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Original Article

Effects of surgical and nonoperative treatment on wrist function of patients with distal radius fracture

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ABSTRACT

Purpose: To study the effects of surgical and nonoperative treatment on wrist function in patients with distal radius fracture.
Methods: In total, 97 patients treated for distal radius fracture in the Department of Orthopedic Trauma at the People's Hospital of Peking University from Jan. 2010 to Jun. 2016 were selected for outpatient follow-up, including manipulative reduction and dorsal splint fixation in 24 cases, bivalve cast fixation in 19 cases and open reduction and internal fixation in 54 cases. Evaluation was based on Sartiento's modification of the Gartland and Werley score. Efficacy was assessed with wrist pain as the focus.
Results: The wrist function scores of the surgical group were better than nonoperative groups. There was no significant difference in wrist function scores between the dorsal splint group and the bivalve cast group. The ulnar wrist pain incidence had no significant difference in surgical and nonoperative groups. The displace rate in dorsal splint group was higher than other groups.
Conclusion: The overall effect of surgical treatment of distal radius fracture is better than nonoperative treatment. The ulnar wrist pain incidence has no significant difference in these groups. Dorsal splint fixation is more prone to displace than bivalve cast fixation.

Introduction

Distal radius fracture is a clinically common fracture accounting for about one-sixth of all fractures,[1] and women over the age of 60 are the most common. Wrist joint is one of the joints with high activity frequency and high functional requirements. Improper treatment of distal radius fracture easily leads to chronic wrist pain and limited mobility, seriously affecting hand function.[2] The therapeutic principle of intra-articular fracture in the distal radius is the same as in other joints. The aim is to restore the smoothness of the articular surface, achieve anatomical reduction and relatively stable internal fixation or external fixation, restore the stability of the wrist, avoid traumatic arthritis caused by an uneven articular surface, and maximally protect the wrist function.[3] Both the nonoperative treatment indications and surgical indications of distal radial fractures have been reported in many literatures.[4] There are many methods for nonoperative treatment, such as small splint, dorsal splint, bivalve cast, and high polymer plaster, while the surgical methods are various, such as the volar approach, the dorsal approach, the combined approach, and external fixation, etc. Some studies have shown that the surgical treatment can make a good reduction,[5] for these patient early exercise can be beneficial to the recovery of the joint. However, some studies suggest that the nonoperative treatment is still an important treatment.[6] The effects of various nonoperative treatments and surgical treatments on the wrist function remain controversial. To study the effects of different treatments for distal radius fractures on wrist function, we designed a retrospective study using a follow-up study of patients with the different treatments.

Patients and methods

Ethics statement

This study was authorized by the ethical committee of Peking University People's Hospital and all patients gave written informed consent for their participation in the study.

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Clinical data

The inclusion criteria were unilateral distal radius fracture, closed and fresh fracture, nonoperative treatment (including manipulative reduction and dorsal splint fixation or bivalve cast fixation) or surgical treatment of internal fixation using a palmar plate, age of ≥18 years, integral clinical data, a postoperative follow-up period of ≥12 months, distal radius fracture with normal union, and provision of informed consent after receiving an explanation of the purpose of this study. The exclusion criteria were old fracture, pathological fracture, open fracture, bilateral distal radius fracture, and fracture of other parts of the wrist (excluding the ulnar styloid). A total of 97 patients with distal radius fractures who met the inclusion criteria were followed up by outpatient visits.

Non-surgical methods

Local anesthesia was used in the hematoma, and manipulative reduction. After the reduction, the dorsal splint or bivalve cast was used. The X-ray showed satisfactory reduction.

Surgical methods

Preoperative examinations were performed to exclude surgical contraindications. The operation time was completed within 2 weeks after injury. All surgeries were completed by doctors with extensive clinical experience. The volar approach was used for open reduction and internal fixation of distal radius fractures.

Follow-up evaluation

All patients included in this study underwent outpatient follow-up. The union and displacement of the fracture were evaluated by X-ray. Sartiento's modification of the Gartland and Werley score was calculated.[7] Sartiento's modification of the Gartland and Werley score included evaluation of residual deformity, subjective evaluation of pain, objective evaluation of range of wrist motion and grip strength, and evaluation of complications of arthritis, neurological symptoms, and finger dysfunction. Efficacy was judged as excellent, good, fair, or poor, and the sum of the above scores was calculated (excellent, 0–2 points; good, 3–8 points; fair, 9–20 points; and poor, ≥21 points).

Statistical methods

SPSS 20.0 statistical software (IBM Corp., Armonk, NY, USA) was used for data analysis. The Mann-Whitney U test and chi-square test were used. A p value of <0.05 was statistically significant.

Results

General information

A total of 97 patients were observed, including 73 females and 24 males. The patients ranged from 18 to 84 years old, with an average age of 54.4 years. All the patients were fresh fractures when they came for treatment, and they had integral clinical data, and a postoperative follow-up period was over 12 months, including manipulative reduction and dorsal splint fixation in 24 cases, bivalve cast fixation in 19 cases and open reduction and internal fixation in 54 cases.

Evaluation of fracture healing/displacement

One week after the treatment of patients with X-ray examination, the results showed that displacement occurred in 7 cases with dorsal splint fixation, 3 cases with bivalve cast fixation and 0 case with surgery. The displacement ratio of dorsal splint fixation group was significantly higher than that of other groups ($p = 0.044$) (Table 1). The displaced cases underwent surgical treatment after informed consent. All fractures were healed at postoperative follow-up.

Gartland and Werley score

The patients were evaluated for long-term effects. The Gartland and Werley score showed that the excellent and good efficacy rate was 90.7% (excellent: $n = 66$, 68.0%; good: $n = 22$, 22.7%; and fair: $n = 7$, 7.2%; poor: $n = 2$, 2.1%). Sex and age did not significantly impact the scores ($p > 0.05$). The excellent and good rate of Gartland and Werley score in the operation group was higher than that in the other groups. The scores were significantly different between the operation group and nonoperative group ($p = 0.006$). No significant difference was observed between dorsal splint group and bivalve cast group ($p = 0.97$) (Table 2).

Evaluation of ulnar wrist pain

Long term follow-up results showed that 25 cases had ulnar wrist pain, and the overall incidence of ulnar wrist pain was 26.6%. The analysis results showed that different treatment groups did not significantly impact ulnar wrist pain ($p > 0.05$) (Table 3).

Discussion

Distal radius fractures are common in outpatient and emergency departments. Treatment methods include surgery and nonoperative treatment. There are different treatments for different types of fractures, however, with the further study of wrist joint treatment, the choice of approach is constantly evolving. At present, most scholars suggest surgical treatment in the following situations: the volar or dorsal cortex of the distal radius is a comminuted fracture, and the

Table 1
Fracture displacement rates after nonoperative treatment of distal radius fracture.

	Gender (cases)		Age (Mean ± SEM, year)	Displacement (cases)	Non-displacement (cases)	Displacement rate (%)
	M	F				
Dorsal splint group	7	17	54.29 ± 2.252	9	15	37.5
Bivalve cast group	5	14	54.53 ± 2.704	2	17	10.5
Value	$X^2 = 0.043$		$t = 0.06721$	$X^2 = 4.053$		
p	0.836		0.9467	0.044		

Table 2
Gartland and Werley score after treatment of distal radius fracture.

	Gender (cases)		Age (Mean ± SEM)	Excellent (cases)	Good (cases)	Fair (cases)	Poor (cases)	Excellent and good rate (%)
	M	F						
Surgical group	14	40	54.83 ± 1.703	36	14	4	0	92.6
Nonoperative group	12	31	54.4 ± 1.713	15	5	3	1	83.3
Value	$X^2 = 0.048$		$t = 0.1791$					
p	0.827		0.8582	0.006				

Table 3
Ulnar wrist pain incidence after treatment of distal radius fracture.

	Ulnar wrist pain (cases)	Non-ulnar wrist pain (cases)	Ulnar wrist pain incidence (%)
Surgical group	13	41	24.1
Dorsal splint group	6	18	25.0
Bivalve cast group	5	14	26.3
X^2	0.039		
p	0.981		

displacement of articular surface is > 2 mm; volar tilt angle leans toward dorsum more than 20–25; shortening of radius is > 5 mm; instable fracture after reduction is prone to re-displacement.[8,9] Displacement of the fracture may lead to a shortening of the radius and deformity, which ultimately affects the recovery of wrist function. Mackenney et al.[10] thought that the unstable factors such as the dorsal compression of the distal radius, the comminution of the metaphyseal cortex and the ligament injury were the main causes of the displacement after reduction. More than 86% of the re-displaced distal radius fractures occurred within 1 week after the plaster fixation.[11] This is also one of the reasons to recommend patients to review X-ray after one week. This study showed that the displacement ratio of the dorsal splint was significantly higher than that of the bivalve cast. The bivalve cast has the effect of supporting both the volar and dorsal side and still has a good supporting role when the limb swelling subsided in about one week. The volar side of the wrist was fixed with bandage when the patient was treated with dorsal splint. When the affected limb swelling subsided, bandage became obviously loose, and resulted in increased displacement probability.

This study showed that the overall effect of surgical treatment of distal radius fracture was better than nonoperative treatment. This may be related to the stability of the fracture, the long time external fixation and the stiffness of the joint. It is difficult to reduce the unstable distal radius fracture. The supporting effect of cortical bone is poor, and tendon and periosteum may be embedded in the fractured end. Although plaster is fixed, the fracture is still prone to re-displace because of some unstable factors such as cortical defect. This may lead to traumatic arthritis and eventually lead to wrist dysfunction.[9,12] For simple and stable fractures, manipulative reduction and plaster fixation should be recommended first. If the reduction is difficult or the fracture is displaced at the follow-up, surgical treatment could be selected. It should be noted that because of the long time immobilization of the joint, it is not conducive to rehabilitation and this is also one of the factors for nonoperative treatment of poor wrist function.

Surgical treatment is still recommended for distal radius fractures with indications of surgery.[3,13] Open reduction and internal fixation with plate technique are reliable, the stability of the fracture can be recovered and good anatomic reduction can be achieved, especially the recovery of the radial length. Early exercise can be beneficial to the union of fracture and postoperative functional recovery, reducing the incidence of complications and improving joint function.[5] Therefore, positive intervention has been suggested for the distal radius fracture, otherwise poor outcomes may take place, including increased incidence of ulnar wrist pain, decreased gripping force, dysfunction of rotation and DRUJ (distal readioulnar joint) instability.[14] The ulnar wrist pain is a common complication of distal radius fracture, and this seriously affects the patient's wrist function. A number of studies have shown that the ulnar wrist pain is related to the TFCC (triangular fibrocartilage complex) injury and DRUJ instability.[15] TFCC included: TFC (triangular fibrocartilage), meniscal homologue, distal radioulnar ligament of volar and dorsal side, ulnar collateral ligament, partial ECU (extensor carpi ulnaris) sheath, ulnolunate (UL) ligament and ulnotriquetral (UT) ligament.[16] A partial injury of TFCC is likely to cause ulnar wrist pain. This study showed that there was no significant difference in the incidence of ulnar wrist pain among the three groups. Therefore, we considered that the occurrence of the ulnar wrist pain was not significantly associated with the treatment method. At present, surgical technique and internal fixation materials are quite mature. With the increasing awareness of the importance of wrist function, surgical treatment of distal radius fracture is increasing year by year.

This study has some limitations. Firstly, it is a retrospective study, and selection bias may therefore be present. Secondly, there are many methods for treatment of distal radius fracture, and only some of the treatments are performed in this study, which may not be comprehensive enough. Finally, although all surgeries were completed by doctors with extensive clinical experience, some technical differences might have existed among the doctors.

In conclusion, surgery and nonoperative treatment are both important approaches for distal radius fracture. Conservative treatment with manipulative reduction is still available for the stable fracture patients because of lower cost and burden. In contrast, for the unstable fractures patients, early and proper surgical treatment often results in better wrist function than nonoperative treatment. In addition, in accordance with the current concept of ERAS (Enhanced Recovery After Surgery), surgical treatment often results in better wrist function than nonoperative treatment does.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.cjtee.2017.11.004.

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