ORIGINAL ARTICLE

# Extension Block Pinning Vs Single Kirshner Wiring to Treat Bony Mallet Finger

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Abstract

*Background:* ***Bony Mallet Finger, also defined as Mallet Fracture, is a prevalent injury among athletes who participate in hand-intensive sports. Surgery is shown when conventional treatment is ineffective or in cases with a fracture involving more than 30% of the articular surface. Surgical options include Extension-Block Pinning and single Kirschner wire fixation, but there is limited comparative evidence on the effectiveness of these methods.***

*Aim:* ***This investigation has been conducted to examine the findings of Extension-Block Pinning. EBP (versus Kirschner wire fixation (K-wire)) in treating Bony Mallet Finger (BMF).***

*Methods:* ***In this prospective clinical trial, 30 patients with a diagnosis of BMF were involved. They have been separeted into two groups. Group one consisted of fifteen cases treated with EBP and Group two, consisting of fifteen cases with single K-wire fixation. The demographics studied include union time, clinical outcome, and complications.***

*Results:* ***No significant distinction was observed among the two groups regarding demographic data, affected finger, cause of injury, fracture type, and time from injury to surgery. No significant distinction was found in either union time or clinical outcomes. In Group one, the outcomes were excellent in four cases, good in nine, fair in one, and poor in one. In Group two, there were five excellent, nine good, and one fair result, with no poor outcome. Early and late postoperative complications were similar in both groups.***

*Conclusion:* ***Both the EBP and single K-wire fixations present relatively comparable outcomes of function and complication rate in the treatment of BMF. None of these two techniques came out to be superior to each other; hence, their usage is considered an effective surgical modality in managing BMF.***

*Keywords:* Bony Mallet Finger, Extension-Block Pinning, Single Kirschner wire

## 1. Introduction

Bony Mallet Finger, also known as Mallet Fracture, is a common hand injury, particularly among individuals who participate in hand sports. Bony mallet finger accounts for approximately 10-20% of all mallet finger injuries and 1-2% of all hand injuries.[1,2] The condition most frequently affects the ulnar-side fingers (middle, ring, and little fingers) of the dominant hand, with a higher prevalence in young and middle-aged males .[1,2]

Mallet finger injuries typically arise in occupational settings or during sports activities. Participation in ball sports predisposes cases to these injuries when the ball strikes the fingertip of an extended finger. This causes the distal interphalangeal joint to assume a position of forced flexion, which ultimately leads to a disruption of the extensor tendon.[3]

Multiple therapy modalities exist for mallet finger. Numerous splint configurations and surgical interventions were documented during the past several decades. The ideal treatment for each variant of mallet finger damage is still controversial.[4]

Surgery is contentious in closed acute mallet finger, but is necessary for all open injuries and in cases with a significant bone mallet fragment accompanied by subluxation of the DIP joint. Fractures involving thirty to fifty percent of the surface of the joint are categorized as unstable and require operative intervention. Operation is advised for cases that are intolerant to splints. Most mallet finger injuries can be treated by primary care practitioners; however, complicated injuries necessitate assessment by an orthopedic or hand surgeon.[5]

Accepted 15 April 2025.
Available online 30 June 2025

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https://doi.org/10.21608/aimj.2025.446621

The primary goal of surgical intervention is to achieve anatomical reduction of the joint surface to reduce joint step-off, insufficient interphalangeal movement, and post-traumatic osteoarthritis that may arise following splinting.[6] A variety of surgical techniques were established, including Kirschner (K-) wire fixation, micro screws6, tension band wiring[7], pull-out wire fixation, small external fixator5, hook plate4, as well as extension-block fixation.[8,9]

Ishiguro's EBP method is a leading treatment for a mallet fracture. This is a clear & reproducible pinning approach, but it necessitates transfixion of the distal interphalangeal joint for several weeks alongside dorsal oblique pinning.[8] Nonetheless, although this therapy is typically considered safe, it may result in osteoarthritis, stiffness, bone fragment rotation, chondral damage, skin decubitus, and nail bed injury.[10] Conversely, a solitary K-wire fixation of the fracture must avoid nearly all of these complications, although it is more difficult and increases the probability of bone fragmentation.[11]

The purpose of both osteosynthesis options is to repair the phalanx while avoiding complications like deformity, non-union, or infection. Nonetheless, both are associated with unique sets of merits and demerits that may help in the selection of treatment depending on the fracture features, the age of the patient and the goals set.

This investigation determined the clinical outcomes of two techniques used for fixing the bony mallet finger. Specific focus was on the union of the fracture, functional recovery, complications, and final results.

## 2. Patients and methods

This prospective clinical trial was conducted in the Orthopedic Department of Al-Azhar University Hospital over a 12-month period. It included 30 patients with bony mallet finger injuries, comparing two surgical techniques: extension block pinning and single Kirschner (K)-wiring. Patients were randomly divided into two groups, each consisting of 15 patients.

Method of patient collection: The present study screened 47 patients for eligibility. The inclusion criteria were patients aged above 18 years, categorized as Wehbe and Schneider 1b, 1c, 2b, or 2c for MF, with a time elapsed since trauma between one day and six weeks. Those with systemic diseases, such as advanced arthrosis, rheumatoid arthritis, or diabetes, were excluded from the research. Of these, 12 cases have been excluded for not meeting the inclusion criteria (8 cases) or refusing to participate (4 patients), and a further 5 cases were lost to monitoring throughout the research (3 from group one and two from group 2). Thus, 30 cases remained in the research and were separated into two groups (Figure 1).

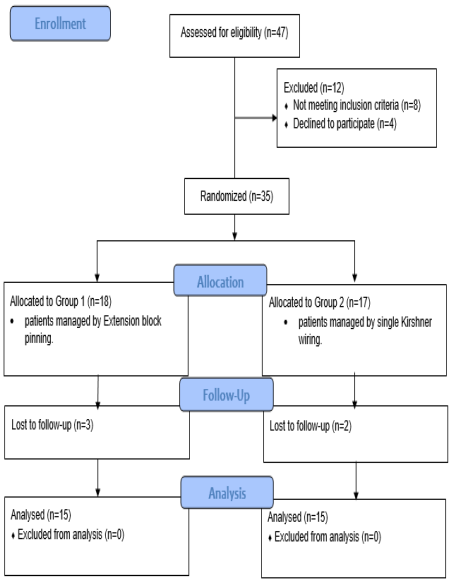


Figure 1. Flowchart of the study.

All the cases were assessed with a detailed history of the person and their injury history. All the patients were subjected to thorough clinical examination to see signs of pain, swelling, and bruising over the dorsum of the finger; extension lag at the distal interphalangeal joint has been noted with loss of active extension. Other radiological investigations included the taking of radiographs of the injured digit, which facilitated distinguishing between bone & soft tissue mallet injuries. A lateral view radiograph was performed to verify the diagnosis of an avulsion fracture at the distal interphalangeal joint and to evaluate the extent of joint involvement and any joint subluxation in injuries of bony mallet.

Treatment Procedures

Group 1 (Extension Block Pinning): Patients in this group underwent the extension block pinning technique, whereby, through a K-wire, the extension of the fractured distal phalanx was done to stabilize it. This technique was performed under local anesthesia with the digit maximally flexed. Fluoroscopic guidance was used to place the K-wire at a 45° angle into the middle phalanx. A second K-wire was then used longitudinally to maintain the reduction, and if necessary, a third K-wire was placed perpendicularly to stabilize the fracture fragment (Figure 2).

Group 2 (Single Kirschner Wiring); Patients in this group were treated using the "umbrella handle" technique. A small K-wire of 1- or 1.2-mm diameter was used to transfix the avulsed dorsal

fragment. The K-wire has been passed through the distal phalanx, with the dorsal end bent to resemble an umbrella handle. A small incision has been made to subcutaneously pull the K-wire, reducing the fracture. The K-wire was anchored in a custom-made thermoplastic splint to prevent displacement (figure 3).

Postoperative Follow-up: All patients were assessed at one, two, four, six, and eight weeks after surgery to evaluate pain, nail bed deformity, capillary refill, pin track infection, fracture healing, range of motion (ROM), and extension lag. X-rays were taken immediately postoperatively and again at four to six weeks to assess fracture healing. ROM of the involved joints was measured using a Goniometer along with extension lag measurement. Functional outcomes were evaluated at the 8-week follow-up, with a final clinical assessment at 6 and 12 months to confirm the treatment results.

Ethical Approval: This study received ethical approval from the relevant Institutional Review Board under the approval number Pat._3Med.Research_0000003.

Statistical Analysis

Data analysis was carried out using IBM SPSS software, version 21.0. Descriptive statistics encompassed means, ranges, standard deviations, and percentages. The Kolmogorov-Smirnov test has been utilized to assess the normality of data distribution. Categorical data were analyzed among groups using the Chi-square test, whereas continuous data were assessed with the Student's t-test for normally distributed variables and the Mann-Whitney U test for non-parametric data. The significance level was set at $p < 0.05$.

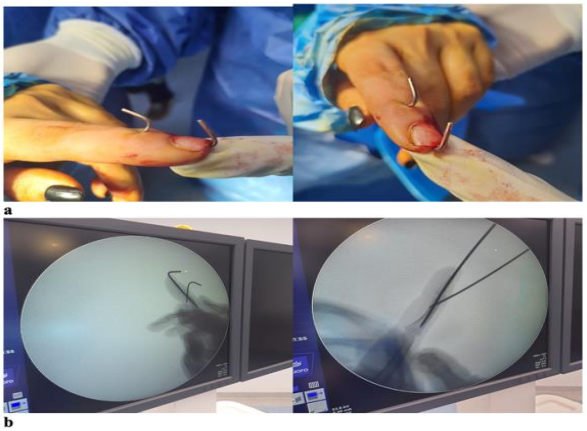


Figure 2. An 18-year-old female patient presented with a fracture base of DP managed by extension block technique (a); patient skin intraoperative after fixation (b): Intraoperative radiology.

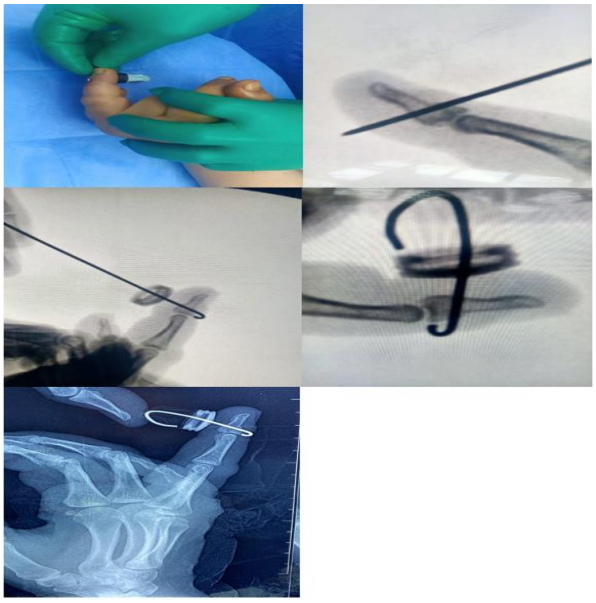

Figure 3. A 40-year-old female presented with a fracture base of the DP of the right Ring finger involving > 1/3 of the articular surface and managed by the single-wire technique; Patient skin intraoperative & imaging intraoperative, and immediate postoperative after fixation.

## 3. Results

This prospective clinical trial includes thirty cases with mallet finger injury who have been treated in the Orthopedic Department of Al-Azhar University Hospital and Mansoura Specialized Hospital. Cases have been allocated into two groups regarding the management of their injury; group 1 (n=15) who have been treated by Extension Block Pinning and group 2 (n=15) cases who were treated by Single Kirschner (K) -Wiring.

Demographics and Baseline Characteristics; the baseline characteristics for both groups of cases proved to be similar. Patient's in group 1 aged 45.6 ± 16.73 years (range 19-65 years) and for group 2, mean age was 45.4 ± 18 yrs. (range 19 - 64 years). The majority of cases in both groups were male, with 73.3% in group 1 and 80% in group 2, showing no significant distinction among the groups in terms of sex (p-value equal 0.772) or age (p-value equal 0.975) (table 1).

In group 1, the most affected finger was the right ring finger (40%), while in group 2, the most affected fingers were the left ring finger (26.7%) and the right index finger (20%). The most widespread cause of injury in both groups was a fall: 53.3% in group 1 and 60% in group 2, without any significant difference between the groups (table 1).

Type of Mallet Finger Injury;the distribution of injury types according to the Wehbe and Schneider system was similar in both groups. The most common injury types in both groups were 2b (46.7% in Group 1 and 40% in Group 2), followed

by 2c (26.7% in Group 1 and 33.3% in Group 2). A Chi-square test revealed no statistically significant difference between the groups in terms of the injury type (p = 0.979) (Table 1).

*Table 1. Comparison of Personal, History Data and type of MF*

| | GROUP 1 (NUMBER = FIFTEEN) | | GROUP 2 (NUMBER = FIFTEEN) | | TEST OF SIG. | P |
|---|---|---|---|---|---|---|
| AGE RANGE. | 19 – 65 | | 19 – 64 | | t= | 0.975 |
| MEAN ± SD. | 45.6 ± 16.73 | | 45.4 ± 18 | | 0.032 | |
| SEX | No. | % | No. | % | | |
| FEMALE | 4 | 26.7 | 3 | 20.0 | $\chi^2$= | 0.772 |
| MALE | 11 | 73.3 | 12 | 80.0 | 0.084 | |
| CAUSE | No. | % | No. | % | | |
| FALL | 8 | 53.3 | 9 | 60.0 | $\chi^2$= | 0.705 |
| FIGHT | 1 | 6.7 | 0 | 0.0 | 1.402 | |
| SPORT INJURY | 2 | 13.3 | 3 | 20.0 | | |
| WORK ACCIDENT | 4 | 26.7 | 3 | 20.0 | | |
| TYPE OF MF | No. | % | No. | % | | |
| 1B | 3 | 20.0 | 3 | 20.0 | $\chi^2$= | 0.979 |
| 1C | 1 | 6.7 | 1 | 6.7 | 0.188 | |
| 2B | 7 | 46.7 | 6 | 40.0 | | |
| 2C | 4 | 26.7 | 5 | 33.3 | | |

Information are showed as frequency (%) unless otherwise mentioned, SD: Standard deviation.

Time from Injury to Surgery; the time between surgery and injury was similar for both groups. The time range from injury to surgery for both groups was from 1 to 6 days. The median time for Group 1 was 4 days, with an IQR of 2 to 5 days, while Group 2 had a median of 2 days, with an IQR of 2 to 3.5 days. However, the statistical analysis (Mann-Whitney U test) of time to surgery did not show any significant difference among groups, p = 0.567 (Table 2).

Union Time;the time to union, defined as the time until radiographic proof of fracture healing was observed, was between 5 and 8 weeks in both groups. The median union time was five weeks (IQR: 5 - 6 weeks) for Group one and five weeks (IQR: 5 - 5 weeks) for Group two. There was no significant distinction in the union time among the two groups, as determined by the Mann-Whitney U test (p = 0.400) (Table 2).

*Table 2. Time from Injury to Surgery and Union Time*

| | GROUP 1 (NUMBER = FIFTEEN) | GROUP 2 (NUMBER = FIFTEEN) | TEST OF SIG. | P |
|---|---|---|---|---|
| TIME FROM INJURY TO SURGERY (DAYS) | | | | |
| RANGE. | 1 – 6 | 1 – 6 | U= | 0.567 |
| MEDIAN (IQR) | 4 (2 – 5) | 2 (2 – 3.5) | 98.0 | |
| UNION TIME (WEEKS) | | | | |
| RANGE. | 5 – 8 | 5 – 8 | | |
| MEDIAN (IQR) | 5 (5 – 6) | 5 (5 – 5) | U= 85.0 | 0.400 |

Information are exhibited as frequency (%) unless otherwise mentioned, IQR: Interquartile range.

Final Results; no statistical distinction concerning final results was noted between the two groups. The final results were good for most of the patients in both groups. In Group 1, 60 percent had a good result, 26.7 percent an excellent outcome, 6.7 percent a fair result, and 6.7 percent a poor result. Similarly, in Group 2, the distribution of results was as follows: 60 percent good, 33.3 percent excellent, and 6.7 fair. The Chi-square test illustrated insignificant distinction in the final results among the two groups, with a p value of 0.774 (Table 3).

Relationship Between Type of Injury and Final Results;the association of the type of mallet finger injury with the final result was analyzed. It was found that, in Group 2, the association among injury type and outcome was statistically significant (p = 0.020). In Group 1, no such correlation has been discovered (p = 0.616) (Table 3).

*Table 3. Comparative analysis among the examined cases according to results and relation between type of MF and results*

| CATEGORY | RESULTS | GROUP 1 (NUMBER = FIFTEEN) | % | GROUP 2 (NUMBER = FIFTEEN) | % | TEST OF SIGNIFICANCE ($X^2$) | P-VALUE |
|---|---|---|---|---|---|---|---|
| OVERALL RESULTS | Excellent | 4 | 26.7% | 5 | 33.3% | $\chi^2$ = 1.111 | 0.774 |
| | Good | 9 | 60.0% | 9 | 60.0% | - | - |
| | Fair | 1 | 6.7% | 1 | 6.7% | - | - |
| | Poor | 1 | 6.7% | 0 | 0.0% | - | - |
| TYPE OF MF | 1b | | | | | | |
| | Excellent | 2 | 13.3% | 1 | 6.7% | $\chi^2$ = 0.667 | 0.414 |
| | Good | 1 | 6.7% | 2 | 13.3% | - | - |
| | Fair | 0 | 0.0% | 0 | 0.0% | - | - |
| | Poor | 0 | 0.0% | 0 | 0.0% | - | - |
| 1C | Excellent | 0 | 0.0% | 0 | 0.0% | $\chi^2$ = 2.000 | 0.157 |
| | Good | 1 | 6.7% | 0 | 0.0% | - | - |
| | Fair | 0 | 0.0% | 1 | 6.7% | - | - |
| | Poor | 0 | 0.0% | 0 | 0.0% | - | - |
| 2B | Excellent | 1 | 6.7% | 2 | 13.3% | $\chi^2$ = 1.376 | 0.503 |
| | Good | 5 | 33.3% | 4 | 26.7% | - | - |
| | Fair | 1 | 6.7% | 0 | 0.0% | - | - |
| | Poor | 0 | 0.0% | 0 | 0.0% | - | - |
| 2C | Excellent | 1 | 6.7% | 2 | 13.3% | $\chi^2$ = 1.440 | 0.487 |
| | Good | 2 | 13.3% | 3 | 20.0% | - | - |
| | Fair | 0 | 0.0% | 0 | 0.0% | - | - |
| | Poor | 1 | 6.7% | 0 | 0.0% | - | - |

Early Complications: concerning the early postoperative complications, pain, and infection were relatively seldom observed in both groups. More precisely, Group 1 expressed 20% of painful symptoms, and 6.7% presented an infected area, whereas Group 2 reported 26.7% pain and 13.3% infection. Regarding early complications, no differences have been outlined in a statistical point of view between Groups one and two: p=0.666 for pain and p=0.543 for infection (Table 4).

Results of Follow-up; at follow-up, there was no significant loss of extension, flexion, pain, delayed union, or nonunion among the 2 groups. Full flexion has been occurred in the majority of cases from both groups: 86.7% in Group one and 93.3% in Group two. Loss of extension was mild in both groups; less than 10 degrees of loss were seen in 60% of patients in both groups. None of these outcomes showed any statistical difference between the groups (Table 4).

These results therefore indicate that both Extension Block Pinning and Single Kirschner Wiring are viable treatments for mallet finger injuries, with neither treatment showing significant differences in terms of recovery time, final results, or complication rates.

*Table 4. Early Complications and Follow-Up Results*

| CATEGORY | RESULTS | GROUP 1 (NUMBER = FIFTEEN) | % | GROUP 2 (NUMBER = FIFTEEN) | % | TEST OF SIGNIFICANCE ($X^2$) | P-VALUE |
|---|---|---|---|---|---|---|---|
| EARLY COMPLICATIONS | Pain | 3 | 20.0% | 4 | 26.7% | $\chi^2 = 0.186$ | 0.666 |
| | Infection | 1 | 6.7% | 2 | 13.3% | $\chi^2 = 0.370$ | 0.543 |
| FOLLOW-UP | Loss of Extension | | | | | | |
| | None | 4 | 26.7% | 5 | 33.3% | $\chi^2 = 1.111$ | 0.774 |
| | 0 to 10 degrees | 9 | 60.0% | 9 | 60.0% | - | - |
| | 10 to 25 degrees | 1 | 6.7% | 1 | 6.7% | - | - |
| | >25 degrees | 1 | 6.7% | 0 | 0.0% | - | - |
| | Flexion | | | | | | |
| | Full | 13 | 86.7% | 14 | 93.3% | $\chi^2 = 0.370$ | 0.543 |
| | Some loss | 2 | 13.3% | 1 | 6.7% | - | - |
| | Pain | | | | | | |
| | None | 14 | 93.3% | 15 | 100.0% | $\chi^2 = 1.034$ | 0.309 |
| | Persistent pain | 1 | 6.7% | 0 | 0.0% | - | - |
| | Delayed Union | 1 | 6.7% | 2 | 13.3% | $\chi^2 = 0.370$ | 0.543 |
| | Nonunion | 1 | 6.7% | 0 | 0.0% | $\chi^2 = 1.034$ | 0.309 |

## 4. Discussion

A common hand injury, particularly among individuals engaged in hand-intensive sports, is Mallet Fracture, also known as Bony Mallet Finger. It accounts for approximately 10-20% of all mallet finger injuries and 1-2% of all hand injuries.[12,13] This condition predominantly affects the ulnar-side fingers (middle, ring, and little fingers) of the dominant hand, with a higher prevalence among young and middle-aged males.[1,2]

Treatment protocols suggest that most cases of BMF can be effectively managed with conservative splinting, while surgical intervention is typically reserved for irreducible subluxation. The primary goal of surgery is to restore joint surface alignment, reducing the risk of complications such as joint step-off, restricted interphalangeal motion, and post-traumatic osteoarthritis, which may develop with prolonged splinting. Various surgical techniques have been introduced over time, including Kirschner (K-) wire fixation, tension band wiring, micro screws, small external fixators, hook plate fixation, pull-out wire fixation, and Extension-Block Pinning (EBP) .[5-7]

Among these techniques, EBP, first described by Ishiguro, has gained popularity due to its simplicity and reproducibility. However, this method requires trans fixation of the DIP joint for an extended period, increasing the risk of complications such as stiffness, osteoarthritis, cartilage damage, pressure ulcers, bone fragment rotation, and nail bed injury .[14] On the other hand, single K-wire fixation provides a less invasive alternative with a lower risk of complications. Despite these advantages, the technique is more technically demanding and carries the potential risk of bone fragmentation.[13]

This prospective clinical trial has been conducted to compare the outcomes of two common surgical techniques in the management of BMF: EBP and single K-wire fixation. The series consisted of 30 patients, separated into two groups: Group one (number=fifteen) consisted of cases treated by EBP, while Group two (number=fifteen) composed of cases treated by single K-wire fixation.

The demographic characteristics of both groups were similar, without any statistically significant difference regarding age, sex, or finger involved. The mean age in Group 1 was 45.6 ± 16.73 years, and in Group 2, it was 45.4 ± 18 years. Female predominance was observed in both groups. Furthermore, no significant difference was observed in cause of injury, fracture type, or time from injury to surgery, which was 4 days (range 2–5 days) for Group 1 and 2 days (range 2–3.5 days) for Group 2. These findings were similar to those from Rocchi et al., who presented comparable demographic data for a larger cohort of 98 cases with an average age of 41.6 years & a median time to surgery of 11.2 days .[15]

No significant differences were observed between the two groups regarding functional outcomes. The results were as follows: in Group 1, 4 patients had excellent results, 9 had good results, 1 had a fair result, and 1 had a poor result, while in Group 2, 5 patients had excellent results, 9 had good results, 1 had a fair result, and no patients had a poor result. When combined, 86% of patients in Group 1 and 93% in Group 2 achieved either excellent or good outcomes. This agrees with Rocchi et al.'s results, in which almost similar proportions of excellent and good outcomes were observed in both K-wire (Group A) and EBP (Group B) groups .[15] Moreover, Toker et al. also showed similar results: 86% of patients in both groups had excellent and good results .[16]

No statistically significant variations were noted in union time among both groups, which means that with both techniques, similar healing times are possible. These findings are in agreement with those from Aydin et al., wherein the same union times and functional outcomes were recorded in

the EBP and the PO-EBPT (pin orthosis-extension block pinning) groups.[14] Similarly, Jörgsholm et al. indicated similar findings, with 23 of the 36 patients described as excellent or good .[17]

While the differences in functional outcomes were not significant, we did observe a significant relationship between fracture type and final results, particularly in Group 2, where Type 2b fractures (less complicated fractures) had better outcomes with K-wire fixation. This discovery coincides with the observations made by Rocchi et al., who similarly discovered that Type 2b and 2c fractures tended to have better results when treated with the K-wire technique .[15]

Regarding postoperative complications, an insignificant distinction has been observed between the two groups. The complication rates were similar, with no major postoperative issues observed. This is in line with the studies by Rocchi et al. and Toker et al., which also reported no significant differences in postoperative complications between EBP and K-wire fixation techniques .[15,16] Further confirmation that complication rates were comparable between the two groups was given by Aydin et al. with a P value of 0.45 .[14] Some minor complications include slight degenerative alterations, pin tract infections, and transient nail ridging; however, no cases led to persistent problems or poor results .[18,19]

Thus, Rocchi et al. reported that the EPB technique is simpler to carry out, despite an elevated possibility of iatrogenic injuries, as it includes the transfixion of the DIP joint for an extended duration, potentially leading to stiffness and chondral damage, particularly if multiple pinning attempts are conducted to properly position the pin within the distal phalanx. Moreover, joint transfixation may result in osteoarthritis if an infection occurs at the pinning site. Furthermore, dorsal oblique pinning may contribute to skin decubitus and nail bed damage. Alternatively, a solitary K-wire fixation of the fracture, akin to the UH approach, may mitigate these difficulties; however, it is more complex, requiring intraoperative Modification of the K-wire design. Moreover, it poses the possibility of bone fragmentation in the tiniest MF. Furthermore, a bespoke thermoplastic splint must be utilized to evenly transfer the pressure of pin fixation across all of the finger pulp.[20]

The major limitations of the present study are its small sample size and single-center design, which restrict the generalization of its findings. More studies with a multi-center design and larger sample size will be necessary to confirm these findings and establish stronger evidence regarding the optimum treatment for BMF.

### *4. Conclusion*

Our findings suggest both the extension block pinning and single Kirschner wiring techniques offer equal functional outcomes and complication rates in the treatment of bony mallet fractures. Neither technique seems superior to the other in terms of clinical results.

## Disclosure

The authors have no financial interest to declare in relation to the content of this article.

## Authorship

All authors have a substantial contribution to the article

## Funding

No Funds : Yes

## Conflicts of interest

There are no conflicts of interest.

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