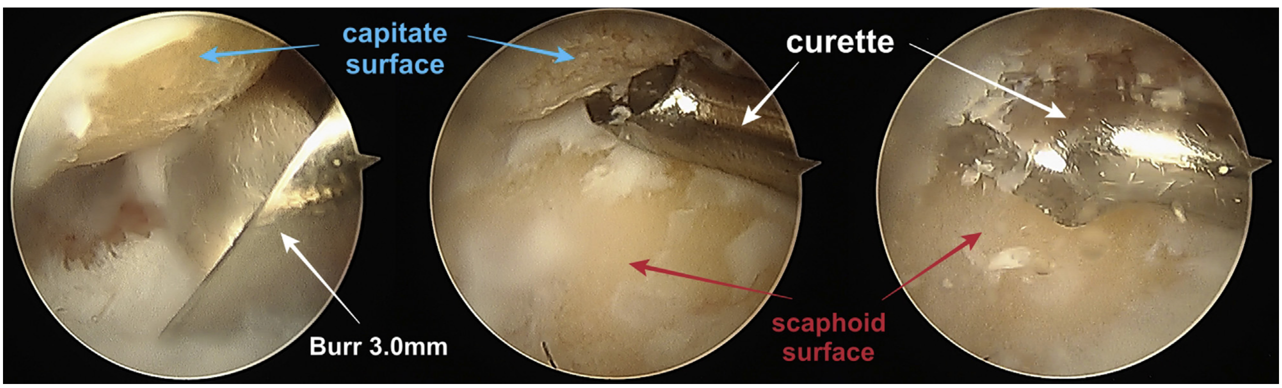

Fig 3. Scaphocapitate bone debridement with an arthroscopic view through the ulnar midcarpal portal (optic) and the use of a 3-mm burr (left) and a curette (center) through the radial midcarpal portal. Debridement should be vigorous until a bloody dew appears. Very often, during bone debridement in a humid environment, a "snowstorm" effect (right) may appear which may compromise arthroscopic visibility in such a narrow space. We recommend the use of numerous washouts, as well as alternating between wet and dry arthroscopy.

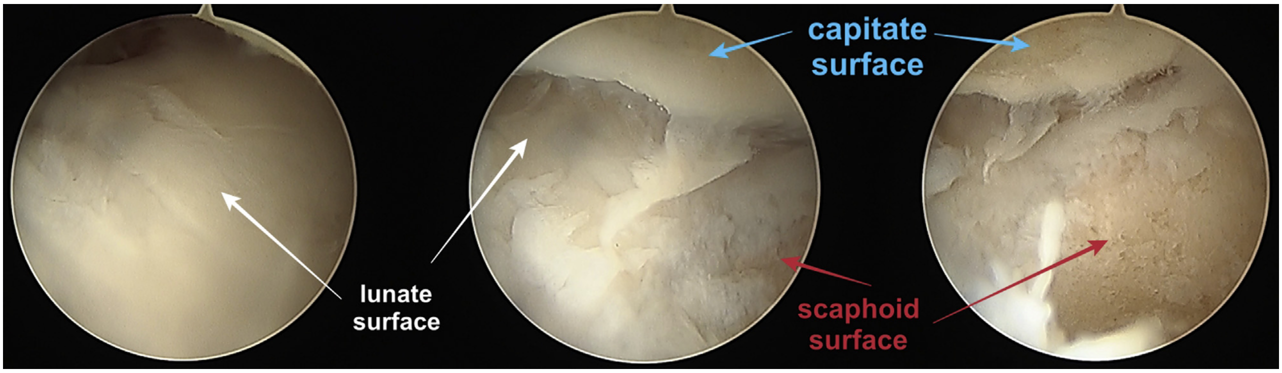

Fig 4. Midcarpal arthroscopic exploration after bone debridement through ulnar midcarpal portal. On the left, we can see that the cartilage of the lunate is intact. The image on the right shows the absence of cartilage on the articular surfaces of the capitate and the scaphoid. The image in the center shows us all the midcarpal articular surfaces of the three mentioned bones.

However, for the vast majority of indications, it will be necessary to ensure the absence of capitellar osteoarthritis, contraindicating scaphocapitate fusion. Any scapholunate ligament injury will not be repaired. As the scaphocapitate space is narrow, a complete synovectomy must be performed to facilitate further surgery (Fig 2).

Bone Debridement

The bone debridement is precise and is performed with a small diameter burr (3 mm; Stryker) to prevent damage to the capitolunate cartilage. The use of a curette to perform a vigorous bone debridement is recommended (Fig 3). Abrasion of the cartilage debris must be complete, exposing the subchondral bone (Fig 4). The limit of resection is considered satisfactory when a “bloody dew” appears on the subchondral bone (Fig 5). We recommend the repeated use of wash-out with the burr cannula after removal of the rotating part to facilitate the removal of small debris, and forceps for thicker debris (Fig 6). To reduce as much as possible the discomfort caused by the suspension of osteocartilaginous debris in a humid environment due to the “snowstorm” effect, we advise that this stage is carried out by “dry-arthroscopy” interspersed with several wash-outs to avoid thermal burns of the bone.

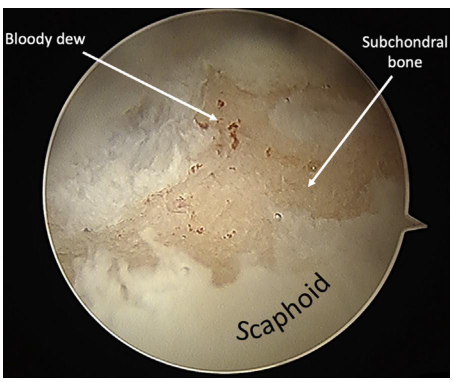

Fig 5. Appearance of a “bloody dew” during excision of the cartilage and milling of the subchondral bone during an arthroscopic view through the radial midcarpal approach. The appearance of this bloody dew is a sign of sufficient swelling for good bone healing. The appearance of bloody dew can be seen even when the tourniquet is inflated.

Harvesting and Preparation of the Bone Graft

The scaphocapitate space is narrow and the entire articular surface is relatively small. In addition, the failure rate of bone fusion is low, with a very satisfactory consolidation rate.[3] Therefore, we believe that a distal radius graft harvest under locoregional anesthesia is a practical and reliable solution with low morbidity. The bone graft is then divided and prepared for insertion under arthroscopic control, using 20-gauge needle trocar caps that are beveled at their blind ends, and then manually prefilled and inserted through the RMC portal. The graft is then positioned and compacted using a palpator or small spatula (Fig 7).

Bone Fixation

After the traction is released, two pins (1 mm) are inserted under the styloid to secure the scaphoid after reduction by pressure on the tubercle at the capitate. The reduction phase is fundamental because it is this that will ensure a halt to the arthrosic process by restoring the stability of the scaphoid and an anatomical congruence between the radius and the head of the scaphoid. Traction, when properly applied, will ensure part of the reduction, and then digital pressure on the distal tubercle will complete the maneuver. Finally, in case of failure, a 1.5-mm anteroposterior percutaneous pin can be placed in the scaphoid tubercle to ensure anatomical restoration by a "joint stick" effect. The 1-mm osteosynthesis guide wires can then be positioned under the radial styloid or even through the styloid to ensure uniform compression. If possible, the wires should cross each other in the space without being parallel. The correct positioning will be checked

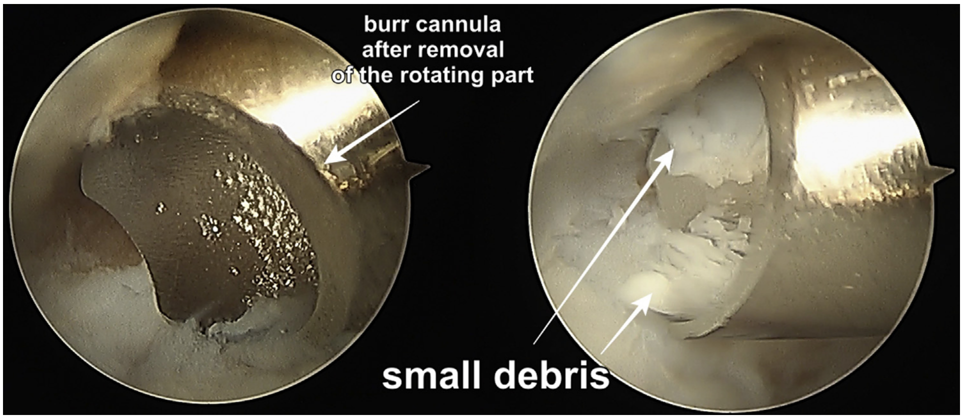

Fig 6. Arthroscopic wash-out (optic through ulnar midcarpal portal). In the case of major joint debridement, a lot of joint debris can impede visibility and be difficult to remove because there is so much of it. One trick is to remove the drill from its cannula and then introduce the cannula into the joint in wet arthroscopy. The suction system left in place allows the bone debris floating in the irrigation fluid to be sucked up and removed, and larger debris to be removed with forceps.

under fluoroscopic control. The placement of the screws also follows a precise procedure in order to obtain the most appropriate compressive effect. First, the length of the screws is calculated simply by placing the screw thought to be of the right length on the skin and taking a fluoroscopic image. In this way, the length can be optimized as best as possible. Next, the screw guide pin is left in place and the others are moved back without being completely removed, to free up the fusion space and allow maximum compression from the outset. Longitudinal speckling around the pin on the skin allows for easy insertion of the screw, while ensuring that there is no conflict with the superficial radial sensory branch. For optimal compression, at least two 3-mm diameter, self-tapping, self-drilling screws (New Clip Laboratory, Nantes, France), perpendicular to the scaphocapitate joint, are required. Screws can also be inserted from the capitate to the scaphoid via a posterior percutaneous approach (Fig 8). The solidity of the assembly and satisfactory compression are verified under radiographic control.

Postoperative Care

The wrist is immobilized immediately postoperatively. The postoperative care includes strict immobilization with a forearm splint for 90 days. Rehabilitation is initiated at approximately 2 weeks for lymphatic drainage, scar care, and analgesic physiotherapy, and then active mobilization and opening of the joint amplitudes is carried out at 3 months.

Discussion

Scaphocapitate fusion is a surgical solution with various indications. However, it results in a loss of mobility with a significant functional impact in young subjects. Arthroscopy is, therefore, sensible in order to avoid a stiffening capsulotomy and to preserve joint amplitudes. Although this fusion presents very satisfactory long-term results in Kienbock's disease,[10] its use is particularly important in carpal collapses.[4] In fact, in static scapholunate instabilities without radioscaphoid osteoarthritis, capsuloligamentary reconstruction, and other conservative methods,[1,2,11]

Fig 7. (A) Insertion of the bone graft into several 20-gauge needle plugs (intramuscular). The ends of the plugs are cut in a bevel shape for better insertion into arthroscopic passages. (B) Once introduced through the midcarpal radial portal, the bone graft is then pushed into the joint using the introducer. (C) Arthroscopic control is used to ensure the correct positioning of the bone graft during its introduction.

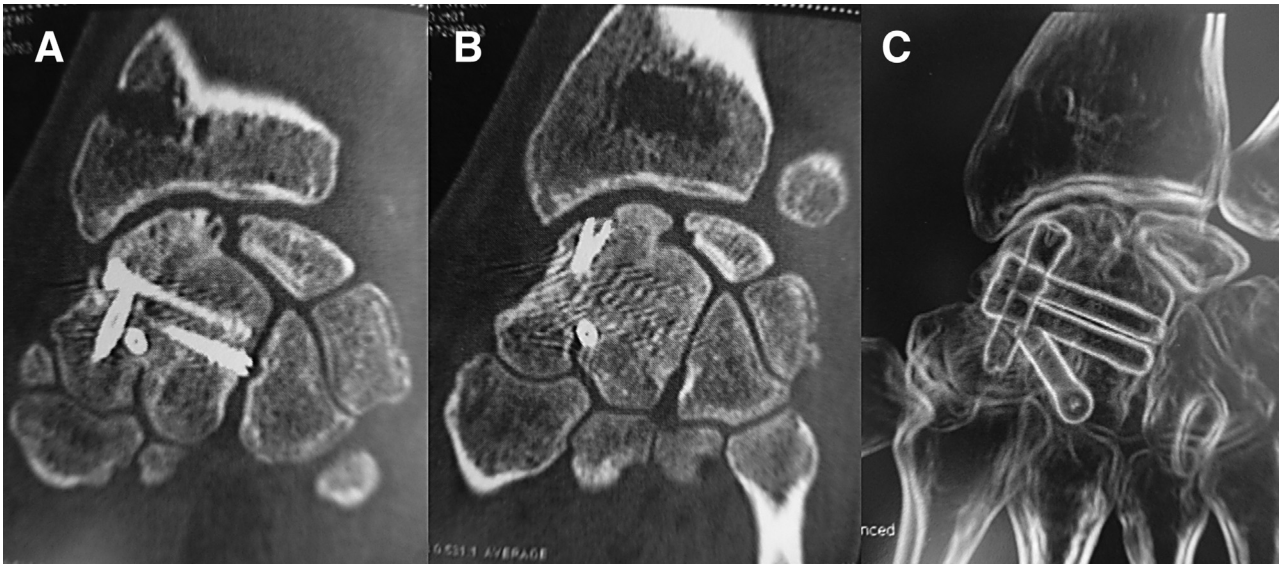

Fig 8. Three-month postoperative CT scan with coronal reconstructions (A and B) and 3D reconstruction (C) for a scaphocapitate fusion due to iatrogenic damage to the capitate cartilage after scaphoid pseudarthrosis. Note here that the addition of a longitudinal screw in the axis of the scaphoid due to the initial scaphoid pseudarthrosis. In A, we can see the screw breaking into the capitate-hamate joint, probably due to an underestimation of the compression effect. However, due to the almost zero mobility of this joint, the patient was symptom-free.

give good long-term results, but these techniques have not demonstrated their effectiveness in the development of carpal arthrosis. The biomechanical disruption of scaphoid motion in scapholunate complex ruptures and scaphoid pseudarthrosis can be corrected using scaphocapitate fusion if the reduction is of good quality, by stopping the articular friction of the scaphoid on the surrounding structures, which causes arthrosic degeneration. Therefore, it offers an effective long-term solution, at the cost of a relative loss of mobility.

In our experience, the most difficult aspect of this surgery is to find the correct reduction position and the right indications to avoid further surgery or painful postoperative sequelae. The purpose of this article is to supplement the literature by describing in detail the relatively simple and reproducible procedure of scaphocapitate fusion under arthroscopy, while providing the reader with our tips and pitfalls to avoid (Table 1).

Table 1. Surgical Tips and Pitfalls

Tips	Pitfalls
- A trick to facilitate the introduction of the bone graft is to remove the cap of an intramuscular needle (20-gauge) and cut the end to form a bevel. The cap is then filled with the bone graft. The preparation of several caps makes it possible to speed up the introduction of the bone graft compared to the usual techniques using a cannula. The caps are then introduced through the midcarpal portals, and the bone graft is pushed into the site of nonunion. - A synovectomy and wide debridement all around the midcarpal aspect of the scaphoid will facilitate instrumentation.	- Consider the effect of compression to select the correct screw size and avoid conflicts with flush screw ends. - Leave the pins in place through the fusion area when screwing in the first screw. - Place the screws percutaneously without checking a possible sensitive terminal branch of the radial nerve.

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