Injury, Int. J. Care Injured 45 (2014) 960–964

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Outcome of delayed primary internal fixation of distal radius fractures: A comparative study

Yoram A. Weil *, Rami Mosheiff, Shimon Firman, Meir Liebergall, Amal Khoury

Department of Orthopaedics, Hadassah Hebrew University Medical Centre, Jerusalem, Israel

ARTICLE INFO

Article history:
Accepted 2 February 2014

Keywords:
Distal radius fractures
Volar locking plate
Delayed surgery

ABSTRACT

Introduction and aim: Operative fixation of distal radius fractures using fixed-angle devices has become increasingly common. Although good to excellent results have been reported in acute fractures, little is currently known regarding the fixation of healing displaced distal radius fractures that were presented late. The aim of this study was to evaluate the results of internal fixation of distal radius fractures presented late (>21 days) as compared with an acute-care control group.
Methods: Forty patients operated on for displaced distal radius fractures, presenting more than 21 days after injury (delayed treatment (DT) group), were compared with 75 age-matched controls with acute fracture repair (≤21 days). The same surgical approach was used in both groups, together with dorsal soft-tissue and brachioradialis release. No osteotomy was required. Direct and indirect reduction aids were used. A fixed-angle device (DVR; Biomet Inc., Warsaw, IN, USA) was used in both groups. Mean follow-up was 3.4 years. Quick DASH (Disabilities of the Arm, Shoulder and Hand) and Short Form 12 scores were used to evaluate outcome, as well as radiographic analysis for Arbeitsgemeinschaft für Osteosynthesefragen(AO)/Orthopaedic Trauma Association(OTA) classification, volar tilt, radial inclination and radial length.
Results: Average age was 53 years in both groups and male to female (M/F) ratio was similar in the study groups. Mean time to surgery was 30 days in the DT group and 8 days in the control group. There were significantly more type C (91.5% vs. 67.5%) fractures in the control group. The average quick DASH score was 27.1 in the DT group as compared with 6.3 in the control group ($p < 0.03$); however, when controlling for two outlier cases with complications (hardware irritation and a sensory neuropathy) there was no significant difference. Volar tilt, radial inclination and length were similar in both groups and were within normal anatomical values.
Conclusions: Delayed primary operative fixation of displaced unstable distal radial fractures is a viable option for cases that were presented late, with predictable, favourable results. Neither extensile approaches nor formal osteotomies are required.

Introduction

Operative treatment for unstable distal radius fracture has recently become popular. The introduction of fixed-angle devices has allowed for rigid fixation, maintenance of fracture reduction, early mobilisation and a decrease in complications associated with other fixation types [1,2]. This has led to the increased tendency for operative fixation [3,4], however, not without criticism. Despite increasing experience in distal radial fixation, available evidence is sufficient for recommending operative fixation only in certain cases such as post-reduction radial shortening, loss of normal radial tilt or articular step-off >2 mm [5]. However, in many cases, late displacement occurs in formerly acceptable reductions, even in undisplaced fractures [6], thus resulting in late referral for corrective surgery. Although good to excellent results regarding the acute treatment of distal radius fractures [7,8] were extensively published, very little is known regarding the results of operatively treated patients who presented late (>21 days) with distal radius fractures that have not as yet healed. As with other fractures, surgeons might feel that results of open reduction and internal fixation of certain fractures will be suboptimal when treatment is delayed.

The aim of this study was to compare the clinical and radiographic outcomes of patients suffering from unstable distal

* Corresponding author at: Orthopaedic Trauma Service, Hadassah Hebrew University Medical Centre, POB 12000, Jerusalem 91120, Israel.
Tel.: +972 2 6776342; fax: +972 2 6423074; mobile: +972 50 7874314.
E-mail addresses: weily@hadassah.org.il, yoramweil@gmail.com (Y.A. Weil).

http://dx.doi.org/10.1016/j.injury.2014.02.011
0020–1383/

radial fractures operated on more than 3 weeks after injury as compared with historical controls who underwent surgery earlier on in the course of treatment.

The Ethics Committee of our Institution approved this research.

Patients and methods

Setting: an academic level I trauma centre. During the years 2007–2011, 40 patients with unstable displaced distal radius fractures who presented more than 21 days from injury were treated by open reduction and internal fixation. Seventy-five previously studied [9] patients were matched by age and sex as historical controls. These were patients operated primarily for acute distal radius fractures between the years 2006 and 2008. The same team performed all surgeries. Mean follow-up was 3.4 years (range 1–6 years).

Surgical technique

All patients were operated via a standard volar flexor carpi radialis (FCR) approach [10]. In the delayed group, the fracture site was thoroughly debrided of callus and soft tissue. In all cases, the fracture plane could be identified and was followed using a sharp dissector. The brachioradialis tendon was released in the majority of cases, especially in those with loss of radial height, followed by dorsal release of the callus tissue and extensor tendons from the distal fracture fragment using a dorsolaterally placed elevator. Both direct and indirect reduction manoeuvres were performed in order to achieve acceptable alignment, including first fixing the metaphysis of the plate and using it as a reduction tool (Fig. 1). In all cases, even one operated on more than 3 months following trauma, a formal osteotomy was not required. Definitive fixation was done using a 2.4/3.5-mm volar locking plate (DVR; Biomet Inc., Warsaw, IN, USA). Intra-operative fluoroscopy was used to verify reduction.

In the control group, operative fixation was carried out using the same surgical approach, using both direct and indirect reduction technique. In the majority of cases, reduction was easily achieved using manipulation with the plate affixed proximally first. Neither bone graft nor bone-graft substitute was used in any of the cases in both groups. Postoperative care was similar in the two study groups. A soft, bulky dressing was applied postoperatively, and gentle, active wrist range of motion, as tolerated, was initiated immediately following surgery.

Data were recorded in the patients' charts and included age, sex and complications. Patients were followed up in the outpatient clinic at 2 weeks, 6 weeks, 3 months, 6 months and 1 year postoperatively; quick DASH (Disabilities of the Arm, Shoulder and Hand) [11] as well as Short Form 12 (SF-12) questionnaire [12] were completed via a telephone interview in 35 out of 40 patients (88% follow-up). The control group had their quick DASH score determined at 1 year postoperatively. A fellowship-trained trauma surgeon (YAW) analysed all healed fracture radiographs available at the latest follow-up.

Preoperative radiographs were analysed for AO/OTA classification. Postoperative analysis included radial height, volar tilt and radial inclination. Radiographic evaluation was measured using the latest follow-up radiographs utilising Picture Archiving and Communication System (PACS) measurement tools (Centricity, GE Healthcare Systems, Inc.).

Statistical analysis

A biostatistician performed the statistical analysis. Kruskal–Wallis one-way analysis of variance was performed on radiographic and clinical variables. A two-tailed *t*-test was done for normal distribution of continuous variables and a nonparametric Mann–Whitney sum-rank *U* test for the rest of the variables. Chi-square test and Fisher's exact test were performed on categorical variables. A *p*-value of <0.05 was considered statistically significant.

Results

There were 15 male and 25 female patients in the delayed treatment (DT) group versus 35 male and 40 female patients in the control group. Average age was 53 (range 22–85 years) in the DT group and 53 in the control group (range 20–84 years). The differences between the groups were not statistically significant.

Mean time from injury to treatment in the DT group was 30 days (range 21–108) versus 8 days in the control group (range 1–20). This difference was significant ($p < 0.01$).

Fracture types according to the AO/OTA classification are depicted in Table 1. There were significantly more type A and B fractures in the DT group as compared with the control group and significantly fewer type C fractures. As for incidence of dorsal comminution, the fractures did not differ between the study groups.

Postoperative radiographic parameters are shown in Table 2. Overall, radial length, inclination and volar tilt were within anatomically acceptable ranges and did not differ significantly between the two study groups. When isolating type C fractures, the volar tilt was significantly lower (7.5 ± 9.5 vs. 9.5 ± 93.0) in the DT group.

Complications in the DT group included tendon irritation due to a radially prominent plate in one case and sensory neuropathy in another case. Both patients refused revision surgery (removal of implant and nerve exploration). In one case, postoperative subsidence of the joint was observed resulting in a prominent screw; hardware was removed with improvement of symptoms. In the control group, there was one case of median nerve neuropraxia.

Quick DASH scores were significantly higher (worse) in the delayed surgery group (21.7 ± 27.5 vs. 6.2 ± 5). However, the distribution of score values between groups was different and skewed, with the two cases with complications as mentioned above displaying a score of >80 (Fig. 2). When excluding these two outlier patients, the average quick DASH score dropped to 15.7 ± 19 without a statistically significant difference between the two groups. The mean quick DASH score for type A fractures (19.45) was significantly smaller than type C (27.8, $p = 0.05$).

The SF-12 physical score in the DT group was 43.4 ± 13.2 and mental score was 51.6 ± 21.2.

Table 1
Fracture types in the two study groups.

AO/OTA classification/group	A	B3	C	Dorsal comminution
Delayed treatment	7 (17.5%)*	6 (15.0%)	27 (67.5%)*	15 (37.5%)
Control	2 (2.8%)	11 (14.6%)	62 (82.6%)*	36 (48%)**

* $p < 0.05$.
** Non-significant.

Table 2
Radiographic postoperative reduction parameters in the two study groups.

Group/radiographic parameter	Radial height (mm)	Radial inclination (°)	Volar tilt (°)
Delayed treatment	11.4 ± 3.1*	22.4 ± 5.5*	8.7 ± 6.1*
Control	11.4 ± 2.0	20.6 ± 2.7	9.7 ± 2.8

* NS.