

The relationship between initial closed reduction and the surgical reconstruction of the radiocarpal joint line in distal radial fractures



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ARTICLE INFO

Article history:

Accepted 13 November 2015

Keywords:

Distal radial fracture
Closed reduction
Internal fixation
Radiocarpal joint
Palmar tilt
Radial inclination

ABSTRACT

Introduction: Whilst initial closed reduction followed by definitive open fixation is widely applied in the treatment of distal radial fractures, the effect of the closed reduction on the reconstruction of the articular surface remains unclear. Our research questions were:

- (1) Does closed reduction followed by surgical fixation reconstruct palmar tilt and radial inclination?
- (2) Does closed reduction influence the surgically reconstructed palmar tilt and radial inclination?

Methods: Palmar tilt and radiocarpal inclination of 425 patients were measured at admission, following initial closed reduction and after surgical reconstruction.

Results: Closed reduction increased palmar tilt by 12.1° and radial inclination by 2.7°. Open surgical reduction further corrected palmar tilt by 17.88° and radial inclination by 3.5°. Whilst there was no association between postoperative palmar tilt and initially achieved closed reduction, a significant association between radial inclination following closed reduction and surgical fixation was found.

Conclusion: Our retrospective study challenges the existence of a relationship between the initial closed reduction and the reconstruction of the anatomic joint line in surgically treated distal radial fractures.

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Introduction

Fractures of the distal radius are the most common fractures in adults and the incidence is expected to further increase over the next decades due to aging population and the subsequent rising prevalence of osteoporosis [1,2]. Initial closed reduction and casting, followed by open reduction and internal fixation using angle-stable plates has become a widely practiced therapeutic approach [3,4]. Whilst the definite reconstruction of the anatomic position of the distal radius is the accepted surgical goal [5], the influence of the initial closed reduction on the definitive postoperative radiological and clinical outcome is unknown [6]. The present study, investigates the reconstruction of palmar tilt and radial inclination after initial closed reduction as well as the influence of the initial closed reduction on the definitive surgically reconstructed palmar tilt and radial inclination.

Methods

This retrospective single centre study was conducted at a level 1 trauma centre (university hospital) in central Europe. All patients with distal radial fractures who were treated at a single level I trauma centre by initial closed reduction followed by open reduction and internal fixation using locking plates between January 2008 and February 2014 were identified. Exclusion criteria were: AO type 23-A1, -B1, -B2 and -B3 fractures, paediatric fractures and others than extension fractures. Furthermore, cases with incomplete medical and radiological documentation were excluded. After diagnosis of a distal radius fracture based on standardised X-rays of the wrist in two views (posteroanterior and lateral) in all patients initial closed reduction under local anaesthesia by ligamentotaxis and manipulation was performed and followed by the application of a plaster cast. Multiple attempts of manipulation were avoided. Results of the closed reduction were routinely documented by X-rays of the wrist in two views. After swelling subsided, open reduction and stabilisation was performed using a palmar or a dorsal approach according to fracture morphology and the individual decision of the surgeon. Following

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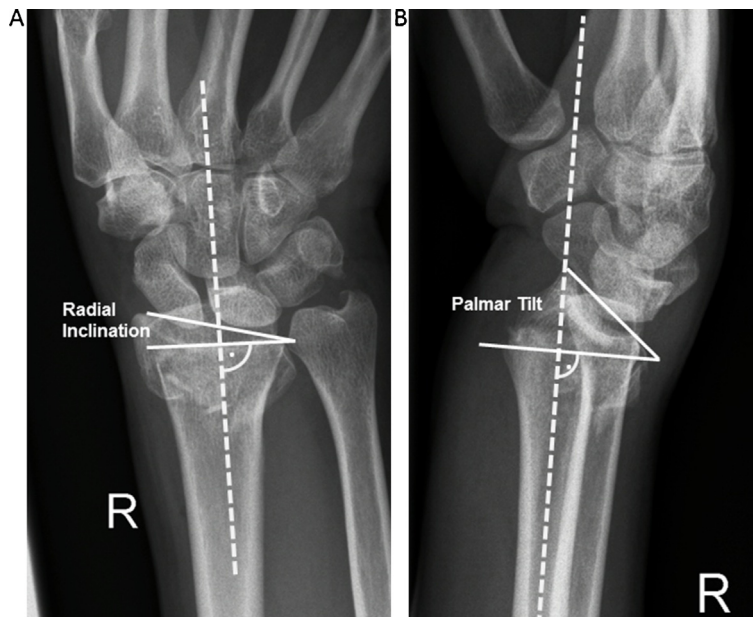


Fig. 1. Measurement of radial inclination (A) and palmar tilt (B) on standardised radiographs of the wrist.

open reduction, the fracture fixation was achieved by angle-stable implants (Medartis AG, Basel, Switzerland).

Patients were treated according to a standardised postoperative protocol. After 2 days, drainages were removed and X-ray of the wrist in two views was performed. Following an immobilisation for 3–5 days postoperatively using a synthetic splint (Dynacast® Prelude, BSN medical GmbH, Hannover, Germany), patients were allowed full range of motion. Full function was allowed 6 weeks following the operation.

Palmar tilt and radial inclination were measured on standardised posteroanterior and lateral radiographs before and after the initial closed reduction and following the definite operative fixation (Fig. 1). For the calculation of deviations from standard anatomic values, the standards were set at 11° for palmar tilt and 22° for radial inclination [7–9]. Radiographs were analysed and stored using IMPAX and IMPAX EE (AGFA HealthCare GmbH, Bonn, Germany). Measured values were stored in a Microsoft Access 2010 database (Microsoft Corporation, Redmond, Washington, USA).

Statistical analysis

For descriptive analysis, mean values and standard deviations (SD) were reported. To visualise the data, box and scatter plots were used. Association of radiologic measurements at varying time points was tested by applying univariate linear regression models. Here, regression coefficients (β) and corresponding 95% confidence intervals (CI) were reported. To adjust for confounding variables, a multivariate linear regression model was fitted using a stepwise approach based on Akaike information criterion (AIC). To fit the model the variables age, AO-classification, Frykman-classification, delay between trauma and operation, dorsal or palmar operative approach, radial inclination and palmar tilt following the trauma and radial inclination and palmar tilt following closed reduction were considered possibly relevant for the postoperative radiologic measurements. *P*-value less 0.05 was considered to be statistical significant. Statistical analyses were performed using R Statistical Software (Foundation for Statistical Computing, Vienna, Austria) and Microsoft Excel 2010 (Microsoft Corporation, Redmond, Washington, USA).

Results

Radiographs of 425 patients (mean age: 61.0 years, SD 17.8) were analysed. Definitive surgical treatment was performed after a mean of 4.9 (SD 2.8) days. The detailed clinical details of the cohort are provided in Table 1. The radiological parameters characterising the radiocarpal joint line at admission, following initial closed reduction and after definitive surgical fixation are shown in Table 2.

At admission, patients presented with a mean palmar tilt of -23.2° (SD 13.8°), which was corrected to -11.1° (SD 10.2°)

Table 1

Clinical characteristics of 425 patients with distal radial fractures treated by initial closed reduction and subsequent open reduction and internal fixation. Two patients could not be classified according to the Frykman classification.

Gender	
Male [n]	110 (25.9%)
Female [n]	315 (74.1%)
Age	
Age [years]	61.0 (\pm 17.8)
AO – classification	
A2 [n]	52 (12.2%)
A3 [n]	152 (35.8%)
C1 [n]	69 (16.2%)
C2 [n]	108 (25.4%)
C3 [n]	44 (10.4%)
Frykman – classification	
I [n]	50 (11.8%)
II [n]	21 (4.96%)
III [n]	6 (1.42%)
IV [n]	7 (1.65%)
V [n]	75 (17.7%)
VI [n]	60 (14.2%)
VII [n]	95 (22.5%)
VIII [n]	109 (25.8%)
not classified	2 (0.5%)
Delay between trauma and operation	
Delay [days (SD)]	4.87 (2.79)
Surgical approach	
Volar [n]	379 (89.2%)
Dorsal [n]	46 (10.8%)

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