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Influence of Ulnar Styloid Fracture Types on the Treatment of Distal Radius Fractures

Jianmin Wang*

Suzhou Industrial Park Xingpu Hospital, Suzhou 215126, Jiangsu Province, China

***Corresponding author:** Jianmin Wang, 13914001044@163.com

Abstract: *Objective:* To analyze the effect of ulnar styloid process fracture types on the treatment of distal radius fracture. *Methods:* A total of 49 patients with distal radius fractures admitted to the hospital between December 1, 2018 and November 30, 2022 were selected. Among the patients, 26 of them were complicated with type I ulnar styloid fracture (the first group), and 23 patients were complicated with type II ulnar styloid fracture (the second group), and were treated with open reduction and internal fixation using Kirschner wire and tension band. The total effective rate, anatomical indicators such as palm inclination and ulnar deviation, and the range of motion of the wrist joint were compared between the two groups. *Results:* The total effective rate of the first group was higher than that of the second group ($P < 0.05$). There was no difference in anatomical indicators between the groups before operation and 3 months after operation ($P > 0.05$). Before operation, there was no difference in the range of motion of the wrist joint between the groups ($P > 0.05$). 3 months after operation, the range of motion of the wrist joint in the first group was greater than that in the second group ($P < 0.05$). *Conclusion:* The types of ulna styloid fracture can affect the effectiveness of treatment and joint mobility of distal radius fracture.

Keywords: Types of ulna styloid fractures; Distal radius fractures; Treatment effect

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1. Introduction

Distal radius fracture is a type of fracture with a relatively high incidence, and its conventional treatment is open reduction and volar plate fixation, which can restore joint function [1,2]. Ulnar styloid fracture refers to the type of fracture in which the ulnar styloid process is damaged in the distal radius fracture. The ulnar styloid process can maintain the stability of the wrist joint, promote the recovery of hand function after fracture, and improve the long-term curative effect of fracture. Previous studies have found that different types of ulnar styloid fractures affect the overall effectiveness of the treatment of distal radius fractures, and limit the wrist joint function and range of motion after fractures [3]. Therefore, this study selected 49 patients with distal radius fractures to analyze the influence of different types of ulnar styloid process fractures on the treatment effectiveness.

2. Materials and methods

2.1. General information

A total of 49 patients with distal radius fractures admitted to the hospital from December 1, 2018 to November 30, 2022 were selected. There were 26 patients in the first group, with 15 male patients and 11 female patients; the age ranged from 27 to 73 years old, with a mean of 51.26 ± 2.78 years old; the fractures involved the right side in 16 cases and the left side in 10 cases. There were 23 cases in the second group, with 13 males and 10 females; the age ranged from 26 to 75 years, with an average of 51.20 ± 2.63 years old; the fractures involved the right side in 14 cases and the left side in 9 cases.

Inclusion criteria included patients aged no less than 18 years; patients with distal radius fracture (unilateral) confirmed by X-ray; patients with complete clinical data; patients with 3-month follow-up; and patients with informed consent. Exclusion criteria were patients with abnormal wrist function before surgery; patients with prior fractures; patients with other upper limb fractures; and patients who dropped out of the study.

2.2. Methods

Brachial plexus block anesthesia was performed, and the fractured end of the distal radius was reduced and treated using Henry approach, and internal fixation was performed with a locking plate. After confirming satisfaction, the stability of the radioulnar joint was evaluated by applying pressure. The distal radius was grasped with one hand, ensuring that the forearm was in neutral rotation, and the other hand was used to push the distal ulna toward the volar and dorsal sides of the radius. If there was a sense of relaxation and friction, differing from that of the healthy side, it indicated instability in the radioulnar joint, which was treated with long-arm plaster external fixation for 2 to 3 weeks. Surgical intervention was recommended if the ulnar styloid fracture was pronounced. The incision was made on the ulnar side of the wrist, with caution taken to protect the tendon sheath and dorsal nerve of the hand on the ulnar side. When the fracture end was fully exposed, the hematoma tissue was removed, treated with reduction, and fixed with Kirschner wires (0.8 to 1.0 mm, 1/2 pieces). The ligament at the ulnar styloid process and the bone hole at the proximal end of the fracture were effectively fixed with a figure-of-eight tension band by the non-absorbable thread. If the ulnar styloid fracture fragment was relatively intact, it was directly fixed with a hollow nail (2.0 mm, 1 piece) after reduction. If the diaphysis was damaged, a miniplate was combined for fixation.

2.3. Observation indicators

Anatomical indicators before the operation and 3 months after the operation were recorded, including palmar tilt, ulnar inclination, and radial height. Before the operation and 3 months after the operation, the range of motion of wrist joints such as ulnar deviation, wrist extension, pronation, wrist flexion, supination, and radial deviation was measured.

2.4. Efficacy evaluation criteria

The Gartland and Werley system was used to evaluate the treatment effectiveness, including 6 points for subjective evaluation, 5 points for complications, 5 points for objective evaluation, and 3 points for residual deformity, with a total of 19 points. A score of ≤ 2 points indicates a significant effect, a score between 3 and 8 indicates a preliminary effect, and a score > 8 points indicates no curative effect.

2.5. Statistical analysis

The data were processed using SPSS28.0 software, the measured values were compared/tested by t value, and the counted values were compared/tested by χ^2 value. $P < 0.05$ indicated a statistically significant difference.

3. Results

3.1. Comparison of the total effective rate between the two groups

The total effective rate of the first group was higher than that of the second group ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of total effective rate between the two groups [n (%)]

Group	Number of cases	Significant effect	Preliminary effect	No effect	Total effective rate
The first group	26	16 (61.54)	9 (34.62)	1 (3.85)	96.15 (25/26)
The second group	23	8 (34.78)	8 (34.78)	7 (30.43)	69.57 (16/23)
χ^2	-	-	-	-	6.316
P	-	-	-	-	0.012

3.2. Comparison of anatomical indicators between the two groups

Based on **Table 2**, there was no difference in the anatomical indicators between the groups before and after the operation ($P > 0.05$).

Table 2. Comparison of anatomical indicators between the two groups (mean ± standard deviation)

Group	Number of cases	Palmar tilt (°)		Ulnar inclination (°)		Radial height (mm)	
		Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative
The first group	26	-17.65 ± 2.65	8.41 ± 1.33	4.92 ± 0.86	14.33 ± 1.85	2.88 ± 0.34	9.22 ± 1.76
The second group	23	-17.02 ± 2.71	8.21 ± 1.29	4.90 ± 0.76	14.02 ± 1.70	2.81 ± 0.39	9.04 ± 1.68
t	-	0.822	0.533	0.086	0.608	0.671	0.365
P	-	0.415	0.597	0.932	0.546	0.505	0.717

3.3. Comparison of the range of motion of the wrist joint between the two groups

Before the operation, there was no difference in the range of motion of the wrist joint between the groups ($P > 0.05$). 3 months after the operation, the range of motion of the wrist joint in the first group was greater than that in the second group ($P < 0.05$), as presented in **Table 3**.

Table 3. Comparison of the range of motion of the wrist joint between the two groups (mean ± standard deviation, °)

Group	Number of cases	Ulnar deviation		Wrist extension		Pronation		Wrist flexion		Supination		Radial deviation	
		Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative
The first group	26	12.36 ± 1.84	24.15 ± 2.32	31.53 ± 2.88	45.18 ± 4.32	35.81 ± 2.83	62.59 ± 4.98	18.59 ± 2.73	47.36 ± 3.75	35.91 ± 3.08	67.28 ± 6.59	7.26 ± 1.53	17.82 ± 1.66
The second group	23	12.41 ± 1.77	22.01 ± 2.17	31.42 ± 2.71	40.18 ± 4.29	36.01 ± 2.71	58.02 ± 4.75	18.45 ± 2.69	42.05 ± 3.61	35.44 ± 3.06	63.02 ± 6.55	7.44 ± 1.50	15.02 ± 1.60
t	-	0.097	3.321	0.137	4.056	0.252	3.276	0.180	5.034	0.535	2.265	0.415	5.993
P	-	0.923	0.002	0.891	0.000	0.802	0.002	0.858	0.000	0.595	0.028	0.680	0.000

4. Discussion

Open reduction combined with volar plate internal fixation is a common treatment for distal radius fractures. Through incision of the surgical wound, volar Henry approach was performed followed by reduction treatment, and internal fixation with a bone plate was used to stabilize the fracture site [4]. Specifically, most distal radius

fractures are accompanied by disease features such as articular surface misalignment and fracture fragment instability. Open reduction combined with volar plate internal fixation can effectively stabilize the fracture site and promote fracture healing and joint function recovery. Open reduction allows direct observation and handling of the broken ends of the fracture, ensuring accurate reduction, so that the broken ends can be correctly connected [5,6]. Open reduction combined with internal fixation can prevent fracture displacement or re-dislocation. The volar plate has strong rigidity offering stable support to the fracture end, ensuring early and mid-term joint stability after surgery, and providing a favorable environment for fracture healing. In addition, this treatment option can shorten the recovery time of hand function, and improve the range of motion of the wrist and the flexibility of fingers, thereby enhancing the postoperative quality of life [7].

The ulnar styloid is an important structure that maintains a stable connection between the distal radius and the metacarpal. When the ulnar styloid process is fractured, its anatomical integrity and physiological function are significantly damaged, resulting in a serious decline in the stability of the wrist joint, which will directly affect the treatment and healing process of distal radius fractures [8]. Firstly, an ulnar styloid fracture increases the instability of the distal radius fracture, making it difficult to maintain the correct anatomical position of the fracture. Unstable fractures can delay the healing process and affect the treatment of distal radius fractures. Secondly, ulnar styloid fractures can damage the related vascular supply, resulting in a disturbance of blood circulation at the fracture site of the distal radius [9]. Adequate blood supply is particularly important for fracture healing, thus impaired vascular supply will impact the effect of postoperative fracture treatment. Lastly, most ulnar styloid fractures necessitate surgical treatment, and the postoperative recovery time is longer, which will delay the fracture healing speed and affect the functional recovery of the patient's wrist joint [10].

Previous studies have pointed out that different types of ulnar styloid fractures have distinct effects on the treatment of distal radius fractures. Therefore, this study divided patients with distal radius fractures into type I fracture (the first group) and type II fracture (the second group). The results showed that the total effective rate of the first group was higher than that of the second group ($P < 0.05$). The reason is that type I ulnar styloid fractures are mostly simple transverse fractures, while type II ulnar styloid fractures are accompanied by lateral fragmentation of the articular surface of the ulnar styloid process or dorsal cortical rupture. Since type II fractures involve multiple fracture lines, the fracture segments are more complex and unstable. Compared with type I fractures, type II fractures are more prone to dislocation, which affects the postoperative treatment effect [11]. In addition, type I ulnar styloid fractures have better fracture stability, thus a fixed steel plate is usually placed below the surgical incision as an internal fixation. The internal fixation method maintains joint function and is conducive to fracture fusion. Type II ulnar styloid fractures are variable and require more complicated internal fixation methods, thus posing higher risks of postoperative complications that affect the prognosis of the fracture [12]. There was no difference in the anatomical indicators before the operation and 3 months after the operation between the first group and the second group ($P > 0.05$). The reason is that although type I and type II ulnar styloid fractures are different in terms of position and degree of fracture line, the fracture sites are relatively concentrated in the area of the ulnar styloid process. The recovery process of distal radius fractures does not only depend on the type of ulnar styloid process fracture, the improvement of palmar tilt, ulnar inclination, and radial height depends on the accuracy of reduction, stability of internal fixation, and the rehabilitation of the patient [13]. In addition, palmar tilt, ulnar inclination, and radial height are also affected by other factors, such as surgical technique, internal fixation materials and methods, surgical incision, and postoperative management. These factors may have a partial impact on the improvement of measurement parameters, and weaken the difference in the impact of various types of ulnar styloid process fractures on anatomical indicators [14]. The range of motion of the wrist joint in the first group was greater than that in the

second group 3 months after operation ($P < 0.05$). This is because type I ulnar styloid fractures are more stable than type II fractures. After surgery and internal fixation, the fracture ends of type I fractures are stable, with rare displacement and dislocation of the fracture site, which helps to maintain the normal range of motion of the wrist joint, so that patients can perform wrist joint exercise training as soon as possible during postoperative recovery period. Type II ulnar styloid fractures can lead to severe soft tissue damage, including articular cartilage damage, joint meniscus tear, etc. [15]. Soft tissue injury may exert a negative impact on the range of motion of the wrist joint, resulting in a more limited wrist range of motion in type II ulnar styloid fractures than in type I fractures.

5. Conclusion

In summary, the difference in the type of ulnar styloid fracture will affect the rehabilitation effect of distal radius fracture, and type II fracture exerts a greater impact on the total effective rate of treatment and the range of motion of the wrist joint. It is necessary to comprehensively evaluate the fractures of the ulnar styloid process and distal radius, and rationally formulate the surgical plan to ensure the treatment effectiveness of the surgery.

Disclosure statement

The author declares no conflict of interest.

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