

TECHNIQUE

Capitolunate Arthrodesis With Compression Screws

Jean-Noël Goubier and Frédéric Teboul
Centre International de Chirurgie de la Main (CICM)
clinique du parc Monceau, 21 rue de Chazelles
Paris, France

ABSTRACT

Scapholunate dissociation or scaphoid pseudarthrosis may lead to wrist osteoarthritis. When osteoarthritis concerns the midcarpal joint, proximal row carpectomy is not possible. Only 4-corner or capitolunate arthrodesis may be indicated. In this procedure, pseudarthrosis was frequently described in literature. However, in these series, fixation was performed with pins or staples. Type and position of the device are important to obtain carpal bones fusion. The efficiency of compression screws has been validated in scaphoid fracture or pseudarthrosis. Moreover, the axial position of the screws, parallel to the physiological wrist loads, may participate to improve bone fusion. Therefore, we present our technique of capitolunate arthrodesis with compression screws fixation through a dorsal approach.
Keywords: capitolunate, arthrodesis, compression screws, wrist osteoarthritis

HISTORICAL PERSPECTIVE

Scapholunate dissociation or scaphoid pseudarthrosis may lead to wrist osteoarthritis. Vender et al[1] and Watson and Ballet[2] described the different stages of joint degenerative changes. In scaphoid nonunion advanced collapse or scapholunate advanced collapse with midcarpal joint osteoarthritis, proximal row resection is not indicated. Lunate-triquetrum-hamate-capitate (4-corner) fusion is generally proposed. This procedure requires the fusion of 4 articular surfaces.[3,4] Kirschner wires (K-wires), staples, or standard plates are generally used to obtain these bone fusions. However, compression is not sufficient in K-wire or staple fixations. New devices such as circular plates have been developed to improve fixation and start early rehabilitation.[4] Furthermore, comparative studies showed that circular plates increase complication and the dissatisfaction rate.[3,5] Therefore, capitolunate arthrodesis with scaphoid and triquetrum resection has been proposed to improve wrist motion and avoid pseudarthrosis.[6–9] The carpal length is more respected than in proximal row carpectomy, to preserve grasp strength. However, pseudarthrosis is not rare in this procedure because of the small contact surface between lunate and capitate. Therefore, compression fixation is proposed to improve the fusion rate.

Address correspondence and reprint requests to Jean-Noël Goubier, PhD, Centre International de Chirurgie de la Main (CICM), clinique du parc Monceau Paris, France. E-mail: jngoubier@numericable.fr.

INDICATIONS

Scapholunate advanced collapse or scaphoid nonunion advanced collapse with midcarpal arthrodesis is the principal indication of capitolunate arthrodesis (Fig. 1). The radiolunate joint must be preserved because of the concentration of mechanical loads in this area after midcarpal arthrodesis.

TECHNIQUE

The patient is brought to the operating room, where a regional anesthetic is administered. The wrist and hand are then placed prone on the operating table. The extremity is exsanguinated and a tourniquet is inflated to more than 100 mm Hg above systolic blood pressure.

A dorsal approach is performed. Dorsal retinaculum is opened in the fourth compartment. The extensor digitorum communis tendons are retracted on the lateral side. The terminal branch of the posterior interosseous nerve is located and divided above the radioulnar joint. Hemostasis of the posterior branch of the interosseous artery has to be performed to avoid hematoma. A straight capsulotomy is performed; radiocarpal and midcarpal joints are exposed in placing the wrist in flexion (Fig. 2). This allows the exploration of cartilage lesions especially the radiolunate joint. Afterward, scaphoid and triquetrum excision is performed. A K-wire is placed in each bone as a "joystick." Using the K-wires, scaphoid and triquetrum may be mobilized in different positions to divide the ligaments. The excision of the lunotriquetrum ligament allows the mobilization of the lunate without dividing volar radiolunate ligaments even if these ligaments are stout. Volar

FIGURE 1. Scapholunate advanced collapse with radioscaphoid and midcarpal arthritis. The radiolunate joint is preserved.

ligaments have to be preserved to keep lunate vascularization. When the scaphoid and triquetrum are removed, a part of the head of the capitate is cut at the level of the proximal pole of the hamate with a rongeur or an oscillating saw. The same procedure is then performed with the distal surface of the lunate to obtain a plane area with cancellous bone (Fig. 3). Only the anterior and posterior margins are resected on the lunate to obtain a plane surface. The surfaces of resection have to be perpendicular to the axis of the capitate and lunate. The

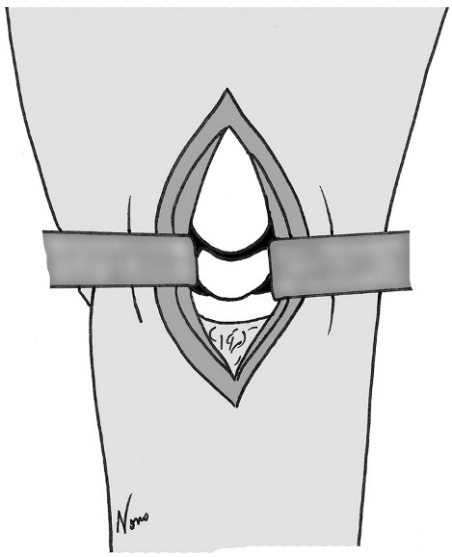

FIGURE 2. Exposition of the capitolunate joint, the lunate, and the capitate through a dorsal approach. The wrist has to be in flexion to correctly expose the capitolunate joint.

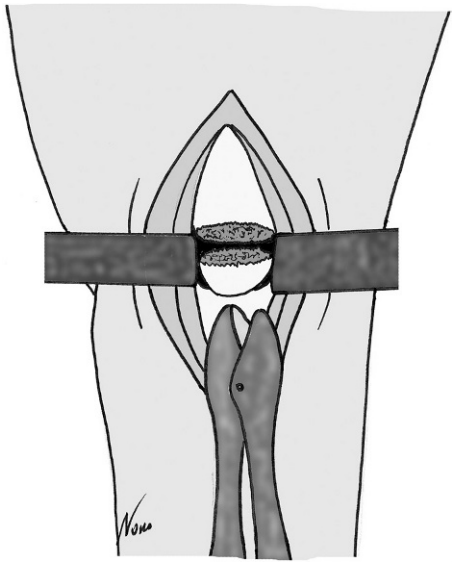

FIGURE 3. Resection of the head of the capitate and the distal surface of the lunate with a rongeur. The 2 surfaces must be perpendicular to the capitolunate axis. This stage may be performed with an oscillating saw.

total height of the resection of the lunate and capitate is about 4 mm. The lunate is placed in neutral position on the capitate and maintained with an axial pin (Fig. 4). Bone graft has never been necessary in our technique. The fluoroscopic lateral view allows controlling the lunatum in neutral position and the pin position. One 0.8-mm K-wire is placed to guide the first cannulated screw (Omnitech, Biotech International, Salon de Provence, France) and measure the length of the screw (Fig. 5). The trajectory of the K-wire is parallel to the third metacarpal axis. The first screw is placed until its head reaches the subchondral area (Fig. 6). The reduction K-wire is removed and the same procedure is performed for the second screw. The length of the screws is checked with fluoroscopy (Fig. 7).

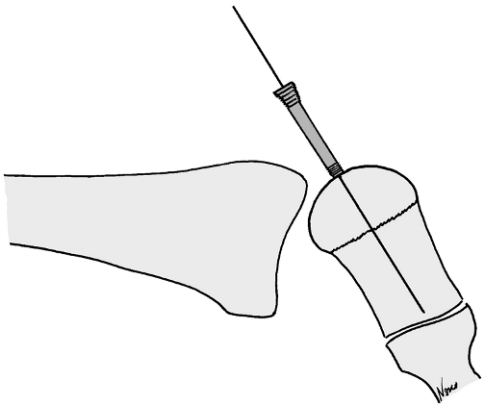

FIGURE 4. Wrist must be in maximal flexion to correctly place the compression screw.

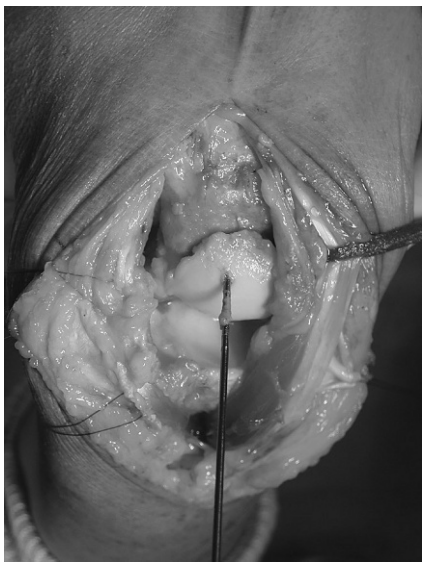

FIGURE 5. The central K-wire allows the fixing of the lunate on the capitate after subchondral bone resection. The compression screws will be placed laterally in the lunate surface.

The capsule and extensor retinaculum are then closed with absorbable sutures. A suction drain is placed to avoid hematomas. Afterward, the skin is closed with separated sutures. The wrist is immobilized in a palmar splint for 1 week and rehabilitation is started.

■ COMPLICATIONS

One must take care of injuries of the dorsal sensory branch of the radial and ulnar nerves. However, nerve lesions are rare because the skin incision is performed in the middle part of the dorsal aspect of the wrist between the radial and ulnar territories. During scaphoid excision procedure, one must take care of the anterior anatomical structures. Therefore, joystick K-wires are useful to expose the deep tubercle of the scaphoid. No median nerve or flexor tendons have been injured in our series. The head of the screws must be gently introduced and deeply placed in the cartilage to avoid focal cartilage disruption and late arthrolysis. Moreover, the radial surface of the lunate must be preserved during the procedure to avoid radiocarpal arthritis.

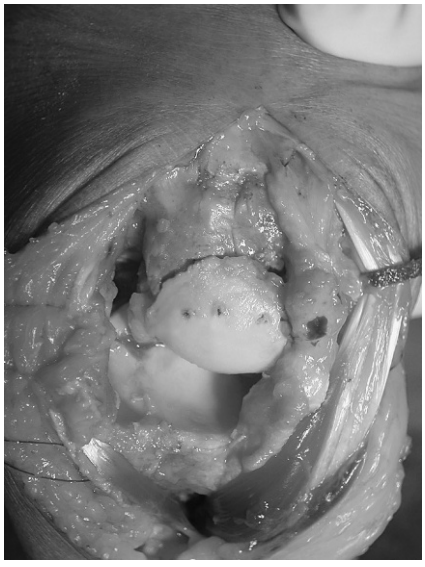

FIGURE 6. The heads of the screws have to be placed deeply under the cartilage surface of the lunate to avoid iatrogenic radiolunate arthritis.

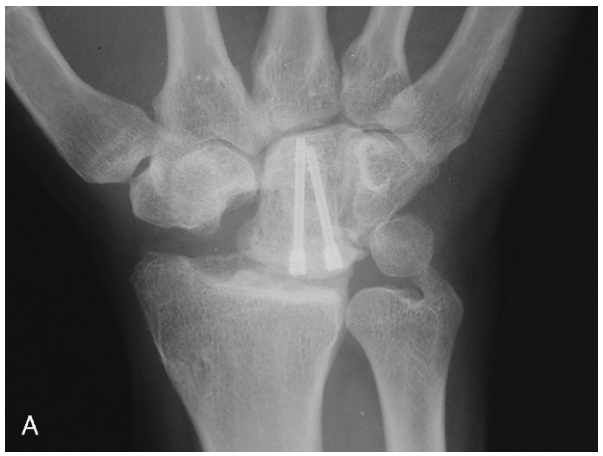

FIGURE 7. A, The anteroposterior view shows the length and axis of the screws. The contact between lunate and capitate must be perfect to obtain bone fusion. B, The lateral view shows the lunate in neutral position.

■ DISCUSSION

Large exposition is needed to correctly perform the capitolunate arthrodesis. Therefore, the dorsal approach

is adapted to achieve this procedure. Straight dorsal capsulotomy allows performing easily the resection of the scaphoid and the triquetrum bone. The anterior part of the scaphoid is deep and sometimes difficult to reach with a Berger approach.[10] Moreover, the scaphotriquetral ligament, preserved in Berger approach, is detached for the scaphoid and triquetrum excision.

In our technique, the axial position of the screws is necessary to obtain a correct stability of the synthesis. Moreover, triquetrum excision is always performed to correctly place the lunate on the head of the capitatum and avoid the constraints on the lunate through the lunotriquetral ligament. Therefore, capitolunate arthrodesis with triquetrum excision cannot be performed through a lateral approach as described by Duteille et al.[11] In this approach, the capitolunate joint is located after scaphoid excision. The proximal surface of the lunate is not correctly exposed and no axial device can be used. Therefore, the authors used staples to perform the capitolunate arthrodesis fixation.

In capitolunate arthrodesis, the distal surface of the lunate has to perfectly match the proximal surface of the capitate. However, 2 types of lunate have been described: the type I lunate with articular surface for the hamate and the type II without articular surface for the hamate.[12] There is a high incidence of type II lunate.[12] In type I lunate, the lunate is easily placed on the capitate surface for capitolunate arthrodesis. However, in type II lunate, the lunate and capitate axes are not collinear. Therefore, triquetrum excision allows placing easily the lunate on the capitate to correctly align their axes.

Two compression screws are necessary to avoid rotation between capitate and lunate during wrist movements.[13] The screw placement in cartilage of the lunate does not injure the surface. The diameter of the screws is 2.3 mm; therefore, the holes in the lunate cartilage surface are small. They are progressively replaced by fibrinous tissue as described in proximal scaphoid fractures.[14]

Pseudarthrosis is the main complication of capitolunate arthrodesis. K-wires or staples are generally used to perform this arthrodesis.[6,8,9,11] However, compression is less efficient with these devices than with axial compression screws.[7] The contact areas of the lunate and capitate are very small and compression techniques are necessary to obtain bone fusion. Proximal to distal fixation allows the placement of the screws in the center of the capitate, improving capitolunate compression. This central and axial position of the screws cannot be achieved with distal to proximal direction because of the third metacarpal. Recently, bioresorbable screws with good compressive properties have been developed.[15] This material could be used in our technique. However, clinical studies have to be carried out to prove the efficiency of this device in routine practice.

New circular plates have been developed to improve fixation and start early rehabilitation in 4-corner fusion.[4] However, material fractures have been described with spider plates.[3,5] The axial position of the screws is mechanically stronger than lateral device as staples or plates because of axial compressive loads during grasp.[13] Therefore, this technique allows obtaining a solid capitolunate fixation. The rehabilitation may be started after only 1 week to decrease wrist stiffness.

RESULTS

Thirteen patients with midcarpal arthritis after scaphoid pseudarthrosis (3 patients) or scapholunate dissociation (10 patients) were operated on. There were 12 men and 1 woman. The average age was 48 years (range, 36–61 years). All patients had a painful wrist. According to visual analogue scale, the average pain was 7.3 (range, 3–10). The average grasp strength was 18 kg (range, 15–31 kg). The average range-of-motion was 32 degrees for wrist flexion (range, 10–50 degrees) and 27 degrees for wrist extension (range, 10–55 degrees). All patients underwent the capitolunate arthrodesis with compression screws.

The average follow-up was 29 months (range, 27–36 months). The average postoperative pain was 1.25 (1–5). The average grasp strength was 22 kg (range, 15–35 kg). The average range-of-motion was 35 degrees (range, 20–50 degrees) for flexion and 29 degrees (range, 15–60 degrees) for extension. No displacements were observed in our series, and 12 of 13 patients achieved capitolunate fusion in an average of 9 weeks (range, 6–13 weeks). The patient with nonfusion did not ask for another procedure because of mild wrist pain. Reflex sympathetic dystrophy was noted in 1 patient, with spontaneous resolution. No radiolunate arthritis was noted.

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