

## The effectiveness of closed reduction of small finger metacarpal neck fractures: a prospective analytical study

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**Objectives** To prospectively assess the effectiveness of closed reduction of small finger metacarpal neck fractures in terms of the extent to which the reduced fracture angulation can be maintained at 2 weeks and 4 weeks after reduction by using a plaster ulnar gutter splint.

**Methods** This prospective, descriptive, single-center study evaluated patients who presented between January 2015 and January 2020 with greater than 40 degrees of angulation within 1 week of a small finger metacarpal neck fracture. The degree of fracture angulation was measured in oblique view from digital radiographs at pre-reduction, immediate post-reduction, 2 weeks post-reduction and 4 weeks post-reduction.

**Results** Forty-three of 67 patients were treated for small finger metacarpal neck fractures of whom 24 were excluded and 19 patients were included in the study. There was a highly significant decrease in fracture angulation at 4 weeks post reduction of from 48.05 degrees pre-reduction to 42.53 degrees ( $p = 0.006$ ). There was a very highly significant increase in fracture angulation from 36.16 degrees immediately post reduction to 42.53 degrees at 4 weeks post reduction ( $p < 0.001$ ).

**Conclusion** Initial reduction of fracture angulation cannot be fully maintained in a plaster ulnar gutter splint at 2 weeks and 4 weeks after reduction, but the angulation at 4 weeks after reduction provides an effective reduction when compared with the pre-reduction angulation. Closed reduction and immobilization in a plaster ulnar gutter splint of small finger metacarpal neck fractures is an effective method of angulation reduction. *Chiang Mai Medical Journal* 2021;60(4):407-13. doi: 10.12982/CMUMEDJ.2021.36

**Keywords:** small finger metacarpal neck fracture, fifth metacarpal fracture, boxer's fracture, metacarpal fracture, sub-capital fracture of metacarpal bone, closed reduction

### Introduction

Small finger metacarpal neck fractures are common and constitute about 20% of all hand fractures (1). Most cases occur among working-age individuals (2). The mechanism of injury is usually axial pressure loaded on the metacarpal head with the fingers clenched in the palm. Small finger metacarpal bones are more slender and less well supported than the shafts of the second and third fingers (3). Presently, the optimal treatment of these fractures is controversial, with options

ranging from non-operative treatment to various internal fixation techniques (4-7). The treatment depends on whether the fracture is opened or closed, the degree of fracture angulation, the presence of rotational deformity and other associated injuries as well as the age and occupation of the patient. The degree of fracture angulation is an important factor in determining treatment options. Closed reduction of these fractures to obtain an acceptable angulation is a common

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treatment, but there is controversy about whether an acceptable degree of angulation achieved after reduction can be maintained by orthotic or cast immobilization (8). Lowdon (2) reported that the correct position of the fracture is not adequately maintained by a volar plaster slab and that manipulation of these fracture is seldom indicated. Pace (8) reported that fracture angulation after reduction could not be maintained effectively by splint immobilization until the final follow up and concluded that closed reduction with pin fixation or open reduction and internal fixation should be considered when maintenance of the reduction was desired. The main objective of closed reduction treatment of a fifth metacarpal neck fracture with plaster ulnar gutter splint in the intrinsic-plus position is restoration of hand function. The cosmetic appearance of the dorsal angulation was not a consideration in this study.

## Objectives

The purpose of this study was to assess the effectiveness of closed reduction of small finger metacarpal neck fractures prospectively in terms of the extent to which the reduced fracture angulation could be maintained in a plaster ulnar gutter splint at 2 weeks and 4 weeks after reduction.

## Methods

This prospective, descriptive, single-center study was conducted at Maharaj Nakorn Chiang Mai Hospital and was approved by the Research Ethics Committee, Faculty of Medicine, Chiang Mai University.

Between January 2015 and January 2020, all patients who presented to the emergency room or plastic surgery outpatient department of Maharaj Nakorn Chiang Mai Hospital with a small finger metacarpal neck fracture of greater than 40 degrees of angulation within 1 week of the injury were included in the study.

Exclusion criteria were: (1) patients less than 15 years of age, (2) open fracture, (3) multiple fractures, (4) irreducible fracture, (5) refracture, (6) pathological fracture, (7) rotational deformity, (8) associated tendon injury, (9) congenital

anomaly of the small finger and (10) incomplete or inadequate radiographs.

After initial evaluation by a plastic surgeon or plastic surgery resident, pre-reduction radiographs (posteroanterior, lateral and 45-degree oblique views) were obtained. The degree of fracture angulation was measured in oblique view from digital radiographs stored on the Picture Archiving and Communication System (PACS). Figure 1 shows the method used to measure the fracture angulation described by Lowdon (2). Line AB runs through the center of the articular surface of the metacarpal head and through the center of the metacarpal base of the neck. Line CD runs along the metacarpal shaft. Closed reduction was performed if the fracture angulation was more than 40 degrees and there were no exclusion criteria. Closed reduction was performed using the Jahss maneuver (9) under local anesthesia, followed by plaster ulnar gutter splinting in the intrinsic-plus position (Figure 2). Immediate post-reduction radiographs were obtained. If the fracture angulation were greater than 40 degrees, repeated reduction would be performed.

The splint was discontinued after 2 weeks, and active range of motion with intermittent splinting was initiated. Radiographs were obtained at 2 weeks and 4 weeks after reduction and the degree of fracture angulation from oblique radiographs at pre-reduction, immediate post-reduction, 2 weeks post-reduction and 4 weeks post-reduction were measured and recorded by 2 observers. Figure 3 shows a pre-reduction radiograph and a 4 weeks post-reduction radiograph.

Means and standard deviations are used to describe continuous variables; frequencies and percentages are used to describe categorical variables. Significance was measured using the paired t test to compare pre-reduction, immediate reduction, 2 weeks post-reduction and 4 weeks post-reduction fracture angulation.

## Results

### Demographic data

Forty-three patients were treated for small finger metacarpal neck fractures at Maharaj Nakorn



**Figure 1.** The method used to measure fracture angulation



**Figure 2.** Plaster ulnar gutter splint in the intrinsic-plus position



**Figure 3.** Pre-reduction radiograph (A) and 4 weeks post-reduction radiograph (B)

Chiang Mai Hospital, of whom 24 were excluded and 19 were included in the study. Most of the cases were men (94.74%). The majority of patients were students or manual workers. Mechanisms of injury included punching (36.84%), falling on an outstretched hand (36.84%) and motorcycle accidents (26.32%). All patients were treated with closed reduction and immobilization with a plaster ulnar gutter splint. The average patient age was 32.42 years. Patient demographic data are shown in Table 1. Intraclass correlation coefficient values

were high for interobserver reliability in measuring fracture angulation pre-reduction, post-reduction (immediate), post-reduction (2 weeks) and post-reduction (4 weeks). All measurements of fracture angulation were made by one observer. Intraclass correlation coefficients are shown in Table 2.

### Fracture angulation

Average pre-reduction angulation was 48.05 degrees. Average immediate reduction angulation

**Table 1.** Demographic data

| Parameters                | N (%) (n=19)  |
|---------------------------|---------------|
| Age mean (SD)             | 32.42 (17.39) |
| Gender n (%)              |               |
| Male                      | 18 (94.74)    |
| Female                    | 1 (5.26)      |
| Mechanism of injury n (%) |               |
| Punching                  | 7 (36.84)     |
| Fall on an stretched hand | 7 (36.84)     |
| Motorcycle accident       | 5 (26.32)     |
| Injured hand n (%)        |               |
| Left                      | 4 (21.05)     |
| Right                     | 15 (78.95)    |
| Occupation n (%)          |               |
| Employee (manual worker)  | 7 (36.84)     |
| Monk                      | 2 (10.53)     |
| Police officer            | 1 (5.26)      |
| Student                   | 8 (42.11)     |
| Business person           | 1 (5.26)      |

was 36.16 degrees. Average 2 weeks post reduction angulation was 40.16 degrees and average 4 weeks post reduction angulation was 42.53 degrees. Fracture angulations are shown in Table 3.

### Mean difference in fracture angulation

There was a very highly significant decrease in fracture angulation immediately following reduction from 48.05 degrees (pre-reduction) to 36.16 degrees ( $p < 0.001$ ). There was a highly significant decrease in fracture angulation at 2 weeks post reduction from 48.05 degrees (pre-reduction) to 40.16 degrees ( $p = 0.001$ ) and at 4 weeks post reduction from 48.05 degrees (pre-reduction) to 42.53 degrees ( $p = 0.006$ ).

Comparing the mean angulation immediate post reduction with 2 weeks post reduction, there was a significant increase fracture angulation from 36.16 degrees (immediate post reduction) to 40.16 degrees ( $p = 0.014$ ). There was also a very highly significant increase in fracture angulation from 36.16 degrees (immediate post reduction) to 42.53 degrees (4 weeks post reduction) ( $p < 0.001$ ). The mean differences of fracture angulations are shown in Table 4.

**Table 2.** Intraclass Correlation Coefficient (ICC)

| Angulation                 | ICC   | Lower | Upper | p-value |
|----------------------------|-------|-------|-------|---------|
| Pre-reduction              | 0.877 | 0.713 | 0.950 | < 0.001 |
| Post-reduction (immediate) | 0.599 | 0.220 | 0.823 | 0.002   |
| Post-reduction (2 wks)     | 0.868 | 0.695 | 0.947 | < 0.001 |
| Post-reduction (4 wks)     | 0.935 | 0.842 | 0.974 | < 0.001 |

**Table 3.** Fracture angulation

| Angulation                 | Mean  | SD   |
|----------------------------|-------|------|
| Pre-reduction              | 48.05 | 5.89 |
| Post-reduction (immediate) | 36.16 | 5.08 |
| Post-reduction (2 wks)     | 40.16 | 8.44 |
| Post-reduction (4 wks)     | 42.53 | 7.86 |

## Discussion

Our study showed that motorcycle accident were the different mechanism of injury compared with previous reports (2), but punching and falling still were a common mechanism, similar to previous reports. Most of the patients were men and the average patient age was similar to a previous report (8).

The method used to measure the fracture angulation on the oblique radiograph was similar to that used in previous reports (2, 8). That method involves less superimposition of the metacarpal bones and allows easier measurement of the fracture angulation than the lateral radiograph (8). Angulations measured on oblique radiographs were found to be on average 10 degrees greater than those measured with lateral views. (2,10)

The degree of fracture angulation is an important factor in determining treatment options. The reported acceptable angulation for not attempting reduction varies from 20-70 degrees (1,5,11-18). Patients who use their hands extensively for gripping, e.g., professional athletes and carpenters, may experience discomfort with the metacarpal head of the small finger flexed into their palm, and angulation greater than 40 degrees would typically not be acceptable (19). In our study, a fracture angulation of greater than 40 degrees was considered

**Table 4.** Mean differences of pre-reduction and post-reduction angulation (degrees)

| Angulation                                          | Mean difference* | SD   | p-value |
|-----------------------------------------------------|------------------|------|---------|
| Pre reduction                                       |                  |      |         |
| Pre reduction – post reduction (immediate)          | -11.89           | 6.76 | < 0.001 |
| Pre reduction – post reduction (2 wks)              | -7.89            | 9.01 | 0.001   |
| Pre reduction – post reduction (4 wks)              | -5.53            | 7.69 | 0.006   |
| Post reduction                                      |                  |      |         |
| Post reduction (immediate) – post reduction (2 wks) | +4.00            | 6.41 | 0.014   |
| Post reduction (immediate) – post reduction (4 wks) | +6.37            | 5.81 | < 0.001 |

not acceptable and reduction was attempted.

Lowdon (2) reported the corrected position of the fracture was not adequately maintained after 2-4 weeks immobilization by a volar plaster slab and that manipulation of these fractures is seldom indicated. That study was limited by a sample size of 16 subjects and there were no clear inclusion and exclusion criteria. In that study, closed reduction was performed if there was moderate or severe angulation, rotation or ulnar deviation. There was no specific fracture angulation for attempted reduction in the study. Our study had clear inclusion and exclusion criteria, and if the fracture angulation was greater than 40 degrees, attempted reduction would be performed. The number of patients (the necessary sample size) calculated by statistical methods was 19. Pace (8) assessed the effect of closed reduction in small finger metacarpal neck fractures in 66 subjects by comparing reduction (23 patients) and non-reduction (43 patients). That study showed attempted reduction of a small finger metacarpal neck fracture did not result in a statistically significant decrease in residual fracture angulation at final follow-up. It further reported that the fracture angulation after reduction could not be maintained effectively by splint immobilization until the final follow-up and concluded that closed reduction with pin fixation or open reduction and internal fixation should be considered when maintenance of the reduction was desired. That retrospective study of all patients with isolated metacarpal neck fractures between 2004 and 2014 included no specific fracture angulation for attempted reduction.

Our study found some different results when assessing reduced fracture angulation main-

tained in a plaster ulnar gutter splint at 2 weeks and 4 weeks after reduction. The results of our study showed that the reduced fracture angulation could not be maintained after reduction. The reduced angulations at 2 weeks after reduction were significantly increased compared with immediately after reduction ( $p = 0.014$ ) and the reduced angulations at 4 weeks were very highly significantly increased compared with the angulation immediately after reduction ( $p < 0.001$ ). However, there was a highly significant decrease in fracture angulation at 4 weeks post reduction compared with the pre-reduction angulation ( $p = 0.006$ ). Even though the initial reduced fracture angulation could not be completely maintained in the plaster ulnar gutter splint at 2 weeks and 4 weeks after reduction, that procedure effectively reduced the angulation when compared with the pre-reduction angulation.

There are many controversial issues regarding the optimal treatment of this type of fracture, e.g., conservative or operative treatment (14), immobilization or early mobilization (20), type of immobilization (21), closed reduction attempt or not, need for follow up or not (20) and what is an acceptable fracture angulation. One of the rationales of the controversy was variable acceptable fracture angulation, ranging from 20-70 degrees (1,5,11-18). Considerable angulation of a small finger metacarpal neck fracture is acceptable without compromising hand function because of compensatory carpometacarpal joint motion. The ring and small finger carpometacarpal joints have 20 to 30 degrees of mobility in the sagittal plane, while the index and middle carpometacarpal joints have less mobility (19). Our study results

support that the reduced angulation at 4 weeks after reduction is an effective reduction when compared with the pre-reduction angulation.

A limitation of our study was the reliability of the measurement of angulation. First, superimposition of the metacarpal head could be seen in some radiographs because the oblique radiograph had not been obtained correctly in the hand with the plaster ulnar gutter splint. Second, it was not easy to identify the center of the articular surface of the head and the center of the base of the neck in some radiographs because the fracture alignment was not clear. Measurements on oblique radiographs were easier than in lateral views.

## Conclusions

Initial reduction of fracture angulation cannot be maintained with a plaster ulnar gutter splint at 2 weeks and 4 weeks after reduction, but the reduced angulation at 4 weeks after reduction is considered an effective reduction when compared with the pre-reduction angulation. Closed reduction and immobilization in a plaster ulnar gutter splint of metacarpal neck fractures of the small finger is an effective treatment.

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## ผลของการจัดกระดูกให้เข้าที่ โดยไม่ผ่าตัด ในผู้ป่วยที่มีส่วนคอของกระดูกฝ่ามือนิ้วก้อยหัก

โอภาส พิณไชย และ พินัย จิรจิตติวงศ์

หน่วยศัลยศาสตร์ตกแต่ง ภาควิชาศัลยศาสตร์ คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่

**วัตถุประสงค์** เพื่อประเมินประสิทธิผลของการรักษาแบบไปข้างหน้า ในผู้ป่วยที่มีส่วนคอของกระดูกฝ่ามือนิ้วก้อยหัก โดยศึกษามุมของกระดูกที่หัก เมื่อจัดให้เข้าที่แบบไม่ผ่าตัดและใส่เฝือกแล้ว มุมนั้นคงที่หรือไม่เมื่อเวลาผ่านไป 2 สัปดาห์และ 4 สัปดาห์

**วิธีการ** ทำการศึกษาเชิงพรรณนาแบบไปข้างหน้าในผู้ป่วยที่มีส่วนคอของกระดูกฝ่ามือนิ้วก้อยหัก ที่มีมุมของกระดูกหัก มากกว่า 40 องศา และกระดูกหักมาไม่เกิน 1 สัปดาห์ ที่มารับการรักษาในโรงพยาบาลมหาราชนครเชียงใหม่ ช่วงเดือน มกราคม พ.ศ. 2558 ถึงเดือนมกราคม พ.ศ. 2563 โดยทำการวัดมุมของกระดูกที่หัก จากภาพเอกซเรย์ เปรียบเทียบกัน 4 ระยะ คือ ก่อนจัดกระดูก, หลังจัดกระดูกทันที, หลังจัดกระดูก 2 สัปดาห์และหลังจัดกระดูก 4 สัปดาห์

**ผลการศึกษา** มีผู้ป่วยมารับการรักษาทั้งหมด 67 คน มี 43 คน ที่มีมุมที่หักมากกว่า 40 องศา เข้าเกณฑ์การคัดออก 24 คน เหลือผู้ป่วยสำหรับศึกษา 19 คน จากการศึกษาพบว่า มุมของกระดูกที่ 4 สัปดาห์ (42.53 องศา) ลดลงอย่างมีนัยสำคัญทางสถิติ ( $p = 0.006$ ) เมื่อเทียบกับก่อนจัดกระดูก (48.05 องศา) อย่างไรก็ตามมุมของกระดูกที่ 4 สัปดาห์ (42.53 องศา) ก็เพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติ ( $p < 0.001$ ) เมื่อเทียบกับหลังจัดกระดูกทันที (36.16 องศา)

**สรุป** มุมของกระดูกที่หัก เมื่อจัดให้เข้าที่และใส่เฝือกแล้ว มุมนั้นไม่คงที่เมื่อเวลาผ่านไป 2 สัปดาห์และ 4 สัปดาห์ แต่มุมของกระดูกที่ 4 สัปดาห์ ก็ลดลงอย่างมีนัยสำคัญทางสถิติเมื่อเทียบกับก่อนจัดกระดูก ดังนั้นการจัดกระดูกที่หักให้เข้าที่แบบไม่ผ่าตัดแล้วใส่เฝือก ในผู้ป่วยที่มีส่วนคอของกระดูกฝ่ามือนิ้วก้อยหัก เป็นการรักษาที่มีประสิทธิภาพ **เชียงใหม่เวชสาร 2564;60(4):407-13. doi: 10.12982/CMUMEDJ.2021.36**

**คำสำคัญ:** ส่วนคอของกระดูกฝ่ามือนิ้วก้อยหัก ส่วนคอของกระดูกฝ่ามือนิ้วที่ห้าหัก กระดูกหักแบบบ็อกเซอร์ กระดูกฝ่ามือหัก กระดูกหักแบบซันแคปิตอล จัดกระดูกให้เข้าที่โดยไม่ผ่าตัด

