ORIGINAL ARTICLE

Plate or intramedullary fixation: A comparative analysis of surgical treatment options for adult both-bone forearm fracture – A retrospective clinical study

Muhammed Enes Karatas,[1] Nazım Canberk Kiliç,[2] Engin Eceviz,[2] Güray Altun[3]

[1]Department of Orthopaedics and Traumatology, Istanbul Medeniyet University, Goztepe Prof.Dr.Suleyman Yalcın City Hospital, İstanbul-*Türkiye*

[2]Department of Orthopaedics and Traumatology, Kartal City Hospital, İstanbul-*Türkiye*

[3]Ortadoğu Hospital, Adana-*Türkiye*

ABSTRACT

BACKGROUND: Both-bone forearm fractures (BBFx) are common, high-energy injuries that significantly disrupt the anatomical and functional integrity of the forearm. While plate-screw osteosynthesis (PSO) has long been the standard treatment, intramedullary nailing (IMN) and hybrid methods combining both approaches have gained attention due to their potential advantages in minimally invasive procedures and functional outcomes. This study aims to compare the surgical and clinical outcomes of four different treatment strategies for BBFx.

METHODS: A retrospective review was conducted on 191 adult patients who underwent surgical treatment for combined radius and ulna fractures between 2012 and 2022. Patients were divided into four groups: PSO for both radius and ulna (Group A), IMN for both bones (Group B), IMN for radius, and PSO for ulna (Group C), and PSO for radius and IMN for ulna (Group D). Surgical outcomes including union time, fluoroscopy exposure, surgical duration, and functional recovery were analyzed.

RESULTS: Group B demonstrated significantly shorter surgical times (75.4 minutes) and faster fracture union (10.1 weeks) compared to Group A, which had a mean union time of 13.2 weeks. Fluoroscopy exposure was significantly lower in Group A, while Groups C and D showed intermediate results. Functional outcomes, including range of motion, grip strength, pinch strength, and QuickDASH (Quick Disabilities of the Arm, Shoulder, and Hand) scores, did not differ significantly between groups. The complication rate was lowest in Groups C and D (2.5%) and highest in Group B (6.5%), with complications such as infection and nonunion observed.

CONCLUSION: While PSO remains the gold standard for BBFx, hybrid methods combining PSO and IMN provide a promising alternative, offering shorter surgical times, faster union, and reduced fluoroscopy exposure. The hybrid technique may become a preferred approach due to these advantages, although further prospective studies are required to confirm these findings.

Keywords: Both-bone forearm fracture; plate-screw osteosynthesis; intramedullary nailing; hybrid fixation; trauma.

INTRODUCTION

Both-bone forearm fracture (BBFx) are orthopedic injuries that frequently occur following high-energy injuries and have shown an increasing incidence in recent years. These types of fractures severely disrupt the anatomical and functional integrity of the forearm, leading to dynamic instability between the wrist and elbow. The ideal treatment method should help patients regain functional mobility as quickly as possible, minimize the risk of complications, and ensure satisfactory long-

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Address for correspondence: Muhammed Enes Karatas

Department of Orthopaedics and Traumatology, Istanbul Medeniyet University, Goztepe Prof. Dr. Suleyman Yalcın City Hospital, İstanbul, Türkiye

E-mail: menskrts@hotmail.com

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term functional recovery. Although conservative management often yields favorable outcomes in pediatric populations, surgical intervention is the primary approach in the adult population. Because fractures of the radius and ulna significantly affect the biomechanical structure and function of the forearm, the selection of the optimal treatment regimen directly influences patient outcomes. The main goal of treatment is to restore axial and rotational stability and help patients regain their previous functional range of motion (ROM).[1]

Open reduction and plate-screw osteosynthesis (PSO) remains the most widely adopted technique for the management of BBFx, owing to its well-documented ability to achieve anatomical alignment and stable fixation.[2,3] While this method provides excellent anatomical restoration and stabilization, it also has several disadvantages, including extensile incisions, disruption of periosteal circulation due to plate pressure, potential plate removal, risk of refracture following plate removal, drainage of the fracture hematoma, and complications such as skin necrosis, nonunion, and infection.[4,5] In contrast, intramedullary nailing (IMN) offers a minimally invasive surgical technique that can reduce soft tissue damage and shorten operation time. However, critics argue that this method has limited capacity to ensure rotational stability and may be inadequate for certain fracture types.[6]

Although the hybrid application of these two methods is not widely discussed in the literature, its use has been increasing in recent years.[7] Combining different treatment approaches for BBFx has become an appealing option to ensure stability while leveraging the advantages of minimally invasive techniques.

We hypothesized that IMN, whether employed in isolation or as part of a hybrid construct, would result in shorter operative time and faster radiographic union compared to conventional plate-screw fixation applied to both the radius and ulna, without compromising functional recovery. This retrospective analysis was designed to delineate the relative advantages and limitations of current fixation strategies for adult both-bone forearm fractures, thereby informing clinical decision-making through comparative outcome data.

MATERIALS AND METHODS

All procedures involving human participants were conducted in accordance with the ethical standards of the institutional and national research committees, and with the 1964 Declaration of Helsinki and its subsequent amendments. The study involved no animal subjects. Ethical approval for this retrospective analysis was obtained (Approval no. 2024/010.99/2/9).

This retrospective study analyzed patients who underwent surgical treatment for combined radius and ulna fractures at our institution between 2012 and 2022. A total of 220 patient records were reviewed, and 191 patients who met the inclusion criteria were evaluated. Patient data were obtained from the institutional electronic medical record system and surgical archives. Inclusion criteria were: age ≥18 years, presence of combined radius and ulna fractures involving the distal, middle, or proximal third of the diaphysis, and a minimum clinical and radiological follow-up duration of 12 months. Exclusion criteria included open fractures, Monteggia or Galeazzi fracture-dislocations, pathological fractures, and fractures associated with neurovascular injuries.

Study Groups

The patients included in the study underwent different surgical treatments, and four main treatment groups were established:

1. Radius and ulna plate-screw osteosynthesis (Group A)
2. Radius and ulna intramedullary nailing (Group B)
3. Radius intramedullary nailing and ulna plate-screw osteosynthesis (Group C)
4. Radius plate-screw osteosynthesis and ulna intramedullary nailing (Group D).

Surgical Technique

Patients were operated on under general anesthesia or axillary block with a tourniquet (Fig. 1-4). One hour before the operation, 1 g of cefazolin was administered to all patients. The volar Henry approach was used for mid- and distal-diaphyseal radius fractures treated with plates, and the Thompson approach was used for proximal-diaphyseal fractures. For ulna fracture surgery, a direct incision was made through the bone. To preserve blood supply, excessive stripping of soft tissue from the osseous structures was avoided. After the fracture lines were identified, the plate was fixated with at least three screws (six cortices) both distally and proximally. In cases where PSO was performed for both radius and ulna, 3.5 mm limited-contact dynamic compression plates (LC-DCP) were used.

Closed reduction was attempted first in the nailing procedure. If closed reduction could not be achieved, open reduction was performed through a 2-cm incision at the fracture line. The nail was inserted with the patient in the supine position on a radiolucent operating table.

Nail length and thickness in patients undergoing IMN were determined using anteroposterior (AP) and lateral views taken prior to surgery. For application of the radius nail, a 1.5-2 cm incision was made over Lister's tubercle. The extensor carpi radialis brevis tendon was released and moved radially. The entry point was then determined under fluoroscopy, and an awl was used to create the path. The nail was directed proximally, and closed reduction was performed at the fracture site. The design of the proximal and distal ends provides rotational stability and restores radial bowing. Its parabolic body, with a 10° angled proximal 3 cm and distal interlocking features, enables three-point fixation.[8] For ulna

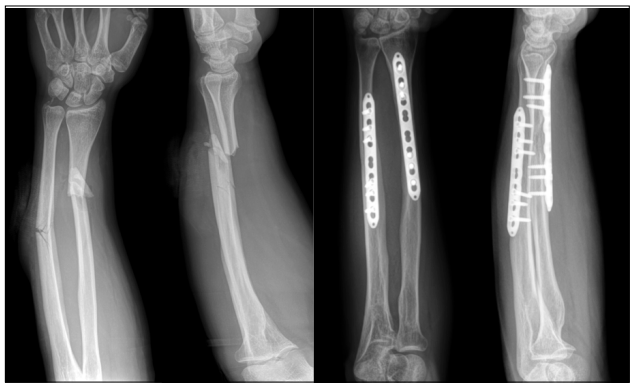

Figure 1. A 35-year-old male patient with a double fracture of the forearm after a traffic accident. Plate-screw osteosynthesis (PSO) was performed on both fractures. Preoperative and postoperative final radiographs are presented.

Figure 2. A 26-year-old male patient with a double fracture of the forearm after a fall while playing soccer. Intramedullary nailing (IMN) was performed on both bones. Preoperative and postoperative radiographs after union are presented.

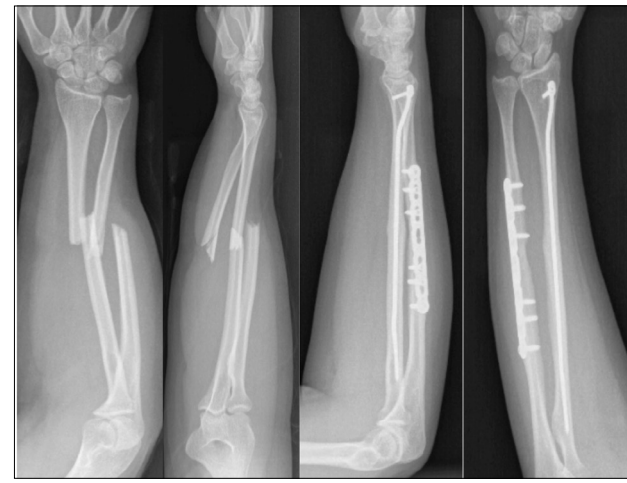

Figure 3. A 31-year-old female patient with a double fracture of the forearm due to a motorcycle accident. Intramedullary nailing (IMN) was performed on the radius, and plate-screw osteosynthesis (PSO) was performed on the ulna. Preoperative and postoperative follow-up radiographs are presented.

Figure 4. A 38-year-old male patient with a double fracture of the forearm after a fall from a height onto the arm. Intramedullary nailing (IMN) was performed on the ulna fracture, and plate-screw osteosynthesis (PSO) was performed on the radius. Preoperative fracture and postoperative radiographs after union are presented.

fractures, the elbow was flexed to 90°, and a 1-1.5 cm incision was made from the olecranon tip. A guide wire was inserted along the ulna shaft and checked with fluoroscopy. After canal preparation with a 3-mm drill, the nail was inserted distally. Closed reduction was attempted first, and if unsuccessful, reduction was achieved through a small open incision. The proximal part of the nail was locked either statically or dynamically. Distal locking was achieved with one or more locking screws passing through the eight transverse grooves on the distal 3 cm of the nail.[8] Distal locking was dependent on surgeon preference; in some cases, a distal locking screw was not used.

All surgical procedures were performed by experienced orthopedic surgeons. A single type of ulna and radius nail was used for IMNs (TST Rakor Medical Instruments Industry and Trade Limited Company, Istanbul, Türkiye). All patients followed a standardized rehabilitation protocol postoperatively, with early mobilization encouraged. Follow-up evaluations were performed at 2, 6, and 12 weeks, during which fracture healing was confirmed radiographically and functional assessments were conducted. Range of motion measurements and functional outcome assessments (the Quick Disabilities of the Arm, Shoulder, and Hand [QuickDASH] and Grace-Eversmann criteria) were conducted at the final follow-up, defined as the last outpatient clinic visit at least 12 months postoperatively.

Evaluation Criteria

Patients were evaluated based on demographic characteristics and specific functional and radiological parameters during the postoperative period:

• **Fracture union time:** Fracture healing was defined radiologically as the re-establishment of cortical continuity in AP and lateral radiographs, visible trabeculae, or callus formation in at least three cortices, together with the absence of tenderness along the fracture line. Time to union was defined as the period from surgery to the first radiological signs of healing. Fractures that did not heal within six months were classified as nonunion.[9]

• **Surgical duration:** Time elapsed from the initial incision to placement of the final suture was recorded.

• **Intraoperative fluoroscopy shots:** The number of fluoroscopic images taken during surgery was recorded as the average number of shots per patient.

• **Pronation and supination angles:** The rotational capacity of the forearm was assessed using goniometric measurements by a surgeon not involved in the procedures. Measurements were taken at the 12-week postoperative mark.

• **Grip strength (kgw):** The grip strength of the dominant and non-dominant hand was measured using a hand dynamometer.

• **Pinch strength (kgw):** Pinch strength between the thumb and index finger was assessed using a pinch meter.

• **Functional scores:** Patients' functional status was evaluated using the QuickDASH and Grace-Eversmann scores.[2,9]

• **Postoperative complications:** Recorded complications included infection, nonunion, malunion, nerve injury, implant-related issues, and other surgical complications.

Statistical Analysis

Statistical analyses were performed using SPSS software (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using the Shapiro-Wilk test. Normally distributed variables were expressed as means and standard deviations, while categorical variables were reported as frequencies and percentages. Group comparisons for continuous data were conducted using one-way analysis of variance (ANOVA) or independent-samples t-tests, as appropriate. The chi-square test was employed to analyze categorical variables, including baseline characteristics and postoperative complications. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 191 patients were included in the study: 51 in Group A, 61 in Group B, 39 in Group C, and 40 in Group D. The mean age was 36.6 years (range: 19-76) in Group A, 33.8 years (range: 19-63) in Group B, 35.4 years (range: 18-66) in Group C, and 29.9 years (range: 18-61) in Group D, with no statistically significant differences observed between the groups (p=0.199). Among the patients, 93 (48.7%) sustained right-sided fractures, while 98 (51.3%) presented with left-sided fractures. The mean follow-up duration across all groups was 58.8 months (range: 13-130), with no statistically significant intergroup variation (p=0.354). Based on the Association for Osteosynthesis/Association for the Study of Internal Fixation (AO/ASIF) classification system, fractures were categorized as 22A3 in 85 cases, 22B3 in 87 cases, and 22C3 in 19 cases (Table 1).

The mean operation period was 105.3 minutes (80-150) in Group A, 75.4 minutes (50-120) in Group B, 100.7 minutes (70-130) in Group C, and 99.1 minutes (75-140) in Group D

Table 1. Baseline demographic characteristics and AO fracture classification of study groups

	Group A (n=51)	Group B (n=61)	Group C (n=39)	Group D (n=40)	p-value
Sex, n (%)					0.199
Male	32 (62.7%)	48 (78.7%)	25 (64.1%)	27 (67.5%)	
Female	19 (37.3%)	13 (21.3%)	14 (35.9%)	13 (32.5%)	
Age, years (mean±SD)	36.6±17.6	33.8±14.1	35.4±15.5	29.9±10.8	0.199
Side, n (%)					0.571
Right	29 (56.9%)	30 (49.2%)	18 (46.2%)	16 (40.0%)	
Left	22 (43.1%)	31 (50.8%)	21 (53.8%)	24 (60.0%)	
Follow-up, months (mean±SD)	58.8±11.3	57.2±10.9	59.7±12.1	60.2±13.4	0.354
AO Classification, n (%)					
22A3	22 (43.1%)	20 (32.8%)	24 (61.5%)	19 (47.5%)	
22B3	23 (45.1%)	35 (57.4%)	13 (33.3%)	16 (40.0%)	
22C3	6 (11.8%)	6 (9.8%)	2 (5.2%)	5 (12.5%)	

Table 2. Comparison of mean forearm pronation and supination angles (degrees) between treatment groups

	Group A (n=51)	Group B (n=61)	Group C (n=39)	Group D (n=40)	p-value
Pronation (°), mean±SD	83.6±7.1	83.2±5.9	83.2±5.3	85.1±4.7	0.413
Pronation (°), min–max	60–90	70–90	75–90	75–90	
Supination (°), mean±SD	84.2±5.3	81.8±5.9	83.5±4.9	84.5±4.5	0.301
Supination (°), min–max	70-90	60-90	70-90	75-90	

p-values were calculated using analysis of variance (ANOVA).

Table 3. Functional outcomes based on QuickDASH (the Quick Disabilities of the Arm, Shoulder, and Hand) questionnaire and Grace-Eversmann scoring system

	Group A (n=51)	Group B (n=61)	Group C (n=39)	Group D (n=40)	p-value
QuickDASH Score (mean, min–max)	8.1 (3–33)	6.9 (3–25)	8.3 (3–35)	7.7 (3–30)	0.601
Grace-Eversmann Score Evaluation					
Group A	**Group B (n=51)**	**Group C (n=61)**	**Group D (n=39)**	**p-value (n=40)**	
Excellent	46	55	36	37	0.877
Good	3	5	2	3	
Acceptable	2	1	1	0	
Unacceptable	0	0	0	0	

(measured from the first incision to the last suture). Statistical analysis revealed that Group B exhibited a significantly shorter operation period compared to the other groups (p<0.001), while no significant differences were found between Groups A, C, and D.

Fluoroscopic exposure, quantified by the mean number of fluoroscopies taken per procedure, was lowest in Group A (10.2±4.2 shots) and highest in Group B (46.2±13.8 shots). Statistical evaluation demonstrated that fluoroscopy use in Group A was significantly lower than in the other three groups (p<0.001). Moreover, Groups C and D displayed significantly lower fluoroscopic exposure than Group B (p<0.001 for both comparisons).

The mean time to radiological union was 13.2±1.7 weeks in Group A, 10.1±1.8 weeks in Group B, 11.2±1.7 weeks in Group C, and 10.5±2.1 weeks in Group D. Statistical analysis revealed that fracture healing in Group A was significantly delayed compared to the other groups (p<0.001).

Assessment of forearm ROM indicated no significant differences between groups in terms of supination (p=0.301) and pronation angles (p=0.413) (Table 2).

Functional outcomes, evaluated using the QuickDASH score and the Grace-Eversmann criteria, showed no significant intergroup differences (p=0.601 and p=0.877, respectively) (Table 3). Similarly, no significant variations were observed in pinch strength and grip strength parameters among the groups (p=0.137 and p=0.533, respectively).

A total of nine complications (4.7%) were observed among the 191 patients. These included two cases of nonunion (1.0%), one in Group A and one in Group B, both successfully treated with revision surgery. Four cases of superficial wound infection (2.1%) were distributed equally across all four groups (n=1 in each group); three resolved with antibiotic therapy and dressing, while one patient in Group A required multiple surgical debridements due to persistent drainage from the ulnar incision. Symptomatic screw irritation requiring implant removal occurred in two patients (1.0%) in Group B. Additionally, one patient (0.5%) in Group A sustained a posterior interosseous nerve (PIN) palsy, which resolved by the fourth postoperative month. No vascular injuries, synostosis, tendon injuries, compartment syndrome, or refractures were observed during the follow-up period.

DISCUSSION

The treatment of forearm diaphyseal fractures in adults continues to be a challenging topic, particularly with regard to IMN. In this study, we evaluated the efficacy of these methods

in four different treatment groups and compared multiple parameters. Our findings contribute to the existing literature by emphasizing the various advantages and limitations of each method. The general consensus for these fractures favors PSO of both bones, although IMN and hybrid treatment methods have recently gained attention. While rotational problems are associated with IMN, the nail designs used in our study are thought to reduce this deficiency by restoring radial bowing and through their locking systems.[8]

Union time was found to be significantly longer in Group A compared to Group B. This result is consistent with the findings of Zhang et al.,[10] who reported that IMN was associated with a significantly shorter union times than plate fixation. This may be explained by the superiority of IMN in axial stability over plate fixation, as IMN is a load-sharing implant that accelerates bone consolidation.[11] In a study published in 2022, significantly earlier bone union was observed in patients treated with both-bone fixation.[12] In another randomized controlled study, union time was shorter in patients who underwent PSO compared to those who underwent IMN.[13] Some studies, however, have reported similar union times for both techniques.[14-16] In our study, union time was longer in patients who underwent PSO compared to those who underwent IMN. Additionally, patients who underwent hybrid surgery demonstrated faster union times compared to patients treated with PSO. We have not found a similar study in adult patients in the literature. In this respect, we assume that hybrid surgery is more advantageous than PSO in both-bone fixations.

A meta-analysis published in 2024 showed that surgical time was significantly shorter in the IMN group compared to the PSO group.[17] In the treatment of isolated fractures involving the distal two-thirds of the ulnar diaphysis, mean operative time was also significantly shorter in the IMN group compared to alternative fixation methods.[18] Similar results have been reported in many studies in the literature.[15] In our study, although shorter surgical times were observed across all three IMN groups, statistically significant results were obtained only in the group treated with IMN for both bones compared to the other three groups. From this perspective, whenever open reduction is performed, the duration of surgery is prolonged. Although surgical time was shorter in the IMN groups, there were far fewer exposures to fluoroscopy among PSO patients who were operated on both bones regarding the preoperative fluoroscopy shot counts. The number of fluoroscopies taken increased when the fracture was treated with closed reduction and IMN. In the literature, many studies have demonstrated longer fluoroscopy times.[12-14] This issue is one of the biggest disadvantages of IMN.

In our study, although slight differences in pronation and supination angles were observed among the four groups, no statistically significant differences were found. This result is supported by many studies in the literature.[6,15,19]

In our study, functional outcomes, including the Quick-DASH and Grace-Eversmann scores, as well as pinch and grip strength measurements, were evaluated. Consistent with previous reports, no statistically significant differences among the groups have been reported in the literature for these parameters, including forearm range of motion.[6,20-22] In our study, there were no unacceptable outcomes according to Grace-Eversmann criteria, and the rate of excellent results was higher in this study. Although the mean Quick-DASH score was lower in Group B compared to the other groups, no significant differences were observed among the four groups for any of the clinical outcomes.

In the literature, complications such as infection, nonunion, refracture after implant removal, PIN injuries, vascular injuries, tendon ruptures, and elbow joint stiffness have been reported.[6,23,24] The overall complication rate in this study was approximately 4.7%. Complication rates were slightly higher in the IMN groups (6.5%) compared to the others, whereas the lowest rate was observed in the hybrid fixation groups (2.5%). In a systematic review published by Box et al.,[15] overall complication rates were reported to be lower in patients who underwent PSO. Many other studies have reported similar complication rates between the two groups.[7,25] Feng et al.[26] reported two major and two minor (14.2%) complications in the hybrid group of older children in their article published in 2016. They also noted complications in 8 out of 22 patients treated with elastic nails and stated that there was no difference between groups. Since there was no locking mechanism in patients with elastic nails and the nail tip was relatively outside the bone, higher complication rates were considered normal compared to the cases operated on with the nails used in our study. In another study involving patients aged 10 to 16 years, outcomes in the hybrid elastic nail and plate group were compared. In this study, the lowest complication rate was observed in the hybrid group, although no significant difference was found between the three groups.[27] We believe that the lower complication rates reported in the hybrid group in similar studies may make this method a preferred option in the future.

This study is not without limitations. The retrospective nature and lack of randomization inherently raise concerns regarding potential selection bias, as the choice of surgical technique was based on the attending surgeon's clinical judgment. Nevertheless, given that all fixation methods were routinely employed by experienced surgeons within the same institution and that no rigid criteria governed treatment allocation, the likelihood of systematic bias was likely mitigated. Furthermore, the single-center design may constrain the external validity of the results. Despite these limitations, the uniformity in surgical protocols and follow-up assessments strengthens the methodological rigor and internal consistency of the study.

CONCLUSION

Although plate-screw osteosynthesis is currently accepted as the gold standard for both-bone forearm fractures, IMN

and hybrid techniques have recently become widespread. Locked IMN for both bones has been reported as an easier technique with shorter surgical times and better cosmetic results; however, its relatively high fluoroscopy exposure and certain complications have prompted the search for different techniques. The hybrid method, which synthesizes both techniques, offers advantages such as shorter surgical times, less fluoroscopy exposure, and faster union compared to PSO applied to both bones. We believe the hybrid technique might become a popular method in the near future due to these advantages. We are aware that each patient should be evaluated individually, and it is critical to administer patient-specific treatment. Further studies are surely needed to compare different fixation techniques in forearm fractures.

Ethics Committee Approval: This study was approved by the Dr. Lütfi Kırdar City Hospital Ethics Committee (Date: 27.03.2024, Decision No: 2024/010.99/2/9).

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: M.E.K.; Design: G.A.; Supervision: E.E.; Resource: N.C.K.; Materials: M.E.K.; Data collection and/or processing: G.A.; Analysis and/or interpretation: M.E.K. Literature review: E.E.; Writing: M.E.K.; Critical review: G.A., N.C.K.

Conflict of Interest: None declared.

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REFERENCES

1. Schemitsch EH, Richards RR. The effect of malunion on functional outcome after plate fixation of fractures of both bones of the forearm in adults. J Bone Joint Surg Am 1992;74:1068–78. [CrossRef]
2. Grace TG, Eversmann WW Jr. Forearm fractures: Treatment by rigid fixation with early motion. J Bone Joint Surg Am 1980;62:433–8. [CrossRef]
3. Anderson LD, Sisk D, Tooms RE, Park WI 3rd. Compression-plate fixation in acute diaphyseal fractures of the radius and ulna. J Bone Joint Surg Am 1975;57:287–97. [CrossRef]
4. Blažević D, Benčić I, Ćuti T, Bakota B, Dobrić I, Sabalić S, et al. Intramedullary nailing of adult forearm fractures: Results and complications. Injury 2021;52:S44–8. [CrossRef]
5. Moss JP, Bynum DK. Diaphyseal fractures of the radius and ulna in adults. Hand Clin 2007;23:143–51. [CrossRef]
6. Saini R, Sharma A, Baisoya K, Ravalji D. A comparative study between plate osteosynthesis and intramedullary nailing for diaphyseal fracture of radius and ulna in adults. Cureus 2023;15:e37277. [CrossRef]
7. Cai L, Wang J, Du S, Zhu S, Wang T, Lu D, et al. Comparison of hybrid fixation to dual plating for both-bone forearm fractures in older children. Am J Ther 2016;23:e1391–6. [CrossRef]
8. Saka G, Saglam N, Kurtulmuş T, Avcı CC, Akpinar F, Kovaci H, et al. New interlocking intramedullary radius and ulna nails for treating forearm diaphyseal fractures in adults: A retrospective study. Injury 2014;45:S16–23. [CrossRef]
9. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: The DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper Extremity Collaborative Group (UECG). Am J Ind Med 1996;29:60–8. Erratum in: Am J Ind Med 1996;30:372. [CrossRef]
10. Zhang B, Zhu Y, Zhang F, Chen W, Tian Y, Zhang Y. Meta-analysis of plate fixation versus intramedullary fixation for the treatment of midshaft clavicle fractures. Scand J Trauma Resusc Emerg Med 2015;23:27. [CrossRef]
11. Miao J, Luo Y, Zhou H, Zheng Y, Zhao C, Zheng F, et al. Comparison of intramedullary nailing versus plating fixation in the treatment of adult diaphyseal both-bone forearm fractures: A meta-analysis. Int J Clin Exp Med 2017;10:11360–70.
12. Polat O, Toy S. Comparison of the clinical and radiographic outcomes of plate fixation versus new-generation locked intramedullary nail in the management of adult forearm diaphyseal fractures. Acta Orthop Traumatol Turc 2022;56:321–6. [CrossRef]
13. Lee SK, Kim KJ, Lee JW, Choy WS. Plate osteosynthesis versus intramedullary nailing for both forearm bones fractures. Eur J Orthop Surg Traumatol 2014;24:769–76. [CrossRef]
14. Kibar B, Kurtulmuş T. Comparison of new design locked intramedullary nails and plate osteosynthesis in adult isolated diaphyseal radius fractures. Eur J Trauma Emerg Surg 2020;46:1429–35. [CrossRef]
15. Box MW, Stegelmann SD, Domingue GA, Wells ME, Werthmann NJ, Potgieter CJ, et al. Intramedullary nail fixation versus open reduction and internal fixation for treatment of adult diaphyseal forearm fractures: A systematic review and meta-analysis. J Orthop Surg Res 2024;19:719. [CrossRef]
16. Kibar B, Kurtulmuş T. Treatment of adult isolated ulnar diaphyseal fractures: A comparison of new-generation locked intramedullary nail and plate fixation. Eklem Hastalik Cerrahisi 2019;30:246–51. [CrossRef]
17. Lari A, Hassan Y, Altammar A, Esmaeil A, Altammar A, Prada C, et al. Interlocking intramedullary nail for forearm diaphyseal fractures in adults-A systematic review and meta-analysis of outcomes and complications. J Orthop Traumatol 2024;25:16. [CrossRef]
18. Şişman A, Polat Ö. Comparison of intramedullary nailing and plate fixation in the surgical treatment of isolated fractures of the distal two-thirds of ulna diaphysis. Jt Dis Relat Surg 2023;34:374–80. [CrossRef]
19. Lee YH, Lee SK, Chung MS, Baek GH, Gong HS, Kim KH. Interlocking contoured intramedullary nail fixation for selected diaphyseal fractures of the forearm in adults. J Bone Joint Surg Am 2008;90:1891–8. [CrossRef]
20. Lee SK, Kim YH, Kim SM, Choy WS. A comparative study of three different surgical methods for both-forearm-bone fractures in adults. Acta Orthop Belg 2019;85:305–16.
21. Köse A, Aydın A, Ezirmik N, Yıldırım ÖS. A comparison of the treatment results of dpen reduction internal fixation and intramedullary nailing in adult forearm diaphyseal fractures. Ulus Travma Acil Cerrahi Derg 2017;23:235–44. [CrossRef]
22. Patel A, Li L, Anand A. Systematic review: Functional outcomes and complications of intramedullary nailing versus plate fixation for both-bone diaphyseal forearm fractures in children. Injury 2014;45:1135–43. [CrossRef]
23. Gao H, Luo CF, Zhang CQ, Shi HP, Fan CY, Zen BF. Internal fixation of diaphyseal fractures of the forearm by interlocking intramedullary nail: Short-term results in eighteen patients. J Orthop Trauma 2005;19:384–91. [CrossRef]
24. Fanuele J, Blazar P. Extensor pollicis longus tendon rupture in an adult after intramedullary nailing of a radius fracture: Case report. J Hand Surg Am 2009;34:627–9. [CrossRef]
25. Ozkaya U, Kiliç A, Ozdoğan U, Beng K, Kabukçuoğlu Y. Comparison between locked intramedullary nailing and plate osteosynthesis in the management of adult forearm fractures. Acta Orthop Traumatol Turc 2009;43:14–20. [Article in Turkish] [CrossRef]
26. Feng Y, Shui X, Wang J, Cai L, Wang G, Hong J. Comparison of hybrid fixation versus dual intramedullary nailing fixation for forearm fractures in older children: Case-control study. Int J Surg 2016;30:7–12. [CrossRef]
27. Zheng W, Tao Z, Chen C, Zhang C, Zhang H, Feng Z, et al. Comparison of three surgical fixation methods for dual-bone forearm fractures in older children: A retrospective cohort study. Int J Surg 2018;51:10–6. [CrossRef]

ORİJİNAL ÇALIŞMA - *ÖZ*

Plak mı, intramedüller fiksasyon mu? Erişkin ön kol çift kemiği kırığında cerrahi tedavi seçeneklerinin karşılaştırmalı analizi: Retrospektif bir klinik çalışma

AMAÇ: Ön kol çift kemiğinin birlikte kırılması (ÖÇKK), ön kolun anatomik ve fonksiyonel bütünlüğünü ciddi şekilde bozan, yüksek enerjili travmalar sonucu gelişen yaygın kırıklardır. Bu kırıkların tedavisinde uzun süredir plak-vida osteosentezi (PVO) standart yöntem olarak kullanılmakta olup; son yıllarda intramedüller çivileme (İMÇ) ve her iki yöntemi birleştiren hibrit teknikler, minimal invaziv cerrahi avantajları ve fonksiyonel sonuçları açısından dikkat çekmektedir. Bu çalışmanın amacı, ÖÇKK tedavisinde uygulanan dört farklı cerrahi yöntemin cerrahi ve klinik sonuçlarını karşılaştırmaktır.
GEREÇ VE YÖNTEM: 2012 ile 2022 yılları arasında radius ve ulna kırığı nedeniyle cerrahi tedavi uygulanmış 191 erişkin hasta retrospektif olarak incelendi. Hastalar dört gruba ayrıldı: her iki kemiğe PVO uygulananlar (Grup A), her iki kemiğe İMÇ uygulananlar (Grup B), radiusa İMÇ ve ulnaya PVO uygulananlar (Grup C), radiusa PSVO ve ulnaya İMÇ uygulananlar (Grup D). Kaynama süresi, floroskopi maruziyeti, cerrahi süresi ve fonksiyonel iyileşme gibi cerrahi sonuçlar değerlendirildi.
BULGULAR: Grup B'de cerrahi süre (75.4 dakika) ve kaynama süresi (10.1 hafta) anlamlı şekilde daha kısa olup, Grup A'da ortalama kaynama süresi 13.2 hafta olarak izlendi. Floroskopi maruziyeti ise Grup A'da anlamlı şekilde daha düşüktü. Gruplar C ve D, bu parametrelerde ara değerler gösterdi. Fonksiyonel sonuçlar (eklem hareket açıklığı, el kavrama gücü, parmak uçları arasındaki sıkma gücü ve QuickDASH skorları) açısından gruplar arasında anlamlı fark bulunmadı. Komplikasyon oranı Grup C ve D'de en düşük (%2.5), Grup B'de ise en yüksek (%6.5) olarak izlendi; komplikasyonlar arasında enfeksiyon ve kaynamama yer aldı.
SONUÇ: PVO halen ÖÇKK tedavisinde altın standart olarak kabul edilse de, PvO ve İMÇ yöntemlerinin birlikte kullanıldığı hibrit teknikler; daha kısa cerrahi süre, daha hızlı kaynama ve düşük floroskopi maruziyeti gibi avantajlar sunarak umut verici bir alternatif oluşturmaktadır. Bu avantajlara rağmen, bulguların doğrulanması için ileriye dönük çalışmalara ihtiyaç vardır.

Anahtar sözcükler: Hibrit fiksasyon; intramedüller çivileme; ön kol çift kemik kırığı; plak-vida osteosentezi; travma.

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