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Original article

The relationship between radiographic parameters and clinical outcome of distal radius fractures in elderly patients

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ABSTRACT

Purpose of the study: Treatment of distal radius fractures in elderly patients is controversial. This study explored the relationship between radiographic parameters and clinical outcomes of patients with distal radius fractures following conservative treatment. The study was done using radiographic measurements of distal radius fractures in elderly patients.
Patients and methods: Ninety-two active, healthy patients with conservatively managed distal radius fractures were included in the study. Functional and radiographic assessments were made 1 year after injury. Fifty patients who underwent corrective osteotomy comprised the control group. Radiographic parameters and clinical outcomes were compared between the two groups. The correlation coefficients of the radiographic parameters were analysed using multiple regression.
Result: Radius height (RH), volar tilt (VT) and Mayo wrist and Disabilities of the Arm, Shoulder and Hand (DASH) scores in the experimental group were significantly superior to those of the control group. There was no significant group difference in radial inclination. Multiple regression analysis revealed that the most important factor affecting functional outcome was RH, followed by VT.
Discussion: RH and VT were significantly correlated with the clinical outcomes of conservative treatment of distal radius fractures. RH should be given foremost consideration in elderly patients. Preoperatively, surgeons should evaluate this parameter carefully and be prepared to treat injuries accordingly.
Level of evidence: Level IV retrospective study.

1. Introduction

Distal radius fractures are among the most common fractures affecting elderly patients [1,2]. In cases of stable fracture, closed reduction and cast immobilization represent the primary choices for treatment [3,4]. Nevertheless, recent reports pertaining to the recommended treatment for elderly patients are equivocal [5–8]. Although there is general agreement regarding the close relationship between anatomy and function in younger patients [9,10], several researchers have suggested that elderly patients should be treated conservatively, even in the context of an unstable fracture pattern, because, in contrast to younger patients, fracture reduction is not associated with functional outcome in this population [8,11].

The correlation between radiological and functional results following distal radial fractures remains controversial. Several previous studies have shown that radiographic parameters do not correlate with self-reported disability [11,12], but others have indicated that radiographic parameters predict functional outcome [13–15].

We employed herein a retrospective comparative design to assess the relationship between radiographic parameters and functional outcome for distal radius fractures in elderly patients using conservative treatment. We also aimed to determine which treatment achieved optimal functional results.

2. Patients and methods

2.1. Study population and design

An observational, retrospective study design was implemented using data obtained from patient records and radiological follow-up examinations. We investigated all patients ≥ 60 years who were

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Fig. 1. Method used to obtain radiographic parameters. A. RH, radial height. B. VT, volar tilt. C. RI, radial inclination.

treated conservatively between 2008 and 2012 for displaced distal radius fractures in emergency wards. Data acquired from patients treated conservatively with closed reduction and cast immobilization were analysed retrospectively. Our institutional review board granted permission for this retrospective study.

Reduction was performed using a standard, intrafractural hematoma block with infiltration of 10 mL 1% Scandicain. Once an acceptable reduction was obtained, a non-circular below-elbow plaster cast was applied up to the metacarpophalangeal joints, with the wrist immobilized in neutral rotation with ulnar deviation and slight flexion. The mean time between injury and reduction was 3 h (range: 30 min–20 h). Radiographic examinations were performed every week, and immobilization was maintained for at least 4–6 weeks. Six weeks post-reduction, the cast was removed, and final standard radiographs were obtained. Corrective functional exercises were then undertaken by all patients. Patients in whom reduction was lost after 1–2 weeks (i.e., unstable fractures [16]; volar tilt < –10°, shortening ≥ 3 mm, articular step-off of 2 mm) were advised to undergo surgical treatment. Fracture reduction was performed by an orthopaedic senior resident. Patients who underwent secondary manipulation at any stage or whose fractures required a secondary surgical intervention were excluded.

A total of 92 active, healthy patients who underwent conservative treatment (15 males, 87 females) were included in the study (conservative group). Their mean age at the time of injury was 69 years (range: 60–94 years). The average follow-up time was 15 months (range: 12–24 months). All fractures were classified according to the Müller AO classification system as A2:18, A3:50, B2:5, C1:3, C2:10 or C3:6.

For the control group [15], we examined preoperative radiographic parameters and clinical outcomes of 50 patients ≥ 60 years of age who presented with malunion of distal radius fractures, with severe pain or wrist dysfunction that led to surgical treatment (corrective osteotomy) at our hospital (osteotomy group). The control patients were referred to our institution by a local practitioner or associate hospital.

2.2. Appraisal

All radiographs included acquisition of standardized, strict anteroposterior and lateral views of the wrist with the forearm in a neutral position. Standard radiographic assessment was performed every week for 6 weeks and then at 3, 6 and 12 months, and again as part of the final follow-up examination, which included assessment of radial height (RH), volar tilt (VT) and radial inclination (RI; Fig. 1). Digital radiographic assessment and AO fracture type classification were performed by two independent assessors using a computerized radiographic system (PACS). Simultaneously, functional outcome was evaluated, including a physician-reported Mayo wrist score (MWS; excellent: 90–100; good: 80–90; fair: 60–80; poor: < 60) [17] and self-reported measures of disabilities of the arm, shoulder and hand (DASH) [18]. Radiographic parameters and outcomes (MWS and DASH) in the conservative group were compared with those obtained preoperatively in the osteotomy group, and the correlations between radiographic parameters and clinical outcomes were analysed by multiple regression analysis.

2.3. Statistical analysis

Descriptive statistics were used to describe the basic characteristics of the patient groups. Data were analysed using Student's unpaired test and multiple regression and comparison analyses (Scheffé's *F*-test). A P value < 0.05 was taken to indicate statistical significance. Data are provided as means ± SD. Statistical analyses were performed using the SPSS for Windows software package (ver. 19; SPSS Inc., Chicago, IL, USA).

3. Results

The majority of the 92 distal radius fracture patients achieved good functional outcomes. Radiographic findings and clinical outcomes were recorded (Table 1). In the conservative group, RH was 9.33 ± 1.72 mm, VT was 0.837 ± 3.92 and RI was 11.18 ± 2.73. The MWS was 79.48 ± 3.93 (excellent, n = 0; good, n = 59; fair, n = 33), and the DASH score was 9.54 ± 2.60. In the osteotomy group, RH was 4.55 ± 1.50 mm, VT was −7.76 ± 6.14 and RI was 10.48 ± 2.39. The MWS was 57.46 ± 3.37, and the DASH score was 39.62 ± 3.99. Radiographic parameters (RH and VT), and clinical outcomes (MWS and DASH) were superior in the conservative versus osteotomy group, and there was no significant group difference in RI.

Multiple regression analysis revealed that radiographic parameters were positively correlated with functional results. In the conservative group, RH and VT were significantly correlated with the MWS and DASH score (Table 2). As shown in Figs. 2 and 3, the correlation coefficient (R) for RH and the MWS was 0.870, and

Table 1
Comparison between the conservative (n = 92) and osteotomy (n = 50) groups in terms of radiographic parameters and clinical outcomes.

	C group	O group	t	P value
RH (mm)	9.33 ± 1.72	4.55 ± 1.50	16.51	< 0.001
VT (°)	0.837 ± 3.92	−7.76 ± 6.14	8.96	< 0.001
RI (°)	11.18 ± 2.73	10.48 ± 2.39	1.52	0.13
MWS (point)	79.48 ± 3.93	57.46 ± 3.37	33.48	< 0.001
DASH (point)	9.54 ± 2.60	39.62 ± 3.99	−48.06	< 0.001

MWS: Mayo wrist score; DASH: Disabilities of the Arm, Shoulder and Hand Score; RH: radius height; VT: volar tilt; RI: radial inclination.