

# Younger Patients and Men Achieve Better Recovery of Function Than Older Patients and Women with Surgically Treated Distal Radius Fracture

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## Research article

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# Abstract

**Abstract Background:** Distal radial fractures (DRF), which are commonly managed by open reduction and internal fixation (ORIF) with a volar fixed-angle plate, are a common upper limb fracture. The potential influence of age and gender on the results of postoperative functional recovery of patients with DRF has not been studied. In this study we therefore reviewed a large cohort of patients with DRF who had undergone ORIF with a volar plate to determine if functional measures as well as pain score differed according to gender and age. **Methods:** This was a retrospective study using routinely collected data. Between November 2013 to November 2018, we performed open reduction and volar locking plate to treat 1396 patients with DRF. Of those, 1089 (78%) patients were found eligible and entered the analysis. We compared a series of measures including ROM (flexion, extension, supination and pronation), grip strength and pain score according to gender and age at one month, three months and six months postoperatively. **Results:** Male patients had greater ROM, lower pain score and better grip strength at each time interval from one to six months postoperatively. However, the differences were attenuated over time. At the final follow-up point, the differences in terms of flexion, grip strength and pain relief were still statistically significant. Younger patients had more favorable outcomes for almost all measures including flexion, extension, supination, pronation and grip strength. The differences had statistical significance at each follow up point and were more obvious with the development of time. There were no significant differences between younger and older groups with regard to pain scores during the entire follow-up period. **Conclusions:** Male and younger patients with volar ORIF of distal radial fractures achieve outcomes that are superior to female and older patients. **Keywords:** Distal radial fractures, Age, Gender, Functional recovery

## Introduction

Distal radial fractures (DRF) are one of the most common of all fractures in skeletal injuries and represent a serious public health concern [1-2]. An increasing prevalence of fractures to the wrist can be predicted with an ageing population[1-3]. The most frequent mechanism is a fall on an outstretched arm. Old patients with osteoporosis typically sustain this kind of fracture from low-energy injuries, while younger patients frequently suffer it from high-energy injuries such as sports activities and traffic accidents. Open reduction and internal fixation (ORIF) with a volar plate is typically performed for the management of DRF to maintain reduction and allow early mobilization [4-5]. Anyone who sustains a DRF will go through a period during which they have to suffer from pain, stiffness, and weakness, which naturally lead to difficulty participating in occupational, personal and sporting activities that may extend to at least several months beyond the time of fracture [6-7]. Therefore, postoperative rehabilitation and functional recovery have attracted wide attention and interest of researchers [2-3, 6]. However, the potential influence of age and gender on the results of postoperative functional recovery of patients with DRF has not been studied. In this study we therefore reviewed a large cohort of patients with DRF who had undergone ORIF with a volar plate to determine if functional measures as well as validated outcome score differed according to gender and age.

## Patients And Methods

This was a retrospective analysis using routinely collected data. Patients receiving surgical management of distal radial fractures at our institution from November 2013 to November 2018 were candidates for the study. Inclusion criteria were (1) surgery within two weeks after the injury, (2) isolated fracture, (3) patients with available complete follow-up, (4) fixation with a volar plate and (5) patients accepting the same postoperative rehabilitation protocol. Exclusion criteria were (1) a previous wrist fracture on the affected side with residual impairment of function, (2) a concurrent injury to the affected limb, (3) bilateral wrist fractures, (4) pre-existing inflammatory joint diseases such as rheumatoid arthritis or gout, and (5) patients lacking self-sufficiency in managing requirements of personal life. We performed ORIF with a volar plate to treat 2367 patients with DRF during this period of time. Ultimately, 1089 (78%) patients were found eligible and entered the analysis. The average age of the eligible cohort was 53 (17 to 83) years at the time of surgery. Of these patients, 392 (36%) were males and 697 (64%) females. Those ineligible and those accounted for were not different referring to age and gender. Patients in male and female groups were comparable with respect to the distribution of age, fracture types, and involvement of dominant upper extremity. Also, patients in younger and older groups were comparable in terms of the distribution of gender and all the other demographics mentioned above.

### Outcome measures

The assessment was performed at 1 month, 3 months, and 6 months postoperatively. At each visit, assessments consisted of wrist ROM (flexion, extension, supination, and pronation), grip strength and pain score (with 0 indicating no pain and 10 indicating the worst possible pain). Postoperative radiographs were routinely obtained at 2 weeks, 6 weeks, and 3 months.

Range of motion (ROM) was recorded bilaterally using a universal goniometer [8]; the measurements included wrist extension, flexion, pronation and supination. Grip strength was measured for both the healthy and the injured hand using a JAMAR Hand Dynamometer (Sammons Preston Rolyan, Chicago, Illinois, USA). The measurements were made in positions recommended by the American Society of Hand Therapists [9]. Each range of motion and grip measurements were documented as the mean of three attempts and expressed in relative values according to normative ones (%) in consideration of interindividual differences. At each visit, patients were also required to complete an ordinal pain scale. Assessments were completed by a number of trained clinical assessors.

### Statistical Analysis

Statistical analyses were performed using SPSS software version 25.0 (IBM Corp., Armonk, New York, USA). We compared the outcomes among age and gender with use of independent sample t tests for

continuous variables and chi-square analysis for categorical variables. The level of significance for every comparison was set below 0.05 ( $p < 0.05$ ).

## Results

Male patients had greater wrist flexion and extension at each time interval from one to six months postoperatively, and these differences were statistically significant ( $p < 0.05$ ) at almost all the three time points (Table 1 and Fig. 1A-B), except that wrist extension was no statistically difference at six months. However, the differences observed between male and female groups were attenuated over time. The results of supination and pronation showed the same trend. Pronation were greater for men than women with differences statistically significant ( $p < 0.05$ ) at one and three months postoperatively (Table 1 and Fig. 1C), while the results of supination only showed statistical difference at one month (Table 1 and Fig. 1D). The recovery of grip strength was better for male patients than female patients, and the differences were statistically significant at all the three time points (Table 1 and Fig. 1E). Male patients also experienced lower pain scores compared with female patients, and the difference between the two groups was found statistically significant ( $p < 0.05$ ) at each time point postoperatively (Table 1 and Fig. 1F).

Younger patients had more favorable outcomes for almost all measures including flexion, extension, supination, pronation and grip strength. The differences had statistical significance at each follow up point and were more obvious with the development of time, except that wrist pronation was no statistically difference at three months and supination was no statistically difference at one month (Table 2 and Fig. 2A-E). There were no significant differences between younger and older groups with regard to pain scores during the entire follow-up period (Table 2 and Fig. 2F).

## Discussion

Distal radial fractures are one of the most common of all fractures in skeletal injuries and represent a serious public health concern. Although many factors may potentially influence the postoperative functional recovery of patients with DRF [10-13], there has been limited attempts to study the impact of gender and age differences in the same population of patients despite one investigation that shows that female gender contributes to the development of complex regional pain syndrome type I after the surgical treatment of DRF [14]. This study intended to investigate if a series of measures including flexion, extension, supination, pronation, grip strength and pain score after surgical treatment of DRF differed according to gender and age.

The results showed that men had better flexion, extension, grip strength and pain relief than women at the last follow-up point. Younger patients had more favorable outcomes for all measures except for pain scores, which were similar between younger and older patients at all the three follow-up visits. The early differences observed between male and female patients were attenuated over time, while they were expanded between younger and older patients. There is evidence that the recovery of range of joint motion is related closely with daily dose of exercise [3, 15]. The more vigorous sport activity and heavier

physical labour might contribute to the more favorable outcomes among male and younger patients. It is noteworthy that female patients reported higher pain scores throughout the whole follow-up period, which might prevent them from functional training and daily exercise to some extent. Degeneration of joints and musculoskeletal system among older patients might also have a potential impact on postoperative functional recovery.

This study should be interpreted in light of several limitations. First, the measuring results were collected within six months postoperatively. These results may continue to improve after the final follow-up visit. Second, a group of assessors was used in this study. Though these assessors were trained on the basis of a standardized assessment protocol, there may still be slight difference. Finally, though it is hard to put to practice, we did not assess the exercise dose of patients, which seems have a nonnegligible influence on postoperative functional recovery of patients with DRF. Strengths of this investigation include the fact that this study attempted to evaluate the effect of gender and age on postoperative functional recovery, which has not been previously attempted with patients following a distal radial fracture.

In conclusion, the results of our study indicate that male and younger patients with volar ORIF of distal radial fractures achieve outcomes that are superior to female and older patients, but further studies are required to determine whether the different amount of postoperative exercise according to gender and age has an impact on the results presented by this study.

## **Abbreviations**

DRF: Distal radial fractures; ORIF: Open reduction and internal fixation; ROM: Range of motion.

## **Declarations**

### **Acknowledgements**

Not applicable

### **Authors' contributions**

TFL analyzed the data, drafted the manuscript and participated in the surgical procedure. JXL collected and analyzed the data. MSH and WJC participated in the surgical procedure and outcome measures. PH performed surgeries, contributed to the conception and design of the study, supervised data collection, and reviewed the manuscript. XFY participated in reviewing and editing the manuscript.

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### **Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### **Ethics approval and consent to participate**

The retrospective study was approved by the Ethics Committee of Shanghai Sixth People's Hospital and informed consent was waived due to the retrospective nature of this study.

### **Consent for publication**

Not applicable.

### **Competing interests**

The authors declare that they have no competing interests.

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## Tables

stoperative Range of Motion, Grip Strength and Pain Score according to Patient Gender

	1 Mon	3 Mon	6 Mon
<i>(% of value on uninjured side)</i>			
↓=392)	57 (13.3)	76 (13.4)	84 (11.2)
↑ (N=697)	50 (14.9)	72 (13.9)	82 (13.8)
	<0.01*	<0.01*	<0.05*
<i>(% of value on uninjured side)</i>			
↓=392)	62 (7.9)	78 (12.2)	87 (15.2)
↑ (N=697)	56 (10.8)	75 (13.1)	86 (14.1)
	<0.01*	<0.05*	0.29
<i>(% of value on uninjured side)</i>			
↓=392)	81 (8.2)	95 (6.6)	98 (13.7)
↑ (N=697)	77 (7.7)	93 (7.8)	97 (14.2)
	<0.01*	<0.05*	0.26
<i>(% of value on uninjured side)</i>			
↓=392)	79 (17.2)	94 (15.8)	98 (10.4)
↑ (N=697)	76 (16.7)	92 (17.7)	98 (10.7)
	<0.01*	0.06	0.55
<i>h (% of value on uninjured side)</i>			
↓=392)	57 (6.5)	88 (3.5)	95 (14.1)
↑ (N=697)	52 (6.8)	84 (7.1)	93 (15.4)
	<0.01*	<0.01*	<0.05*
<i>(points)</i>			
↓=392)	2.9 (1.2)	1.5 (0.7)	0.8 (1.6)
↑ (N=697)	4.2 (1.5)	2.8 (0.9)	1.2 (1.5)
	<0.01*	<0.01*	<0.01*

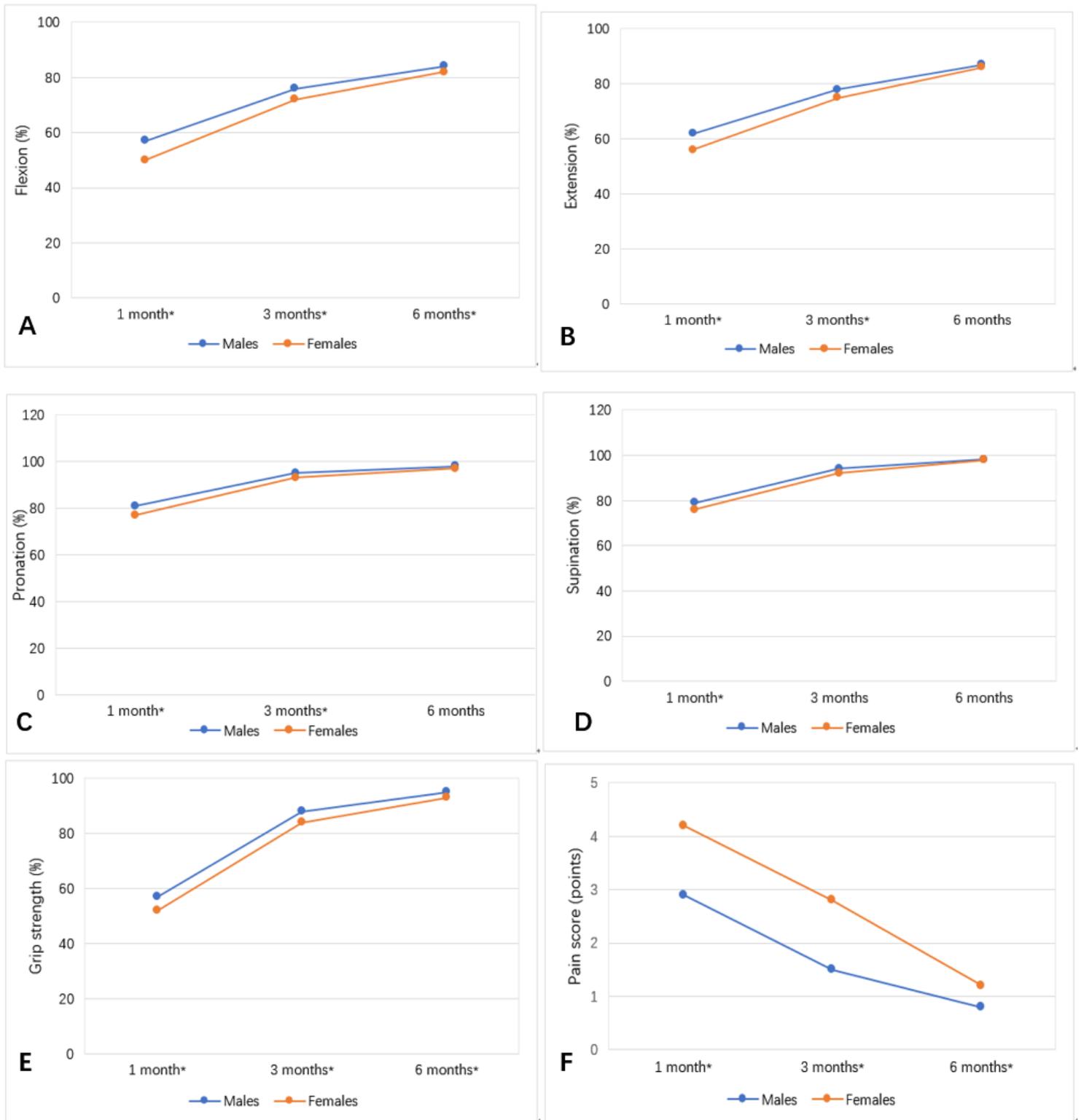
↓ and ↑ are given as the mean and the standard deviation. \*The difference between the groups was p<0.05).

## II Postoperative Range of Motion, Grip Strength and Pain Score according to Patient Age

	1 Mon	3 Mon	6 Mon
<b>Flexion (% of value on uninjured side)</b>			
55 years <sup>†</sup> (N=563)	54 (15.6)	78 (17)	89 (13.1)
65 years <sup>†</sup> (N=526)	47 (14.6)	70 (13.8)	78 (12.9)
p-value	<0.01*	<0.01*	<0.01*
<b>Extension (% of value on uninjured side)</b>			
55 years <sup>†</sup> (N=563)	62 (13.9)	81 (12.7)	92 (9.0)
65 years <sup>†</sup> (N=526)	57 (12.3)	73 (13.4)	81 (10.0)
p-value	<0.01*	<0.01*	<0.01*
<b>Internal rotation (% of value on uninjured side)</b>			
55 years <sup>†</sup> (N=563)	80 (15.1)	96 (17.2)	98 (4.6)
65 years <sup>†</sup> (N=526)	78 (15.3)	94 (16.5)	94 (6.2)
p-value	<0.05*	0.05	<0.01*
<b>External rotation (% of value on uninjured side)</b>			
55 years <sup>†</sup> (N=563)	78 (8.7)	95 (4.7)	99 (1.7)
65 years <sup>†</sup> (N=526)	77 (10.1)	93 (5.4)	96 (2.6)
p-value	0.08	<0.01*	<0.01*
<b>Grip strength (% of value on uninjured side)</b>			
55 years <sup>†</sup> (N=563)	56 (16.4)	88 (9.5)	96 (3.3)
65 years <sup>†</sup> (N=526)	53 (17.2)	84 (8.9)	92 (5.1)
p-value	<0.01*	<0.01*	<0.01*
<b>Pain score (points)</b>			
55 years <sup>†</sup> (N=563)	3.5 (1.6)	2.3 (2.4)	0.8 (1.4)
65 years <sup>†</sup> (N=526)	3.5 (1.5)	2.1 (2.2)	0.9 (1.8)
p-value	0.83	0.13	0.3

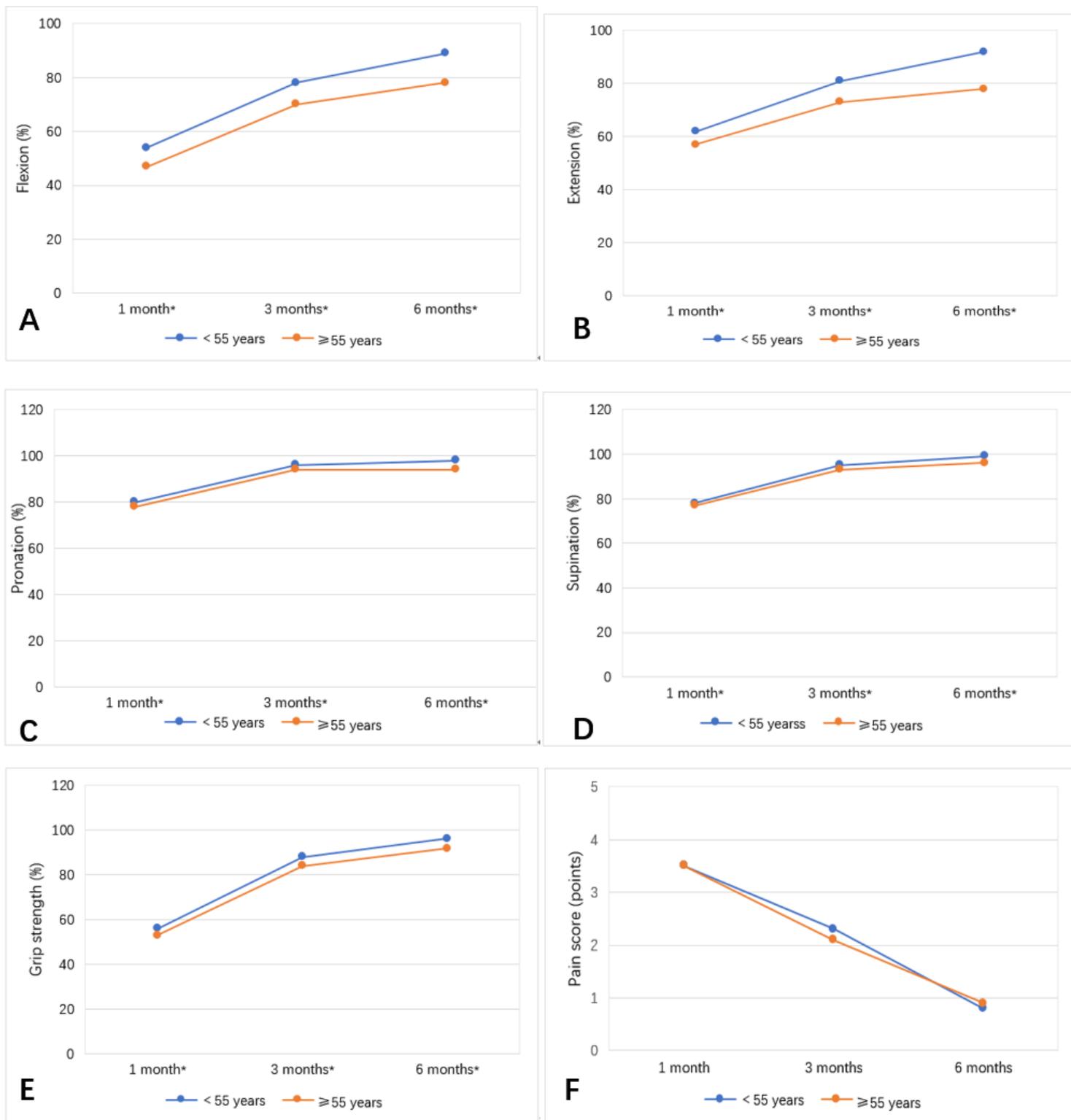
Values are given as the mean and the standard deviation. \*The difference between the groups was significant (p<0.05).

## Figures



**Figure 1**

Graphs showing ROM, grip strength and pain score of the affected hand at the postoperative time points according to patients gender. A, B, C, D and E Extension, flexion, forearm supination, pronation and grip strength as a percentage of the healthy side (empirically 100%) at the postoperative time points. F Pain score of the affected hand at the postoperative time points. An asterisk indicates a significant difference between groups at that time point.



**Figure 2**

Graphs showing ROM, grip strength and pain score of the affected hand at the postoperative time points according to patients age. A, B, C, D and E Extension, flexion, forearm supination, pronation and grip strength as a percentage of the healthy side (empirically 100%) at the postoperative time points. F Pain score of the affected hand at the postoperative time points. An asterisk indicates a significant difference between groups at that time point.