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Comparison of Treatment Proposed Based on Prediction of the Risk of Instability with Orthopedic Surgeons' Preferred Treatment for Management of Distal Radius Fracture

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Abstract

Background: Calculation of the risk of instability and malunion in patients with distal radius fracture and choosing treatment based on this risk percentage is a new method that can greatly help surgeons in decision-making. In this study, we have tried to make a comparison between treatment decision-making based on prediction of the risk of instability and experience of orthopedic surgeons for management of this fracture.

Methods: Recorded information of 69 patients with extra-articular distal radius fracture diagnosis was examined. Radiographs and age of each patient were submitted to two orthopedic surgery professors and they were asked to express their opinion about surgical or non-surgical treatment for each patient based on their own personal habit. The risk of instability was calculated for each patient and surgical or non-surgical treatment for each patient was proposed based on this risk percentage with cut-off point of 70%. Then, the treatment proposed by each surgeon was compared with the treatment proposed based on the calculated risk of instability.

Results: The study demonstrated that treatment decision-making for distal radius fracture according to the risk of instability with cut-off point of 70% (this is surgery for fractures with instability risk of more than 70% versus non-surgical intervention for cases with risk of less than 70%) is not significantly and reliably consistent with the opinions of two orthopedic surgeons who had the experience of confronting this fracture.

Conclusions: Prediction of the risk of instability for management of distal radius fracture needs to be validated through further studies before being used as the decisive factor for management of this fracture. Colleagues are invited to assess the outcomes of using the risk of instability more accurately with further studies. It is suggested to be more prudent and perform more evaluations when the risk of instability calculation with cut-off point of 70% is used to choose the appropriate treatment.

Keywords: Distal Radius Fracture, Malunion, Instability

1. Background

Distal radius fracture is highly prevalent and its incidence seems to be rising worldwide (1-5).

Management of this fracture in all its aspects has been a controversial issue among orthopedic surgeons (6). There is no consensus among surgeons about an evidence-based and reliable treatment protocol in this regard; thus, physicians have to rely on personal principles, habit, and different methods to make treatment decisions enhancing clinical inconsistencies (7-9).

Mackenney and McQueen team conducted a study to determine the important independent factors predicting distal radius fracture malunion and instability. Using computer algorithms, they finally introduced a formula calculating the risk of instability and malunion of distal radius fracture that could greatly contribute to the surgeon's decision making for an appropriate treatment (10).

Calculating the risk of instability and malunion for each patient with distal radius fracture and choosing treatment based on this probability is a new method that can potentially alleviate discussions and disagreements on the management of distal radius fracture.

In this study, we tried to make a comparison between decision-making based on prediction of the risk of instability and experience of orthopedic surgeons independent of this formula for management of distal radius fracture.

2. Methods

This is a cross-sectional study. The recorded information of patients with extra-articular distal radius fracture (AO/OTA Classification Type A) diagnosis admitted to the Tehran's Imam Khomeini hospital complex was used. Demographic characteristics and radiographic images of 69 patients were examined.

X-ray image (PA and lateral views) and age of each patient with distal radius fracture were submitted to two orthopedic surgery professors, and they were asked to express their opinion about surgical or non-surgical treatment for each patient based on their own personal habit and, of course, without formula calculation.

Next, dorsal angle and ulnar variance were measured through radiography for each patient. Comminution (dorsal or volar or none or both) was assessed based on the x-ray image. According to their history, the patients who did not need help to do daily tasks were recorded as Independent and the other patients, on the contrary, as Dependent. Then, by visiting the web address (www.trauma.co.uk/wristcalc) and inserting the available information and patient age in the special form embedded on the site, the risk percentage of instability and malunion of the fracture was calculated for each patient.

To determine the recommended treatment based on calculating the risk of fracture instability and malunion, the author's recommendations on the management of distal radius fracture in the book "Rockwood and Green's Fractures in Adult- 8th edition" were applied, so that in cases that the risk of fracture malunion was above 70%, surgical treatment and in cases that the risk of malunion was less than 70%, non-surgical treatment were recorded (11).

Finally, the treatments proposed by each surgeon, independent of formula calculating, were compared with the treatments proposed based on calculated risk of instability and malunion. Moreover, in this study, the opinions of the two surgeons on the appropriate treatment for distal radius fracture were compared.

The data were analyzed by SPSS software version 24. Mean $\pm$ SD were used for displaying quantitative data, and frequency and percentage were used for qualitative data. Level of significance was considered less than 0.05. In order to examine the compatibility of the two surgeons' opinions with each other and with the calculated ratio, kappa correlation coefficient was used.

3. Results

In this study, 69 patients with distal radius fracture and average age of 50 were examined. The youngest patient was 20 and the oldest one was 83 years old.

The first surgeon believed that 39 patients out of 69 (56%) required surgery while for other 30 patients (44%) he proposed non-surgical treatment.

The second surgeon proposed surgery for 42 patients (60%) and non-surgical treatment for other 27 patients (40%).

The risk of fracture instability and malunion was investigated for all 69 patients through formula calculation. The average risk of malunion for the patients was 69%. In case of selecting treatment based on cut-off point (70%) of the risk of malunion for those 69 patients, 23 cases (33%) required surgical treatment and 46 cases (67%) required non-surgical treatment (Tables 1 - 4).

Table 1. Frequencies of Surgical and Non-Surgical Treatment Suggested by Surgeons and by Calculated Risk of Instability

	First Surgeon's Opinion	Second Surgeon's Opinion	Treatment Based on the Risk of Instability
Surgical treatment	39 (56)	42 (60)	23 (33)
Non-surgical treatment	30 (44)	27 (40)	46 (67)

4. Discussion

Distal radius fracture is one of the most common fractures orthopedic surgeons confront, and its incidence rate seems to be increasing throughout the world (1-5). This fracture is the reason for one-sixth of the referrals to the emergency department (12, 13), 26% - 46% of all skeletal fractures seen in the primary care setting (14-19), and 17.5% of all adult fractures (20). These values are the load imposed by this fracture on orthopedics departments.

Distal radius fracture is common in all age groups, with major peaks of incidence among children of 5 - 14 years, men under 50 years, and women over 40 years (21). In younger populations, this fracture has been due to high-energy traumas following the sportive activities and motorcycle riding, while in the old population, it is mostly resulted from low-energy traumas (22).

Management of this prevalent fracture, with predicted increase of incidence due to old population growth and higher activity of this age group (23), has always been controversial for the surgeons. The disagreement about distal radius fracture management includes all the aspects such as fracture assessment, diagnosis, treatment, and investigation of outcomes (6).

Lack of evidence-based consensus on therapeutic protocols for managing distal radius fracture aggravates the disagreements and differences regarding this issue and makes physicians to rely on ideology, habit, and different methods for managing this fracture.

The remarkable impact of variance in distal radius fracture management on cost and quality represents the need for compiling evidence-based consensus guidelines and more clinical trials to assist in the management of this common fracture (7).

Table 2. Comparison Between the Treatments Proposed by Surgeon 1 and Treatments Proposed Based on Calculating the Risk of Instability and Malunion

P = 0.1; Kappa = 0.27		Treatment Based on Formula		Total
		Non-surgical care	Surgery	
Surgeon 1	Non-surgical care	25	5	30
	Surgery	21	18	39
Total		46	23	69

Table 3. Comparison Between the Treatments Proposed by Surgeon 2 and Treatments Proposed Based on Calculating the Risk of Instability and Malunion

P = 0.002; Kappa = 0.3		Treatment Based on Formula		Total
		Non-surgical care	Surgery	
Surgeon 2	Non-surgical care	24	3	27
	Surgery	22	20	42
Total		46	23	69

Table 4. Comparison Between the Opinions of the Two Surgeons on the Appropriate Treatment for Distal Radius Fractures

P = 0.001; Kappa = 0.6		Surgeon 1		Total
		Non-surgical care	Surgery	
Surgeon 2	Non-surgical care	22	5	27
	Surgery	8	34	42
Total		30	39	69

Currently, therapeutic options for distal radius fractures include a range from conservative interventions and nonsurgical approaches to surgical reduction and fixation. These options include closed reduction with splint or cast immobilization, external fixation, percutaneous pinning, open reduction with internal fixation, and replacement of lost bone with a bone graft (22). Indications for performing each of the mentioned options are different based on patients, their demands, and type of fracture.

Since the main aim of treating distal radius fracture is proper hand and wrist function depending on the needs and activities of the patient, the important factors, which may predict fracture instability or functional outcome, should be considered for making therapeutic decision. Surgical intervention at the time of referral with this fracture, if there is a probability of instability, can prevent it and other side effects like malunion and function reduction.

The need for a reliable evidence-based method, which could be beneficial in predicting instability of distal radius fracture, is felt. Such method could identify those cases that definitely require surgical intervention at the time of referral. Moreover, it might be able to prevent nonessential surgical interventions that impose costs and side effects themselves.

Mackenney, McQueen, and coauthors have performed a study to evaluate 4000 cases of distal radius fractures in a period of 5 years and determine the important independent factors predicting instability and malunion for this fracture (10). These factors can be used as a method of prospectively predicting the radiographic outcome about each of the patients and can help the surgeons make therapeutic decisions at the time of referral for surgical or nonsurgical interventions.

In this study, cases of early instability defined as redisplacement in less than two weeks, those with late instability defined as redisplacement within two weeks after the fracture until its union, and cases of malunion in patients with distal radius fracture were carefully evaluated. Thus, the most important independent factors predicting instability and malunion have been determined for this type of fracture, according to which these factors were introduced as patient's age, metaphyseal comminution, and ulnar variance. This study finally has made and proposed formulas using computerized algorithms to calculate the risk percentage for instability and malunion of distal radius

fracture for each of the patients that could be helpful in making decisions about proper therapeutic intervention (10).

The calculating formula for the risk percentage of instability and malunion of distal radius fracture is easily accessible through the web address www.trauma.co.uk/wristcalc.

Based on the study performed by Mackenney et al. in the 8th edition of the book Rockwood and Green's Fractures in Adults, the author has recommended using this formula for calculating the risk of instability and malunion for management of distal radius fracture. In this book, percentage of 70 has been considered for making decisions between surgical or non-surgical intervention. Therefore, surgical intervention has been recommended for those patients with instability risk of more than 70%, while non-surgical interventions have been recommended for those with risk of lower than 70% (11).

First, we talked about the necessity, need for compiling evidence-based, and consensus guidelines for therapeutic management of distal radius fractures. Calculation of the risk of instability and malunion for each of the patients with this type of fracture and choosing therapeutic intervention based on this probability is a novel method that could help the surgeons overcome this need and could be a potential and uniform approach reducing the disputes about management of distal radius fracture, as well. However, this is still the beginning and needs to be validated by further studies.

The study that we performed demonstrated that treatment decision-making for distal fracture according to the risk of instability with cut-off point of 70% (this is surgery for fractures with instability risk of more than 70% versus non-surgical interventions for cases with the risk of less than 70%) is not significantly and reliably consistent with the opinions of two orthopedic surgeons who had the experience of dealing with this fracture.

We also made a comparison between the opinions of two surgeons that indicated disagreement about choosing therapeutic intervention for management of distal radius fracture; it is not surprising because we requested from the surgeons to recommend the suitable treatment according to their own ideology and personal habit without calculations. It should be noted that the disagreement between surgeons was significantly less than the disagreements between surgeon opinions and the formula output calculating the risk of instability.

It should be mentioned that the author prefers neither treatment based on the risk of instability nor treatment according to personal independent opinion of the surgeon. Therefore, regarding the difference between the surgeons, their personal opinion could not be used as a reliable and comprehensive criterion to evaluate the novel diagnostic methods.

It is finally suggested to be more prudent and perform more evaluations when the risk of instability calculation with cut-off point of 70% is used to choose the therapeutic intervention.

Choosing treatment based on prediction of the risk of instability needs to be validated through further studies before being used as the decisive factor for management of distal radius fracture. Colleagues are invited to assess the outcomes of using the risk of instability for management of distal radius fracture more accurately with further studies.

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