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Dorsal Bridge Plating for Comminuted Distal Radius Fractures: Functional Outcomes of Distal Fixation on 2nd Metacarpal versus 3rd Metacarpal

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Learning Point of the Article:

Distal fixation on the 2nd metacarpal had better functional results than the 3rd metacarpal in dorsal bridge plating for comminuted distal radius fractures.

Abstract

Purpose: To compare the functional outcome of distal fixation on the second metacarpal versus the third metacarpal in patients treated with dorsal bridge plating for comminuted intra-articular distal radius fractures.

Materials and Methods: The functional outcome of 60 patients treated with dorsal bridge plating was assessed 6 months postoperatively comparing distal fixation on the second metacarpal versus the third metacarpal. Pain, ability to work post-fixation, range of movements, stiffness, and grip strength were the parameters assessed.

Results: Distal fixation on the third metacarpal resulted in more stiffness and risk of tendon entrapment of the first and third extensor compartments when compared to distal fixation on the second metacarpal.

Conclusion: Dorsal bridge plating with a distal fixation on the second metacarpal shower better functional outcome compared to the third metacarpal with a better range of movements, less risk of tendon entrapment, and better fracture stabilization.

Keywords: Distal radius fracture, dorsal bridge plate, second and third metacarpal, distal fixation, functional outcome.

Introduction

Distal radius fractures are the most common fractures of the upper extremity and account for approximately 17–18% of all fractures in orthopedic emergencies [1]. It has a bimodal age distribution, with younger individuals being affected due to high-energy trauma or falls from height whereas older individuals are affected by trivial falls due to poor bone mass [2]. These fractures significantly affect a person's daily life activities, due to pain, stiffness, affect hand function, range of motion, and grip strength [3].

Several treatment options exist for distal radius fractures, depending on the severity and fracture pattern. Non-surgical management with casting is often preferred for simple, stable fractures. However, for complex fractures involving comminution, intra-articular extension, or significant displacement, surgical intervention is typically necessary [1, 4, 5].

Surgical options for complex distal radius fractures include volar plating, the traditional technique that involves placing a plate on the palmar aspect of the radius to achieve fracture reduction and

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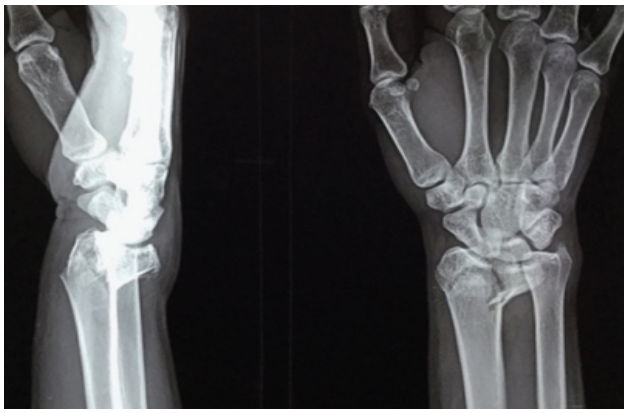

Figure 1: Comminuted intra-articular fracture of distal radius

Figure 2: After 2 weeks of surgery on the third metacarpal was fixated with dorsal bridge plating during suture removal.

Figure 3: After suture removal.

stabilization. However, it can lead to flexor tendon complications and potential loss of wrist extension [6]. External fixation is a minimally invasive technique that utilizes pins or wires placed through the skin and bone to maintain fracture alignment externally. While this avoids tendon disruption, it can limit early motion and may require a longer rehabilitation process [4, 7].

Dorsal bridge plating is a relatively newer technique that involves placing a plate on the dorsal aspect of the radius, spanning the wrist joint and the carpus, to achieve fracture reduction and stability through distraction. It works on the principle of ligamentotaxis and can distract and reduce intra-articular fragments. The plate is temporarily fixed distally to the second or third metacarpal bone on the dorsal aspect under the extensor tendons and proximally to the shaft of the radius. It allows for immediate weight loading and can be kept for a longer duration to allow fracture healing and avoid complications of prolonged use of external fixators. Once the healing has been confirmed, the plate can be removed and therapy for wrist motion and stability can be initiated [1, 2, 8, 9].

Biomechanical studies using cadaveric models have demonstrated the advantages of dorsal bridge plating in terms of stability and fracture reduction [10]. Furthermore, early range of motion of wrist joint exercises can be initiated sooner compared to volar plating due to less risk of tendon irritation. It also allows for an early return to work when compared to a volar locking plate [6, 11].

The potential complications of the procedure include risk of infection, hardware failure, tendon irritation, and complex regional pain syndrome [11-13]. Tendons of the first and third dorsal compartments such as abductor pollicis longus, extensor pollicis brevis, and extensor pollicis longus are prone to entrapment at the level of lister's tubercle.

Some contraindications to dorsal bridge plating include distal radius fractures that are irreducible by ligamentotaxis, fractures with severe dorsal soft-tissue compromise which might result in exposed hardware, associated fractures of the ipsilateral radial shaft or second/third metacarpal, severe pre-existing arthritis and patients who are unlikely to return for follow-up and plate removal.

Figure 4: After 1 week of surgery on second metacarpal fixation with dorsal bridge plating during wound inspection

Figure 5: Distal radius fracture fixated with k wire and dorsal bridge plating on the third metacarpal.

Figure 6: Distal radius fracture fixated with dorsal bridge plating of second metacarpal.

Figure 7: Demonstrating ROM left wrist joint in extension after implant removal of dorsal bridge plating on second metacarpal after 6 months.

Figure 8: Demonstrating ROM of the left wrist in flexion after implant removal

As of now, there is no consensus as to the best location for distal fixation of the dorsal bridge plate. In the study by Hanel et al., distal fixation was done on the second metacarpal [14]. In studies by Dr. Mohammed Shoaib Qureshi and Dr. Mangesh Panat, the average union time was 8.65 ± 0.93 weeks and average removal implant removal at 8.75 ± 0.85 and all patients achieved full ROM at wrist maintaining articular congruity post-implant removal. Studies by Mohamed et al. in comparisons to external fixation bridge plating may provide earlier functional recovery and lower complication rates and the distal fixation was on the third metacarpal [14]. Studies by Alexander Lauder distraction bridge plate fixation for distal radius fracture are safe with minimal complications. Sarah Lewis et al. plating to the second metacarpal decreases the risk of entrapment of extensor tendons compared with plating to the third metacarpal. Ali Azad et al. dorsal bridge fixation of distal radius fractures restores pre-operative physiologic measures of the radius, ulna, and carpus. Rajneesh Garg Eloy Tabeayo et.al in a cadaveric radiocarpal dislocation model anatomic alignment can be maintained with bridge plate fixation to the second metacarpal or third metacarpal, Ana Thomas John Carroll et.al concluded that dorsal bridge plating may be a fixation modality that can offer clinically equivocal result compared with volar locking plate and utilized distal fixation on both second and third metacarpal [2, 5, 6, 8, 9, 15-17].

Materials and Methods

This prospective study was carried out between April 2022 and April 2024 after obtaining clearance from the Institutional Ethics Committee, among patients from the age group of 18–80 years who underwent dorsal bridge plate fixation for distal radius fracture at the Orthopedic Department, Government Medical College Kannur, Kerala, from April 2022 to April 2023 and followed up between April 2023 and April 2024. Patients who did not consent to the study, with open distal radius fractures or with distal radius fractures fixed with volar buttress plates, k wire, or external fixators were excluded from the study. A consecutive sampling method was used to identify the test subjects.

The subjects were categorized into two groups based on distal fixation of the dorsal bridge plate at the second or third metacarpals. Patients with distal radius fractures (figure 1) underwent surgery either within 24 h or within a week of their injury. Suture removal was done on the 12th day following surgery (figure 2,figure 3,figure 4). Implant removal was done 6 weeks postoperatively after radio graphically ensuring that adequate union had taken place (figure 5, figure 6). Following this, physiotherapy for wrist movement was initiated. Patients were assessed during monthly follow-ups of surgery based on the stiffness, range of movements(figure 7, figure 8)and tendon entrapment using the Green and O'Brien Score. The data collected was entered in Excel sheets and statistical analysis was done using SPSS version 26. Data were shown as mean ± standard deviation.

Results

During the study period, there were 68 patients who had undergone dorsal bridge plate fixation for distal radius fracture. Out of these patients, five did not provide consent for the study. Out of the remaining 63 patients, two did not follow up at our hospital as they had moved to a different location, whereas one patient expired due to myocardial infarction. The remaining 60 patient's data were compiled and analyzed for the study. The study population was divided into two groups based on the distal fixation of the dorsal bridge plate. Group 1 consisted of 36 subjects who had their dorsal bridge plate fixed on their second metacarpal whereas Group 2 consisted of 24 subjects with distal fixation on their third metacarpal bone (Table 1).

Table 1: Demographics and fracture characteristics

Parameter		Total (n=60) (%)	Group 1 (n=36) (%) Fixed on 2nd metacarpal	Group 2 (n=24) (%) Fixed on 3rd metacarpal
Age		39.42 ± 16.25	36.69 ± 15.20	43.50 ± 17.22
Sex	Male	47 (78.33)	29 (80.6)	18 (75)
	Female	13 (21.67)	7 (19.4)	6 (25)
Mode of injury	High energy trauma	51 (85)	31 (86.1)	20 (83.3)
	Fall at home	7 (11.7)	4 (11.1)	3 (12.5)
	Fall at work	2 (3.3)	1(2.8)	1 (4.2)
Fracture type	23-C1	13 (21.7)	7 (19.4)	6 (25)
	23-C2	14 (23.3)	7 (19.4)	7 (29.2)
	23-C3	33 (55)	22 (61.1)	11 (45.8)
Days from injury to surgery	1-Jan	45 (75)	25 (69.4)	20 (83.3)
	3-Jan	6 (10)	4 (11.1)	2 (8.3)
	7-Jan	9 (15)	7 (19.4)	2 (8.3)
	Mean ± SD	2.10 ± 2.16	2.39 ± 2.38	1.67 ± 1.74
Week of implant removal	6	42 (70.0)	28 (77.8)	14 (58.3)
	7	8 (13.3)	3 (8.3)	5 (20.8)
	8	7 (11.7)	3 (8.3)	4 (16.7)
	9	3 (5.0)	2 (5.6)	1 (4.2)
	Mean ± SD	6.5 ± 0.89	6.42 ± 0.87	6.67 ± 0.92
Complications	Tendonitis	3-Jan	0-Jan	3-Jan
	Infection	0-Jan	0-Jan	0-Jan
	Hardware failure	0-Jan	0-Jan	0-Jan
	Tendon Rupture	0-Jan	0-Jan	0-Jan
	Tendon entrapment	3-Jan	0-Jan	3-Jan
	Post-operative regional pain	3-Jan	0-Jan	3-Jan
Green and O'Brien Score		90.83 ± 8.60	92.08 ± 6.58	88.96 ± 10.83

Among the 60 study subjects, the mean age was 39.42 ± 16.25 years [include sex also]. According to AO classification, there were 13 (21.7%) 23-C1, 14 (23.3%) 23-C2, and 33 (55%) 23-C3 type fractures. Predominant subjects were males – 47 (78.33%). The predominant form of injury was high energy trauma – 51 (85%), 7 (11.7%) had fallen at home, whereas 2 (3.3%) had fallen at work. Five patients had associated injuries such as intertrochanteric fractures, the shaft of femur fracture, clavicular fracture, or rib fractures. The average time from injury to surgery was 2.10 ± 2.16 days. There were no incidences of any superficial infections, tendon rupture, or hardware failures in our study. The range of movements was more painful during the initial weeks of implant removal. Stiffness was associated with 60% of the patients with distal fixation of the third metacarpal than the second metacarpal. During the period of study, three patients were not able to fully extend the thumb after fixing with the dorsal bridge plate on the third metacarpal; three patients were found to have pain during extension of the thumb suspected tendinitis, and were given analgesics and antibiotics. Patients who had their dorsal bridge plate installed to their third metacarpal had tendonitis, tendon entrapment, and post-operative regional pain. No further workup such as the use of bone scan was not indicated or pursued for the diagnosis of complex regional pain syndrome.

Discussion

The current study investigated the functional outcomes of dorsal bridge plating for distal radius fractures with intra-articular involvement, comparing fixation on the second versus third metacarpal. Their findings suggest that fixation on the second metacarpal may lead to better functional outcomes compared to the third metacarpal because stiffness was associated with 60% of the patients with distal fixation of the third metacarpal than the second metacarpal. Patients who had their dorsal bridge plate installed to their 3rd metacarpal were found to have tendonitis, tendon entrapment, and post-operative regional pain. This observation aligns with some previous studies, but further research is needed to solidify this recommendation.

Benefits of second metacarpal fixation are reduced tendon entrapment. Cadaveric studies suggest a higher risk of extensor tendon complications with a fixation on the third metacarpal compared to the second. This is likely due to the proximity of the plate to the extensor tendons in the third compartment during movements [9,16]. Second, the Improved Biomechanics. While biomechanical studies by Alluri et al. [10] have not shown significant differences in overall stability, some concerns exist regarding screw pullout with a fixation on the third metacarpal [12]. The second metacarpal may offer a slightly stronger bone purchase for screw placement.

The Demerits and Complications of Second Metacarpal Fixation is that, the limited availability of data. While the current study and cadaveric studies provide some evidence, more robust clinical outcome data are needed to definitively confirm the advantage of second metacarpal fixation. Furthermore, Carpal Boss, that is Hembd et al. [18] noted a higher incidence of partial tendon injuries in patients with a carpal boss at the second carpometacarpal joint when fixated with a plate on the second metacarpal. Careful evaluation of carpal anatomy preoperatively is crucial.

The Benefits of Third Metacarpal Fixation is on the Anatomic Considerations. Studies by Ali Azadg et al. and Alluri et al. suggest that both second and third metacarpal fixation can achieve good coronal alignment for radiocarpal instability [10, 17]. Third metacarpal fixation might be more suitable in specific fracture patterns [9, 10].

The major Demerit and Complication of Third Metacarpal Fixation is the increased Tendon Entrapment Risk. As discussed earlier, cadaveric studies suggest a higher risk of extensor tendon complications with fixation on the third metacarpal [16]. This necessitates careful surgical technique and potentially formal exposure of the extensor tendons during plate application. Our study has a few limitations. A smaller sample size and a relatively less follow-up period are limitations. Direct comparison with other surgical techniques and randomization of the patients for choosing second versus third metacarpal for distal fixation would add further validity to the results. Future directions can be focused on prospective studies which comprise multicenter, prospective, randomized controlled trials comparing fixation on the second versus third metacarpal is needed to definitively determine the optimal location for functional outcomes and minimize complications. Along with that, a long-term follow-up will be beneficial. The current study assessed outcomes at 1 year. Long-term follow-up studies are crucial to evaluate potential late complications such as implant loosening or hardware irritation.

Conclusion

The current evidence suggests potential advantages for fixation on the second metacarpal compared to the third metacarpal for dorsal bridge plating in distal radius fractures with intra-articular involvement. However, more robust clinical data and long-term follow-up studies are necessary to definitively establish this recommendation. Surgeon experience, pre-operative fracture pattern analysis, and careful attention to potential tendon complications are crucial factors when choosing the optimal location for screw fixation during dorsal bridge plating.

Clinical Message

Distal fixation on the 2nd metacarpal had better functional results than the 3rd metacarpal in dorsal bridge plating for comminuted distal radius fractures.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

References

1. Fares AB, Childs BR, Polmear MM, Clark DM, Nesti LJ, Dunn JC. Dorsal bridge plate for distal radius fractures: A systematic review. J Hand Surg Am 2021;46:627.e1-8.

2. Garg R. Role of bridging plate in comminuted distal end radius fracture: A prospective study. Int J Orthop Sci 2020;6:617-9.

3. Blomstrand J, Wendt GK, Karlsson J, Wangdell J, Fagevik Olsén M. Pain, hand function, activity performance and apprehensiveness, in patients with surgically treated distal radius fractures. J Plast Surg Hand Surg 2023;57:247-52.

4. Meena S, Sharma P, Sambharia AK, Dawar A. Fractures of distal radius: An overview. J Family Med Prim Care 2014;3:325-32.

5. Dahl J, Lee DJ, Elfar JC. Anatomic relationships in distal radius bridge plating: A cadaveric study. Hand (N Y) 2015;10:657-62.

6. Carroll TJ, Dondapati A, Malin M, Ketonis C, Hammert W, Gonzalez R. Clinical and radiographic outcomes following volar-locked plating versus dorsal bridge plating for distal radius fractures. J Hand Surg Glob Online 2023;6:227-32.

7. Mohamed MA, Abdel-Wanis ME, Said E, Abdel-Aziz IA, Ahmed AM, Addosooki A. Dorsal Bridge plating versus bridging external fixation for management of complex distal radius fractures. Injury 2022;53:3344-51.

8. Lauder A, Agnew S, Bakri K, Allan CH, Hanel DP, Huang JI. Functional outcomes following bridge plate fixation for distal radius fractures. J Hand Surg Am 2015;40:1554-62.

9. Tabeayo E, Saucedo JM, Srinivasan RC, Shah AR, Karamanos E, Rockwood J, et al. Bridge plating in the setting of radiocarpal instability: Does distal fixation to the second or third metacarpal matter? A cadaveric study. World J Orthop 2023;14:207-17.

10. Alluri RK, Bougioukli S, Stevanovic M, Ghiassi A. A biomechanical comparison of distal fixation for bridge plating in a distal radius fracture model. J Hand Surg Am 2017;42:748.e1-8.

11. Vakhshori V, Alluri RK, Stevanovic M, Ghiassi A. Review of internal radiocarpal distraction plating for distal radius fracture fixation. Hand (NY) 2020;15:116-24.

12. Hanel DP, Ruhlman SD, Katolik LI, Allan CH. Complications associated with distraction plate fixation of wrist fractures. Hand Clin 2010;26:237-43.

13. Wang WL, Ilyas AM. Dorsal bridge plating versus external fixation for distal radius fractures. J Wrist Surg 2020;9:177-84.

14. Hanel DP, Lu TS, Weil WM. Bridge plating of distal radius fractures: The Harborview method. Clin Orthop Relat Res 2006;445:91-9.

15. Qureshi MS, Panat M. An assessment of distraction plating in the management of intra-articular comminuted distal end radius fractures in the elderly patients. Int J Orthop Sci 2020;6:707-11.

16. Lewis S, Mostofi A, Stevanovic M, Ghiassi A. Risk of tendon entrapment under a dorsal bridge plate in a distal radius fracture model. J Hand Surg Am 2015;40:500-4.

17. Azad A, Intravia JM, Hill JR, Leland H, Vakhshori V, Stevanovic M, et al. Carpal translocation following dorsal bridge plate fixation of distal radius fractures: A cadaveric study. J Wrist Surg 2019;8:234-9.

18. Hembd A, Koehler D, Sammer D, Golden A. Second or Third Metacarpal Fixation for Dorsal Bridge Plating in Distal Radius Fractures? - A Cadaveric Study. In: Poster: American Association for Hand Surgery Annual Meeting. Fort Lauderdale, FL: American Association for Hand Surgery; 2020.

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