Comparative Outcome Analysis of Arthroscopic-Assisted Versus Open Reduction and Fixation of Trans-scaphoid Perilunate Fracture Dislocations

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Purpose: To compare union rates and clinical and radiological outcomes of arthroscopic-assisted reduction and fixation with those of open reduction and fixation in patients with trans-scaphoid perilunate fracture dislocations. **Methods:** This retrospective study included consecutive patients with trans-scaphoid PLFDs who underwent arthroscopic-assisted reduction and fixation (group A) or open reduction and fixation (group O), and who were followed up for a minimum of 2 years between May 2005 and March 2013. We excluded initially missed patients. Each different surgeon who was on call had performed each experienced operation. These clinical outcomes were assessed: range of motion, grip strength, Mayo wrist score, and Disabilities of Arm, Shoulder, and Hand (DASH) score. For radiologic outcomes, the scapholunate angle, radiolunate angle, and lunotriquetral distance were measured. **Results:** The total number of included patient was 20 (11 in group A and 9 in group O). Scaphoid union occurred in all patients except 1 individual (11 of 11 in group A, and 8 of 9 in group O). At the last follow-up, the mean flexion-extension arc was significantly greater in group A (125.0°) than in group O (105.6°) ($P = .028$). The mean grip strength was 81.1% that of the contralateral side in group A and 80.9% in group O ($P = .594$). The mean Mayo wrist score was 85.5 in group A and 79.4 in group O ($P = .026$), and the mean DASH score was 10.6 in group A and 20.8 in group O ($P = .001$); however, only the DASH score showed a minimum clinically important difference. The mean scapholunate angle, radiolunate angle, and lunotriquetral distance were similar between the 2 groups: 47.2°, 1.7°, and 2.0 mm in group A and 48.8°, 5.6°, and 2.1 mm in group O, respectively. **Conclusions:** Although both arthroscopic and open techniques achieved stability of the injured wrists in patients with trans-scaphoid PLFDs, it is shown that the arthroscopic-assisted technique showed a clinically meaningful better DASH score and greater flexion-extension arc with other parameters being similar. **Level of Evidence:** Level III, retrospective comparative study.

Trans-scaphoid perilunate fracture dislocations (PLFDs) are among the most complex carpal injuries and involve severe disruption of carpal bone alignment.[1-3] Early treatment of these injuries is necessary to prevent devastating complications, such as chronic carpal instability and eventual post-traumatic arthritis. Although closed treatment was historically advocated, several studies have reported that closed reduction and immobilization alone results in nonunion of the scaphoid, intercalary segmental instabilities, and unfavorable wrist arthritis.[4-6] Although studies comparing conservative treatment with open treatment have shown consistently better results with operative fixation,[7,8] the trend has been toward anatomic reduction and repair of the ligamentous and osseous structures with early open reduction and internal fixation.[1,4,9-11]

Despite the superiority of open treatment over closed treatment for trans-scaphoid PLFDs, diminished wrist function seems to be inevitable.[3,9,12] Previous studies have shown that the flexion-extension arc of the effected wrist decreased to between 57% and 75% compared with the contralateral side.[1,4,9-11,13,14] This may be attributed to fibrosis of the injured joint being promoted by the addition of surgical trauma to the severely injured capsular and ligamentous structures.[3,11,12]

Recently, arthroscopic-assisted reduction and fixation of trans-scaphoid PLFDs has been used as an alternative to open surgery, introducing the potential advantages

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of minimal invasiveness. Several authors have shown that the arthroscopic method allows anatomical reduction of intercarpal alignments, maintains carpal stability, and results in more than 80% wrist motion compared with the contralateral wrist.[12,15] However, there are lack of studies comparing arthroscopic-assisted surgery with open surgery.

The purpose of the current study was to compare union rates and clinical and radiological outcomes of arthroscopic-assisted reduction and fixation with those of open reduction and fixation in patients with trans-scaphoid PLFDs. The authors hypothesized that arthroscopic-assisted repair would achieve better wrist motion and function postoperatively than open anatomical repair.

Methods

We retrospectively reviewed the records of all patients who met the following criteria between May 2005 and March 2013: (1) acute (<1 week) trans-scaphoid PLFD who underwent arthroscopic-assisted or open reduction and fixation; and (2) followed up for a minimum of 2 years. Patients fulfilling the following criteria were excluded: (1) initially missed trans-scaphoid PLFDs; (2) trans-scaphoid, transcapitate PLFDs; (3) concomitant fractures or dislocations of the ipsilateral elbow or shoulder; (4) major central or peripheral nervous system injury at the time of injury; (5) any previous surgery on the involved wrist; and (6) inadequate follow-up (<24 months). One of the 2 surgeons (Y-R.C., H-J.K.) who was on call had performed an operation in turn. Both of them were experts in the field of the hand surgery. One of them (Y-R.C.) had experience in arthroscopic-assisted reduction and fixation, and he had performed arthroscopic surgery during the study period. The other (H-J.K.) had experience in open reduction and fixation, and he had carried out open surgery during the same period. The patients who underwent arthroscopic-assisted surgery were classified as group A, and those who underwent open surgery were classified as group O. Our institutional review board approved the study and waived the requirement for informed consent.

Surgical Technique

The closed reduction was attempted and successful in the emergency department using the technique described by Jones.[16] In the operation room, however, these injuries were so unstable that closed reduction should be repeated immediately before operation in cases of the redislocation. All operations were conducted while the patients were receiving general anesthesia. With the patient in the supine position, the arm was prepped and draped on a hand table. A pneumatic tourniquet and Esmarch bandage were used to exsanguinate the arm.

In group A of arthroscopic-assisted reduction and fixation (Fig 1), the patient's arm was suspended in an Arc Wrist Tower (Acumed, Hillsboro, OR) with 5 to 8 kg of traction after placing the index, middle, and ring fingers in finger traps. A 3-4 portal, 6-R portal, and midcarpal ulnar portal were created sequentially, and a 1.9-mm video arthroscope was introduced through each portal. While using the midcarpal ulnar portal as the viewing portal, a scaphotrapeziotrapezoidal portal or midcarpal radial portal (depending on the level of the scaphoid fracture) was created under direct vision as the working portal to facilitate the approach. Bone or cartilage fragments, as well as frayed edges of torn intrinsic or extrinsic ligaments that interrupted reduction, if present, were thoroughly debrided or removed to facilitate reduction of the scaphoid fracture or lunotriquetral joint. After releasing longitudinal traction, the scaphoid fracture was reduced with manipulation of the distal fragment using a probe or percutaneous joystick K-wire, under guidance from the arthroscopic and fluoroscopic images. Subsequently, a K-wire was inserted from the scaphoid tubercle and passed through the fracture site for temporary fixation. After the arthroscopy switched into the scaphotrapeziotrapezoidal or midcarpal radial portal, the lunotriquetral joint was reduced using the same method and pinned percutaneously from the ulnar side of the wrist, starting at a point dorsal to the pisiform and aiming in a slight proximal direction. To insert a guidewire for headless screw fixation of the scaphoid fracture, the arthroscope was introduced into the 6-R portal. The guidewire, inserted through a 15-G needle, was inserted percutaneously, proximal and ulnar to the 3-4 portal, to target the ideal starting point at the most proximal tip of the scaphoid pole, immediately adjacent to the insertion of the scapholunate interosseus ligament along the long axis of the scaphoid.[17] After removal of the provisional K-wire, a 5-mm transverse incision was then made at the point of the pre-positioned guidewire. A sharp straight hemostat was used to spread the soft tissue and pierce the dorsal capsule (proximal 3-4 portal). After reaming, a headless compression screw (either an HCS 3.0 [Synthes, Paoli, PA] or Acutrak mini screw [Acumed, Hillsboro, OR] system) was inserted over the guidewire to fix the scaphoid fracture.

In group O of open reduction and fixation (Fig 2), a 5-cm longitudinal incision was created on the dorsal aspect of the wrist in line with Lister's tubercle. Skin flaps were raised radially and ulnarly, and the incision was extended down to the extensor retinaculum. The retinaculum was divided in line with the third dorsal compartment, and the extensor pollicis longus tendon was identified distally and retracted radially. Only the distal 1 cm of the third compartment was released. The second and fourth compartments were then reflected