

ORIGINAL PAPER

**[Translated article] Prospective study about
orthopaedic treatment of fifth metacarpal neck
fractures**



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KEYWORDS

Metacarpal;
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Abstract

Introduction: The fifth metacarpal neck fracture is traditionally treated with closed reduction and intrinsic plus cast immobilisation. Another alternative and more functional treatment is the syndactylia. The aim of our study is to compare both treatments searching for any differences in their functional outcomes.

Method: We did a prospective, controlled, masked, randomised cohort study with patients over 18 years old attended from May 2019 to May 2020 in Vigo's Sanitary Area with this injury and an angle below 40°. The collected data was: sex, age, fracture angle, range of motion of the metacarpophalangeal articulation (MCFA), grip strength, pain, fracture consolidation, *Quick DASH* and comfort 4 and 6 weeks after the injury.

Results: 39 men and 1 woman were included in the sample. 36.1 years old as the age average. 90% of the injuries affected the right hand, being all the patients right-handed, finding statistically significant differences in MCFA flexion within 4 weeks and in grade of discomfort, both in favour of the syndactylia ($p < .05$). Any of the other collected data was statistically significant. Every fracture achieved consolidation at the end of the follow-up.

Conclusion: Following the results, we consider both immobilizations good treatment options of these fractures; nevertheless, syndactylia has proven an earlier MCFA flexion recovery and a better tolerance.

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PALABRAS CLAVE

Metacarpiano;
Fractura;
Conservador;
Inmovilización;
Sindactilia

Estudio prospectivo sobre el tratamiento conservador de las fracturas de cuello de quinto metacarpiano

Resumen

Introducción: La fractura de cuello del quinto metacarpiano se trata tradicionalmente mediante la reducción cerrada y la inmovilización con férula en intrínseco plus. Una alternativa es el tratamiento funcional mediante sindactilia. Nuestro objetivo es comparar ambos tratamientos buscando diferencias de resultado funcional entre ambas opciones.

Método: Realizamos un estudio de cohortes prospectivo, controlado, enmascarado y aleatorizado con pacientes mayores de 18 años con esta lesión y angulación $< 40^\circ$, atendidos entre mayo de 2019 y mayo de 2020 en el Área Sanitaria de Vigo. Se recogieron las variables: sexo, edad, lado, angulación de la fractura, movilidad de la articulación metacarpofalángica (MCF), fuerza de prensión, dolor, consolidación de la fractura, *Quick DASH* y grado de satisfacción y confort. Esta información fue recogida a las 4 y a las 6 semanas.

Resultados: La muestra constó de 39 hombres y una mujer. La edad media fue de 36,1 años. El 90% afectó a la mano derecha, siendo todos los pacientes diestros, encontrando diferencias estadísticamente significativas en la flexión de la articulación MCF a las 4 semanas y en el grado de molestia de la inmovilización, ambos en favor de la sindactilia ($p < 0,05$). El resto de variables recogidas no mostraron significación estadística. En todos los pacientes se consiguió la consolidación de la fractura.

Conclusión: A raíz de los resultados obtenidos, consideramos que ambas inmovilizaciones pueden utilizarse en el tratamiento de estas fracturas; sin embargo, la sindactilia demuestra una movilidad en flexión de la articulación MCF más temprana y mejor tolerancia.

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Introduction

Fifth metacarpal neck fracture, also known as “boxer’s fracture”, is one of the most frequent trauma pathologies in the emergency department and its treatment is eminently conservative. It represents 10% of all fractures, with the fifth metacarpal being the most frequently fractured (25% of all metacarpal fractures).¹ These fractures are generally caused by a longitudinal compression force while the hand is in a closed fist posture.^{2,3}

At the time of injury, the normal palmar angulation of the metacarpal head increases. This angulation causes a shortening of the metacarpal neck, which may result in loss of the normal prominence of the fifth metacarpophalangeal joint (MTCP).⁴ In general, fifth metacarpal fractures with palmar angulation less than 40° do not have an associated rotational deformity and are treated conservatively without requiring fracture manipulation.^{4,5}

Several authors have reported that functional results can be achieved with little or no correction of these fractures in the sagittal plane.^{6–8} However, marked angulation and the resulting poor healing may result in dorsal protrusion in addition to loss of prominence of the metacarpal head when making a fist.⁹ Some authors state that metacarpal shortening and angulation greater than 30° may also lead to difficulties secondary to altered hand mechanics in patients who are manual labourers who are required to perform forceful grasping activities.^{10,11} Traditionally, treatment of this fracture consists of closed reduction and immobilisation with external splinting in the Edinburgh or intrinsic plus position (immobilisation of the fourth and fifth radius from the wrist to the proximal interphalangeal joint) (Fig. 1).



Figure 1 Intrinsic plus immobilisation performed for this study.

An alternative is functional treatment (which does not limit range of motion in any joint), either by compressive bandaging over the entire hand or syndactyly between the fourth and fifth fingers (Fig. 2). These types of treatment allow the wrist and finger joints to move freely. The theoretical advantage of this type of treatment is an earlier functional return.^{12,13} A third alternative is for patients to receive full dynamic treatment (i.e., without using any immobilisation), with normal use of the hand being recommended.⁴



Figure 2 Immobilisation with syndactyly performed for this study.

An evidence-based systematic review stated that there was no single non-surgical treatment regimen for fracture of the neck of the fifth metacarpal superior to another, although insufficient statistical power was found to detect significant differences, justifying further research as necessary.⁴

In more recent randomised controlled trials and meta-analyses, the functional outcomes were similar.^{1,14,15} Since discomfort, hand function and ability to work may be considered variably, depending on patient-physician interaction, current data are insufficient to provide a consensus for the optimal management of patients with boxer's fractures.^{1,4,16}

The main objective of this study was to compare the degree of MTCP mobility after conservative treatment of fifth metacarpal neck fractures with a displacement of 40° or less, using two types of immobilisation: syndactyly and intrinsic-plus splinting. The secondary objectives were to measure hand grip strength, satisfaction and pain after these immobilisations in patients with fifth metacarpal neck fractures.

Material and method

Design

A prospective, controlled, masked, randomised, controlled cohort study of fifth metacarpal neck fractures treated in the Vigo Health Area between May 2019 and May 2020 with an initial displacement of 40° or less measured on pure lateral radiography (Fig. 3) was conducted.

Sample size estimation

A 1:1 ratio was assumed between the two groups. Based on the work of Strub et al.¹⁷ and Harding et al.,¹³ we calculated that, to detect differences in the test of the null hypothesis that the mean difference in range of motion between the two groups of patients is equivalent, with a power of 80%, a significance level of 5%, a standard deviation of 17° and assuming a limit of equivalence of 20° (mean of the group with immobilisation with orthosis in functional position is 66°,¹⁷ mean of the group with immobilisation with syndactyly is 65°¹³ and standard deviation of both groups is

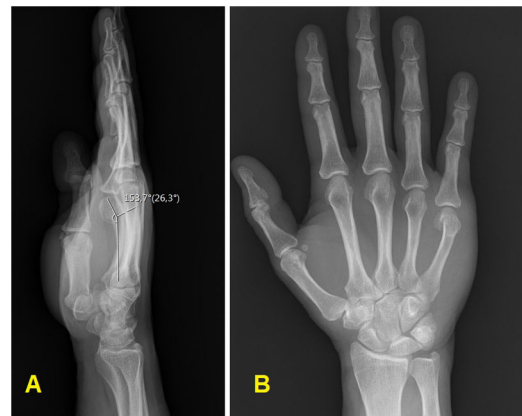


Figure 3 Lateral (A) and anteroposterior (B) projection with the fracture site angle measurement performed on the first.

17°), it would be necessary to include 16 patients in the classic immobilisation group and 16 patients in the syndactyly group, totalling 32 patients in the study. Taking into account a percentage of possible losses and/or dropouts during follow-up of 20%, it would be necessary to recruit 20 patients in the classical immobilisation group and 20 patients in the syndactyly group, totalling 40 patients in the study to find statistically significant differences in mobility.

Inclusion criteria

1. Patient diagnosed with a fracture of the fifth metacarpal neck of the hand.
2. Patients over 18 years of age.
3. Having an initial angulation (volar displacement of the metacarpal head) of less than or equal to 40° measured on a pure lateral radiograph of the hand (Fig. 3).
4. No malrotation of the fracture or overcrossing of the fingers at clinical examination.
5. Follow-up as prescribed in the outpatient consultations of the Upper Limb Unit of our Orthopaedic Surgery and Traumatology Department.
6. Agree to participate in the study and sign the informed consent form.

Exclusion criteria

1. Present with an open wound in the affected region or soft tissue-associated injury.
2. Present with another associated fracture in both upper limbs.
3. Be legally disabled or not in possession of sufficient cognitive ability to follow study indications.
4. Impossibility of carrying out follow-up and completing the study.

Variables and tools of measurement

The primary variable studied was the mobility of the MTCP joint of the fifth finger at 4 and 6 weeks after immobilisation, measured with a goniometer in degrees of active flexion and degrees of extension (measured in negative, as the degrees remaining to reach neutral or full extension). As secondary variables, the grip strength of the affected and contralateral hands was measured with a JAMAR hand dynamometer, the level of current pain measured with a visual analogue scale (VAS) and the degree of satisfaction and comfort with immobilisation. Fracture healing was also assessed if radiological signs of bone callus formation were observed; if these signs were not present, the fracture was also considered to be healed if the patient was pain-free and no mobilisation was observed at the fracture site. The degrees of volar angulation of the fracture on pure lateral radiographs were also measured.

Procedure

The study included 40 patients who attended the ED and met the previously described criteria, between 1st May 2019 and 31st May 2020. These patients were informed of their pathology, and after signing the informed consent form, one of the two types of immobilisation proposed without prior manipulation of the fracture was used fracture¹⁸:

- Type A: immobilisation with syndactyly (Fig. 2).
- Type B: immobilisation with plaster splint in functional position (Fig. 1).

The selection of the type of immobilisation was randomised according to the month in which the patients attended the ED, with month 1 (May 2019) immobilised with type A, month 2 (April 2019) with type B, and so on.

The patients included in the study underwent a review at 2 weeks by the treating physician in the ED to confirm that the immobilisation was in good condition. Four weeks after attending the ED, they were reviewed again in the outpatient department where the nursing staff removed the immobilisation, followed by a control X-ray. After this, the area specialist, as an independent observer, recorded in all the patients included in the study the variables of sex, age and involvement of the dominant hand, measuring: range of mobility using a goniometer, grip strength of the affected and contralateral hand with a JAMAR type manual dynamometer, VAS of pain at the present time and degree of satisfaction and comfort with their immobilisation. Fracture healing was also assessed, in addition to the degree of volar

angulation of the fracture in the pure lateral radiographic projection.

The patient was seen again 2 weeks after the removal of immobilisation (6 weeks from the start of follow-up) and, with the same specialist physician as an independent observer, the same parameters were recorded as in the previous consultation, adding the subjective scale for assessing the outcome of their pathology using the validated Spanish version of the Quick DASH19 questionnaire (Fig. 4).

Statistical analysis

A descriptive analysis of the variables was carried out with frequencies (percentages) and measures of central tendency (mean and 95% confidence intervals). Chi-square, Fischer's exact, Student's T and Mann-Whitney U tests were performed to compare these variables between the different groups of patients. A 2-factor repeated measures ANOVA analysis was performed to study the relationship of variables at different follow-up points as well as their interaction with respect to treatment. Data were analysed with SPSS 24.0 software and the accepted level of significance for all hypothesis tests was considered to be .05.

Ethical aspects

The researchers respected the fundamental principles of the Declaration of Helsinki and the Council of Europe Convention on Human Rights and Biomedicine, as well as all current legislation related to the study. The study had the authorisation of the Health Area management and was approved by the Galician Network of Research Ethics Committees.

Results

The total number of patients analysed in our study was 40 (20 in the cast splint group and 20 in the syndactyly group). The mean age of the sample was 36.13 years (95% confidence interval [95% CI]: 33–39.2), with 97.5% of the patients being male (39 men and one woman). All participants in our study were right-handed (right-hand dominant), with this side being affected in 90% of cases. No statistically significant differences ($p = .92$) were observed in the mean initial angulation of the fractures (measured in the ED X-ray) between the two groups (Table 1).

At 4 weeks of treatment, the immobilised group with syndactyly had a greater range of motion reaching statistically significant differences in the measurement of fifth finger MTCP joint flexion ($p = .003$) (Table 2); however, at the 6-week review the differences between the two groups no longer reached statistical significance (Table 3). The flexion of the MTCP joint of the fifth finger in the overall patients varied from 4 weeks (82.5, 95% CI [77–86.5]) to 6 weeks (89.25, 95% CI [88–90]), this increase being statistically significant ($p = .008$). However, the type of immobilisation proposed to the different groups does not produce a statistically significant interaction on joint flexion ($p = .058$) (Table 4).

With regard to grip strength, the immobilised group with syndactyly presented greater grip strength at 4 and 6 weeks

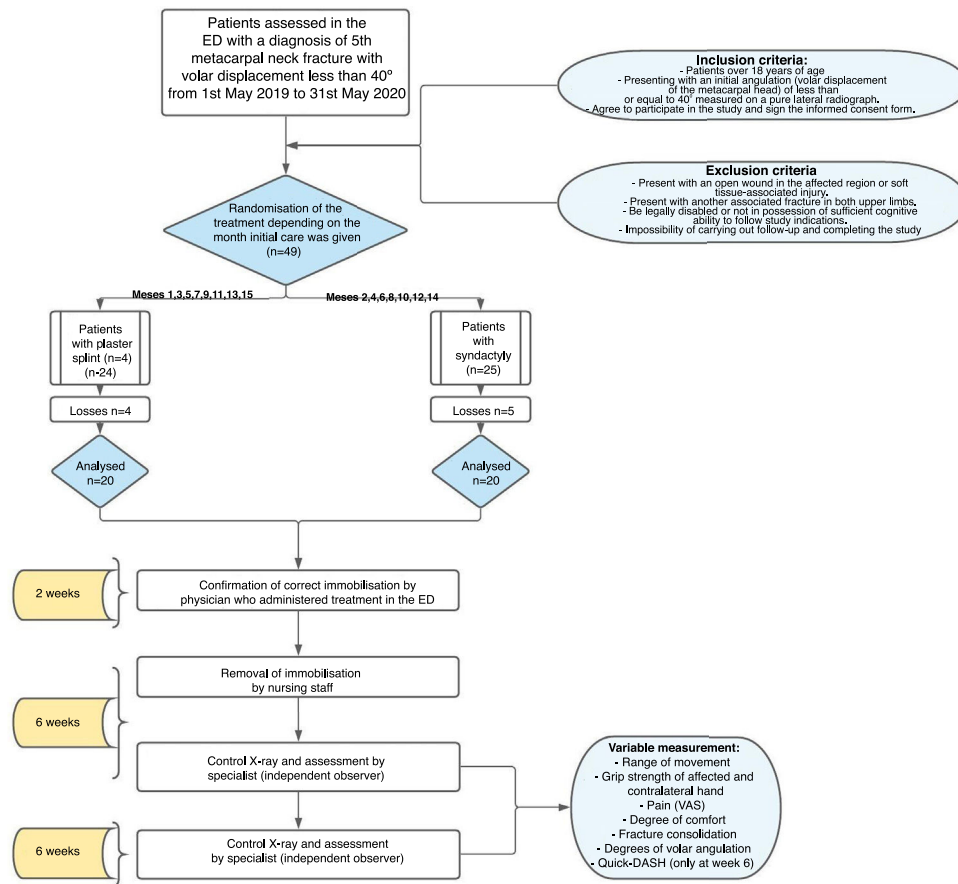


Figure 4 Diagram of the clinical trial selection and follow-up method.

Table 1 Group characteristics.

	Splint (n = 20)	Syndactyly (n = 20)	p
Age (years), mean (95% CI)	36.7 (32.4–41.1)	35.6 (31.6–39.9)	.7*
Sex, n (%)			
Man	19 (95)	20 (100)	1 ^a
Woman	1 (5)	0 (0)	
Side, n (%)			
Right	18 (90)	18 (90)	1 ^a
Left	2 (10)	2 (10)	
Affected hand, n (%)			
Dominant	18 (90)	18 (90)	1 ^a
Non dominant	2 (10)	2 (10)	
Fracture angle, mean (95% CI)	23.85 (19.5–28.2)	23.5 (19.1–27.8)	.9*

95% CI: 95% confidence interval.

* Student's t test.

^a Fisher exact test.

of follow-up without obtaining statistically significant differences ($p=.4$ and $p=.2$, respectively) with respect to the immobilised group with plaster splint (Tables 2 and 3). The strength in the affected hand, in the overall patients, varied from 4 weeks (27.5 kg, 95% CI [30.97–23.4]) to 6 weeks (41 kg, 95% CI [36.73–44.85]), this increase being statistically significant ($p<.0001$). However, the type of

immobilisation proposed to the different groups does not produce a statistically significant interaction on the strength of the affected hand ($p=.64$) (Table 4).

At 4 weeks, in the group treated with plaster splinting, consolidation was achieved in all cases, while in the group immobilised with syndactyly, no radiographic signs of consolidation were observed in 2 patients ($p=.4$). At the

Table 2 Results at 4 weeks.

	Splint (n = 20)	Syndactyly (n = 20)	p
Strength in affected hand (kg), mean (95% CI)	26.05 (21.04–31.35)	28.95 (23–34.43)	.4*
MTCP flexion (°), mean (95% CI)	77 (65.63–84.78)	88 (85.91–89.52)	.03 ^u
MTCP extension (°), mean (95% CI)	–7.25 (–13.15 to –2.96)	–3.75 (–8.44 to 0)	.2
Fracture angle (°), mean (95% CI)	23.85 (19.47–28.25)	23.5 (19.07–27.82)	.9*
VAS, mean (95% CI)	2.9 (2.1–3.81)	2.55 (1.88–3.29)	.7 ^u
Consolidation, n (%)	20 (100)	18 (90)	.4 ^a
No malrotation, n (%)	20 (100)	20 (100)	

95% CI: 95% confidence interval; MTCP: metacarpophalangeal; VAS: visual analogue scale.

* Student's t test.

^a Fisher exact test.^u Mann–Whitney U test.**Table 3** Results at 6 weeks.

	Splint (n = 20)	Syndactyly (n = 20)	p
Strength in affected hand (kg), mean (95% CI)	38.8 (32.6–45.2)	43.2 (37.24–48.54)	.231 ^u
MTCP flexion (°), mean (95% CI)	88.5 (86–90)	90 (90–90)	.602 ^u
MTCP extension (°), mean (95% CI)	–1 (–3.5 to 0)	–1 (–2.5 to 0)	.82 ^u
Fracture angle (°), mean (95% CI)	23.85 (19.5–28.2)	23.5 (19.07–27.82)	.915*
VAS, mean (95% CI)	1.05 (.4–1.9)	.5 (.12–.95)	.583 ^u
Quick DASH	14.88 (9.2–21.4)	10.98 (7.67–14.88)	.398 ^u
Consolidation data, n (%)	20 (100)	20 (100)	
No malrotation, n (%)	20 (100)	20 (100)	
Discomfort			
Slight or imperceptible, n (%)	8 (40)	15 (75)	.025 ^x
Moderate or severe, n (%)	12 (60)	5 (25)	
Satisfied patient, n (%)	18 (90)	20 (100)	.487 ^a
No complications, n (%)	19 (95)	20 (100)	1 ^a

95% CI: 95% confidence interval; MTCP: metacarpophalangeal; VAS: visual analogue scale.

* Student's t test.

^a Fisher exact test.^u Mann–Whitney U test.^x Chi-squared.**Table 4** Differences between flexion and strength at 4 and 6 weeks evolution.

	4 weeks	6 weeks	p
MTCP flexion (°), mean (95% CI)	82.5 (77–86.5)	89.25 (88–90)	.008*
Interaction between type of immobilisation and difference of flexion at 4 and 6 weeks			.058 ^a
Strength in affected hand (kg), mean (95% CI)	27.5 (23.4–30.97)	41 (36.73–44.85)	.001*
Interaction between type of immobilisation and difference in strength at 4 and 6 weeks			.64 ^a

95% CI: 95% confidence interval; MTCP: metacarpophalangeal.

* Paired Student's t tests.

^a ANOVA for 2-factor repeated measures.

6-week review, 100% healing of fractures was observed in both groups (Tables 3 and 4). No malrotation was observed in any of the sample at the 4-week and 6-week revisions, and no increase in fracture angulation was observed in either group at the control revisions.

At the 6-week review, no statistically significant differences were found in pain perception as measured by VAS and hand function as measured by the Quick DASH questionnaire

score (Table 3). In this review, only one complication (complex regional pain syndrome type I) was found in the group of patients immobilised in plaster splint ($p = 1$).

With regard to the perception of comfort with immobilisation, 75% of patients immobilised with syndactyly reported mild or imperceptible discomfort compared to 40% of patients immobilised with splinting, these differences being statistically significant ($p = .025$) (Table 3). Ninety per

cent of patients immobilised with splinting were satisfied with their treatment compared to 100% of those treated with syndactyly ($p = .4$). The patients who did not report satisfaction with their outcome were the patient who suffered the complication and one patient who scored 5 on the VAS scale at 6 weeks.

Discussion

In our clinical practice, the usual treatment for this type of fracture is standard immobilisation with a plaster splint in the intrinsic plus position, reserving syndactyly for fractures with minimal displacement. In no case is the full dynamic treatment described above carried out. This type of treatment offers good functional results in our environment, however, we had no objective data recorded on the results.

In our study, we sought to prospectively compare the two most commonly used immobilisation methods for this type of fracture with a volar angulation equal to or less than 40° (plaster splint and syndactyly), without having found statistically significant differences in the final revision (6 weeks) between the two groups in the variables studied except for comfort with immobilisation.

As a possible consequence of early mobilisation, we found in the group of patients treated with syndactyly a greater range of flexion of the MTCP joint at 4 weeks ($p = .003$). In their randomised clinical trial, in which they included fractures with a volar angulation of less than 70° , Martínez-Catalán et al.²⁰ also found at 3 and 9 weeks greater range of flexion in patients who were immobilised with syndactyly. These findings were also published by McMahon et al.²¹ and Braakman et al.⁶ in their papers. In our study, the mean MTCP flexion values at 6 weeks were very similar (88.5 in the splint group and 90 in the syndactyly group), without reaching statistically significant differences, a finding consistent with that published by Statius Muller et al.,²² who also found no differences in the measurement of joint range at 6 and 12 weeks.

In line with previous studies,^{6,14,23} the group of immobilised patients with syndactyly showed greater grip strength in the measurements taken at 4 and 6 weeks, without reaching statistical significance with the data obtained in the other group, unlike the work of Kuokkanen et al.²³ and Braakman et al.⁶ where this difference was found at 4 weeks of follow-up. After removal of the immobilisation, it was found that in both groups the patients gained grip strength with the affected hand without finding statistically significant differences between the two groups, so we can affirm that the patients recovered grip strength in a similar way, without influencing the type of immobilisation performed.

The majority of our sample was young males. By treating this type of fracture with a simple syndactyly and allowing freedom of movement, one might think that these patients would use their hand more, with the possibility of more fracture displacement or pain. However, in no case in the sample was an increase in the angulation of the fracture observed, nor was the presence of malrotation detected. Furthermore, no statistically significant differences were found in the perception of pain recorded in the VAS in any of the reviews (Tables 2 and 3). Of note is the fact that 2 of the patients treated with syndactyly had no radiographic signs of

consolidation at 4 weeks. This may suggest that finger mobility may have played a role; however, this was not associated with any displacement of the fracture site.

There were also no statistically significant differences in the Quick DASH questionnaire score at 6 weeks, which assesses the patient's perceived functional status. This finding is consistent with Pellatt et al.¹⁶ and Van Aaken et al.¹⁴ who also found no significant differences with this questionnaire. Bansal and Craigen²⁴ found no differences in the DASH questionnaire at 12 weeks, even postulating that these are fractures in which no specific follow-up would be necessary.

The variable that was affected by the type of immobilisation was the comfort perceived by the patient. Seventy-five percent of patients treated with syndactyly reported mild or imperceptible discomfort, compared to 40% in the splint-immobilised group, and this difference was statistically significant. Following our literature search, we were unable to find many articles that analyse in detail the comfort of the patient with immobilisation. Only Van Aaken et al.,¹⁴ in their multicentre randomised clinical trial, report finding no significant differences between the two groups. We consider this to be an important nuance, given that these are fractures associated with young patients² and direct blows,²⁵ in which correct adherence to treatment is of the utmost importance. In our case, 100% of patients treated with syndactyly were satisfied with the treatment carried out, compared to 90% of those immobilised with a splint. Previous studies have also reported greater satisfaction in patients with syndactyly,²⁴ although in our case no significant difference was found ($p = .487$).

We found only one complication in the entire sample, and this was recorded in the group of patients immobilised with splinting in the functional position. It was due to complex regional pain syndrome type I, a complication associated with prolonged immobilisation, although the fracture itself can also be a triggering factor.²⁶

As published in previous studies,²³ at 6 weeks follow-up all the fractures were consolidated with a good range of mobility, demonstrating both the clinical and radiological effectiveness of both therapeutic options.

We consider syndactyly to be an immobilisation technique that is easily reproducible at any level of care. In our hospital, the Emergency Department is used to performing this type of immobilisation for minor trauma, so it could also be used for this type of fracture, based on the results obtained. The fact that it does not require a doctor specialising in Orthopaedic Surgery and Traumatology, unlike the placement of an intrinsic plus splint (which can be more demanding in order to avoid complications), could help to increase the resolution potential of the Emergency Department and avoid duplication of care.

Our study has important limitations. The immobilisations were performed by up to 5 different orthopaedic surgeons, despite the fact that the in-office examinations and measurement of parameters were performed by a single surgeon. Furthermore, the follow-up of the patients was only 6 weeks. As strengths to be noted, a very close follow-up with measurement of variables was performed, combining analysis of clinical, radiological and, in addition, patient satisfaction and comfort outcomes. Finally, this was a prospective cohort study in which there was also treatment masking, as the physician responsible for the study and

analysis only assessed the patients once the immobilisation was removed by the nursing staff.

In conclusion, we can affirm that syndactyly between the fourth and fifth fingers is an easily reproducible, valid and effective treatment for fifth metacarpal neck fractures with volar angulation less than or equal to 40°, without increasing complications, without reducing functional capacity and providing the patient with better tolerance and greater flexion range in the first month than immobilisation with an intrinsic plus splint.

Level of evidence

Level of evidence II.

Conflict of interests

The authors have no conflict of interests to declare.

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