J Shoulder Elbow Surg (2017) 26, 923–930

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

SHOULDER

Temporary ipsilateral stiff shoulder after operative fixation of distal radial fractures

Soo Min Cha, MD, PhD, Hyun Dae Shin, MD, PhD*, Sung Jin Hwang, MD

Department of Orthopedic Surgery, Regional Rheumatoid and Degenerative Arthritis Center, Chungnam National University Hospital, Chungnam National University School of Medicine, Daejeon, Republic of Korea

Background: This study was conducted to identify variables affecting the development of temporary stiff shoulder after operative fixation for distal radial fractures (DRF).

Materials and methods: The study retrospectively analyzed 167 patients who had undergone internal fixation using volar locking plate for DRF between 2010 and 2013. Group 1 was denoted as the "normal group," and group 2 was denoted as the "stiff shoulder group." Basic demographic factors evaluated included age, sex, bone mineral density (BMD), and the dominancy. Also investigated were radiologic variables, including concurrent fractures of the styloid process, positive ulnar variances, classification of DRF, and morphologic type of the distal radioulnar joint. Finally, the type of plate, methods used for postoperative protection, and time of union were analyzed.

Results: Group 1 consisted of 114 patients, and group 2 consisted of 53 patients. On overall univariate analysis, BMD, hand dominancy, and the protective methods after plating were significantly different between the 2 groups. On multivariate analysis, a lower BMD and injury on the nondominant side were significant factors for shoulder stiffness. Stiffness was significantly higher in patients with a mean BMD < -2.6 than in patients with a mean BMD ≥ -2.6. At the final follow-up, all of the 53 patients in group 2 were relieved of the symptoms of a stiff shoulder.

Conclusions: A lower BMD and injury on the nondominant distal radius were distinct factors for the development of a stiff shoulder after operative fixation in DRF. Fortunately, nonoperative treatments, such as stretching exercises/injections, were useful for the relief of these symptoms in the short-term follow-up.

Level of evidence: Level II; Retrospective Design; Prognostic Study

Keywords: stiff shoulder; bone mineral density; distal radius fractures; volar locking plate; hand dominancy; sarcopenia

Distal radial fractures (DRF) are commonly encountered in orthopedic practice, particularly in elderly patients. A number of studies have suggested that anatomic restoration of the distal end of the radius is essential to gain a superior outcome.[10,11,15] Among numerous operative tools, such as Kirschner wire, dorsal/volar plate, and external fixator, the volar locking plate has become increasingly popular in the developed world since the late 2000s because of many benefits, such as stable fixation even for osteoporotic bone, reduction of the immobilization period after surgery, and enabling an early return to the activities of daily living.[17,18,21]

The Chungnam National University Hospital Institutional Review Board approved this research (IRB No: CNUH 2016-05-003).

*Reprint requests: Hyun Dae Shin, MD, PhD, Department of Orthopedic Surgery, Chungnam National University School of Medicine, 640, Daesa-Dong, Jung-Gu, Daejeon, Republic of Korea.

E-mail address: hyunsd@cnu.ac.kr (H.D. Shin).

1058-2746/$ - see front matter © 2017 Journal of Shoulder and Elbow Surgery Board of Trustees. All rights reserved.
http://dx.doi.org/10.1016/j.jse.2017.02.008

Common preventable complications associated with operative fixation include flexor/extensor tendon injuries, inadequate reduction, subsidence or collapse, intra-articular placement of the screw, nerve injury, and complex regional pain syndrome.[3,9,14,22,25,26] In addition to these major complications that require secondary procedures, temporary minor problems, such as perioperative pain, temporary joint stiffness of the wrist/hand, and sensory problems, including numbness/hypoesthesia, are also important conditions for patients during the perioperative period.

Among these temporary problems, we have noted during the last few years the occurrence of temporary shoulder stiffness after operative fixation in DRF. Most instances of stiff shoulder occurred approximately 2 to 4 months postoperatively. Moreover, up to approximately 6 months postoperatively, most patients were relieved from pain or discomfort by nonoperative treatment, including intra-articular steroid injections. Despite the temporary nature of the symptoms, painful shoulders raise issues from the patient's viewpoint during the early postoperative period, including dissatisfaction with the surgery and the worry that the injured arm may not recover. Our hypothesis was that certain factors would play important roles in the development of temporarily stiff shoulders after operative fixation to treat DRF. To verify this hypothesis, we analyzed basic demographic, clinical, radiologic, and operative factors.

Materials and methods

Patient selection

This was a retrospective case-control study, and all patients provided written informed consent before participation. Of an initial cohort of 276 patients who had undergone operative fixation for DRF performed by the author (S.M.C.) between March 2010 and December 2013, 182 patients met the inclusion criteria, and 167 were finally included in the investigation. The inclusion criteria were (1) age older than 60 years and living independently; (2) unilateral acute DRF; (3) operative treatment using a volar side locking plate system; (4) availability of complete medical records and radiologic data; and (5) a postoperative follow-up of at least 2 years. Patients with the following characteristics were excluded: (1) open fracture; (2) DRF in combination with any other injuries in the ipsilateral arm, including fractures/ligamentous injury (from finger to shoulder); (3) concurrent distal radioulnar joint (DRUJ) instabilities requiring repair of the triangular fibrocartilage complex, including unstable styloid base fractures of the ulna; (4) arthritic changes at the DRUJ; (5) the presence of painful pathologic lesions in the shoulder before the radial fracture (eg, rotator cuff tears, stiff shoulder); (6) the presence of symptomatic neuropathy, confirmed by electromyography/nerve conduction velocity in the ipsilateral upper extremity; and (7) a history of surgery in the ipsilateral arm.

We evaluated the shoulder joint between 1 and 3 months postoperatively during the regular follow-up period of at least 2 years. Group 1 was deemed the "normal group," and group 2 was deemed the "stiff shoulder group."

Demographic and clinical variables

We evaluated the basic demographic factors, including age, sex, bone mineral density (BMD), dominant/nondominant wrist, workers' compensation issues, smoking, and diabetes mellitus status. BMD was measured as part of the preoperative general evaluation, using dual-energy X-ray absorptiometry (DEXA) scans with the Lunar Prodigy enCORE 8.8 software (GE Medical Systems, Milwaukee, WI, USA). The lowest T score of the proximal femur and lumbar spine, except the value for the Ward area of the proximal femur, was recorded. We then used the mean value of the scores measured from the hip and spine.

Active smokers, who were defined as those who smoked within 4 weeks of surgery or smoked currently, were enrolled as "smokers" for comparison with "nonsmokers."[24]

Radiologic and operative variables

Concurrent fractures of the styloid process were considered potential variables. In addition, positive ulnar variances were measured on simple radiographs just after plate fixation using the traditional method.[8] Fracture classification was performed according to the Arbeitsgemeinschaft für Osteosynthesefragen (AO)/Orthopaedic Trauma Association (OTA) classification. The morphologic DRUJ type was classified into 3 categories according to the DRUJ types described by Tolat et al[23]: type I, apposing joint surfaces are parallel to the longitudinal axis of the ulna; type II, apposing joint surfaces are oblique (positive sigmoid notch angle); and type III, apposing joint surfaces are in reverse oblique orientation (negative sigmoid notch angle, Fig. 1).

Three types of locking plates were used in both groups. An anatomic volar DR plate (Stryker Leibinger, Freiburg, Germany), Aptus Volar Plate (Medartis, Basel, Switzerland), and the DVR plate (Biomet, Warsaw, IN, USA) were used.

The wrist was immobilized in a short arm splint after surgery, and active range of motion (ROM) exercises of the digits were started immediately with the arm elevated and positioned overhead. In patients who met the criteria for osteoporosis/severe osteoporosis,[2] the splint was changed to a short arm cast (below the elbow) at discharge for 6 weeks. The initial splint was maintained during these 6 weeks in patients who met the criteria for osteopenia. In patients with a BMD within the normal reference range, the initial splint was changed to a movable wrist brace during the same period (Fig. 2).

Definition and evaluation of stiff shoulder

The passive ROM of the shoulder was evaluated during regular visits to the outpatient department after surgery. A ROM that was less than 100° in forward flexion, less than 10° in external rotation, and less than the fifth lumbar vertebra (L5) level in internal rotation was defined as global limitation of the ROM[12] and termed "stiff shoulder after volar plating" at the first month follow-up visit. If a patient had been diagnosed with a stiff shoulder, we commenced continuous passive motion twice weekly for 4 weeks. The patient was given passive stretching exercises to perform at home and was assessed again 4 weeks later. If the symptoms continued and motion was restricted, patients were given an intra-articular steroid injection, maintained on the continuous passive motion/passive exercise program, and assessed again 4 weeks later. At the third follow-up, patients with persistent symptoms were given a final injection and