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A minimally invasive fixation for boxers fracture – fifth metacarpal neck using antegrade K wire fixation – functional outcome study

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ABSTRACT

Background: Fifth metacarpal fractures are more common fractures in hand which are treated by conservative or surgical methods. Using retrograde k-wire fixation is associated with more complications due to damage to articular surface causing deformity or decreasing range of motion. Studies are done using single k-wire usage by antegrade technique, results vary due to k-wire complications and surgeon experience. **Aims and Objectives:** In this study, we are used a technique to bend a K wire in S-shaped fashion to negotiate through fracture to hold and reduce the fracture by rotating the tip of K-wire. **Materials and Methods:** This prospective study was done for fracture neck of fifth metacarpal presenting to outpatient department in 36 patients with dorsal angulation of more than 300 treated by passing a single k wire bent at the tip and shaft to form an S shape retrogradely with a follow-up period of 6 months following surgery. **Results:** Majority of injuries were in males in the dominant hand with a mean age group of 27.25 years. The mean pre-operative flexion angle of distal fragment was 44.11° (SD–4.12), and after the end of follow-up healing was achieved in all cases with a mean flexion angle improvement to 5.25° (SD–2.16). Disabilities of the arm, shoulder, and hand score measured at the end of study showed a mean of 6.25, and total active motions core showed excellent results in 25 cases (69.4%) cases and poor in 1 case (2.77%). **Conclusion:** This study emphasizes that bending a K wire in a lazy S fashion and passing antegradely will replicate results similar to using 2 K wires and have a better prognosis than retrograde wiring through the head of metacarpal. Furthermore, this procedure can be done in a primary care setting with minimal resources.

Key words: Antegrade; Hand surgery; K wire; 5th metacarpal; Lazy S-shaped; Metaizeu technique

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INTRODUCTION

Fifth metacarpal neck fractures also synonymous with Boxer's fracture are well-known injuries usually self-inflicted while hitting a forceful object with a fist. In this fracture, the energy is transferred to fifth metacarpal axially and this force mostly results in apex dorsal angulation due to the pull of the interosseous muscles of the hand. They correspond to 9.7–50% of all hand cases.[1] The most common mode of injury for this fracture is when a patient tries to hit a person, misses him, and hits a hard object. Due to the type of mechanism, these injuries are mostly seen in the dominant hand.

Majority of these fractures are minimally displaced with no rotational component for which conservative treatment is the

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choice. Operative treatment is for fractures with angulation toward the volar aspect along with rotational component. The problem in treating this fracture is mainly due to the bony angulation of the distal fragment which is very difficult to correct and maintain in a slab or to pass a k wire.

Fifth metacarpal fracture treatment is difficult and various methods are employed to treat these fractures mainly retrograde pinning with k wires, transverse pinning with K wires, closed reduction with towel clips or reduction forceps, and passing k wires. External fixators are also used to correct these fractures using ligamentotaxis.[2-4]

These methods are known to produce deformity due to flexion of distal fragment which displaces easily with any of the above procedures. A new technique is still in search to prevent these complications and shortening of the fifth metacarpal due to deformity.

Shortening of the fifth metacarpal is a very common complication seen with these fractures treated with cast/slab application. The shortening of the fifth metacarpal decreases the tensile strength in the extensors and flexors of the finger causing weakened grip strength and difficulty in doing daily activities.[5]

To prevent shortening and flexion deformity of the fifth metacarpal head, our new technique helps to stabilize these fractures with k wires entering from the proximal end of the fifth metacarpal and fixing the fracture fragment with antegrade k wires using the metaizeau technique as used to treat displaced radial neck fractures in child.[6]

A closed, not angulated, and not malrotated-fifth metacarpal fracture can be managed by immobilization with an ulnar gutter splint. Buddy strapping of little finger with ring finger is also a known conservative mode of treatment for these fractures.[7]

Many studies conducted previously recommended angulation up to 70° in fifth metacarpal neck fractures.[8-10] A biomechanical study conducted by Ali et al., in 1999 concluded an 8% loss in flexor digiti minimi grip strength and a 22% reduction in the range of motion (ROM) associated with 30° of angulation, suggesting an upper limit for acceptable angulation of 30°.[5]

K-wires are minimally invasive implants used for both percutaneous and open fracture fixation. However, K-wires can cause sometimes neurovascular injury, tendon adhesions, pin site infection, and pin loosening.[11] Even with these complications, K-wires can cause minimal scar and better fracture reduction in small bone fractures such as metacarpal and distal radius.

K-wires are inserted using four techniques (cross-pinning, crucifix pinning, bouquet pinning, and single K-wire in lazy S fashion). Our study shows the results of Single k wire passed in lazy "s" fashion antegradely.

Aims and objectives

To evaluate functional and radiological outcome of union following antegrade k wire fixation for 5th metacarpal neck fracture.

MATERIALS AND METHODS

This study was conducted in a tertiary care center after obtaining ethical committee clearance. The patients were included with fifth metacarpal fractures, which came to the emergency department as closed fractures. This study was conducted between January 2022 and September 2023 with the patients presenting to outpatient department with fifth metacarpal fractures.

Patients were advised pre-operative investigations and after these patients were planned for surgery. All patients in our study were treated with K wires which were passed antegrade from the fifth metacarpal base toward the head to reduce the fracture and hold it. Pre-operative angulation of the neck of fifth metacarpal was measured in a radiograph and was recorded.

Patients were taken to the operating room after proper consent for the procedure and these patients were given regional anesthesia, mostly wrist block or an axillary block and patient was kept in a supine position and the skin was draped with sterile drapes.

Intraoperative fluoroscopy is done to see for reduction after anesthesia. In our study, we used K wires passing antegrade for which the entry point is taking over the fifth metacarpal base over the medial aspect. Predrilling of bone is done with 1.8 mm k wire at an angle to accommodate the k wire which is passed through this predrilled hole. After predrilling with 1.8 mm k wire, a 1.5 mm k wire is bent at the tip to make an S-shaped bent with an obtuse bend to facilitate the wire to pass through the medullary canal. This 1.5 mm K wire which is bent is passed through the predrilled hole into the medulla with a K wire passer/T handle.

Under fluoroscopy guidance, the k wire is advanced till the head of the fifth metacarpal. After reaching the head, the k wire is rotated to correct the neck angulation and maintain reduction (Figure 1). Excess k wire is bent and cut, a sterile dressing is applied over the entry area, and a gutter slab or cast is applied for immobilization.

This slab is maintained for 3 weeks, after which the slab is removed, the patient is mobilized with K wire in place

for 1 week, and then the k wire is removed after a total duration of 4 weeks. After this, patient is advised for strict physiotherapy for grip strength and ROM.

Total active motions (TAM) score and disabilities of the arm, shoulder and hand (DASH) score were used to evaluate the functional outcome at 3 weeks, 6 weeks, and 3 months duration, and radiographs were also taken during these visits to assess bony union and angulation of fragments at different stages of union.

RESULTS

We conducted this study on 36 patients presenting with closed fifth metacarpal fractures to our hospital among which males were 30 and females were 6.

Table 1: TAM score assessment table

Finger	Thumb	Result
220–260	119–140	Excellent
180–219	98–118	Good
130–179	70–97	Fair
<130	<70	Poor

TAM: Total active motions

Table 2: Results of our study by TAM score

Result	Number of cases (%)
Excellent	25 (69.4)
Good	8 (22.2)
Fair	2 (5.5)
Poor	1 (2.77)

TAM: Total active motions

The mean age in our study was 27.25 years with a range from 19 years to 38 years with a Standard Deviation (S.D) of 5.19.

The major cause of the trauma in these patients is due to patient being involved in a fight/assault in 27 patients and RTA in nine patients. All the cases had closed fractures with mild abrasions in patients with RTA. The most common side to be involved is right side (30 cases) and the most common hand to be involved is the dominant hand in most of the cases (32 cases).

The pre-operative flexion angle of the displaced fragment was measured and mean neck flexion angle was 44.11 (SD–4.12), this was measured at serial examinations at 3 weeks and 6 weeks which showed a mean of 9.45 (SD–5.46) and 5.25 (SD–2.16)°.

The mean flexion angle of the flexed fragment was measured at 3 months at the final follow-up which showed a mean flexion angle of 5.25°.

DASH score was used to assess the functional outcome subjectively for each patient by a questionnaire which showed a mean score of 6.25±1.1.

TAM score was measured at 3 months to assess the functional outcome of fingers which was postulated by Duncan et al (Table 1).

Our study showed results of excellent in 25 cases, good in eight cases, fair in two cases, and poor in one case as the patient was not compliant and started movement on

Table 3: Comparison of present study with previous studies of similar fixation methods

Sl. No.	Name of author	Sample size	Preop angulation	Post op angulation	DASH score
1	Mohammed et al.,[19]	20	50.4	NR	NR
2	Shen et al.,[17]	69	48.8±3.0	15.8±1.8	1.7±1.5
3	Boussakri et al.,[16]	28	54.64±17.6	10.2±7.3	NR
4	She and Xu et al.,[15]	27	50.2±6.3	7.4±2.3	2.1±3.6
5	Assi et al.,[18]	30	50±11.35	4.86±2.8	11.52±0.66
6	Our study	36	44.10±4.12	5.25±2.16	6.25±1.1

DASH: Disabilities of the arm, shoulder and hand

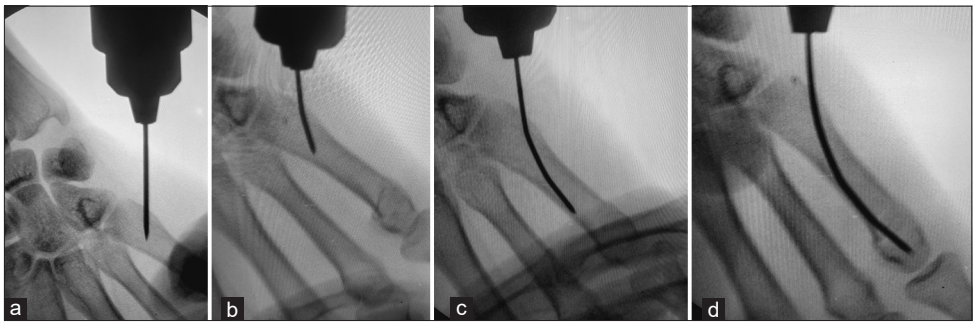

Figure 1: (a) Making entry with a 1.8 mm k wire, (b) passing a 1.5 mm k wire which is bent by 15° at tip through the predrilled hole, (c) passing it through shaft, and (d) rotating the k wire to reduce the fracture

plaster from the 5th day of surgery. This showed an excellent result in most of the patients accounting for nearly 70%. Poor result (Table 2) was seen in one patient due to poor compliance. No infection was found in any case as the injuries were closed and manipulation was less.

DISCUSSION

Our study mainly focuses on functional outcomes using a single bent k wire for fixing and reducing the fracture. The results were similar to previous studies of fixing this fracture with 2 k wires rather than single k wire.[12] Antegrade k wire fixation was superior to retrograde nailing given complications such as decreased ROM, shortening, and pain as the articular surface was involved.[2]

Kim and Kim's study[13] in 2015 stated that for early return to function and with fewer complications antegrade nailing is better than conservative treatment which was also proved in studies by Strub et al.,[14] who suggested long-term results of conservative treatment and antegrade k wire fixation is favoring towards fixation with nailing rather than conservative treatment for early return to work and good functional outcome.

Our results corresponded to other studies of single k wire fixation with mean preoperative angle same as per previous studies but post-operative angulation even in a tertiary centre with fewer facilities because of bending the k wire in lazy s fashion to negotiate the fracture, the fracture purchase was good which gave an extra advantage of correcting deformity compared to other studies.

The pre-operative mean angles were approximately similar to other studies, the post-operative mean angulation values in our study show a better correction of the dorsal angulation (5.25±1.1 in comparison with 7.4±2.3,[15] 10.21±7.3[16] and 15.8±1.8.[17] Our study corresponds to a study done by Assi et al.,[18] which reported a mean post-operative angulation of 4.86, this study was done by four individual senior hand surgeons which gave a good result even without bending the k wires. Our study showed a better result of postoperative angulation even in a tertiary care center with only two main operating surgeons in the study due to the configuration of k wire which holds in the medullary canal properly preventing further deformity.

Comparison of studies of antegrade nailing or k-wire fixation is summarized in the below table with pre- and post-operative angulation (Table 3).

Limitations of the study

This study was conducted in a tertiary centre by only taking into consideration of closed fractures and this cannot be attributed to all metacarpal fractures which are open and having a Neurovascular deficit.

CONCLUSION

Using a single antegrade k wire in a lazy "s" fashion by bending the k wire to hold in the medulla not only helps in proper fixation but also helps to reduce the angulation of the distal fragment by manipulating the k wire from the proximal end.

The results of this technique are consistent with studies using 2 k wires which produced the same results as our study even in a tertiary care center. This technique is useful even in primary care centers where minimal orthopedic equipment is available by a beginner-level orthopedician also to hold and reduce the fracture with less deformity than using conservative treatment with regional blockade.

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REFERENCES

1. Feehan LM and Sheps SB. Incidence and demographics of hand fractures in British Columbia, Canada: A population-based study. J Hand Surg Am. 2006;31(7):1068-1074.
https://doi.org/10.1016/j.jhsa.2006.06.006
2. Schädel-Höpfner M, Wild M, Windolf J and Linhart W. Antegrade intramedullary splinting or percutaneous retrograde crossed pinning for displaced neck fractures of the fifth metacarpal? Arch Orthop Trauma Surg. 2007;127(6):435-440.
https://doi.org/10.1007/s00402-006-0254-y
3. Harris AR, Beckenbaugh RD, Nettrour JF and Rizzo M. Metacarpal neck fractures: Results of treatment with traction reduction and cast immobilization. Hand (N Y). 2009;4(2):161-164.
https://doi.org/10.1007/s11552-008-9150-y
4. Zong SL, Zhao G, Su LX, Liang WD, Li LG, Cheng G, et al. Treatments for the fifth metacarpal neck fractures: A network meta-analysis of randomized controlled trials. Medicine (Baltimore). 2016;95(11):56-59.
https://doi.org/10.1097/MD.0000000000003059
5. Ali A, Hamman J and Mass DP. The biomechanical effects of angulated boxer's fractures. J Hand Surg Am. 1999;24(4):835-844.
https://doi.org/10.1053/jhsu.1999.0835
6. Brandão GF, Soares CB, Teixeira LE and de Castro Boechat LC. Displaced radial neck fractures in children: Association of the métaizeau and böhler surgical techniques. J Pediatr Orthop. 2010;30(2):110-114.
https://doi.org/10.1097/BPO.0b013e3181cf118a
7. Bansal R and Craigen MA. Fifth metacarpal neck fractures: Is follow-up required? J Hand Surg Eur Vol. 2007;32(1):69-73.
https://doi.org/10.1016/j.jhsb.2006.09.021
8. Holst-Nielsen F. Subcapital fractures of the four ulnar metacarpal

bones. Hand. 1976;8(3):290-293.
https://doi.org/10.1016/0072-968x(76)90017-6

9. Hunter JM and Cowen NJ. Fifth metacarpal fractures in a compensation clinic population. A report on one hundred and thirty-three cases. J Bone Joint Surg Am. 1970;52(6):1159-1165.
10. Theeuwen GA, Lemmens JA and van Niekerk JL. Conservative treatment of boxer's fracture: A retrospective analysis. Injury. 1991;22(5):394-396.
https://doi.org/10.1016/0020-1383(91)90103-I
11. Padegimas EM, Warrender WJ, Jones CM and Ilyas AM. Metacarpal neck fractures: A review of surgical indications and techniques. Arch Trauma Res. 2016;5(3):e32933.
https://doi.org/10.5812/atr.32933
12. Wong TC, Ip FK and Yeung SH. Comparison between percutaneous transverse fixation and intramedullary K-wires in treating closed fractures of the metacarpal neck of the little finger. J Hand Surg Br. 2006;31(1):61-65.
https://doi.org/10.1016/j.jhsb.2005.06.022
13. Kim JK and Kim DJ. Antegrade intramedullary pinning versus retrograde intramedullary pinning for displaced fifth metacarpal neck fractures. Clin Orthop Relat Res. 2015;473(5):1747-1754.
https://doi.org/10.1007/s11999-014-4079-7
14. Strub B, Schindele S, Sonderegger J, Sproedt J, von Campe A and Gruenert JG. Intramedullary splinting or conservative treatment for displaced fractures of the little finger metacarpal neck? A prospective study. J Hand Surg Eur Vol. 2010;35(9):725-729.
https://doi.org/10.1177/1753193410377845
15. Mohammed R, Farook MZ and Newman K. Percutaneous elastic intramedullary nailing of metacarpal fractures: Surgical technique and clinical results study. J Orthop Surg Res. 2011;19:37.
https://doi.org/10.1186/1749-799X-6-37
16. Shen K, Xu Y, Cao D, Wang Z and Cai H. Outcome of antegrade intramedullary fixation for juvenile fifth metacarpal neck fracture with titanium elastic nail. Exp Ther Med. 2017;13(6):2997-3002.
https://doi.org/10.3892/etm.2017.4369
17. Boussakri H, Elidrissi M, Azarkane M, Bensaad S, Bachiri M, Shimi M, et al. Fractures of the neck of the fifth metacarpal bone, treated by percutaneous intramedullary nailing: Surgical technique, radiological and clinical results study (28 cases). Pan Afr Med J. 2014;18:187.
https://doi.org/10.11604/pamj.2014.18.187.3347
18. She Y and Xu Y. Treatment of fifth metacarpal neck fractures with antegrade single elastic intramedullary nailing. BMC Musculoskelet Disord. 2017;18(1):238.
https://doi.org/10.1186/s12891-017-1592-3
19. Assi C, Mansour J, Samaha C, Ajjoub S and Yammine K. A single antegrade intramedullary k-wire for fifth metacarpal neck fractures. Eur J Trauma Emerg Surg. 2020;46(2):389-395.
https://doi.org/10.1007/s00068-018-01073-2

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PS- Idea for the fixator and made manuscript ready and primary surgeon to perform surgeries and evaluation of results and **MSP-** primary surgeon and collected review of literature.

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