

Prospective study of surgical management of distal radius fractures by volar palting and it's clinico radiological outcome

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Abstract

Introduction: Uncommon and unstable fractures are Distal Radius fractures. The aim of treatment in this case is to establish anatomic fracture union by adequate reduction and quick stabilisation, which will allow for early wrist movement and the prevention of fracture sequelae. Gap, stability, and blood supply are all important for fracture healing. In order to achieve stability, the locking plate reduces the compressive forces applied to the bone. This prevents associated impairment of the blood supply and periosteal compression, which is advantageous for fracture healing

Materials & Methods: Study conducted at NRI Institute of Medical Sciences, Anil Neerukonda Hospital, Sangivalasa, Visakhapatnam. Prospective study. The study will be carried out over a period from SEP 2020 to SEPT 2022. A sample size of 30 patients

assigned blindly into the study. Patients for the study ranged in age from 18 to 60, with a mean age of 36.7 years, and included 23 men and 7 women. The follow-up lasted between six and twelve months. Use the Radius Union Score and Mayo Wrist Score

Results: We achieved results of 63% excellent, 16% good, 13% fair, and 6% poor.

Conclusion: Both patients and the surgeon are happy with the results of fixing a DISTAL RADIUS fracture with a locking compression plate. When treating this type of fracture, locking plates produce satisfactory results with quicker and greater functional recovery.

Keywords: Distal Radius Fracture, volar Barton Fracture, Locking Compression Plate, Open Reduction And Internal Fixation.

Introduction

Distal end of the radius is subject to many different types of fracture, depending on factor such as age, transfer of energy, injury of mechanism and bone quality i.e. Colles' fracture, Smith's fracture, volar and dorsal Barton's fracture. the most frequent skeletal injuries treated by orthopaedic or trauma surgeons is fractures of distal radius. One-sixth of all fractures seen and treated in emergency departments are caused by these wounds. In addition to frequently failing, conservative treatment is also fraught with problems such deformities, early osteoarthritis, subluxation, and instability. Distal radius fractures are uncommon and unstable. In this scenario, the goal of treatment is to establish anatomic fracture union with sufficient reduction and prompt stabilisation, which will enable early wrist movement and prevent fracture complications⁷⁻⁹. Gap, stability, and blood supply are three elements that affect how well a fracture heals¹⁰. The locking plate lessens the compressive forces applied to the bone in order to achieve stability, which is beneficial for fracture healing because it prevents blood supply impairment and periosteal compression. The treatment of distal radius fractures is currently recommended with open reduction and internal fixation using a volar plate system, which leads to good reduction and provides immediate stability. Various surgical techniques have been reported in the literature¹²⁻¹⁷, including percutaneous pinning, external fixator and internal fixation with Volar locking compression plate. Internal fixation can restore anatomy and enhance functional outcomes when significant fracture reduction cannot be accomplished using conventional techniques¹⁶. Distal end radius fractures are type B3 fractures, according to the AO classification system. Volar incision with volar anatomical plate or

locking plate fixation is the typical surgical treatment for distal end radius fractures^{17, 20, 21}. By placing a plate on the volar surface of the radius and using it as a buttress to stop the volar displacement of the distal fragment, Ellis popularised plating for volar displaced distal radius fractures in 1965. When paired with a locking compression plate, the locking screw resists axial loads while supporting subchondral bone. The periosteal blood flow can be preserved without compressing the locking compression plate to the bone. (22). Extra-articular distal end radius fractures that are unstable can be treated with volar locking compression plates because they allow for early post-operative rehabilitation.⁽²³⁾ Regardless of the bone, a locking screw in a plate creates primary stability that prevents secondary displacement, resulting in satisfactory outcomes for patients with young and osteoporotic bones. (24) Two fixed angle multiple locking compression plates are present. and one fixed angle locking compression plate for the distal radius. (3) Multi-locking compression plates with varying angles. In this study, individuals with distal end radius fractures treated with locking compression plates had their functional outcomes and comorbidities examined.

Classification

Distal radius fractures have historically been referred to by eponyms including Colles', Smith, and Barton fractures. For at than 80 years, surgeons have categorised distal radius fractures. Some classifications, including those made by Pilcher (1917), Destot (1923), Taylor, and Parsons, have either been forgotten about or are not frequently accepted. The literature regularly makes use of others.

1. **Fracture displacement or radiographic appearance.** - The classification of AO - Sarmiento categorization - The Lidstrom classification.

2. **The way that harm is caused.** - casting characterization - The classification of Fernandez - The classification of Lincheid

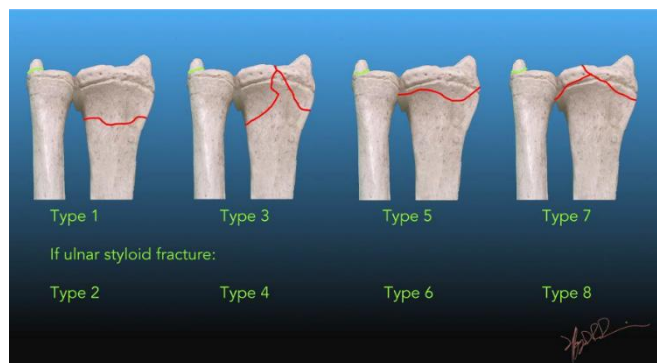
3. **Involvement of the articular joint surface.** - The Mayo classification - The McMurthy and Jupiter classification - The Melone classification.

4. **The level of grinding** - The Gartland and Werley classification. - The Jenkins classification - The Older classification.

Frykman's is the most well-liked but offers no prognosis or therapy alternatives. It was developed in 1967 and determined if the ulnar styloid had fractured or not, as well as the involvement of the radiocarpal and radioulnar joints.

Frykman's classification of distal radius fractures:

FRACTURES	ULNAR STYLIOD#	
	ABSENT	PRESENT
Extra-articular	1	2
Intra-articular Radiocarpal joint	3	4
Radioulnar joint	5	6
Radiocarpal and radioulnar joints	7	8

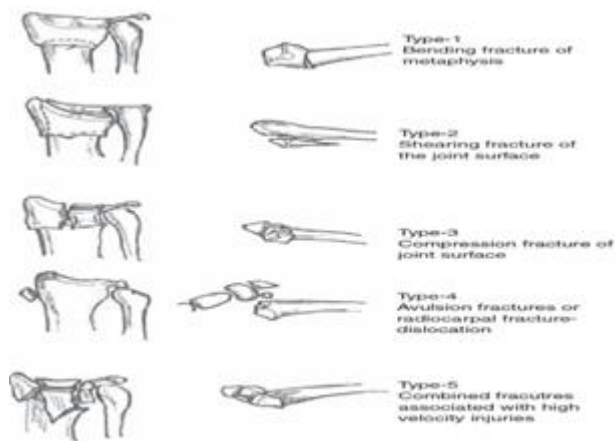


Lidstrom Classification: (1959)

Type 1	Minimal displacement
Type 2a	Extra articular, dorsal angulation
Type 2b	Intra-articular, dorsal-angulation and joint surface not comminuted
Type 2c	Extra-articular, dorsal angulation, dorsal displacement
Type 2d	Intra-articular, dorsal angulation, dorsal displacement
Type 2e	Intra articular, dorsal angulation, dorsal displacement, joint surface comminuted

Fernandez Classification: (1992)

TYPE1	Bending fracture of metaphysis	Colles/Smith fracture
TYPE 2	Shearing fracture of joint surface	Barton Fracture
TYPE 3	Compression fracture of joint surface	Die punch fracture
TYPE4	Avulsion fracture, radiocarpal fracture, dislocation	Ulnar/ radial styloid process fracture
TYPE5	Combined fracture (I,II,III,IV,V),high velocity injury	Comminuted fracture

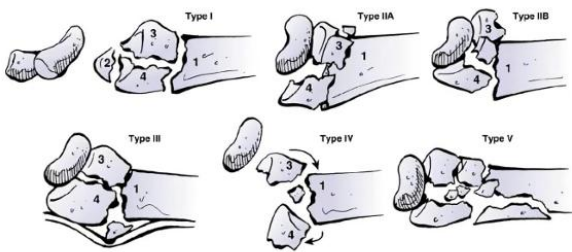


Gartland and werley classification: (1951)

TYPE 1A	Extra-articular, displaced.
TYPE 2	Intra-articular, non displaced
TYPE 3	Intra-articular, displaced.
TYPE 1B	.Nondisplaced extra-articular fractures have been introduced (added by Sologard and Sarmiento)

Melone's intra-articular fractures classification: (Table 8)

TYPE1	Minimal comminution – stable
TYPE2	Comminuted - stable displacement of medial complex; Posterior; die punch, Barton anterior; Smith.
TYPE 3	Displacement of medial complex as a unit + anterior spike.
TYPE 4	Wide separation or rotation of the dorsal fragment and palmar fragment rotation.



AO Classification:

23 A = extra-articular fracture

- A1 = ulna, radius intact
- A2 = radius, simple and impacted
- A3 = radius, multifragmentary

23 B = partial articular fracture

- B1 = radius, sagittal
- B2 = radius, frontal, dorsal rim
- B3 = radius, frontal, volar rim

23 C = complete articular fracture of radius

- C1 = articular simple, metaphyseal simple
- C2 = articular simple, metaphyseal multifragmentary
- C3 = articular multifragmentary

Objectives

The selection of the patient will receive special consideration. Clinical criteria such as pain, patient comfort, early mobilisation, surgical procedures, radiographic examination for union, until full recovery and any related problems are studied subjectively and objectively utilising Volar plating. The final outcome & efficacy will be assessed by Radius Union Scoring System and Mayo wrist score as excellent/good /satisfactory / poor in our study.

Materials and Methods

Between September 2021 and May 2022, the Department of Orthopaedics at Anil Neerukonda Hospital Sangivalasa treated thirty adult patients with distal end radius fractures.

Inclusion criteria

- Age 18-60 years
- Closed fractures
- Injury less than two weeks old
- Communitated fractures
- Intra articular fractures

Exclusion Criteria

- Age below 18 years and above 60 years
- Open fractures
- Pathological fractures

- Associated fractures of shaft of radius

Between the ages of 18 and 60, there were 23 (76%) men and 7 (23.3%) women, with a mean age of 36.7. 8 (26%) of the patients had left side involvement while 22 (73%) had right side involvement (dominant wrist). Of the 30 cases, 10 (33%) patients fell on an outstretched hand and suffered an injury, and 20 (66%) patients were involved in an accident.

Following hospital admission, a thorough history was taken from patients and/or caregivers to determine the mechanism of injury and the degree of trauma. All patients underwent in-depth examinations. Their overall health, systemic illnesses, and resulting injuries were noted. The patient proforma accurately recorded each finding. The ecchymosis, swelling, and deformity underwent careful examination. Clinically, the relative positions of the radial and ulnar styloid processes, as well as pain, crepitus, and bony irregularity, were elicited. The wrist and forearm's range of motion was examined and found to be uncomfortable and constrained. Radial artery pulsations, capillary filling, pallor, and paraesthesia over finger tips were used to measure distal vascularity. The affected forearm was kept raised and immobilised in a POP slab below the elbow. Analgesics were given to treat the pain and inflammation.

Ethical clearance from Institutional Ethical Committee of GSL Medical College, was obtained before initiating the study. Prior to the commencement of the study, the procedure was explained to the patient and informed consent was taken from the study participants after explaining the purpose of the study in vernacular language in an understandable manner.

Data Collection

Initial Assessment: To confirm the diagnosis and determine the pattern of fracture, standard radiographs in Postero and lateral views were taken. A small percentage of patients with complicated comminuted fractures, oblique images were also obtained. The fracture pattern was examined, and Frykman's and AO classifications were used to evaluate and classify the involvement of the radiocarpal and distal radioulnar joints.

Surgical Procedures

Anaesthesia The operations were performed under brachial block in all cases.

Position and tourniquet: On the operating table, the patient was positioned supine. Exsanguination occurred on the injured leg. Then a pneumatic mid-arm tourniquet was put on. On a side arm board, the limb was placed. The limb's posture should permit full imaging of the distal radius in the frontal and sagittal planes. The hand and forearm were washed thoroughly, coated with betadine and spirit, then covered.

Instruments and implants used: • Standard locking compression plates, multilocking fixed angle plates, variable angle multilocking plates of varying length, and both universal and side-specific types. • 3.5mm and 2.7mm LCP drill bit and sleeve system • Power drill or hand drill • Depth gauge and tap for 3.5mm and 2.7mm cortical screws • a locking screwdriver and a hexagonal screwdriver for 2.7mm and 3.5mm cortical screws • Retractors, periosteal elevators, reduction clamps, bone levers, and other general instruments • pneumatic tourniquet

Procedure

A 5 to 7 cm incision is made along the radial border of the flexor carpi radialis tendon in accordance with the modified volar Henry technique. The tendon retracts

toward the ulna as the sheath is opened. Incision between should the radial artery and the long flexor pollicis be made deeper. On the radial side, care must be made to protect the radial artery, and on the ulnar side, the median nerve's palmar cutaneous branch. Sweeping the flexor pollicis longus muscle belly in the direction of the ulna requires a finger. This widens the area and makes the Pronator quadratus muscle visible. An L-shaped incision on the Pronator quadratus muscle's radial border should be made to raise the muscle and reveal the distal radius.

Together, the distal radius is taken off. Reduce the fracture by hyperextending the wrist over a pad after exposing and cleaning the fracture site. Under fluoroscopy, the fracture is reduced and temporarily fixed with K-wires, reduction forceps, or suture fixation. Reduction aids should be placed out of the way of the plate's installation. After the fracture is reduced, the proper plate is chosen. In order to temporarily fasten the plate to the proximal fragment, a conventional cortical screw was first placed in the most distal oval hole of the vertical limb of the plate. Concurrent proximal and distal plate adjustment was made possible by this. When necessary, additional radial length was obtained by pressing the plate distally after the distal component had been fixed with subchondral locking screws.

The oval hole is a combined hole designed for locking head screw placement at the distal end and standard screw placement at the proximal end of the same hole. The initial standard screw can be left in place or replaced with another locking screw. The distal screws need to be inserted at the radial styloid, below the lunate facet, and close to the sigmoid notch in order to be effective. It is possible for the distal screws to engage in a monocortical or bicortical fashion.

When the wrist is volarly flexed as much as feasible by a helper, more volar tilt can be attained during distal screw placement. Additionally, by moving the entire plating system distally while using the oval plate hole and screw as a glide, radial length can be increased still further. Utilizing fluoroscopy, the plate's final location was verified. When the wound was closed, the pronator quadratus muscle was used to partially conceal the implants that had been placed on the radius's anterior surface. The wound was closed in layers and a sterile compression dressing was put on when stable fixation and hemostasis were achieved.

After the tourniquet was taken off, the fingers' capillary refilling was examined. With the wrist in a neutral posture, the operated limb was supported by an anterior below elbow POP slab. All patients had their sutures removed between days 10 and 14. then follow-up for 6 weeks, 12 weeks, and 24 weeks.

Statistical Analysis

Data extraction and analysis was done using Microsoft Excel 2007 and SPSS version 2.0. Results were expressed as percentages for categorical variables. Continuous variables were expressed as mean and standard deviation. Paired 't' test was applied to compare the mean scores at every follow-up. A 'P' value of <0.05 is considered as statistically significant.

Results & Discussion

AGE INCIDENCE TABLE NO

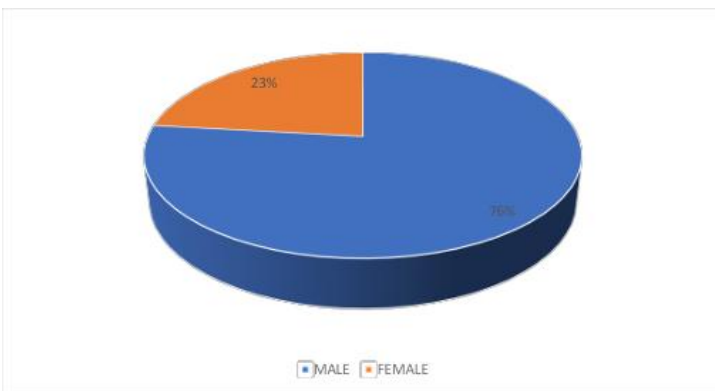
Age in Years	No. of Cases	Percentage %
18 -<20	4	13.3%
21-30	6	20%
31-40	11	36.6%
41-50	4	13.3%
51-60	5	16.6%

There were 6 (20%) individuals in this group who were between the ages of 18 and 20. Patients ranged in age from 21 to 60, with an average age of 36.7 years, and 11 (36%) were between 31 and 40, 4 (13.3%) between 41 and 50, and 5 (16.6) between 51 and 60.

SEX INCIDENCE

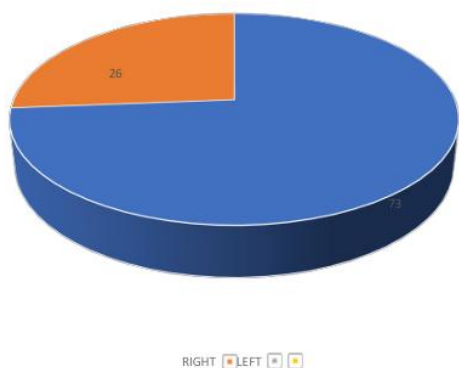
Sex	No. of Cases	Percentage%
Male	23	76%
Female	7	23.3%

Out of 30 patients, 23 (76%) were men and 7 (23%) were women, indicating a 3:1 (M:F) preponderance of men.



SIDE	NO.OF CASES	PERCENTAGE%
RIGHT	22	73%
LEFT	8	26%

22 patients (73%) had involvement of the right side (dominant wrist), while 8 patients (26%) had involvement of the left side.



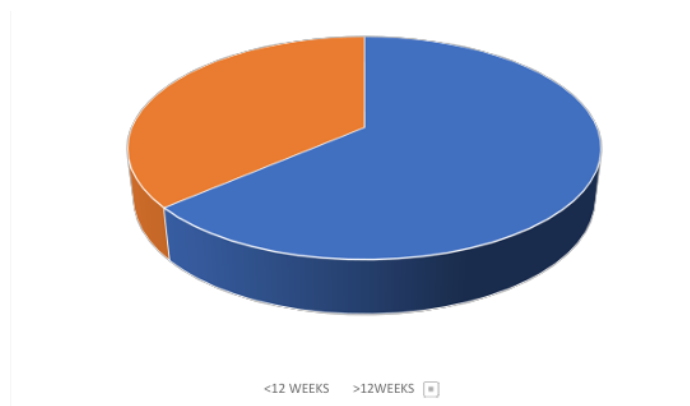
MODE OF INJURY

Mechanism of Injury	No/of cases	Percentage%
Road traffic accident (RTA)	20	66%
Fall on outstretched hand (FOOH)	10	33%

In our study, 10 (33%) patients fell on their outstretched hand, while 20 (66%) patients were involved in auto accidents.

DURATION OF FRACTURE UNION

Time of Union	No. of Cases	Percentage
<12 weeks	19	63%
>12 weeks	11	36%



RANGE OF MOTION: T

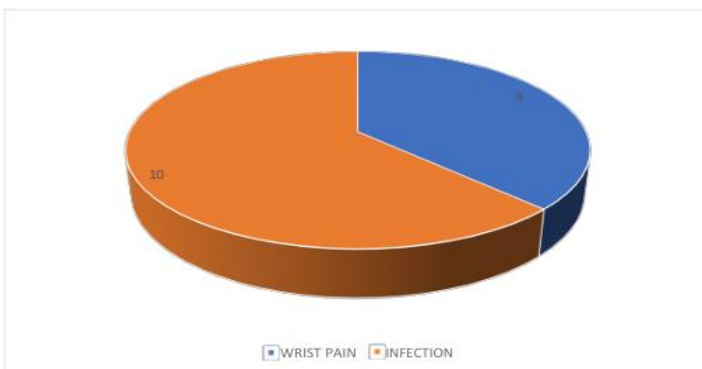
Movement (within normal functional range)	No. of Cases	INDIVIDUAL MOMENT PERCENTAGE
Dorsiflexion (min. 45°)	27	90%
Palmar flexion (min 30°)	27	90%
Pronation (min 50°)	26	86%
Supination (min 50°)	26	86%
Radial deviation (min 15°)	26	86%
Ulnar deviation (min 20°)	27	90%
Grip strength (60% or less than on opposite side)	28	93%

In our study, 26 (86%) of the patients' pronation or supination was within the normal functional range (minimum 50°), their dorsiflexion was within the normal

functional range (minimum 45°), their palmar flexion was within the normal functional range (minimum 30°), their radial deviation was within the normal functional range (minimum 15°), and their dorsiflexion was within the normal functional range for 27 (90%) of the patients. 28 (93%) of the patients had grip strength greater than 60% on the opposite side. Two people experienced a significant reduction in grip strength (7%; 60% relative to the contralateral side). The distal radioulnar joint caused pain in 2 patients (or 6% of all patients). None of the participants had a stiff wrist.

COMPLICATIONS:

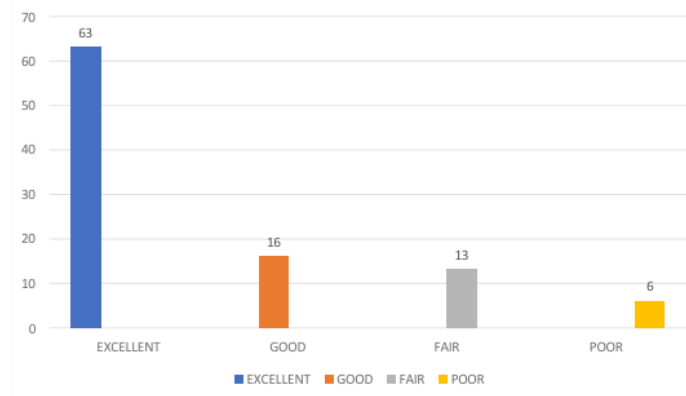
Complications	No. of Cases	Percentage
Wrist pain	2	6%
Infection	3	10%
Total		



Evaluation of results: Results were evaluated using the Modified MAYO wrist SCORE demerit score system based on objective and subjective criteria, persistent deformity, and complications.

Results	No. of Cases	Percentage
Excellent	19	63%
Good	5	16%
Fair	4	13%
POOR	2	6%

Using score system of Modified MAYO WRIST SCORE functional score for wrist we had 19 (63%) Excellent result, 5 (16%) Good result, 4 (13%) Fair result and 2 (6%) had poor result.



The most prevalent fractures of the upper extremity are those of the distal radius. The restoration of anatomic integrity and functioning is the fundamental goal of its treatment. Closed techniques are frequently ineffective for stabilising unstable intra articular fractures of the wrist and maintaining radial criteria such radial inclination, radial length, and radial tilt. Such circumstances necessitate an open reduction and positioning. A better understanding of wrist anatomy and functioning as a consequence of recent studies as well as increased patient expectations has broadened the boundaries of surgical therapy. Furthermore, improvements in fixing materials have created new opportunities.

AO system distal radius fractures of the B and C types are treated surgically due to their intra-articular and unstable character. The most frequent of them all, volarly displaced intra articular fractures—also known as Volar Barton fractures—have the most instability and require an open reduction technique. Plate fixation is the surgical technique that is most commonly used nowadays. Comparing locked plates to standard plates, the results are good. Locked plates are recommended in

osteoporotic and/or multiple fractures because they offer greater biomechanical strength against stresses exerted on the fracture surfaces than anatomical plates without the screw-plate interlocking characteristic.

There are other methods for plating the distal radius, but Modified Henry's is now the method of choice among surgeons all over the world since it is safer and less difficult. The current study set out to assess the functional outcomes of using a volar locking compression plate in surgically treating volar Barton fractures.

In light of our study, our analysis is as follows.

1) Age distribution: With an average age of 36.7 years, distal radial fractures were more prevalent in our study's third to fourth decade. Young people typically get injuries from high energy trauma, such as car accidents and tree falls.

2) Distribution of patients by gender: In our study, there are 23 male patients and 7 female patients. Males are more likely to see an increase in incidence because of their participation in outdoor activities, use of motor vehicles, and heavy manual labour.

Involved side: In our study, 8 individuals had left wrist involvement whereas 22 patients had right side involvement.

3) Mode of injury: 20 patients in our study had distal radius fractures as a result of traffic accidents, and 10 patients fell on their own at or near their residences.

According to Kevin C. Chung et al. (2006) and Arora Rohit et al. (2007), falling on an outstretched hand caused the majority of injuries. According to our data, auto accidents were the most common reason for injuries. Ayhan Kilic et al. (2009) and R.E. Anakwe et al. (2010) both reported similar findings in their series.

4) Complications

- Our encountered rate of intra operative complications was 0%
- while post operatively 16% cases got complications(5 cases).
- 2 patients had wrist joint pain
- Three patients had superficial surgical wound infection which was treated with antibiotics and resolved.

Complication rates ranged from 11.1% recorded by Ayhan Kilic et al. in 2009 to 9.1% reported by Kevin C. Chung et al. in 2006, 4.8% reported by R.E. Anakwe et al. in 2010, and 57% reported by Arora Rohit et al. in 2007.

Our study we have evaluated post operative patients with Modified MAYO SCORE functional score for wrist. 19 cases showed excellent result (63%) 5 patients got good result (16%) 4 patients showed Fair result (13%) 2 patient with poor result (6%) Patients who had excellent outcomes reported no discomfort or long-lasting deformity. The range of motion was consistent with normal function. They were free of issues and arthritic alterations. They underwent surgery 24 hours after the injury. The radial length, volar tilt, and articular step-off were all within acceptable limits. They participated in physical treatment.

Minor issues, pain in the distal radio-ulnar joint, and persistent deformity, pain, and restriction were also seen in patients with fair results. Few of their movements fell short of what was required for them to operate normally. Despite having a satisfactory fixation, the patient with the poor result was uncooperative throughout patient was unable to perform day-to-day work due to a limited range of motion.

In comparison to Ayhan Kilic et al (2009).s series, which had 44.4% excellent, 44.4% good, and 11.2% fair scores, ours had 11.2% fair.

Using radiographic traits such grip strength, lateral pinch strength, the Jubsen Taylor test, wrist range of motion, and the Michigan hand questionnaire, the outcomes were compared to the normal side.

Kevin C. Chung and others - the average wrist flexion, wrist flexion, and loss in pinch and grip strength in his series were all 86% of the normal side.

R.E. Anakwe et al. (2010) examined the system outcome using radiography, grip strength measurements from clinical examinations, and PRWE (patient related wrist evaluation) ratings. A very high level of patient satisfaction, good functional results, and enhanced grip strength were seen in 95% of his series.

Conclusions

The current experiment, which looked at the functional outcomes of surgically treating adult distal radius fractures with a volar locking compression plate, came to the following conclusions.

In the third to fourth decades, distal radius fractures are more frequent. Due to their participation in physical labour, outdoor sports, and driving, males predominate in these fields. The majority of fractures in younger people are brought on by high intensity trauma or auto accidents. The osteoporotic bone will shatter as a result of an insignificant fall on an outstretched hand in older people. The injuries were either caused by a fall on the outstretched hand or by a car collision.

Younger patients were more likely to experience road accidents, but older patients were more likely to experience self-injury. Numerous studies have shown that locking plates are treatment for intra- articular unstable distal radius fractures. Locking compression

plates are used in distal radius fractures due to their effective anatomic reduction and early joint mobility due to their tight fixation. Its biomechanical benefits include being situated close to the joint interface and having the capacity to screw in different orders.

The modified Volar Henry technique offers fixation with greater tissue adaptation and access with less surgical trauma to the distal radius. With a modified volar Henry technique, in our study subjects, a successful anatomic alignment was attained. The majority of patients, who were young adults, returned to their regular activities after a 90% recovery. our study, we ran upon a few issues (16%). Three patients experienced superficial skin infections following surgery; these infections were managed with medication, and the patients healed in two weeks.

As soon as the surgeon becomes accustomed to the operation, these difficulties can be avoided. When locked compression plates are employed in distal radius fractures, the distal radius anatomy is successfully corrected and maintained.

In compared to conventional fixation techniques, these plates allow for a quicker restoration of joint motion and daily functioning, and the patient can resume his regular activities and employment with almost all of his normal functions.

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