



# Fifth Metacarpal Neck Fractures: Outcome-influencing Factors

## *Fracturas del cuello del quinto metacarpiano: factores que influyen en el resultado*

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### Abstract

**Introduction** Fifth metacarpal neck fractures are extremely common, but there is still no consensus regarding the ideal course of treatment.

Volar angulation and shortening are decisive factors; however, there is still controversy about the cut-off values that translate into worse clinical results.

The present study aims to answer these questions in order to provide additional data to aid in the clinical practice and decision making.

**Materials and Methods** A retrospective study evaluated patients with fifth metacarpal fractures treated between 2013 and 2018. A total of 133 patients were included, with an average follow-up of 2 months. Surgery was performed in 21 patients, and 112 were treated conservatively. The radiological assessment of volar angulation and shortening was based in the first and last radiographs of the follow-up. The patients were contacted and submitted to a questionnaire that included the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score and subjective evaluations of pain (Visual Analogue Scale, VAS), hand strength, stiffness and finger mobility, and cosmetic result.

**Results** Surgery was more successful in reducing angulation than the conservative treatment, achieving more anatomic final values for angulation and shortening ( $p < 0.05$ ). On the other hand, surgery seems to be associated with a higher notion of limited finger mobility ( $p = 0.02$ ).

Among patients treated conservatively, initial angulations  $> 60^\circ$  and final angulations  $> 50^\circ$  were associated with worse cosmetic results ( $p = 0,039$ ). Final shortening  $> 4$  mm translated into a higher notion of stiffness and limited finger mobility ( $p = 0.034$ ). More advanced age showed a correlation with higher scores on the VAS ( $p = 0.023$ ) and QuickDASH ( $p < 0,001$ ). Female patients ( $p = 0.02$ ) were also associated with higher VAS scores. The overall satisfaction rate was of 97%.

### Keywords

- ▶ fifth metacarpal neck fractures
- ▶ volar angulation
- ▶ shortening

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**Conclusion** Although globally the functional outcome of these fractures is very good, the present study reports several factors that should be considered when treating fifth metacarpal neck fractures.

## Resumen

**Introducción** Las fracturas del cuello del quinto metacarpiano son muy comunes, pero no hay consenso sobre el tratamiento de elección. Angulación y reducción son factores decisivos en la elección del tratamiento; sin embargo, hay alguna controversia sobre los valores a partir de los cuales se da un peor resultado clínico.

Este estudio busca responder a estas cuestiones a fin de proporcionar una evidencia más para auxiliar en la decisión terapéutica.

**Materiales y Métodos** Este estudio retrospectivo evaluó a enfermos con fractura del quinto metacarpiano tratados entre 2013 y 2018. Se incluyó en el estudio a 133 enfermos, con 2 meses de seguimiento medio. Se trató quirúrgicamente a 21 enfermos, y a 112 se aplicó el tratamiento conservador. La evaluación radiográfica de la angulación volar y acortamiento se basó en las imágenes al inicio y al final del seguimiento médico. Se contactó a los enfermos y se los sometió a un cuestionario que incluyó la versión corta del puntaje de discapacidades de brazo, hombro y mano (Quick Disabilities of the Arm, Shoulder and Hand, QuickDASH, en inglés), la evaluación subjetiva de la intensidad del dolor (Escala Visual Analógica, EVA), fuerza de prensión, amplitud de movimiento, y resultado estético.

**Resultados** Se consiguió una mejoría más significativa de angulación con la cirugía, y se obtuvo de esta forma valores finales más anatómicos ( $p < 0,05$ ). Sin embargo, a la cirugía parece también que se asocia una mayor noción de limitación del movimiento ( $p = 0,02$ ).

Con el tratamiento conservador, angulaciones iniciales  $> 60^\circ$  y finales  $> 50^\circ$  se asocian a un peor resultado estético ( $p = 0,039$ ). Valores de acortamiento final superiores a 4 mm se tradujeron en una mayor limitación del movimiento ( $p = 0,034$ ).

Las edades más avanzadas se correlacionaron con puntuaciones más altas en la EVA ( $p = 0,023$ ) y en el QuickDASH ( $p < 0,001$ ). Las mujeres ( $p = 0,02$ ) también estuvieron asociadas a puntuaciones más altas en la EVA. El índice de satisfacción de los enfermos en el estudio fue de 97%.

**Conclusión** Pese a que el resultado funcional en estos enfermos ha sido genéricamente bueno, este trabajo revela factores a tener en cuenta a la hora de decidir la terapéutica de las fracturas del cuello del quinto metacarpiano.

## Palabras Clave

- fractura del quinto metacarpiano
- angulación volar
- acortamiento

## Introduction

Fractures of the neck of the fifth metacarpal are extremely common, comprising up to 20% of all hand fractures<sup>1,2</sup>

They are commonly known as “boxer’s fracture”, due to the fact that the mechanism of injury is often punching solid objects with clenched fists.

Most of these fractures are isolated and stable, which are usually accepted for conservative treatment, with good functional results. Other fracture sequelae commonly observed in other parts of the skeletal system, like non-union and secondary arthritis in the adjacent joints, are rare after metacarpal fractures. However, there are a few situations in which the surgical treatment is recommended, like any degree of rotational deformity and “significant” volar angulation and shortening.

Many authors<sup>3,4</sup> believe that the functional impairment of the hand is minimal even after mal-union in a fracture angulated up to  $70^\circ$ . Meanwhile, the recommendations found in the literature for the acceptable values of volar angulation vary between  $20^\circ$  and  $70^\circ$ .

Even though volar angulation and shortening are important factors to consider when choosing the treatment, there is still much controversy around the cut-off values above which patients report worse functional outcomes or residual symptoms when treated conservatively, and no treatment guidelines have been established yet.

For the conservative treatment, the traditional type of immobilization is made with Plaster-of Paris, and it includes the ray of the affected finger and of its neighbouring finger, which extends proximally to the upper forearm.<sup>2,5-7</sup>

Another aspect for which there is no consensus is the duration of immobilization in the conservative treatment. The recommendations are also extremely variable, with a few studies reporting only one week, followed by progressive functional rehabilitation, while other studies<sup>2</sup> report longer periods.

When the surgical treatment is indicated, the fracture is usually fixed with intramedullary (IM) mininails/ Kirschner wires (K-wires).<sup>8,9</sup> Other surgical options can be used, such as K-wires placed as crossed pins at the fracture site,<sup>10</sup> transverse pins to the neighbouring metacarpal<sup>11</sup> or open reduction and internal fixation (ORIF) with screws and plates. Compared to IM K-wire fixation, these carry the risk of increased stiffness and significant reduced range of motion of the finger.<sup>12</sup>

With the present study, we aim to tackle some of the aforementioned controversial topics, as a way of providing additional evidence to aid clinicians in their decision making when faced with fifth metacarpal neck fractures.

## Methods

Patients presenting in the emergency room with fifth metacarpal neck fractures between 2013 and 2018 were identified, and their demographic data, admission and follow-up radiographs, and clinical records were retrospectively reviewed.

Subjects were excluded if they were under 18 years old, had multiple metacarpal or open fractures, incomplete medical records, or inadequate radiographic images. Subjects were also excluded if their follow-up was conducted at a different institution (such as insurance companies).

A total of 133 patients were included. Their mean age was of 34 years, and 92% of them were male. Patients were followed up in the outpatient clinic until fracture consolidation. The mean follow-up time was of two months.

Surgery was performed in 21 patients (17 with IM K-wires, and 4 with a mini-plate), and 112 were treated conservatively. The immobilization time varied between 1 and 7 weeks, with an average of 3.7 weeks. (► **Table 1**)

The records of the follow-up appointments were extensively reviewed, and data regarding complications such as malunion, non-union, rotational deformity, iatrogenic fractures, or hardware-related complications were collected.

**Table 1** Demographic data of the study sample

Gender	Male	122
	Female	11
Mean age (in years)		34
Mean follow-up (in months)		2
Treatment	Conservative	112
	Surgery	21
Surgical procedure	Intramedullary Kirschner wire	17
	Mini-plate	4
Mean immobilization time (in weeks)		3.8

The radiographic measurements of the volar angulation were performed using a 30° oblique view, according to method medullary canal-oblique (MC-30).<sup>13</sup> The shortening measurements were performed using the antero-posterior (AP) view. These measurements were performed in the initial X-rays and at the end of the follow-up.

At least two years after the fracture, the included patients were contacted by telephone, and they answered a questionnaire about the impact of the fracture on their daily activities and work, which included the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score and a subjective evaluation of pain through the Visual Analogue Scale (VAS), loss of hand strength and finger mobility, and cosmetic result. Out of the 133 patients included, only 71 were available to answer the questionnaire.

The data were organized, and the statistical analysis was performed using the Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, IBM Corp., Armonk, NY, US) software, version 26.0.

The parametric Student *t*-test was used to compare quantitative values, and non-parametric tests were used when the variables did not meet the criteria. We used the Chi-squared test to compare qualitative values  $\geq 5$ . The Fisher test was used for lower values, and the Pearson correlation coefficient was used to determine the association between two continuous variables. Values of  $p < 0.05$  were deemed statistically significant.

## Results

The average initial fracture angulation for all patients was of 43.75° (range: 16°–84°), and the final angulation averaged 37.8° (range: 13°–63°). The mean variation between these two measurements was of –5.9°.

The average initial and final shortenings were of 2.86mm (range: 0–8.7 mm) and 2.84 mm (range: 0–8.9 mm) respectively. The mean variation between these measurements was of 0.04 mm.

A total of ten complications were reported, three in patients treated surgically and seven in the group treated conservatively. No statistically significant differences were found between them regarding the rate of complications (► **Table 2**).

The surgical group had a significantly higher initial volar angulation (50° versus 43°;  $p = 0.008$ ), a greater difference in angulation was achieved with surgery (–23° versus –3°;  $p < 0.001$ ), and the final volar angulation was, therefore, significantly lower in the surgical group (27° versus 40°;  $p < 0.001$ ) when compared to the conservative treatment group.

The surgical group had a significantly higher mean initial shortening (4.02 mm versus 2.63 mm;  $p = 0.001$ ), but no statistically significant difference was found regarding the shortening variation or the final values. (► **Table 3**)

The mean score on the QuickDASH (0-100) was of 5.46 (range: 0 to 68.2); the VAS score (0-10) averaged 1.24 (range: 0 to 9), and the cosmetic result (0-5) averaged 1.17.

**Table 2** Treatment complications

	Conservative (N = 112)	Surgery (N = 21)		p*
		Intramedullary Kirschner wires (N = 17)	Mini-plate (N = 4)	
TOTAL	7	3	0	0.35
Refracture	4	0	0	1
Loss of fixation	0	1	0	0.15
Iatrogenic fracture	0	1	0	0.15
Malunion	2	1	0	0.40
Rotational deformity	1	0	0	1

Note: \* Values of  $p < 0.05$  were deemed statistically significant.

**Table 3** Angulation and shortening measurements

		Conservative	Surgery	p*
Angulation (°)	Initial	43	50	0.008
	Final	40	27	< 0.001
	Variation	(-) 3	(-) 23	< 0.001
Shortening (mm)	Initial	2.63	4.02	0.001
	Final	2.8	2.9	0.734
	Variation	(+) 0.3	(-) 1.1	0.078

Note: \* Values of  $p < 0.05$  were deemed statistically significant.

Most patients (83%) did not report any limitation in finger mobility or stiffness, 14% reported mild limitation, and only 3% reported severe limitation in finger mobility and stiffness, with an impact on their daily activities.

Moreover, most patients (73%) did not report any notion of diminished hand strength, 21% had mild loss, and only 6% noted severe loss of hand strength.

Overall, 97% of the patients claimed to be satisfied with their treatment (► **Table 4**).

Patients who underwent surgery reported a significantly higher notion of limitation in finger mobility and stiffness than the ones treated conservatively ( $p = 0.02$ ). No other statistically significant differences were found between the surgical and conservative treatment groups regarding the clinical outcomes.

Among the patients treated conservatively, higher values of volar angulation were significantly associated to a worse cosmetic result. The cut-off values that yielded worse cosmetic results were initial angulations higher than  $60^\circ$  ( $p = 0.039$ ) and final angulations higher than  $50^\circ$  ( $p = 0.039$ ). Among the large range of volar angulations, there were no other significant differences regarding the functional results, pain, stiffness, or hand strength.

When considering shortening, patients with final values higher than 4 mm reported more limited finger mobility ( $p = 0.034$ ). The shortening values had no significant influence on the other outcomes.

**Table 4** Outcomes according to the descriptive statistics

		Mean	Count	%
QuickDASH (0-100)		5.46		
Visual Analog Scale (0-10)		1.24		
Cosmetic score (0-5)		1.17		
Finger mobility limitation	None		59	83
	Mild		10	14
	Severe		2	3
Loss of strength	None		52	73
	Mild		15	21
	Severe		4	6
Patient satisfaction	Yes		69	97
	No		2	3

Abbreviation: QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand.

Advanced age was positively correlated with higher VAS ( $p = 0.023$ ) and QuickDASH ( $p < 0.001$ ) scores at the end of the follow-up. The female gender ( $p = 0.02$ ) was also associated with higher VAS scores (► **Table 5**).

## Discussion

The age and sex distribution of the sample of the present study is typical for this fracture.

The only difference found in the present study between the two main treatment approaches was a higher notion of stiffness and limitation in finger mobility among the patients submitted to surgery. This was consistent with reports found in the literature;<sup>12,14</sup> however, we have found no differences regarding the complication rate and the two types of surgical treatment (IM K-wires and plates).

The worse cosmetic result reported by patients with higher initial volar angulation values could be used as an argument for the operative treatment in such patients; however, no relationship was found between the angulation

**Table 5** Outcomes of the comparative analysis

	QuickDASH (0-100)		p	VAS (0-10)		p	Cosmetic score (0-5)			p	Stiffness/limitation in finger mobility			p	Loss of strength			p	Patient satisfaction	
	Male	Female		None	Mild		Severe	None	Mild		Severe	Yes	No							
Gender	4		p=0.02*	1		p=0.023	1										61	1		
	15.7			3														8	1	
Mean age (in years)																				
Mean Follow-up time (in months)			p<0.001																	
Treatment	Conservative	4.8		1			1													
	Surgery	7.9		1			1													
Surgical procedure	Kirschner wire	2.9		0			1													
	Mini-plate	21.6		1			1													
Immobilization time (in weeks)																				
Angulation (°)	Initial (a)																			
	Final (b)																			
	Variation																			
Shortening (mm)	Initial																			
	Final (c)																			
	Variation																			

Abbreviations: QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand; VAS, Visual Analog Scale.

Notes: (a) The cut-off value of 60° was deemed statistically significant (p<0.05).

(b) The cut-off value of 50° was deemed statistically significant (p<0.05).

(c) The cut-off value of 4 mm was deemed statistically significant (p<0.05).

\*Independent predictors of higher VAS score on the multivariate analysis.

values and the worse functional results or pain scores; in fact, there were only incidental complaints among the patients with worse cosmetic deformity. At the end of the follow-up, 97% of the patients were satisfied with the overall result, irrespective of the cosmetic result.

The good results of the conservative treatment may be due to the great mobility of the fifth ray of the hand, which makes it more forgiving regarding the permanent changes in the skeletal anatomy than the fixed second and third rays.

In the literature, the optimal management of these fractures is still highly variable. Studies support the conservative treatment for fractures with up to 70° of residual angulation,<sup>3,4</sup> and other studies support more an aggressive management of these injuries.<sup>1,15</sup>

The present is a retrospective study, and the use of clinical records as a source of data may introduce some bias.

Due to the coronavirus disease 2019 (COVID-19) contingency, the assessment of the functional outcomes was based on a questionnaire applied by telephone, which may lead to more subjective results regarding some of the outcomes, such as stiffness/finger mobility or strength.

Another potential limitation was the use of oblique radiographs for the measurements of the volar angulation. Although there is less superimposition of the metacarpals, which is one of the reasons we chose this view, there have been reports that this incidence is associated not only with higher fracture angles (by approximately 10°) when compared with the lateral view, but also with more rotational variability, which may influence the measurement of the angle.<sup>16,17</sup>

## Conclusion

The functional outcome of these fracture is overall very good. The surgical treatment appears to yield more anatomical values of angulation and shortening than the conservative treatment; however, these differences do not seem to result in better functional or clinical results. In fact, surgically-treated patients reported a higher notion of stiffness and limited finger mobility, as did patients with final shortening values higher than 4 mm.

Initial and final angulations higher than 50° and 60° respectively were associated with worse cosmetic results, without any influence on the other outcomes.

### Conflict of Interests

The authors have no conflict of interests to declare.

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