Orthopaedics & Traumatology: Surgery & Research 102 (2016) 1001–1004

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

Original article

# How well can step-off and gap distances be reduced when treating intra-articular distal radius fractures with fragment specific fixation when using fluoroscopy

M. Thiart , A. Ikram , R.P. Lamberts *

*Division of Orthopaedic Surgery, Department of Surgical Sciences, Faculty of Medicine and Health Sciences, Stellenbosch University, Tygerberg Campus, P.O. Box 19063, Tygerberg, Cape Town 7505, South Africa*

ARTICLE INFO

*Article history:*
Received 1st February 2016
Accepted 6 September 2016

*Keywords:*
Distal radius fracture
Intra-articular
Fluoroscopy
Fragment specific fixation
Gap distance
Step-off distance

ABSTRACT

*Introduction:* Although fragment specific fixation has proved to be an effective treatment regime, it has not been established how successfully this treatment could be performed using fluoroscopy and what the added value of arthroscopy could be. Establish gap and step-off distances after in intra-articular distal radius fractures that have been treated with fragment specific fixation while using fluoroscopy.
*Material:* Forty-four patients with an intra-articular distal radius fracture were treated with fragment specific fixation while using fluoroscopy.
*Methods:* After the treatment of the intra-articular distal radius fracture with fragment specific fixation and the use of fluoroscopy, but before the completion of the surgical intervention, all gap, and step-off distances were determined by using arthroscopy. In addition, the joint was checked for any other wrist pathologies.
*Results:* Arthroscopy after the surgical intervention showed that in 37 patients no gap distances could be detected, while in six patients a gap distance of $\leq 2$ mm was found and in one patient, a gap distance of 3 mm. Similarly, arthroscopy revealed no step-off distances in 33 patients, while in 11 patients a step-off distance of $\leq 2$ mm was found. Although additional wrist pathologies were found in 48% of our population, only one patient needed surgical intervention. Three months after the surgical intervention wrist flexion was $41 \pm 10^{\circ}$, wrist extension $51 \pm 17^{\circ}$, ulnar deviation $19 \pm 10^{\circ}$, radial deviation $32 \pm 12^{\circ}$ while patients could pronate and supinate their wrist to $85 \pm 5^{\circ}$ and $74 \pm 20^{\circ}$, respectively.
*Conclusion:* Intra-articular distal radius fractures can be treated successfully with fragment specific fixation and the use of fluoroscopy. As almost all gap and step-off distances could be reduced to an acceptable level, the scope for arthroscopy to further improve this treatment regime is limited. The functional outcome scores that were found 3 months after the surgical intervention were similar to what has been reported in other studies using different treatment option. These findings suggest that fragment specific fixation is a good alternative for treating intra-articular distal radius fractures. As in most cases, only fluoroscopy is needed for fragment specific fixation, this treatment technique is a good treatment option for resource-limited hospitals, setting who do not have access to arthroscopy.
*Level of evidence:* III, case-control study.



## 1. Introduction

Today, more than 5000 articles have been published on distal radius fractures. The most common mechanisms of intra-articular distal radius fractures are low energy falls, motor vehicle accidents, falls from a height and sport related injuries [1,2]. The majority of these fractures (50–60%) are intra-articular fractures and are associated with socio-economic stress, disability and unemployment [3]. In addition to the actual fracture, distal radius fractures are commonly associated with soft tissue injuries, which range from tears of the triangular fibrocartilage complex (TFCC) (40–60%) [4–6], cartilage lesions (30%) [6] to lesions of the scapholunate (SL) (20–40%) or lunotriquetral (LT) ligaments (20–68%) [5].

It is important to treat intra-articular radius fractures with care and minimize the risk of complications [7]. The initial aim of treating these types of intra-articular radius fractures is to restore the anatomy by using a stable fixation method. As part of this process, it

* Corresponding author.
*E-mail address:* RPLam@hotmail.com (R.P. Lamberts).

http://dx.doi.org/10.1016/j.otsr.2016.09.005
1877-0568/

is important that all step-off and gap distances are reduced as much as possible. Reducing all step-off and gap distances minimizes the risk of complications, such as tendon adherence and arthrofibrosis [8]. In addition, the degree of radial deformity [4], joint congruity and associated soft tissue injuries [9,10] have shown to be important predictive markers of the treatment's success.

One of the ways of treating complex distal radius fractures [11] is by using a fragment specific fixation technique. This technique was first described by Regazzoni et al. [12] in 1996 and has become popular over the last 20 years. To our knowledge, no study to date has established how well step-off and gap distances can be reduced with using a fragment specific fixation when using fluoroscopy. Therefore, the aim of this study was to determine the step-off and gap distances in complex distal radius fractures that have been treated with fragment specific fixation while using only fluoroscopy.

## 2. Materials and methods

A prospective descriptive study was conducted at the Hand Unit based at Tygerberg Hospital, Cape Town, South Africa. All patients who visited the Hand Unit with an intra-articular radius fracture and met the inclusion criteria were invited to participate in the study. Inclusion criteria for the study included:

- a fracture requiring open reduction internal fixation (radial height < 10 mm; radial inclination < 15 degrees; dorsal tilt > 10 degrees and intra-articular step-off distance > 2 mm);
- the fracture was closed;
- the fracture was isolated;
- patients had no previous history of wrist injury.

Patients with a compromised immune system (CD4 count < 200) and/or who had been admitted to the hospital with multiple injuries were excluded from the study. All participating subjects were fully informed of the study and the associated risks before signing an informed consent form. The study was approved by the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences of Stellenbosch University (N11/09/291), while the principles outlined by the declaration of Helsinki (2013) were adopted in this study.

### 2.1. Surgical technique

All patients received either a general anaesthetic or a regional block on the elective Hands Unit theatre list, as in line with the Hospital policy. The choice of anaesthetic was dependent on the patient's medical risk profile, the patient's preference and, the anaesthetist's preference. In theatre, patients were placed in the supine position after which they were given two grams of Cefazolin IVI [Zefkol, Aspen Pharmacare under Brimpharm SA (Pty) Ltd, Port Elizabeth, South Africa] as per hospital protocol and as a prophylactic antibiotic unless the admission of this was contraindicated in a patient. Patients had a tourniquet applied to the upper arm above the injured hand in order to reduce blood loss and provide better visualisation of the operative field. The tourniquet was inflated to 250 mmHg or about 100 mmHg above the systolic blood pressure.

The surgical approaches followed were specific to the fracture fragments. In most cases, a radial styloid approach was performed first from the tip of the radial styloid, extending 7 cm proximal to it. Careful attention was paid to the superficial branches of the radial nerve. The first dorsal compartment was opened and the tendons displaced to visualise the brachioradialis muscle. This was split and released in order to access the radius and reduce the fracture. A K-wire was drilled from tip of the radial styloid to the ulnar side of the radius through the fracture line, in order to reduce and immobilise the fracture. A Trimed radial pin plate (TriMed, Inc., Santa Clarita, California) was placed over the K-wire through one of the holes in the plate made specifically for the K-wire, until the plate lay flush with the radius. A second K-wire was drilled through the plate to the ulnar side of the radius. Cortical non-locking screws were used to secure the plate to the proximal shaft. The brachioradialis muscle was repaired to cover the plate and the K-wires passing under the first extensor compartment of the wrist. This ensures that the implanted hardware does not irritate the tendons, which could lead to synovitis and possible rupture. Depending on the fracture configuration, a dorsal or a volar approach was performed in addition, in order to gain access to the fragments. These fracture fragments were then reduced and fixated with the appropriate fixation device – either a pin plate or a loop buttress plate. These reductions were checked using intraoperative fluoroscopy (see Fig. 1). If deemed acceptable they were not re-fixated; if deemed unacceptable, having a step-off or gap distance of > 2 mm, the hardware was removed, the fragments reduced and the hardware reinserted.

**Fig. 1.** A fluoroscopy image of the wrist, which was used to assess whether the desired reduction had been achieved post-reduction and fixation with fragment specific fixation.

### 2.2. Assessments

Once all the fracture fragments had been fixated, an intraoperative arthroscopy was performed to assess the step-off and gap distances. Before the scope was inserted, the fingers were placed in finger traps to allow better access to the joint space. After placing the wrist in the correct position, a dry scope (HOPKINS® Wide Angle Forward-Oblique Telescope 30° scope, Karl Storz, Tuttlingen, Germany) was inserted into the joint, using a 3/4 and 6R position. Before assessing the joint, the haematoma at the fracture site was washed out with 5–10 mL saline solution to improve visibility within the joint. During the assessment, the step-off and gap distances of all fixated fragment parts were measured. In addition, all joint surfaces were inspected for cartilage lesions and soft tissue injuries were assessed. Step-off and gap distances of more than 2 mm and other pathologies including soft tissue injuries were treated where necessary.

Three months after the surgical intervention, patients returned to the hand unit based at Tygerberg Hospital, Cape Town, South Africa, for a follow-up assessment. During this visit flexion,