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. 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
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.8

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.

It can be concluded that the new technique of antegrade k wire fixation is useful for patients with displaced 5th metacarpal neck fractures.
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.

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 1: TAM assessment table**

<table>
<thead>
<tr>
<th>Finger</th>
<th>Thumb</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>220–260</td>
<td>119–140</td>
<td>Excellent</td>
</tr>
<tr>
<td>180–219</td>
<td>98–118</td>
<td>Good</td>
</tr>
<tr>
<td>130–179</td>
<td>70–97</td>
<td>Fair</td>
</tr>
<tr>
<td>&lt;130</td>
<td>&lt;70</td>
<td>Poor</td>
</tr>
</tbody>
</table>

TAM: Total active motions

**Table 2: Results of our study by TAM score**

<table>
<thead>
<tr>
<th>Result</th>
<th>Number of cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>25 (69.4)</td>
</tr>
<tr>
<td>Good</td>
<td>8 (22.2)</td>
</tr>
<tr>
<td>Fair</td>
<td>2 (5.5)</td>
</tr>
<tr>
<td>Poor</td>
<td>1 (2.77)</td>
</tr>
</tbody>
</table>

TAM: Total active motions

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

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of author</th>
<th>Sample size</th>
<th>Preop angulation</th>
<th>Post op angulation</th>
<th>DASH score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mohammed et al.,19</td>
<td>20</td>
<td>50.4</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>2</td>
<td>Shen et al.,17</td>
<td>69</td>
<td>48.8±3.0</td>
<td>15.8±1.8</td>
<td>1.7±1.5</td>
</tr>
<tr>
<td>3</td>
<td>Boussakri et al.,16</td>
<td>28</td>
<td>54.6±17.6</td>
<td>10.2±7.3</td>
<td>NR</td>
</tr>
<tr>
<td>4</td>
<td>She and Xu et al.,15</td>
<td>27</td>
<td>50.2±6.3</td>
<td>7.4±2.3</td>
<td>2.1±3.6</td>
</tr>
<tr>
<td>5</td>
<td>Assi et al.,18</td>
<td>30</td>
<td>50±11.35</td>
<td>4.86±2.9</td>
<td>11.52±0.66</td>
</tr>
<tr>
<td>6</td>
<td>Our study</td>
<td>36</td>
<td>44.10±4.12</td>
<td>5.25±2.16</td>
<td>6.25±1.1</td>
</tr>
</tbody>
</table>

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. Antegrade k wire fixation was superior to retrograde nailing given complications such as decreased ROM, shortening, and pain as the articular surface was involved.

Kim and Kim’s study 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. 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 pre-operative 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, 10.21±7.36 and 15.8±1.8). Our study corresponds to a study done by Assi et al., 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

8. Holst-Nielsen F. Subcapital fractures of the four ulnar metacarpal


https://doi.org/10.1016/0020-1383(91)90103-l


https://doi.org/10.5812/atr.32933


https://doi.org/10.1016/j.jhsb.2005.06.022


https://doi.org/10.1007/s11999-014-4079-7


https://doi.org/10.1177/1753193410377845


https://doi.org/10.3892/etm.2017.4369


https://doi.org/10.11604/pamj.2014.18.187.3347


https://doi.org/10.1186/s12891-017-1592-3


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 review of literature.
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