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Closed Reduction and Percutaneous Pinning of Distal Radius Fracture Without Intra-Operative X-Ray

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Abstract

Background: Although intra-operative X-ray is deemed necessary for closed reduction and percutaneous pinning of distal radius fracture, it is not uncommon, in several operative rooms in developing countries, to encounter situations when the access to image intensifier or even portable X-ray emitter is impossible.
Objectives: The aim of the present study was to assess the quality of reduction and pin insertion of distal radius fractures treated by closed reduction and percutaneous pinning without application of intraoperative X-ray.
Patients and Methods: Attempts were made to restore volar tilt and radial height by palpating of dorsal cortex of distal radius and styloid of radius, after infraclavicular block, by closed reduction and percutaneous pinning for 31 patients with types A2, A3 and non-displaced B1 distal radius fractures (AO classification). After careful pinning, dressing and splinting, X-rays were obtained in the radiology department, immediately.
Results: Totally, nine male and seven female patients, with mean age of 39.2 years (SD: 16.6; range: 13 - 58 years), were included in the study. Parameters of reduction were acceptable in all patients. Three complications (18.75%) occurred, concerning placement of pins in three patients (wrong placement of pins from styloid of the radius, excessive length of pin with skin irritation at its tip and a pin penetration to radio scaphoid joint.
Conclusions: Closed reduction and percutaneous pinning of distal radius fracture may be possible in the absence of intraoperative X-ray by the risk of several insignificant complications.

Keywords: Radius Factures, X-Rays, Percutaneous Pins, Developing Countries, Complications

1. Background

Closed reduction and percutaneous pinning represents known method for fixation of distal radius fracture (DRF) (1). This approach is appropriate for AO type A2, A3, B1 and C1 fracture (2, 3). It has the advantages of being easy and fast to perform, requires inexpensive fixation devices and has shown its efficiency (2, 4). Image intensifier (C-arm) is an expensive and sensitive instrument that is accounted necessary to perform closed reduction and to insert pins percutaneously (5). The extent of usage of this device during DRF surgery may depend on factors like surgeon's experience and, also, complexity of the fracture (6). Access to image intensifier is limited in several hospitals from developing countries because of logistic obstacles. The presence of only one system for all surgical services, including orthopedic surgery, neurosurgery and urology, leads to excessive usage in different positions, by several surgical services that sometimes cause malfunctions and, eventually, unavailability of this device for periods of time, especially in cities far from warranty services.

2. Objectives

In this brief report, we aimed to assess the quality of reduction and pin insertion of distal radius fractures, treated by closed reduction and percutaneous pinning, without application of image intensifier.

3. Patients and Methods

Because of the major technical problem of image intensifier, we did not have access to it for about 9 months for intraoperative use. From March to September 2011, each patient of type A and non-displaced B1 DRF that was candidate for closed reduction and percutaneous pinning, who decided to be operated in Khalij Fars Hospital, Bushehr University of Medical Sciences, in spite of the problems with the availability of the C-arm, was included in this study. The portable X-ray emitter was not in access, at the same time. Exclusion criteria were patient refusal, Barton and AO type C fractures, open fractures, compartment syndrome, severe edema, vascular injury and failure of two attempts of closed reduction that raised the suspicion of soft tissue interposition. During this period of 9 months, we referred to other trauma center the patients wishing to be treated in another hospital, after explanation about the lack of image intensifier or who

affected to fractures for which the lack of C-arm involved a high risk. However, after informing the patients and receiving consent, we treated DRFs recognized to be possible to be reduced closely and fixed by percutaneous pins, by reliance on the surgeon's experience and restoration of appearance, range of motion and surface anatomy of the wrist. All patients were operated by one experienced surgeon. The ethical committee of our university hospital approved the details of the study and a written consent was signed by each patient. After regional block and deep sedation, preparation and sterile draping was done. The landmarks of styloid of radius, Lister's tubercle and ulnar styloid were palpated first and marked. Edema may prevent palpation of these landmarks easily. When the forearm was pulled by an assistant, the distal part of radius was pulled gently and continuously by the surgeon. The surgeon held the distal fragment of the fracture and volar tilt was restored, along with simultaneous traction (radial > ulnar side). After restoration of apparently normal anatomy (like reduction for closed reduction and casting), two pins entered from the tip of styloid of radius on the radiovolar side of the radiocarpal joint, in a dorsal and ulnar direction. For insertion of each pin, a small (0.5 cm) incision was made and dissected bluntly to the bone. To avoid entering the carpal joint, these pins were inserted on the radial side of the tip of the styloid. Reaching and passing of the proximal and far cortex usually could be sensed during drilling. The tip of the pin could be sensed by the surgeon when it passed from the far cortex and was adequately retracted to avoid skin irritation. One pin was also inserted from dorsal lip of distal radius, at about 1 cm ulnar to the Lister's tubercle, while the tip of the pin was used as a finder for the entering point. This pin was inserted in volar and radial direction, at angles of 45° and 10°, respectively. The stability, appearance of distal radius and wrist movements were controlled and, if they seemed appropriate, pins would be bent and shortened outside the skin. The surrounding skin around pins was checked for excessive traction and incisions were added, to prevent necrosis. Sterile dressing and sugar-tong were applied that changed to short arm cast, after 3 weeks. Correct placement of pin and quality of reduction by measurement of palmar tilt (normal: 12°), ulnar variance (normal: 0.9 mm) and radial inclination (23°) were assessed by initial postoperative antero-posterior and lateral X-ray. If the placement of the pins was inappropriate or palmar tilt was not between 0 - 20°, radial shortening > 3 mm, reduction of radial inclination < 15° and articular step off > 2 mm, the patient would be returned to the operating room and revision surgery would be performed under the same regional block by another closed reduction internal fixation (re-CRIF) or open reduction internal fixation. The pins and cast were removed 6 - 8 weeks postoperatively. Data about failure of pin insertion and malreduction were analyzed.

4. Results

Sixteen fracture of type A (12 cases) or non-displaced B1 (four cases) in 16 patients (nine men and seven women) were included in this study. The average of age was 39.2 years (SD: 16.6; range: 13 - 58). Parameters of reduction are shown in Table 1. In a 33-years-old female with type A2 fracture, postoperative X-rays showed that no pin inserted from styloid of radius passed through the fracture site. The patient had significant swelling and palpation of surface anatomy was impossible, intraoperatively. Early re-CRIF was done. One patient

Table 1. Type, Direction of Deformity and Parameters of Reduction, Just After Closed Reduction and Percutaneous Pinning of Sixteen Distal Radius Fractures, Without Usage of Intraoperative X-ray

Case	AO Type	Direction of Primary Deformity	Post-Op Palmar Tilt, Degree[a]	Post-Op Ulnar Variance, mm[b]	Post-Op Radial Inclination, Degree[c]	Post-Op Articular Step Off, mm[d]	Problem In Pin Placement[e]
1	A2	Dorsal	6	1	18	NA	No
2	A2	Dorsal	10	2	20	NA	No
3	A2	Dorsal	4	2	16	NA	No
4	A2	Dorsal	9	0	18	NA	No
5	A3	Volar	9	2	18	NA	No
6	A2	Dorsal	9	1	20	NA	Did not pass fracture site
7	A2	Dorsal	8	2	23	NA	No
8	B1	Dorsal	3		20	1	No
9	A3	Volar	18	1	20	NA	Too long pin → skin irritation
10	A2	Dorsal	6	2	19	NA	No
11	B1	Dorsal	15		18	0	No
12	A3	Dorsal	5	1	22	NA	One of styloid pins enter the joint
13	A2	Dorsal	9	0	17	NA	No
14	B1	Dorsal	11		16	1	No
15	A2	Volar	16	0	19	NA	No
16	B1	Dorsal	10		19	0	No

Abbreviation: NA, not available.
[a]Acceptable range: 0 - 20°; mean ± SD: 9.25 ± 4.21.
[b]Acceptable > 3 mm; mean ± SD: -1.16 ± 0.83.
[c]Acceptable > 15°; mean ± SD: 18.93 ± 1.91.
[d]Acceptable < 2 mm; mean: 0.5.
[e]Number of problem in pin placement = 3.

experienced irritation of the dorsal skin of the forearm from the tip of the inserted pin, 3 weeks after surgery, because of excessive pin length, which managed by partial extraction. This problem was not detected immediately postoperatively. In another case, one of two pins inserted from styloid radius, which entered into the radio scaphoid joints, was removed at an outpatient clinic, at 3 weeks postoperative visit.

5. Discussion

The DRF is one of the most common limb fractures (7). Challenges concerning the treatment of this type of fracture (closed reduction and casting, percutaneous pinning or external fixation and internal fixation by plate) go on, although the selection of treatment method is made on the basis of the fracture type and characteristics (8). Another ongoing debate regards the correlation between appropriate radiologic parameters and functional outcome of DRFs (9). Therefore, the type of treatment for one type of DRF may differ dramatically among different surgeons. One of the most simple, feasible and cheap fixation methods for extra-articular and non-displaced styloid fractures is percutaneous pinning (2-4, 8, 10). This method had paradoxical results in comparison to locking plate, in different studies; nevertheless it is a common method for multiple DRFs (2, 3, 11). One of the minimal equipment that accounted necessary for closed reduction and percutaneous pinning of distal radius is intraoperative imaging (8). There are studies about the emission of radiation in plating of DRF. Kraus et al. (6) demonstrated that type C fractures and inexperience of the surgical team significantly led to more ionizing emission during volar plating of DRF. No study, up to now, has assessed the necessity of intraoperative X-ray for closed reduction and percutaneous pinning. When in the emergency room, closed reduction of a simple DRF is accepted, it is possible to do it in the operation room, as well. Although it is not expressed in the literature, actually, certain surgeons become self-confident and experienced to do percutaneous pinning by guiding on the surface anatomy and sense of palpation. It seems that the art of the surgeon to know the anatomy and its 3D imagination capacity and use of intraoperative X-ray simultaneously, to control this imagination, are essential. Unfortunately, there are occasions when the surgeon forgets his abilities and relies on the guide of the X-ray. Despite of correct technique, a wrong decision about applying X-ray may lead to excessive emission of ionizing radiation and loss of the concentration on the right pin placement (6, 12). By relying on experience and surface anatomy, our study shows that closed reduction and percutaneous pinning result in reduction criteria comparable to studies that applied intraoperative X-ray. In the 55 wrists from the study of Glickel et al. (4), the immediate postoperative X-ray parameter was the average of palmar tilt, ulnar variance, radial inclination and articular step-off, 6° (± 6) mm, 0.1 (± 1.5) mm, 22° (± 4) and 0.11 (± 0.04) mm, respectively. Das et al. (3), after immediate postoperative X-ray of 32 DRFs treated by the same method, reported an average of palmar tilt of 11.13° (range: 8 -16). Regarding the accuracy of pin placement, which seems the most arguable point of our study, three cases (18.75%) were problematic. In one case, the pin inserted was too long. This problem might be preventable by precise search through palpation the tip of the pin in its trajectory. One trans-styloid pin, in another case, entered the radio scaphoid joint. This could be a risk factor for septic arthritis and is one of the pitfalls of deprivation of intraoperative X-ray. Such a situation may be avoided by changing the angle of insertion, far from the joint. In this case, we removed the intra-articular pin upon the 3 weeks follow-up visit and no complication occurred. In another case, no pin of the two pins inserted from the styloid tip traversed the fracture site. We think that the swelling and difficulty in palpation of bony landmarks were the main reasons for this complication and percutaneous pinning is better to be performed under the guide of intraoperative X-ray, in this particular condition.

5.1. Conclusion

Although the risk of misplacement of pin for DRF was only about 19%, the quality of reduction was satisfactory in this study. The consequences of pin misplacement required revision surgery in only one case, with significant swelling of the wrist. Therefore, it seems that, by regional block and in the absence of intraoperative X-ray, closed reduction and percutaneous pinning of selected distal radius fracture is possible. It is obvious that, in the presence of image intensifier, there is no justification to neglect its usage in the right way.

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