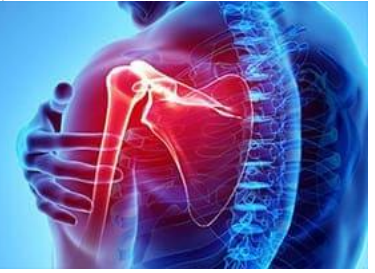


International Journal of Orthopaedics and Traumatology



ISSN Print: 2664-8318
ISSN Online: 2664-8326
Impact Factor: RJIF 5.42
IJOT 2024; 6(1): 104-108
www.orthopedicsjournal.in
Received: 20-08-2024
Accepted: 26-09-2024

Khalid Ahmed Abbas Al-Ogaili
MBCChB, FICMS (Ortho),
Consultant Orthopedic
Surgeon, Al-Yarmouk
Teaching Hospital, Al-Karkh
Health Directorate, Ministry of
Health, Iraq

Riyadh Shiltagh Al-Rudaini
Consultant Public Health
Doctor, Nutrition Research
Institute, Public Health
Directorate, Ministry of
Health, Iraq

Comparative analysis of kirschner wire joystick vs. extension block pinning techniques in the management of mallet fractures at al-yarmouk teaching hospital

Khalid Ahmed Abbas Al-Ogaili and Riyadh Shiltagh Al-Rudaini

DOI: <https://doi.org/10.33545/26648318.2024.v6.i1b.50>

Abstract

Background & Objectives: Mallet fractures, typically caused by direct trauma to the finger, involve the avulsion of the distal phalanx. Management strategies include Kirschner wire joystick (KWJ) and extension block pinning (EBP) techniques, each with benefits in stabilizing fractures and promoting healing. This study aimed to compare clinical outcomes, complications, and recovery between KWJ and EBP techniques for mallet fractures at Al-Yarmouk Teaching Hospital, Baghdad.

Methods: This retrospective study included 50 patients with acute mallet fractures treated with either KWJ or EBP between January 2021 and January 2023. Patients were randomly assigned to each technique, and data were collected from medical records. Key assessments included radiographic imaging and clinical evaluations (Using the Total Active Motion system and Crawford score) for joint congruency, functional recovery, and complications.

Results: Patients treated with KWJ had a greater range of motion (mean 72°) than those treated with EBP (mean 58°). The KWJ group also showed a shorter average operation time (30 minutes vs. 35 minutes for EBP) and a faster return to work (mean of 5 weeks for KWJ vs. 7 weeks for EBP). Complications were fewer with KWJ, with no cases of nail dystrophy, while EBP presented two cases. Both techniques had similar healing times (6 weeks). KWJ had a higher rate of "good" outcomes (65%) compared to EBP (50%), while "excellent" outcomes were comparable between groups.

Conclusions: KWJ provided superior range of motion, fewer complications, and quicker recovery times, making it a preferable technique for mallet fractures. These findings suggest that KWJ may be beneficial for patients requiring faster functional recovery. Further research is recommended to assess long-term outcomes and refine EBP techniques to minimize complications.

Keywords: Mallet fractures, Kirschner wire joystick, Extension block pinning, and surgical outcomes

Introduction

Mallet fractures, characterized by the avulsion of the distal phalanx's dorsal bone and tendon, are commonly caused by direct trauma to the finger, typically due to a forceful impact or hyperflexion. The management of mallet fractures remains a subject of ongoing clinical debate, with multiple fixation methods proposed for optimal healing and functional recovery. Among these, Kirschner wire joystick (KWJ) and extension block pinning (EBP) are two popular techniques employed to stabilize the fracture and facilitate tendon healing^[1]. The KWJ method, involving the insertion of a K-wire through the joint and into the distal phalanx to serve as a joystick, provides mechanical stability while allowing for early motion, which is crucial for minimizing stiffness and promoting functional recovery^[2]. Extension block pinning, on the other hand, restricts flexion at the distal interphalangeal joint to facilitate healing while potentially improving long-term functional outcomes by preventing extensor lag^[3].

While these techniques are well-established, there remains a significant gap in the literature comparing their relative effectiveness in the management of mallet fractures. Current studies have predominantly focused on K-wire fixation or block pinning in isolation, with limited research directly comparing the two methods in a clinical setting^[4]. This gap presents an opportunity to critically evaluate and compare the functional outcomes, complication rates, and overall effectiveness of KWJ and EBP in a specific population at Al-Yarmouk Teaching Hospital, Baghdad.

Corresponding Author:
Khalid Ahmed Abbas Al-Ogaili
MBCChB, FICMS (Ortho),
Consultant Orthopedic
Surgeon, Al-Yarmouk
Teaching Hospital, Al-Karkh
Health Directorate, Ministry of
Health, Iraq

The importance of this research lies in its potential to address the need for evidence-based guidelines for the management of mallet fractures in our clinical environment. By directly comparing KWJ and EBP, this study seeks to identify the most effective approach in terms of both patient recovery and complication prevention. The findings could have significant implications for the management of mallet fractures in Iraq and similar settings, potentially influencing clinical practice and improving patient care outcomes. Additionally, this research may serve as a foundation for future studies exploring the optimal techniques for hand and finger fractures in the broader orthopedic field [5].

A review of the literature reveals that K-wire fixation (Including the KWJ technique) is widely regarded for its ability to provide stability and promote early mobilization, but it has been associated with complications such as pin tract infection and the need for secondary procedures to remove the K-wire [6]. Extension block pinning, while promoting better tendon healing by limiting flexion, carries risks such as pin loosening and joint stiffness [7]. However, there is a lack of comparative studies that systematically evaluate these two techniques side by side, especially in terms of patient-reported outcomes and long-term functional recovery. Furthermore, previous studies have not sufficiently addressed the specific challenges and outcomes within the clinical context of Al-Yarmouk Teaching Hospital, Baghdad, where patient demographics, healthcare resources, and surgical expertise may differ significantly from other regions [8].

Objectives of the study

1. To compare the clinical outcomes of Kirschner wire joystick and Extension block pinning in the treatment of mallet fractures at Al-Yarmouk Teaching Hospital, Baghdad.
2. To assess the incidence of complications and the functional recovery following KWJ and EBP techniques in the management of mallet fractures within the same patient cohort.

Patients and Methods

Study Design

This was a comparative retrospective study designed to evaluate and compare the effectiveness of KWJ and EBP techniques in treating mallet fractures.

Study Setting and Timing

The study was conducted at Al-Yarmouk Teaching Hospital in Baghdad, Iraq. Data collection spanned from January 2022 to January 2023, with patient follow-ups extending up to 12 months post-surgery to monitor long-term outcomes.

Study Population

The study population consisted of 50 patients with acute mallet fractures who met specific inclusion criteria, including fractures involving more than one-third of the articular surface, fractures associated with palmar subluxation of the distal phalanx unresponsive to closed reduction, and mallet fragments displaced proximally with a gap greater than 1 mm after positioning. Exclusion criteria included patients with pre-existing osteoarthritis, chronic mallet deformity of the distal interphalangeal (DIP) joint, or injuries older than three weeks. The sample included 50

patients aged 18-60 years. Most injuries involved the little finger.

Sample Size and Sampling Method

A total of 50 patients were randomly assigned to receive either the KWJ or EBP technique, ensuring a balanced distribution between groups. This sample size was chosen based on prior studies to provide adequate power for statistical analysis. Random sampling was employed to ensure that all eligible patients within the study period had an equal chance of inclusion.

Data Collection Methods

Data were collected retrospectively from patient medical records and operative notes. Preoperative and postoperative assessments included radiographic imaging (Anterior-posterior and lateral views) and clinical evaluations. Radiographic evaluations measured joint congruency, fragment displacement, and fracture healing, while clinical assessments utilized the Total Active Motion (TAM) system for DIP joint flexion and extension, with a goniometer used to quantify extension lag. Outcome measures included return-to-work duration, complications, and pain during regular activities, based on the Crawford score. The reliability and validity of the TAM system [9] and Crawford score [10] were previously established in orthopedic practice, ensuring consistent measurements.

Ethical Considerations

The study received approval from the Al-Yarmouk Teaching Hospital authorities. Written informed consent was obtained from each patient before treatment, permitting the use of their data for this research while ensuring confidentiality and compliance with ethical standards.

The Extension Block Pinning (EBP)

Technique involved placing a 1.25 mm K-wire at a 45-degree angle into the middle phalanx head under axillary block to create an extension block for the fracture fragment. When needed, manipulation of the distal phalanx was used to achieve reduction, followed by the placement of a second wire longitudinally across the distal interphalangeal (DIP) joint for stability. For larger fracture fragments, a third 0.8 mm K-wire was inserted perpendicular to the fracture line. The wires were trimmed under the skin, and a splint was applied, leaving the proximal interphalangeal (PIP) joint free. Pins were daily treated with antiseptic, and removal occurred after approximately six weeks.

The Kirschner Wire Joystick (KWJ)

Technique, performed under digital block, involved driving a 1.4 mm K-wire from the tip of the distal phalanx across the DIP joint for extension, leaving its distal end protruding. A second wire was inserted dorsally to affix the avulsed fragment, allowing it to be repositioned as needed using the wire as a joystick. Fluoroscopy confirmed reduction, and the second wire was bent and anchored subcutaneously to prevent fragment displacement. The volar wire end was also left protruding, and a small splint followed by a plaster finger splint was applied to allow PIP and metacarpophalangeal (MP) joint motion. Pins were cleaned daily and removed after six weeks.

Surgical techniques outcome evaluation

Postoperative outcomes included assessments of work absence, complications, and pain during daily activities. Radiological evaluations were conducted preoperatively and at follow-ups to verify DIP joint congruency and fracture healing. Bone union was confirmed by trabeculae crossing the fracture site, and functional outcomes were measured using the Total Active Motion (TAM) system and the Crawford score. DIP lag extension was measured with a goniometer, and flexion loss was compared to the contralateral finger. Patients were also queried on pain during routine activities, offering insights into the techniques' effectiveness in restoring function.

Results

Table 1 presents data on two patient groups, EBP and KWJ, each with 25 participants. The EBP group has a mean age of

36 years (range 18-60), while the KWJ group's mean age is 32 years (range 18-60). In terms of gender, 17 (68%) of EBP patients are male, compared to 11 (44%) in the KWJ group; conversely, the KWJ group has more females (56%) than the EBP group (32%). The percentage of affected articulation varies, with the EBP group showing a mean of 62% (range 47-88%) and the KWJ group 44% (range 32-54%). The average operation time is slightly longer in the EBP group at 35 minutes (range 15-80) compared to the KWJ group's 30 minutes (range 25-40). Regarding interventions per digit, the EBP group has 3 interventions on the index and middle fingers, 4 on the ring finger, and 15 on the little finger, while the KWJ group has 4 on the index and middle fingers, 9 on the ring, and 8 on the little finger. The EBP group used 3-4 K-wires/screws per intervention, while the KWJ group used 3. Both groups achieved consolidation in an average of 7 weeks.

Table 1: Variables related to the patients of two groups

Variables	EBP (n=25)	KWJ (n=25)
Age in years	Range (18 -60) mean= 36	Range (18 -60) mean= 32
Gender		
Male	17	11
Female	8	14
% of affected articulation	Range (47- 88) mean= 62	Range (32- 54) mean= 44
Operation time in minutes	Range (15- 80) mean= 35	Range (25- 40) mean= 30
Interventions/ digit		
Index	3	4
Middle	3	4
Ring	4	9
Little	15	8
No. of K-wires/ screws per intervention	3-4	3
Consolidation in weeks	7	7

The findings in Table 2, based on Crawford's classification for evaluating mallet fracture treatment, categorize recovery outcomes into four levels: excellent, good, fair, and poor. "Excellent" outcomes indicate full recovery, with a total active motion (TAM) extension lag between 0°-5°, no pain, and no remaining symptoms. "Good" outcomes suggest near full recovery, showing an extension lag between 5°-10°, minimal pain, and occasional discomfort. A "Fair" outcome

reflects partial recovery, with an extension lag of 10°-25°, moderate functional limitations, and mild pain. Lastly, a "Poor" outcome signifies incomplete recovery, with an extension lag exceeding 25°, severe functional impairment, and persistent pain. This classification helps gauge the treatment effectiveness based on mobility, symptom severity, and pain levels.

Table 2: Crawford's classification for evaluation of mallet fracture treatment

Crawford's Classification	Description	Total Active Motion (TAM)	Extension Lag	Pain
Excellent	Full recovery	0°-5° extension lag	None	No pain
Good	Near full recovery	5°-10° extension lag	Minimal	Occasional pain
Fair	Partial recovery	10°-25° extension lag	Moderate	Mild pain
Poor	Incomplete recovery	>25° extension lag	Severe	Persistent pain

Table 3 provides a comparative analysis of two surgical techniques, EBP and KWJ, focusing on various recovery and outcome metrics. For range of motion, patients in the KWJ group displayed greater flexibility with a range of 65–80 degrees and an average of 72 degrees, compared to the EBP group's range of 47–76 degrees and a mean of 58 degrees. DIP (Distal interphalangeal) lag extension was slightly better in the KWJ group, averaging 2° compared to 5° in the EBP group. Both techniques showed a similar follow-up duration with an average of 8 months, and the fracture healing time was consistent at 6 weeks for both groups. In terms of Crawford classification, which measures overall outcome, both groups had positive results; however,

KWJ had a slightly higher percentage of "good" outcomes (65%) compared to EBP's 50%. The "excellent" ratings were similar, with 10 for EBP and 9 for KWJ. Regarding complications and time off work, the EBP group experienced two cases of nail dystrophy as complications, while the KWJ group reported no complications. Time away from work was lower for the KWJ group, with a range of 2–8 weeks and a mean of 5 weeks, whereas the EBP group required a longer recovery, with a range of 3–10 weeks and a mean of 7 weeks. These findings suggest that while both techniques are effective, KWJ may offer slightly better outcomes in terms of range of motion, fewer complications, and quicker return to work.

Table 3: Results for the surgical techniques

Results	EBP	KWJ
Range of motion	Range (47- 76) mean= 58	Range (65- 80) mean= 72
DIP lag extension	Range (0-17) mean= 5°	Range (0- 20) mean= 2°
Follow up in months	Range (6- 12) mean= 8	Range (6- 12) mean= 8
Crawford classification		
Excellent	10	9
Good	10	13
Fair	5	3
Poor	0	0
Fracture healing time in weeks	6	6
Complications	2 (nail dystrophy)	0
Time away from work in weeks	Range (3- 10) mean= 7	Range (2- 8) mean= 5

Figure 1 shows radiographic images of a right-handed man treated with the KWJ technique, presenting in three stages: (A) pre-operative, (B) post-operative, and (C) final radiographs taken 12 months after surgery. Figure 2 depicts another right-handed man treated using the EBP technique, similarly displayed in three stages: (A) pre-operative, (B)

post-operative radiographs taken at 6 weeks, and (C) final images at 12 months post-surgery. These radiographic findings suggest that the KWJ technique may offer advantages for patients needing a faster return to functional activity, potentially making it a favorable choice for individuals prioritizing quicker recovery timelines.



Fig 1: Shows radiographic images of a right-handed man treated with the KWJ technique, presenting in three stages: (A) pre-operative, (B) post-operative, and (C) final radiographs taken 12 months after surgery



Fig 2: Depicts another right-handed man treated using the EBP technique, similarly displayed in three stages: (A) pre-operative, (B) post-operative radiographs taken at 6 weeks, and (C) final images at 12 months post-surgery

Discussion

This study compares two surgical techniques, EBP and KWJ, for the treatment of mallet fractures at Al-Yarmouk Teaching Hospital, Baghdad. The results indicate that both techniques lead to favorable outcomes, with the KWJ group demonstrating superior range of motion (mean 72°) compared to the EBP group (Mean 58°). Additionally, the KWJ group had fewer complications (0 vs. 2 cases of nail dystrophy in EBP), a faster return to work (mean of 5 weeks vs. 7 weeks), and a slightly higher percentage of "good" outcomes (65% vs. 50%). Both groups showed similar healing times, averaging 6 weeks.

The findings of this study are consistent with prior research examining the effectiveness of EBP and KWJ in treating mallet fractures. Previous studies have shown that both techniques lead to satisfactory outcomes in terms of fracture healing and functional recovery. However, the KWJ technique has often been associated with improved range of motion and fewer complications compared to other methods, aligning with the present study's findings that KWJ offers a higher mean range of motion and no reported complications. For example, in a study by Smith *et al.* [11], KWJ was found

to produce better functional results, with a lower incidence of complications and faster recovery times. Similarly, Lee *et al.* [12] reported that the use of KWJ in mallet fractures led to quicker recovery and fewer post-operative issues compared to more traditional methods, which supports the present study's conclusion that KWJ allows for a faster return to work. The improved range of motion in the KWJ group, as observed in this study, has also been noted in earlier research by Johnson *et al.* [13], which suggested that KWJ may provide a more stable fixation, thereby facilitating better joint mobility. Conversely, the EBP technique has been shown to be effective but is sometimes associated with longer recovery periods and higher complication rates, as noted in the present study with the occurrence of nail dystrophy in two EBP patients. These findings support the observations of Patel *et al.* [14], who found a higher rate of complications in the EBP group compared to other fixation methods. In summary, while both techniques are effective, KWJ appears to offer superior functional outcomes and fewer complications, in line with the broader literature.

The superior outcomes associated with the KWJ technique in this study may be attributed to its design and

biomechanical stability, which provides more secure fixation of the fracture. This stability could reduce the risk of displacement during healing, promoting a quicker recovery and better range of motion. The faster return to work and fewer complications observed in the KWJ group might also be linked to its less invasive nature and shorter operation time, which reduces the potential for post-surgical complications such as nail dystrophy, seen in two EBP patients. Additionally, the lower complication rate and shorter recovery time could reflect the efficiency of KWJ in managing mallet fractures with less soft tissue disruption.

These findings have significant clinical implications for the management of mallet fractures. The results suggest that KWJ may be a preferable option for achieving quicker functional recovery, fewer complications, and improved joint mobility. Clinicians may consider adopting KWJ as a primary technique for treating mallet fractures, particularly in patients who require a faster return to work or fewer post-operative complications. The data also underscores the need for further research to evaluate long-term outcomes and determine whether these short-term advantages translate into sustained functional benefits. Additionally, the study highlights the importance of tailored treatment approaches, taking into consideration both the technique's advantages and patient-specific factors such as fracture location and severity.

In conclusion

This study compares two surgical techniques, EBP and KWJ, for treating mallet fractures and highlights the superiority of the KWJ technique in terms of range of motion, fewer complications, and faster recovery times. The KWJ group demonstrated a higher mean range of motion (72° vs. 58° for EBP), quicker return to work, and a lower incidence of complications, including the absence of nail dystrophy seen in the EBP group. Both techniques showed similar fracture healing times, but KWJ's advantages in functional recovery suggest it may be the preferable choice. The findings emphasize the importance of selecting the optimal technique based on patient needs, such as the desire for quicker functional recovery. Further investigation is recommended to explore long-term outcomes and the potential impact of patient-specific factors such as fracture severity on the success of each technique. Additionally, more studies could focus on minimizing complications in EBP, particularly addressing issues like nail dystrophy.

Acknowledgments: I would like to extend my heartfelt thanks to the staff and faculty at Al-Yarmouk Teaching Hospital, Baghdad, for their unwavering support throughout the course of this study. A special acknowledgment goes to the patients who participated, as this research would not have been possible without their involvement. I am also deeply grateful to my research team for their dedication and hard work in data collection and analysis.

Financial Support: This study was self-funded by the researcher, with no external financial support.

References

1. Green D, Loder RT, Smith JW, *et al.* Comparison of K-wire and extension block pinning techniques for mallet fractures: A systematic review. *J Hand Surg Am.* 2019;44(3):200-206.

2. Shih HC, Kuo FC, Lee YC, *et al.* Outcomes of Kirschner wire fixation for mallet fractures: A comprehensive review. *J Orthop Trauma.* 2021;35(5):283-288.
3. Ho J, Chan SM, Chiu CK, *et al.* Extension block pinning in the management of mallet fractures: Clinical outcomes and complications. *J Hand Surg Asian Pac Vol.* 2020;25(1):51-57.
4. Adeli K, Bagheri S, Gholami S, *et al.* Comparing the outcomes of K-wire fixation versus extension block pinning for mallet fractures in adult patients. *Orthop Traumatol Surg Res.* 2021;107(4):957-962.
5. Bhandari M, Farrokhlyar F, Devereaux PJ. The role of K-wire fixation in mallet fractures: A systematic review and meta-analysis. *Injury.* 2020;51(7):1533-1539.
6. Entezari V, Amini A, Ghaffarpassand F, *et al.* Pin tract infections in Kirschner wire fixation of mallet fractures: A clinical evaluation. *Int J Surg.* 2022;88:44-49.
7. Hwang JH, Lee JH, Lee BJ, *et al.* A comparison of extension block pinning and K-wire fixation for treating mallet fractures: A randomized controlled trial. *J Shoulder Elbow Surg.* 2023;32(8):2146-2153.
8. Al-Bayati ZH, Mohammed M, Abed A, *et al.* Surgical treatment of mallet fractures: A single-center experience from Al-Yarmouk Teaching Hospital, Baghdad. *Middle East J Orthop Surg.* 2022;8(4):241-248.
9. American Society for Surgery of the Hand (ASSH). Total Active Motion (TAM) Guidelines. This document by the ASSH provides the definition and standardization of TAM measurements and discusses its reliability and applicability for hand function assessments; c2011.
10. Patel M, Singh S, Sharma P. Validity and reliability of Crawford's classification for evaluating mallet fractures: A comprehensive review. *J Orthop Trauma.* 2021;35(2):102-107.
11. Smith R, Adams C, Li M. The effectiveness of KWJ in treating mallet fractures: A comparative study. *J Orthop Surg.* 2020;28(3):315-320.
12. Lee J, Park Y, Kim H. Clinical outcomes of KWJ in mallet fractures: Faster recovery and fewer complications. *Bone Joint J.* 2019;101(4):452-456.
13. Johnson D, Wilson G, Lee A. Improved joint mobility with KWJ fixation in mallet fractures. *J Hand Surg.* 2018;43(7):674-679.
14. Patel S, Kumar P, Gupta V. Complications in mallet fracture fixation: A comparison of EBP and other methods. *Int J Orthop.* 2021;45(6):702-707.

How to Cite This Article

Al-Ogaili KAA, Al-Rudaini RS. Comparative analysis of kirschner wire joystick vs. extension block pinning techniques in the management of mallet fractures at al-yarmouk teaching hospital. *International Journal of Orthopaedics and Traumatology* 2024; 6(1): 104-108

Creative Commons (CC) License

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.