

Hand Function of Patients with Fifth Metacarpal Bone Neck Fractures Treated Conservatively

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ABSTRACT

Introduction: The fifth metacarpal bone (5th MCB) fracture is common particularly among the young adults. Treatment options for 5th MCB neck fractures can be treated surgically. Studies suggest non-surgical treatment also yields good outcomes. No established guideline on optimal treatment strategy exists. This study was performed to measure functional outcomes of 5th MCB neck fracture treated conservatively.

Materials and methods: A retrospective cross-sectional study was done to assess hand function in patients with 5th MCB neck fractures treated non-operatively from January 2015 to September 2023 at HPUSM. Grip strength in both injured and contralateral hands were measured and QuickDASH questionnaire was utilised to evaluate function. Flexion gap measurements was also analysed.

Results: There were total of 43 patients, [35 males (81.4%) and 8 females (18.6%)] included in this study. There was a significant drop in mean grip strength compared injured to the contralateral normal hand with percentage loss is averaging 11.5%. QuickDASH points accumulated showed 36 patients (83.7%) with 'Good' outcome while 7 patients (16.3%) having 'Satisfactory' outcomes. Most common complication was cosmetic (30.2%), followed by reduced ROM in 8 patients. Residual pain was present in five patients. Out of 43 patients, 3 patients had flexion gap deformity.

Conclusion: The overall scores from the QuickDASH questionnaire showed no significant drop in functional outcome. There was significant decline in mean grip strength. Most patients had favourable outcomes. Conservative treatment for 5th MCB neck fracture is still a good option of treatment. Further evaluation comparing outcome with operated cases will be worthwhile.

Keywords:

5th MCB fracture, conservative treatment, functional outcome, grip strength, QuickDASH

INTRODUCTION

Metacarpal bones serve as the intermediate section of the hand skeleton, connecting proximally with the carpal bones and distally with the phalanges. They are numbered as metacarpal I-V from the radial side, which means that the thumb is metacarpal numbered the 1st, and the little finger metacarpal is numbered the 5th. Structurally, a metacarpal bone comprises a head, neck, body, and base¹. Metacarpal fracture is the most common upper extremity injuries in adults, accounting 26-36% of hand fractures, with 5th metacarpal bone fracture commonest². Metacarpal fractures typically occur in patients aged 10 to 40, with higher incidence among men compared to woman^{3,4}.

Fractures of the neck fifth metacarpal bone (5th MCB) are common among young and working individuals, often resulting from punching or direct trauma with a clenched fist. The energy transferred axially through the 5th MCB commonly causes a dorsally angulated neck fracture due to intrinsic muscle pull, resulting in volar angulation and potential malunion⁵. Excessive volar angulation can lead to loss of dorsal knuckle prominence and discomfort in the palm, impacting hand function, while also affecting muscle lever arms and resulting in reduced grip strength and limited range of motion (ROM) in the fifth metacarpophalangeal joint⁶.

Numerous treatment options for 5th MCB neck fractures have been documented, ranging from surgical interventions with Kirschner wire pinning, mini plating, and intramedullary fixations⁷⁻⁹, to non-surgical approaches such

as pain relief, immobilisation with or without closed reduction, or the use of functional braces¹⁰⁻¹². However, there is no established treatment guidelines. Predominance of retrospective studies focuses on specific treatments without comparative analysis between groups making the optimal treatment approach remain a subject of ongoing debate.

Considerate amount of evidence shows that conservative treatment comparable to surgical intervention with good patient satisfaction and good functional outcome^{4,6,12,13}. A study by Wormald *et al* in 2019 indicated that no significant difference in outcomes assessed when operative and non-operative interventions for 5th MCB fracture directly compared in terms of primary functional outcomes measured¹⁴. Westbrook *et al* in 2008 retrospectively compared operative vs non-operative treatment for 5th MCB neck and shaft fractures and found no difference in DASH scores or other clinical outcomes for neck fractures, with better outcomes in the non-operatively managed shaft fractures¹⁵⁻¹⁸.

This study analyses the outcomes of hand functions in 5th MCB neck fracture treated conservatively. The outcome of this study serves as a reference for clinicians and therapist to strategies treatment and functional outcome follow ups, in addition to rehabilitation plans for patients with 5th MCB neck fracture.

MATERIALS AND METHODS

This retrospective cross-sectional study was done to investigate and analyse the outcome of hand functions in patients with 5th MCB neck fracture treated non-operatively with a minimum six-month duration of follow-up at Hospital Pakar Universiti Sains Malaysia (HPUSM). The patients were selected from period of January 2015 till September 2023. Patients with shaft fractures, open fractures and multiple hand fractures with other associated injury were excluded.

Basic demographic data and consent was taken before enrolment. For grip strength evaluation, patient asked to sit with arm adducted, elbow flexed to 90° and then squeeze hand dynamometer. Grip strength will be recorded both for injured and non-injured hand (average of 3 readings were recorded).

For QuickDASH questionnaire, the questions were asked by researcher and the points were accumulated and tabulated for functional status outcomes. A score of less than 5 is deemed excellent; 6-15 is good function; 16-35 is satisfactory and anything above that is poor. Presence of flexion gap deformity was also measured.

Hand grip strength of injured and contralateral hand was evaluated using paired T-test. QuickDASH questionnaire to evaluated using Chi-square, independent T-test and Mann-

Whitney U test appropriately comparing variables with age, gender, occupation, hand dominant, post trauma duration and fracture angulation. Flexion gap measurement (Fig. 1) was assessed using descriptive analysis. P-values <0.05 were considered statistically significant.

RESULTS

The sample size was determined from calculations using the available literature⁹ for a statistical power of 95% using single mean, adding an estimated 10% drop out a total of 44 patients was required. A total of 71 patients who sustained closed 5th MCB neck fracture was treated non-operatively from 2015 to 2023 in HPUSM were identified. All patients were above 18 years old and have at least completed minimum of 6 months post treatment. Out of 71, 28 patients were not included in the study as 10 patients were uncontactable, and 18 patients refused participation. A total of 43 patients agreed for study participation.

There were 35 males (81.4%), and 8 females (18.6%) patients included in study. The age of the patients ranged from 18 to 77 years, with a median of 37.67 years, with an interquartile range (IQR) of 22 years. There were 15 patients with background government occupation (34.9%), 14 patients from private occupation (32.6%) and 14 is either unemployed or retired (32.6%). Four participants (9.3%) have a left dominant hand, while 39 participants (90.7%) have a right dominant hand (Table I). The injuries mainly were from motor vehicle accident.

The mean grip strength for injured hand is 32.35kg (SD± 12.06kg; CI 95% [28.3,36.3]) with as compared to non-injured hand is 34.7kg (SD ± 11.44kg; CI 95% [30.9,38.5]). The minimal and maximal grip strength values of the injured hand were 2.9kg and 57.7kg, while the values for the non-injured hand was 9.2kg and 58.1kg, respectively. Utilising Shapiro-Wilk test for normality, the mean grip strength for injured and non-injured hand scores were distributed normally. Using Paired T-test, there was a significant mean difference of grip strength between injured and non-injured hands ($p = 0.002$). The median grip strength of an injured hand was lower compared to a non-injured hand. Average percentage of grip strength loss between injured and non-injured hand was 11.47%.

The outcome of hand function following QuickDASH questionnaire is based on total points accumulated and divided into four parameters, excellent, good, satisfactory, and poor. Based on points accumulated for our patients, 36 patients have good outcome (83.70%) while 7 has satisfactory outcome (16.3%) (Table II). However, there were no significant mean difference between age ($p = 0.276$), gender ($p = 0.459$) and hand dominance ($p = 1.00$) with functional status QuickDASH in both 'Good' and 'Satisfactory' groups (Table III).

Table I: Patient clinical characteristics (n=43).

Variable	N	(%)	Median (IQR)
Age			37.67 (22)
Gender	Female	8	18.6
	Male	35	81.4
Occupation	Government	15	34.9
	Private	14	32.6
	Unemployed	14	32.6
Dominant Hand	Left	4	9.3
	Right	39	90.7
Complications	No	17	39.5
	Cosmetic	13	30.2
	Pain	5	11.6
	ROM	8	18.6
Post Trauma Duration (months)			Median (SD)
Fracture Angulation (degrees)			23.39 (15.61)
Injured Hand (average grip strength) (kg Force)			31.51 (14.55)
Non-Injured Hand (Average grip strength) (kg Force)			32.35 (12.05)
Flexion Gap (cm)			34.76 (11.44)
			0.19 (0.69)

Table II: QuickDASH data characteristic.

Variable	Mean	(SD)
Quick Dash Score	14.00	5.22
Quick Dash	Good (score 6-15)	36
	Satisfactory (score 16-35)	7
		83.7
		16.3

Table III: Associations of functional status (DASH) and clinical characteristics.

Variable	Good N / Mean	Satisfactory % / (SD)	N / Mean	% / (SD)	p-value*
Age	36.50	16.28	43.71	12.85	0.276 [^]
Gender	Female	6	16.7%	2	28.6%
	Male	30	83.3%	5	71.4%
Occupation	Government	12	33.3%	3	42.9%
	Private	12	33.3%	2	28.6%
	Unemployed	12	33.3%	2	28.6%
Dominant Hand	Left	4	11.1%	0	0.0%
	Right	32	88.9%	7	100.0%
Complications	No	17	47.2%	0	0.0%
	Cosmetic	12	33.3%	1	14.3%
	Pain	3	8.3%	2	28.6%
	ROM	4	11.1%	4	57.1%
Post Trauma Duration	28.28	18.06	17.57	7.41	0.133 [^]
Fracture Angulation (Degree)	30.06	15.85	36.79	15.35	0.308 [^]
Flexion Gap (cm)	(Median, IQR)	0.00	0.00	0.00	0.711 [']

*Chi Square Test [^]Independent T Test [']Mann-Whitney U Test

The distribution of complications among participants is as follows: 17 individuals (39.5%) experienced no complications, 13 (30.2%) had cosmetic issues, 5 (11.6%) reported pain, and 8 (18.6%) had limited range of motion (ROM). The mean duration post-trauma was 28.28 months in the 'Good' outcome group and 17.57 months in the 'Satisfactory' outcome group. The mean fracture angulation was 30.06° in the 'Good' outcome group and 36.79° in the

'Satisfactory' outcome group. However, there was no statistically significant difference in mean post-trauma duration ($p = 0.133$) or fracture angulation ($p = 0.308$) between the two groups (Table III).

As for flexion gap deformity, 2 patient's had gaps of 2cm, and one patient had a 3cm gap out of 43 patients. These patients had history of rotational deformity at initial

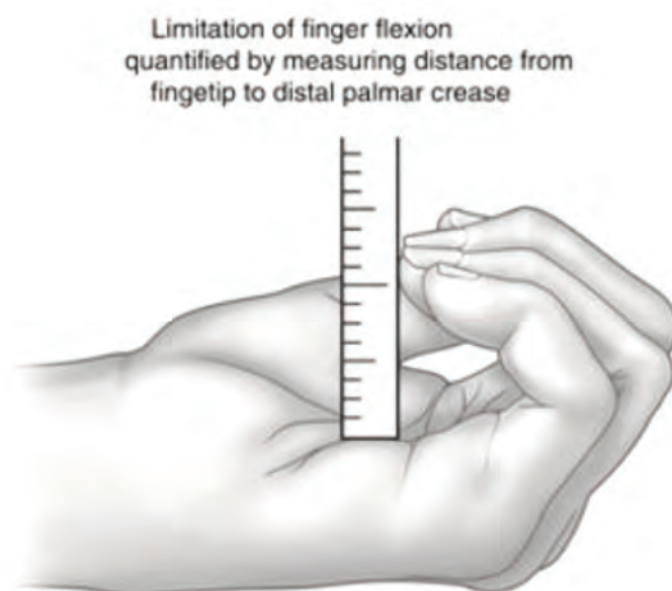


Fig. 1: Flexion gap measurement technique using ruler.

presentation. Eight patients had limited ROM at the metacarpophalangeal joint as complication possible due to extension deficit of little finger. The median flexion gap is 0.19 and no significant median difference ($p = 0.711$) between flexion gap and functional status.

DISCUSSION

The incidence of 5th MCB neck fracture predominantly in young adults and male population and often observed in individuals who participate in activities that put significant strain on the hands, such as sports like boxing or martial arts, as well as occupations involving manual labour or motor vehicle accident. In this study, the average age was 37 years with a higher proportion of males, 39 out of 43 (81.4%) affected as well. Our study included individuals from diverse employment backgrounds, including government, private, and unemployed individuals.

Between period from 2015 to 2023, a total of 71 patients with 5th MCB fractures meeting the study's criteria were identified, but only 43 agreed to participate (39% non-participation). Reasons for non-participation included factors such as geographic, socioeconomic circumstances and satisfaction with their treatment outcomes, not needing them to come for further check-up and study participation. Low follow-up rates are commonly reported in similar studies; for instance, Porter *et al* found that only 38% of patients returned for a planned two-month follow-up assessment¹⁷. Similarly, Westbrooke *et al* reported a follow-up rate of only 17% for conservatively treated 5th MCB fractures, compared

to 54% in the operative group, mentioning most patients are presumed managing well and has resumed their normal activities giving excellent healing potential for the nature of fracture¹⁵.

In our study, the grip strength parameters were assessed using the non-injured hand as a reference for the patient's pre-fracture baseline. The grip strength values of the injured hand were then compared to these baseline values to gauge the level of recovery. We found a statistically significant difference loss between the grip strength of the injured and non-injured hands, with an averaging percentage grip strength loss of 11.47% in injured hands. However, only three patients reported of subjective weakness related to work profile. The increased use of non-injured hand due to reduced usage of injured hand may have affected the percentage, more common in non-dominant hand. In contrary, most other studies comparing different conservative treatment type groups shows no significance loss in grip strength between groups when compare with non-injured contralateral hand^{4,9,11}. However, Ford *et al* in 1989 did a prospective study on 62 patients with 5th MCB fracture treated noted significant grip strength loss in injured hand but mentioned all the patients did not complain of any weakness¹².

The QuickDASH questionnaire was utilised to evaluate functional status, with majority of patients (83.7%) reporting a 'Good' functional status, while the rest were classified as 'Satisfactory'. Age, gender, occupation, and hand dominance did not appear to influence functional outcomes in either group. However, patients classified as having a 'Good'

functional status tended to have a longer duration post-trauma at the time of assessment and less fracture angulation compared to those in the 'Satisfactory' group, although these differences were not statistically significant. Most patients expressed concerns about cosmetic appearance of the depressed knuckle, with some experiencing occasional discomfort, but overall, they had resumed their daily activities with adequate functionality. Gamble *et al* conducted a retrospective study analysing functional outcomes using the QuickDASH questionnaire for 5th MCB fractures treated in the Emergency department, reporting good patient satisfaction and acceptable functional results, even without direct patient assessment, based only on its validity¹⁹.

Flexion gap deformity was observed in only 3 patients, with one patient recording a gap of 3cm. This patient exhibited rotational deformity with a volar angulation of 50°. However, the patient expressed no interest in further intervention and reported satisfaction with his current functional outcome.

Based on the results obtained in our study, 36 patients had overall good functional outcome in 5th MCB fracture that treated conservatively. This indicates non-operative management is a good treatment method with adequate functional outcome. Despite some of the residual symptoms, the findings of each of the individual parameters and overall outcome was similar to the studies that were done elsewhere.

As in most retrospective studies, there are inherent limitations to this study. The sample size was not high to obtain more significant results. The hand dominance was not taken into consideration when evaluating the grip strength due to the small sample of patients. Besides QuickDASH

questionnaire, other validated research tools could be added to improve the strength of the study, however most studies till date still utilise the QuickDASH questionnaire as gold standard. A short-term evaluation of functional outcome at six months may be appropriate to show outcome of non-operative treatment. Patients who have adjusted to the disability with time may have better scores as in our study. The comparison to the normal hand was necessary not hand dominance to come to the conclusion for this study. The study did not evaluate demographic data as possible confounders to the results using statistical test as it was not a study objective. The severity of initial and final neck shaft angulation was also not taken into consideration in the final outcome. It is the practice of the studied establishment to allow up to only 45° of angulation to be treated non-operatively. This parameter may be a reason for better results.

CONCLUSION

The overall scores from the QuickDASH questionnaire shows no significant drop in functional outcome although there is a significant percentage loss in mean grip strength. However, most patients have a favourable outcome with less complications. Hence, non-operative treatment for 5th MCB fracture is a good option of treatment. Further evaluation comparing operative vs non-operative cases would reflect the better option of treatment for 5th MCB neck fractures.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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