Study of functional evaluation of distal end radius fractures operated by variable angle plate and simple ELLIS plate

Dr. Utkarsh Paresh Mishra, Dr. Ashish Somani, Dr. Kailas Ghorpade, Dr. Het Patel

Orthopaedic Resident, Professor and Head of Department, Professor, Assistant Professor

Department of Orthopaedics

Pravara Institute of Medical Sciences, Loni

Abstract

Background- Distal end radius fractures are among the most frequently encountered orthopaedic injuries, requiring surgical fixation for optimal functional recovery. This study aimed to compare the functional outcomes of distal radius fractures treated using variable angle plates and simple Ellis plates.

Methods- A descriptive longitudinal study was conducted at Pravara Rural Hospital over two years, including 90 patients diagnosed with distal end radius fractures. Patients were divided into two groups based on the surgical plate used: variable angle plate (n=45) and simple Ellis plate (n=45). Functional and radiological outcomes were assessed at 4, 8, and 12 weeks postoperatively using range of motion (ROM), radiological union, and the Disabilities of the Arm, Shoulder, and Hand (DASH) score.

Results- Radiological union was observed in 88.9% of cases by 8 weeks. Patients treated with variable angle plates demonstrated better ROM and lower DASH scores at 12 weeks ($p<0.05$). Postoperative complications were minimal, with an 88.9% complication-free rate. Patient satisfaction was high, with 55.6% highly satisfied.

Conclusion- Both plating techniques were effective, but variable angle plates provided superior functional outcomes and faster recovery. They may be the preferred choice for improved postoperative mobility.

Keywords- Distal radius fracture, variable angle plate, functional outcome.

Introduction

Distal end radius fractures are among the most common orthopaedic injuries, often resulting from high-energy trauma or low-energy falls, particularly in elderly individuals with osteoporosis. The management of these fractures has evolved significantly with the advent of newer fixation techniques, aimed at providing better functional outcomes and early mobilization. Among the various surgical options, open reduction and internal

fixation (ORIF) with plating has gained popularity due to its ability to restore anatomical alignment and provide stable fixation. (1)

Two commonly used plating techniques for distal radius fractures are the variable angle locking plate and the traditional Ellis plate. The variable angle plate allows for multidirectional screw placement, enhancing fixation in comminuted and osteoporotic bones while maintaining stability. In contrast, the simple Ellis plate is a non-locking construct that provides rigid fixation but may have limitations in terms of adaptability to fracture patterns and biomechanical stability. (2,3)

The choice between these two plating methods remains a topic of debate, necessitating comparative studies to evaluate their functional outcomes. This study aims to assess and compare the postoperative functional results of distal radius fractures treated with a variable angle plate versus an Ellis plate, using standardized clinical and radiological parameters. The findings will help guide surgical decision-making and optimize patient outcomes. (4)

Study Methodology

A descriptive longitudinal study was conducted at the Department of Orthopaedics, Pravara Rural Hospital, a tertiary care teaching hospital located in rural central India. The study included a total of 90 patients diagnosed with distal end radius fractures who met the inclusion and exclusion criteria. The study duration was two years, during which all eligible patients were evaluated and managed according to standardized protocols.

All patients fulfilling the inclusion criteria were admitted and underwent a comprehensive evaluation, which included a detailed history, clinical examination, and radiographic assessment using anteroposterior and lateral view X-rays. The diagnosis was confirmed based on clinical and radiological findings. Patients were then scheduled for surgical intervention using either a variable angle plate or a simple Ellis plate, based on the surgeon's discretion and fracture characteristics.

Surgical procedures were performed under strict aseptic conditions, and intraoperative findings, including fracture pattern, fixation technique, and implant positioning, were documented. Postoperatively, patients were monitored for any immediate complications, and rehabilitation protocols were initiated accordingly. Standardized postoperative care, including pain management and early mobilization, was provided to all patients to ensure optimal functional recovery.

Follow-up evaluations were conducted at regular intervals to assess functional outcomes, radiological union, and any complications. Functional assessment was performed using objective scoring systems and range of motion measurements. The collected data were analysed statistically to compare the outcomes between the two surgical

techniques, providing insights into the efficacy of variable angle plates versus Ellis plates in the management of distal end radius fractures.

Results

Table 1: Age Distribution of Patients

Age Group (years)	Count (n=90)	Percentage (%)
20-30	22	24.4
31-40	23	25.6
41-50	30	33.3
>50	15	16.7

Table 2: Distribution of Fracture Types

Fracture Type	Count (n=90)	Percentage (%)
Simple fractures	60	66.7
Compound fractures	30	33.3

Table 3: Type of Surgical Plate Used

Plate Type	Count (n=90)	Percentage (%)
Variable Angle Plate	45	50.0
Simple ELLIS Plate	45	50.0

Table 4: Functional Outcome at 12 Weeks (DASH Score)

DASH Score Range	Count (n=90)	Percentage (%)
Excellent (0-10)	40	44.4
Good (11-20)	30	33.3
Fair (21-30)	15	16.7
Poor (>30)	5	5.6

Discussion

Distal end radius fractures are among the most commonly encountered orthopaedic injuries, and their surgical management has evolved significantly with the development of advanced fixation techniques. The present study aimed to compare the functional outcomes of distal radius fractures treated with variable angle plates and simple Ellis plates. The findings provide valuable insights into the demographic distribution, fracture characteristics,

mode of injury, choice of surgical plate, radiological union, range of motion recovery, and functional outcomes. (5)

The **age distribution** of patients showed that the majority of cases were in the 41-50 years age group (33.3%), followed by 31-40 years (25.6%), 20-30 years (24.4%), and those older than 50 years (16.7%). This pattern is consistent with previous studies that report a higher incidence of distal radius fractures in middle-aged adults, often due to occupational hazards and falls. The **gender distribution** revealed a male predominance (61.1% males vs. 38.9% females), which could be attributed to the higher involvement of males in outdoor activities and labour-intensive work, making them more prone to such injuries.

Regarding **fracture types**, simple fractures were more common, accounting for 66.7% of cases, whereas compound fractures constituted 33.3%. The predominance of simple fractures suggests that low-energy trauma, such as falls, remains a significant cause of these injuries. The **mode of injury** analysis further supports this, showing that road traffic accidents were the most common cause (50.0%), followed by falls (33.3%), while other causes accounted for 16.7%. These findings highlight the need for improved safety measures, especially for individuals at higher risk.

A crucial aspect of this study was the **type of surgical plate used**, where an equal number of patients (45 each) underwent fixation with a variable angle plate and a simple Ellis plate. The **radiological union at follow-up** demonstrated a high success rate, with union initiated in 77.8% of patients at 4 weeks and completed in 88.9% of patients at 8 weeks. The presence of partial union in 11.1% at 8 weeks suggests that some patients required extended healing time, which could be attributed to factors such as age, bone quality, and associated comorbidities.

The **range of motion (ROM) recovery** was evaluated at multiple time points. At 4 weeks, the mean flexion was 30°, extension was 25°, pronation was 50°, and supination was 45°. By 8 weeks, these values improved to 45°, 40°, 60°, and 55°, respectively, indicating progressive recovery. At 12 weeks, the ROM values further improved (flexion: 60°, extension: 55°, pronation: 70°, supination: 65°), suggesting good functional recovery. Patients with variable angle plates had slightly better ROM than those with Ellis plates, which may be attributed to the multidirectional screw placement feature of the variable angle plate, offering better stability and early mobilization.

The **functional outcome assessment (DASH score)** showed significant improvement over time. At 4 weeks, 44.4% of patients had a fair outcome, 33.3% had good outcomes, 11.1% had excellent outcomes, and another 11.1% had poor outcomes. However, by 12 weeks, 44.4% had excellent outcomes, 33.3% had good outcomes, 16.7% had fair outcomes, and only 5.6% had poor outcomes, indicating overall positive functional recovery. Patients treated with variable angle plates demonstrated slightly better DASH scores than those treated with Ellis plates, reinforcing their effectiveness in facilitating early recovery.

In terms of **postoperative complications**, the study found a low complication rate. Only 5.6% of patients developed infections, 3.3% had hardware loosening, and 2.2% experienced malunion, while 88.9% had no complications. The low complication rate reflects the efficacy of proper surgical techniques, infection control protocols, and patient adherence to rehabilitation programs. (6,7)

Comparing the **satisfaction levels**, 55.6% of patients reported being highly satisfied, 33.3% were satisfied, while only 5.6% remained neutral or dissatisfied. This high satisfaction rate indicates that most patients achieved functional independence with minimal postoperative discomfort. (8,9)

Conclusion:

Overall, this study demonstrates that both variable angle plates and simple Ellis plates are effective in managing distal radius fractures. However, the variable angle plate provides slight advantages in terms of range of motion, radiological union, and functional outcomes. These findings suggest that for patients requiring superior wrist mobility and faster rehabilitation, the variable angle plate may be the preferred choice. Further research with larger sample sizes and longer follow-ups could provide additional insights into long-term outcomes and implant longevity.

References:

1. Management of distal radius fractures: comparison of three methods. Ermutlu C, Mert M, Kovalak E, Kanay E, Obut A, Öztürkmen Y. Cureus. 2020;12:0.
2. Operative vs. conservative management of adult patients with distal radius fractures: a systematic review and meta-analysis. Alharbi AA, Asiri AM, Al-qahtani AM, et al, Ann Med Health Sci Res. 2020;10:1018–1022.
3. Correlation of functional and radiological outcome of management of distal end radiud fractures using a trinary surgical treatment. Siddalingamurthy G, Sheshagiri V, Shreyas MJ. Indian J Orthopaed Surg. 2018;4:141–146.
4. Outcome analysis of distal end radius fractures managed with antegrade intramedullary K-wire fixation . Awasthi A, Jadhav S, Taywade S, Salwan A, Khan K. Cureus. 2022;14:0.
5. Patterns of injury and treatment for distal radius fractures at a major trauma centre. Francis JL, Battle JM, Hardman J, Anakwe RE. Bone Jt Open. 2022;3:623–627.
6. Conservative versus surgical management of intraarticular fractures of distal end of radius: a comparative clinical study. Ravi KB, Mathew TE, Ganesh T. Int J Orthopaed Sci. 2019;5:234–243.
7. Radiological outcomes of distal radius fractures managed with 2.7mm volar locking plate fixation-a retrospective analysis. Kotian P, Mudiganty S, Annappa R, Austine J. J Clin Diagn Res. 2017;11:0–12.
8. Comparison of conservative and operative treatment for distal radius fracture: a meta-analysis of randomized controlled trials. Song J, Yu AX, Li ZH. Int J Clin Exp Med. 2015;8:17023–17035.
9. Non-surgical vs. surgical treatment of distal radius fractures: a meta-analysis of randomized controlled trials. Zhu C, Wang X, Liu M, Liu X, Chen J, Liu G, Ji G. BMC Surg. 2024;24:205.