"A COMPARATIVE STUDY BETWEEN CLOSED REDUCTION AND CAST APPLICATION VERSUS PERCUTANEOUS K-WIRE FIXATION AND CAST APPLICATION FOR FRACTURE DISTAL END OF RADIUS"

By

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DISSERTATION SUBMITTED TO SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA, KOLAR, KARNATAKA

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MASTER OF SURGERY

IN

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Under the Guidance of
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LIST OF ABBREVIATIONS

DRUJ	Distal Radio-Ulnar joint
AO	Arbeitsgemeinschaft für Osteosynthesefragen
OTA	Orthopaedic trauma association
TFCC	Triangular fibro Cartilage
K-wire	Kirschner wire
CC	Cannulated cancellous
#	Fracture
RTA	Road traffic accident
POP	Plaster of paris
ROM	Range of motion
R.L.J.H	R.l.jalappa hospital
SF-36	Short form-36
DEXA	Dual energy x-ray absorptiometry
AP	Anteroposterior
PA	Posteroanterior
G&W	Gartland & Werley
BMD	Bone mineral density
&	And
%	Percentage

OE	Objective evaluation
OP	Operative
mm	Millimeter
CT	Computed tomography
APL	Abductor pollicis longus
EPB	Extensor pollicis brevis
EPL	Extensor pollicis longus
FDP	Flexor digitorum profundus
FPL	Flexor pollicis longus
ECU	Extensor carpi ulnaris
HIV	Human Immunodeficiency virus
HBsAg	Hepatitis B surface antigen
HCV	Hepatitis C virus
ECG	Electrocardiogram
FBS	Fasting blood sugar
PPBS	Post prandial blood sugar
HbA1c	Hemoglobin A1c
Rh	Rhesus factor

ABSTRACT

"A COMPARATIVE STUDY BETWEEN CLOSED REDUCTION AND CAST APPLICATION VERSUS PERCUTANEOUS K-WIRE FIXATION AND CAST APPLICATION FOR FRACTURE DISTAL END OF RADIUS"

Introduction: Fracture of distal end radius is the common type of fractures constituting upto 18% cases in adult age group and upto 25% cases in paediatric age group. This distal end radius fracture was common among elderly population who sustained fracture due to low energy trauma which is attributed to osteoporotic bone. But in recent years there is increase in the incidence due to rise in the road traffic accidents especially in younger age group. Closed reduction and cast immobilization is an effective way of treating elderly patient with stable distal radius fracture but it often results in malunion and poor functional outcome.

Closed reduction, percutaneous K-wire fixation and below elbow cast application is a simple and minimally invasive surgical procedure that provides additional stability to maintain the reduction of fracture and offers good radiological outcome in fracture distal end radius both extraarticular fractures and extraarticular fractures with simple intraarticular extension.

Objectives:

1. Management of the fracture distal end radius by closed reduction and cast application.
2. Management of the fracture distal end radius by closed reduction, percutaneous K-wire fixation and cast application.
3. To compare the functional outcome between the two methods using Gartland and Werley demerit point scoring system.

Materials and methods: This was a prospective study consisting of 44 patients, conducted at R.L.J. HOSPITAL AND RESEARCH CENTRE, attached to SRI DEVARAJ URS MEDICAL COLLEGE, Kolar from December 2018 to September 2020. 44 patients with distal end radius fracture patients were allocated into two groups consisting of 22 patients in each group using computer generated simple randomization protocol. Group A was managed by closed reduction and cast application. Group B was managed by closed reduction, percutaneous K-wire fixation and cast application.

Results: Evaluation of the functional outcome was done using demerit point scoring system of Gartland and Werley. In group A i.e., closed reduction and cast application 31.8% had excellent, 40.9% had good, 22.7% had fair and 4.5% had poor Gartland & Werley results. In group B i.e., closed reduction, percutaneous K-wire fixation and cast application 36.4% had excellent, 45.5% had good, 13.6% had fair and 4.5% had poor Gartland & Werley results. There was no statistically significant difference in functional outcome between two groups.

Conclusion: We conclude that there is statistically insignificant difference in the functional outcome of the fracture distal end radius (extraarticular and extraarticular with simple intraarticular extension) managed by closed reduction and cast application as compared to closed reduction, percutaneous K-wire fixation and cast application. However, there is a statistically significant difference in the radiological outcome in terms of radial height, volar tilt and radial inclination in the closed reduction, percutaneous k- wire fixation and cast application group when compared to closed reduction and cast application only. Thereby, suggesting that percutaneous K- wire fixation provides additional stability which favours anatomic reduction of distal end radius fracture.

KEY WORDS: distal end radius fracture, closed reduction, cast, percutaneous K-wire

TABLE OF CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF FIGURES

INTRODUCTION

Sir Abraham Colles from Ireland in the year 1814 was first to describe distal end radius fracture and he termed it as Colle's fracture, but Puntcan in 1783 was the first person to mention about this fracture.[1]

Fracture of distal end radius is the common type of fracture constituting upto 18% cases in adult age group and upto 25% cases in paediatric age group. Current and past clinical data shows a significant increase in the incidence of these fractures.[2]

This distal radius fracture was most common among elderly population who sustained fracture due to low energy trauma which is attributed to osteoporotic bone. But in recent years there is increase in the incidence due to rise in road traffic accidents especially in the younger age group.[3]

Various treatment modalities available for treating a distal radius fracture which includes- closed reduction & casting; closed reduction with percutaneous pinning using Kirschner wire by distinct methods such as kapandiji intrafocal pinning, transradial styloid pinning, pinning through lister's tubercle, ligamentotaxis method; open reduction & internal fixation using screws and plates by various approaches.[4]

The treating surgeon has to keep in mind on identification of fracture pattern, management options, possible outcome of surgery and associated complications in order to achieve a good functional outcome. Outcome of the management of this distal radius fractures can additionally be influenced by patient related factors such as age, attitude, family support, economic condition, comorbid conditions and compliance with treatment.[5]

However, there is no as such definitive treatment of choice available. The strategic choice of treatment should be based on the pattern of distal radius fracture,

patient's characteristics and experience of the treating surgeon. The ultimate goal of treatment is to restore the functional and near normal anatomy by a method which do not compromise hand function.[4]

Closed reduction and cast immobilization were the mainstay in treatment of distal radius fractures over the years, but if often resulted in malunion, poor functional outcome of the injured wrist and hand. However, it is still an effective in treating stable fractures, elderly patients who are at operational risks, patient with low functional demand and extra articular fractures.[6]

Closed reduction, percutaneous K-wire fixation and below elbow cast application is a simple, minimally invasive procedure that provides additional stability to maintain the reduction of fracture and offers good anatomical, radiological outcome in fracture distal end radius both extraarticular and extraarticular fractures with simple intraarticular extension.[3]

In an elderly patient, the quality of bone is reduced due to osteoporosis as compared to younger age group. In these patients it is often hard to maintain the anatomical reduction of distal radius fracture by closed reduction and casting alone. In such cases percutaneous pinning adds the extra support needed to maintain the fracture in anatomical alignment after reduction.[7]The purpose of this study was to evaluate and compare the functional outcome of fracture distal end radius (extraarticular fractures and extraarticular fractures with simple intraarticular extension) in skeletally mature patients coming from Kolar region to R.L.J Hospital managed by two commonly used methods - closed reduction and cast; closed reduction, percutaneous K- wire fixation and cast application.

OBJECTVES OF STUDY

1. Management of the fracture distal end radius by closed reduction and cast application.
2. Management of the fracture distal end radius by closed reduction, percutaneous K-wire fixation and cast application.
3. To compare the functional outcome between the two methods using Gartland and Werley demerit point scoring system.

REVIEW OF LITERATURE

The treatment for fracture distal end radius has a long record which includes various modalities of treatment from non-operative to operative. But there is no standard protocol available for management of extraarticular distal end radius fracture.

Sir Abraham Colles discovered the distal radius fracture first in 1814 and named it as Colle's fracture which lacked the typical feature of fracture like crepitus at the fracture site and abnormal motility. Further he stated that the high incidence of residual deformity persists when the fracture had healed. Proper reduction was essential or else there was a tendency for recurrence of deformity. He noted that "one consolation remains, that the fractured wrist / limb at some remote period will again enjoy its freedom in all its motions and was completely exempt from pain".[1]

A study on Colles' fracture complications by Cooney and his colleagues in the year 1980 comprising of 565 fractures revealed about 177 patients had complications like neuropathies of the radial, median and ulnar nerves in about forty-five cases, arthrosis of radiocarpal or radio-ulnar joint in thirty-seven cases, malunion in thirty cases, tendon ruptures in seven cases, associated injuries which were unrecognized in twelve cases, Volkmann's ischemia in four cases, stiffness of the fingers in nine cases and shoulder-hand syndrome in twenty cases.[8]

In 1986, Maurizio and colleagues in a follow up study on long term results of the conservative management of distal radius fractures involving 297 cases, observed that there were excellent results in 38%, good in 49%, fair in 11.5%, and poor in 1.5% cases. Hand grip strength was reduced but restriction of the wrist range of movements was not reduced. Median nerve neuropathy was commonly seen. The values of radial deviation, volar tilt and radio-ulnar index were inconsistent compared to normal values. They observed loss of reduction when compared with post reduction and follow-up radiograms.

They concluded that distal radius fractures are not easy to treat and long-term results following conservative management may not be as acceptable as it was generally assumed to be.[9]

In the year 1988, McQueen and Caspers investigated thirty patients of Colles' fracture in which functional and radiographical evaluation was done. Patients with displaced fracture had worse functional outcome compared to undisplaced. They concluded that a painful, weak and deformed wrist was seen in malunited Colles' fracture.[10]

In the year 1992, Atkinson and Mah conducted a study on 32 unstable Colles' fractures, which was treated by closed reduction, percutaneous K-wire fixation through the radial styloid and below elbow cast application. When assessed radiologically, three cases showed displacement in the K-wires due to failure of the K- wire to cross the fracture site or inadequate bony purchase in the proximal ulnar (medial) cortex of the radius. Assessment of functional outcome was made at the final review which showed excellent or good results. There were no infective and neurovascular complications observed.[11]

Naidu and his colleagues in the year 1996 in a bio-mechanical study on percutaneous pining of distal radius fracture which was performed by mechanical testing of extra-articular distal end radius fractures secured with percutaneous K-wires. K- wires of size 1.1 mm, 1.6 mm, 2.0 mm was used in four pin configurations. When subjected to mechanical testing they did found that cross pinning of K-wires of at least 1.6mm pins with two styloid pins of distal radius and a pin from ulnar corner of the radius was the most rigid construct in torsional as well as cantilever bending.[12]

D. V. Stoffelen and his colleague in the year 1997 conducted a study on kapandji pinning versus closed reduction and casting for extra-articular distal radial fractures,

concluded that both techniques were ideal for treating extra-articular fractures of distal end radius. They performed closed reduction and below elbow casting in 50 patients, kapandji-pinning was done in 48 patients and found that there was no statistically significant differences when compared between the two methods in terms of maintenance of fracture reduction as well as the functional outcome with one year follow up.[13]

In the year 2005, Azzopardi and colleagues performed a prospective, randomized study on 57 patients older than 6th decade with unstable, extra-articular fractures of distal end radius to compare the outcome of immobilization by cast application with that using supplementary percutaneous pinning. In a year follow up, they found that there was statistically significant improvement in the dorsal angulation (mean 7°), radial length (mean 3 mm) and radial inclination (mean 3°) noted in patients treated with percutaneous wires. There was no significant difference in functional outcome. They had used crossed K-wire construct for better stability. They concluded that percutaneous K-wire fixation for unstable, extra-articular fractures of distal end radius provides a marginal improvement in the radiological parameters compared with immobilization in a cast alone. There was no as such difference in functional outcome.[14]

Sahin et al., in 2005 conducted a study titled- the effect of long and short arm plaster of paris cast on the stability of reduction and BMD in conservative management of Colles' fracture. Eighty-three patients with an isolated Colles' fracture according to the Frykman's classification underwent closed reduction and casting. Both bone mineral density and radiographic parameters were reassessed after removal of cast on a mean of 45.3days. Statistically significant loss of bone density was found at diaphyseal region. Hence, they concluded that bone mineral density loss and failure of reduction following treatment of Colles' fracture was independent of the type of cast used.[15]

In the year 2007, Zoltan et al., observed the long-term outcome after non surgically managed distal radius fractures which included recovery of hand grip strength, wrist mobility and radiological parameters. Eighty-seven patients were treated with closed reduction and casting. They were evaluated radiographically as well as clinically during the first 6 months and finally after 9-13 years. Their data indicated that, few patients with nonsurgical management of distal radius fractures witnessed some sort of wrist and hand impairment even after a decade following the trauma. They concluded that fracture class according to AO classification (Arbeitsgemeinschaft für Osteosynthesefragen) was not correlating to the outcome, whereas severity of initial fracture influenced the clinical outcome. Patients with poor outcome had sustained moderate to severe displaced fractures which also healed with greater displacement. They also observed that recovery of range of motion was faster than the grip strength. Young patients recovered faster than elderly.[16]

Kurup and his colleagues in the year 2008, conducted a study on late collapse of distal radius fractures after K-wire removal in 56 patients. Radiographs taken just prior to removal of K-wires and 1 month after wire removal were analyzed to study three radiological parameters namely- palmar or dorsal tilt, radial inclination and negative or positive ulnar variance. They concluded that following K-wire removal there was no subsequent loss of reduction irrespective of age, sex, fracture variant according to AO classification and duration of wire fixation. They also concluded that K-wire fixation for unstable fractures of distal radius was a good technique to prevent redisplacement following closed reduction. Removal of K-wires can be done after 5 weeks and preferably before 6 weeks.[17]

Benjamin et al, in 2009 conducted a study on cadaver anatomy to demonstrate the proximity of K-wires to structures at risk. They used 1.5 mm K-wires in 15 cadaver

specimens, stimulating fixation of distal radius fracture. The average gap of superficial radial nerve from volar radial styloid K-wire was 1.47mm +/- 1.7, 0.35 mm +/- 0.64 from dorsal radial styloid and 1.07mm +/- 1.57 from transverse radial K-wire. All the three K-wires penetrated either tendons or nerves. About 1 to 2 cm skin incision just distal to the radial styloid prior to insertion of the radial styloid K-wires was recommend to directly see the underlying structures and prevent tendon or nerve injury. There were chances of injuring extensor digitorum communis tendon if K-wire was placed 5mm medial to lister's tubercle on dorsal aspect.[18]

Egol and his colleagues conducted a study in the year 2010 comparing operative and non-operative management of distal radius fracture in 90 elderly patients. They came to a conclusion that there is insignificant difference in functional outcome based on the disabilities of the arm, shoulder and hand scores and pain scores at any of the follow-up when analyzed in both groups. Whereas wrist range of motion and grip strength were significantly better in operative group.[19]

Abhishek das and his colleagues conducted a study in the year 2011 which aimed to examine the functional outcome of 32 patients who underwent percutaneous K-wiring for extra-articular distal radius fractures followed by casting in neutral position of the wrist. About 93.75% cases had excellent - good, 6.25% had fair functional outcomes. Complications like pin loosening in 13 cases, infection of pin tract in 2, reduced grip strength 2 and injury to the superficial branch of radial nerve in 1 case were observed. They recommended that percutaneous pinning and cast application in neutral position of wrist for non-comminuted extraarticular distal radius fracture was effectual way to treat and maintain reduction in these fractures there by preventing wrist rigidity.[20]

Raghu and his colleagues in 2016 conducted a comparative study involving closed reduction and cast application versus closed reduction with K- wire fixation and

below elbow cast application for extraarticular fracture distal end radius which included 60 patients.13 excellent, 9 good, 7 fair and 1 poor result was obtained in cast group and 11 excellent, 13 good, 5 fair and 1 poor result in percutaneous group. The mean difference in functional outcome was 0.03 which was statistically insignificant. The difference in the mean radial height was 3.75; volar tilt was 2.64; radial inclination was 4.87 at final follow up. They concluded that statistically significant radiological outcome obtained with operative group, there by suggesting that closed reduction with percutaneous K-wire fixation technique was simple and effective way providing additional stability in treating extra articular distal radius fracture.[3]

Abhishek Chattopadhyay and his colleague conducted a prospective study of distal radius fracture classified as per the AO classification and managed by closed reduction, percutaneous Kirschner wire fixation and plaster immobilization on 79 patients in the year 2017. At final follow up, Sarmiento's Criteria was used for anatomical evaluation which showed excellent result in 33 cases, 15 good result and 5 cases with fair result. Functional outcome assessment was done using Gartland and Werley criteria which showed excellent in 37, good in 13, fair in 3 and poor in 1 case. They concluded that percutaneous Kirschner wire pinning was a minimally invasive technique which maintains reduction in anatomical position and it did not require the use of special instruments and learning curve was steep. It was the appropriate method for treating displaced Colles' fracture with or without minimal intra-articular extension.[21]

Vasudevan and Lohith in their study for a period of one decade on standardized percutaneous 5 pin fixation for management of fractures of distal radius on 418 patients, introduced a novel concept of 5 pin technique for extra as well as intraarticular distal end radius fracture with or without comminution. Cooney's modification of Green and O'Brien's score was used for measuring clinical outcome. About 95.7% had excellent,

3.9% had good and 0.4% had poor outcome. They noted, there was no collapse of reduced fragments when post-op and last follow up x-rays were compared. They concluded that this novel technique was the most effective way to address all the fragments in distal radius fractures and there by providing outstanding radiological and functional outcome.[22]

Vamshi and his colleague in 2017 conducted a comparative study of management of Colles' fracture by closed reduction followed by casting versus closed reduction with internal fixation using K-wires or 4 mm canulated cancellous (cc) screws. About 60% excellent to good results was obtained in closed reduction with internal fixation group. About 10% excellent to good results was obtained in closed reduction and cast group. They concluded that percutaneous pinning / cc screws and cast immobilization in neutral position of the wrist for initial 3 weeks and then starting physiotherapy was the effective way of treating these fractures which showed early healing and quicker recovery of wrist range of movements.[23]

A study by Maluta with his colleagues on below versus above-elbow cast for distal radius fractures. They stated that there is statistically insignificant difference between the two study groups in terms of maintenance of fracture reduction. However below elbow cast was preferred because elbow was mobilized and elbow stiffness could be prevented.[24]

Sandeep and his colleagues in 2019 conducted a comparative study between closed reduction and plaster cast application versus K- wire fixation for extra-articular fracture distal end radius. The evaluation of the functional outcome was done by demerit scoring system of Gartland and Werley which showed had 13 excellent, 9 good, 7 fair and 1 poor result with the mean outcome score of 5.2. Percutaneous K-wire group had 11 excellent, 13 good, 5 fair and 1 poor result, the mean score was 5.17. There was no

statistically significant difference in functional outcome between the groups. The mean radial height in the cast application group was 8.033 mm while the mean in the K-wiring group was 11.783 mm. Mean volar tilt was 4.867 degrees and 7.5 degrees respectively. The mean radial inclination was 14.23 degrees and 19.1 respectively. They concluded that closed reduction, percutaneous K-wire fixation and below elbow cast application was an effortless, minimally invasive method providing an extra stability and better radiological outcome of fracture of distal radius when compared to closed reduction and below elbow cast application.[25]

Adarsh and colleagues in the year 2020 conducted a study on Colles' fracture concluded that there is statistically insignificant difference in functional outcome using Gartland and Werley scoring system which was evaluated at 6th month post operatively between closed reduction and cast immobilization versus percutaneous K-wire fixation. But they found that percutaneous K-wire fixation provides better outcome in terms of radiological parameters like radial length, radial inclination and volar tilt. Thus, they suggested that the later modality of management was better for Colles' fracture.[26]

ANATOMY

BONES AND JOINTS OF WRIST:

The wrist comprises of metaphyseal portion of distal radius and ulna, the proximal & distal carpal rows, the metacarpal bases and investing soft tissues as depicted in figure 1.

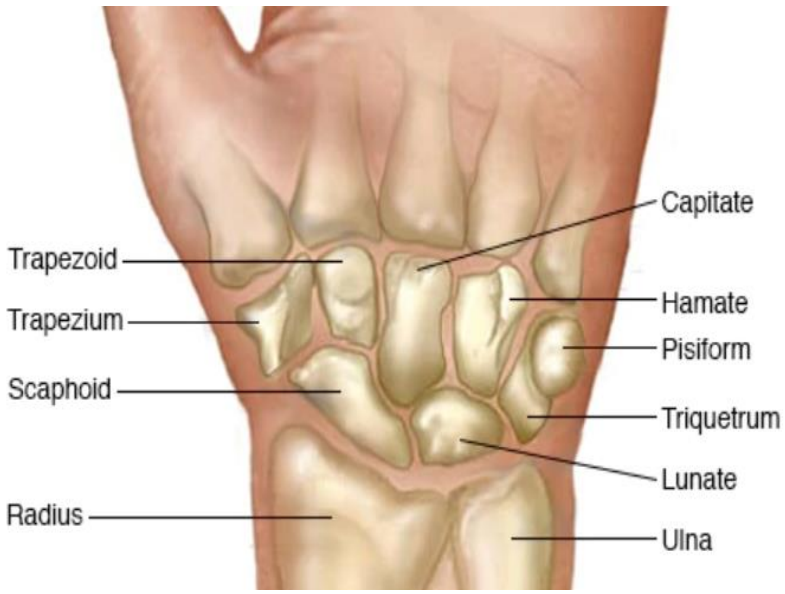


Figure 1: Bones of wrist

Distal end radius:

The widest part of the radius is its distal end as depicted in figure 2. It has four sides. The lateral surface projects distally to form radial styloid process. The articular surface is smooth and a ridge divides it into medial quadrangular area and lateral triangular areas. The volar aspect of distal radius is thicker and as a palpable prominent ridge 2 cm proximal to the thenar eminence. At the sigmoid notch distal radius articulates with ulnar aspect on its medial surface.

The posterior surface has a palpable dorsal tubercle (Lister's tubercle). There is a wide and shallow groove lateral to the tubercle which is divided by a ridge which is vertical in orientation.[27]

Figure 2: Distal end radius & ulna

Distal ulna:

The distal ulna is slightly expanded, consists of head of ulna and styloid process. The head is seen easily in pronated position of the forearm in the posteromedial aspect of the wrist and it articulates with radius at sigmoid notch. The articular disc separates the ulna and carpal bone. The styloid process of ulna is a short and projects posteromedially on the distal ulna. It is easily palpable on the medial aspect of the wrist in supinated position of the forearm. It is 1 cm proximal to the tip of radial styloid process. The distal articular surface of ulna is covered by triangular fibro cartilage.[27]

Triangular fibro Cartilage:

The triangular fibrocartilage complex in short known as TFCC (figure 3) is a ligamentous and cartilaginous structure that connects the ulna to the carpal bones and distal radius.[28] It stabilizes the ulnocarpal and radioulnar joints, transmits and distributes about 20% load from the carpus to the ulna. It facilitates complex movements at the wrist.

By definition, TFCC is made up of the triangular fibrocartilage proper (the articular disc), meniscus homologue (the ulnocarpal meniscus), ulnar collateral ligament, dorsal and palmar radio-ulnar ligaments, floor of ECU subsheath and the ulnolunate & ulnotriquetral ligaments. The triangular fibrocartilage disc is biconcave in shape and is made up of chondroid fibrocartilage that extends across the ulnar head, ranging in thickness between 2 to 5 mm.[29]

The triangular fibrocartilage complex is attached on the medial aspect of the lunate fossa of radius. Medially, it is inserted into ulnar head and the base of the ulnar styloid. Here, it is joined by fibres from the medial part of the ulnar styloid (the ulnar collateral ligament); thus thickened, it attaches to the lunotriquetral interosseous ligament, triquetrum, hamate body and base of the 5th metacarpal.[30] The triangular fibrocartilage complex acts as a cushion for the ulnar carpus, preventing ulnocarpal abutment and overloading of the ulna in ulnar deviation. It is a major stabilizer of the DRUJ.[31]

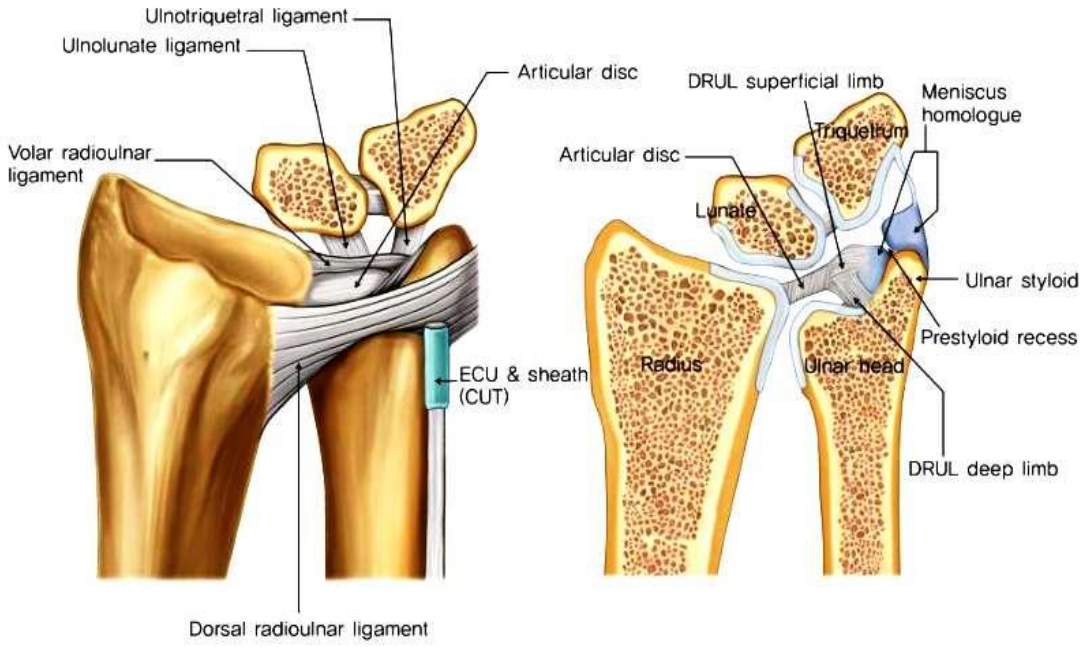


Figure 3: Triangular fibrocartilage complex

Radiocarpal (wrist) joint:

Articulating surfaces: It is a synovial, biaxial and ellipsoid joint formed by articulation of the distal end radius and the articular disc of the triangular fibrocartilage with the triquetrum, lunate and scaphoid.

Scaphoid and lunate are in contact with the distal radius and articular disc in neutral position of the wrist. Triquetrum comes into apposition with the articular disc only in full radial deviation of the wrist joint.

The radial surface is bisected into two concave areas by a low ridge. A similar kind ridge present between the medial radial concavity and distal discal surface.[27]

The fibrous capsule is lined by synovial membrane. The capsule is strengthened by palmar radiocarpal & ulnocarpal, dorsal radiocarpal, radial and ulnar collateral ligaments.[27,32]

Distal radio-ulnar joint: Is a type of uniaxial pivot joint.

Articulating surfaces: Between the ulnar head and the ulnar notch (sigmoid notch) of the radius. They articular disc connects them.[33]

Fibrous capsule: It is thicker anteriorly and posteriorly, and laxer proximally.

Articular disc: It is fibrocartilaginous which is composed of collagen with elastic fibres. It is triangular and binds the distal radius and ulna. It is thicker at periphery and perforated at center sometimes. The blunt thick apex of the disc is attached to area of depression present between styloid process of the ulna and distal articular surface.[27,33] Its margins are smooth and concave in nature, it is united to adjacent carpal ligaments. Proximally it articulates with the head of ulna, distally is a part of radiocarpal joint and articulates with lunate but when the hand is radially deviated, it articulates with triquetrum. The disc undergoes degeneration with advancing age, becomes thin and finally perforates in about 50% of the population who are aged above 50 years.[27,34]

Synovial membrane: The capsule which lined by the synovial membrane projects proximally in between radius and ulna as a recessus sacciformis which is in front of the distal most part of interosseous membrane.[27]

Ligaments around wrist:

The wrist ligaments can be grouped into distal radioulnar, palmar radiocarpal, dorsal radiocarpal, ulnocarpal, palmar midcarpal, dorsal midcarpal, and interosseous categories, entirely dependent on the principal location of the fibers of the ligament. Generally, the ligament is named for its most prominent bony connections.[27,35]

Palmar radio carpal ligaments:

Is a broad membranous band and is partly intracapsular extending from anterior margin of the distal end of radius and to base of radial styloid. Its fibres passes inferiorly and medially to get inserted into the anterior surface of the scaphoid, lunate and triquetral bones. But some fibres extend till capitate. [27,36]

Palmar ulnar carpal ligaments:

Is round and fascicular band extending from the base of ulnar styloid process and anterior margin of articular disc of DRUJ upto the triangular bones and lunate. It is perforated by apertures through which vessels pass. They are in relation with the tendons of FDP and FPL anteriorly. [27,36]

Dorsal radio-carpal ligaments:

These dorsal ligaments are thinner and comparatively weaker than palmar ligaments of the wrist. They extend from tendons of distal end radius upto the scaphoid, lunate and triquetrum bones on their dorsal surface. It is continuous with dorsal intercarpal ligaments which is related to the extensor tendons of wrists as well as the fingers. Anteriorly it blends with the articular disc of inferior radio-ulnar articulation. [27,36]

Ulnar carpal collateral ligaments:

It divides into two dips after getting attached to the ulnar styloid process, among which one is attached to the triquetrum on the radial side and pisiform on medial side. [27,37]

Radial collateral ligaments:

Extending from the tip of radial styloid process till the radial side of scaphoid bone. Few of its fibres are prolonged to extend till the trapezium in relation to radial artery. [27,38]

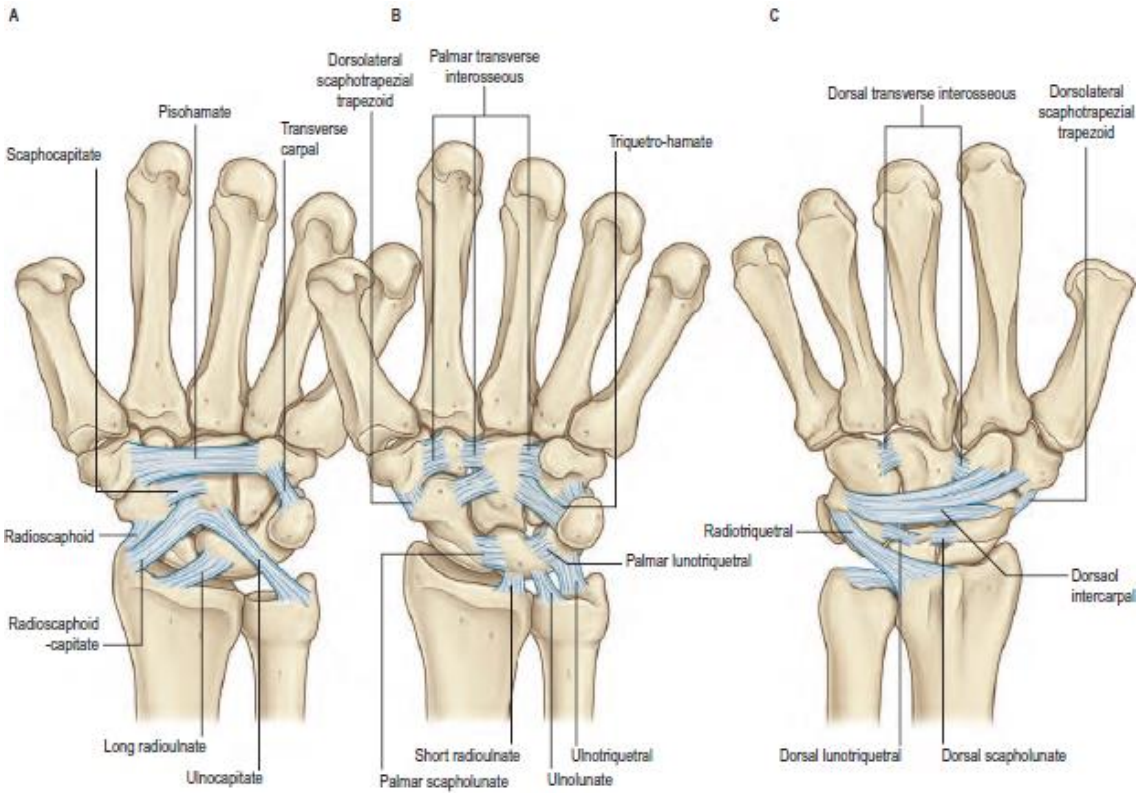


Figure 4: Joints and ligaments of the left hand.
(A) Palmar aspect: extrinsic ligaments (B) Palmar aspect: intrinsic ligaments
(C) Dorsal aspect.

Extrinsic ligaments of wrist:

The radius, ulna and carpal bones are connected by extrinsic ligaments of wrist as shown in figure 4A.

Extrinsic palmar carpal ligaments:

When we dissect the synovial layer of the carpal tunnel, two V-shaped band of ligaments will be seen with their apex lying distally (see Fig 4A). The limbs of the 'V' originate from ulna and radius with apex of one 'V' attached to distal row and second 'V' to proximal row.[27,39]

Radioscaphocapitate ligament:

It arises from styloid process of radius and palmar lip of radius. It is divided into three parts. On the radial aspect of scaphoid waist, the radial part get inserted and the middle part continues as distal 'V' and inserts on to the scaphoid distal pole. The ulnar part which passes above the proximal pole of scaphoid, directed towards the mid-carpal bone and it blends with fibres of TFCC (triangular fibrocartilage complex) to form an arcuate ligament. Some of these fibres attach to the capitate body. The interval is present between inferior margin of radioscaphocapitate ligament and lunate palmar horn which is called as space of Poirier. [27,40]

Long radiolunate ligament:

On the palmer lip of the distal radius this long radiolunate ligament arises adjacent to the radioscaphocapitate ligament.[41] It provides support to the proximal portion of scaphoid and inserts to lunate palmar horn. It is separated by the interligamentous sulcus which is in continuation with space of Poirier, hence making it discrete from radioscaphocapitate ligament. [27,42]

Radioscapholunate (ligament of Testut):

This ligament is surrounded by thick synovial lining and also a landmark during wrist arthroscopy. This is not a true ligament as it contains neurovascular structures. [27,42]

Short radiolunate ligament:

It is a part of proximal 'V'. It is arising from palmar lip of lunate fossa of radius which passes to the lunate palmar horn. On the ulnar side, these fibres blend with the palmar TFCC to pass and insert on lunate. The stability of lunate is because of this ligament. [27,42]

Ulnolunate ligament:

It arises from the ventral aspect of the ulna next to the short radiolunate ligament, insertion is to the lunate palmar horn. Partial fibres forms arcuate ligament by arching radially and blending with the radioscaphocapitate complex. [27,42]

Ulnotriquetral (ulnar collateral) ligament:

They arise from the ventral aspect of the ulna and inserts to the ulnar side of the triquetrum. This ligament extends distally to attach to the ulnar aspect of hamate. This ligament along with ulnolunate ligament attaches to the marginal ligament of the triangular fibrocartilage complex. [27,42]

Extrinsic dorsal carpal ligaments:

It is a thin ligament and reinforced by the floor, septae of fibrous tunnels for 6 extrinsic compartments of the wrist as depicted in figure 4C. This ligament along with dorsal intercarpal ligaments has a 'Z'-shaped pattern.[27,42]

Dorsal radiolunotriquetral ligament:

It is an intracapsular ligament having two components i.e., superficial and deep. The superficial part is connected to the radius and triquetrum and the deep portion of this ligament connects lunate, radius and triquetrum. The superficial portion is wide and

originates from extensor margin of the distal radius and courses ulnar wards to insert on to the dorsal margin of triquetrum. The narrower deep portion arises from the medial aspect of distal end radius on dorsal surface and it is directed towards ulnar side to get attached to part of the articulation of the lunotriquetrum and lunotriquetral ligament. [27,42]

Intrinsic ligaments of the wrist:

They are attached to carpal bones as shown in figure 4B. They are stronger and shorter than extrinsic ligaments. By interdigitating fibres they are connected to extrinsic ligament complexes of the wrist. [27,42]

They are divided as:

- Proximal row interosseous ligaments - figure 5A
- Distal row interosseous ligaments - figure 5B
- Palmar midcarpal ligaments
- Dorsal midcarpal ligaments

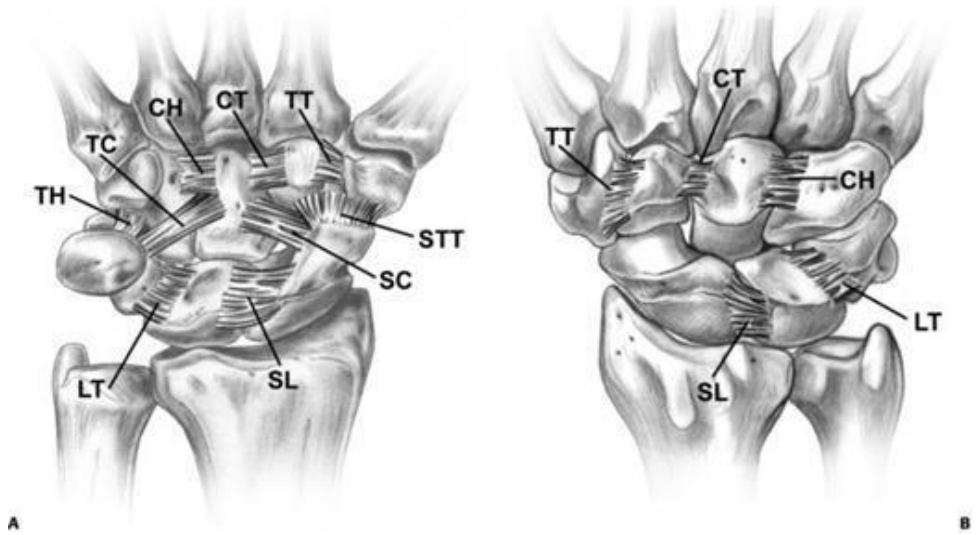


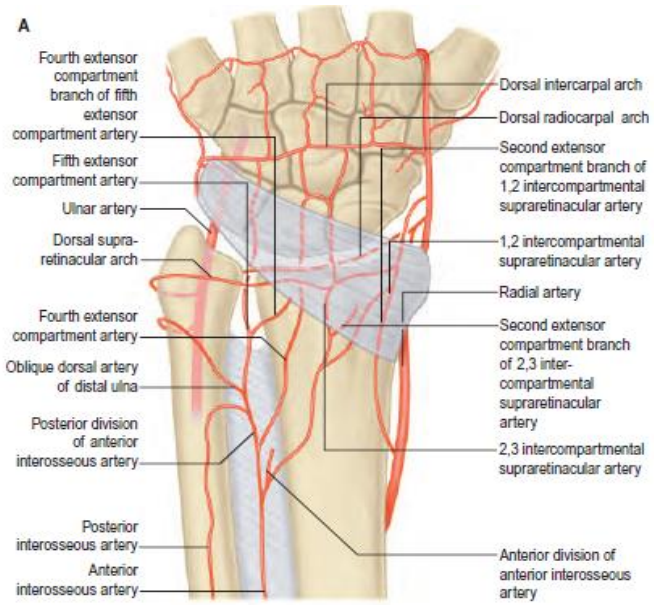
Figure 5A: The palmar intrinsic ligaments: Scaphotrapeziotrapezoid ligament (STT), Scaphocapitate ligament (SC), Triquetrocapitate ligament (TC), and Triquetrohamate ligament (TH).
Figure 5B: The dorsal intrinsic ligaments: Capitohamate ligament (CH), Capitotrapezoid ligament (CT), Lunotriquetral ligament (LT), Scapholunate ligament (SL), Trapeziotrapezoid ligament (TT).

NEUROVASCULAR SUPPLY OF DISTAL RADIUS

Vascular supply of the distal forearm and lymphatic drainage:

The articular disc and distal radio-ulnar joint is supplied by anterior interosseous artery through dorsal and palmar branches. They are often reinforced by the ulnar and posterior interosseous artery. The branches pass through the fourth and fifth extensor compartments of the wrist and provide metaphyseal nutrient arteries. Intercompartmental vessels send nutrient arteries to radius bone through retinaculum between the first & second dorsal compartments, second & third dorsal compartments. These vessels arise from radial as well as anterior interosseous arteries to anastomose with dorsal palmar arch as depicted in the figure 6A and 6B.[43]

The posterior and anterior interosseous nerves supply the wrist joint.



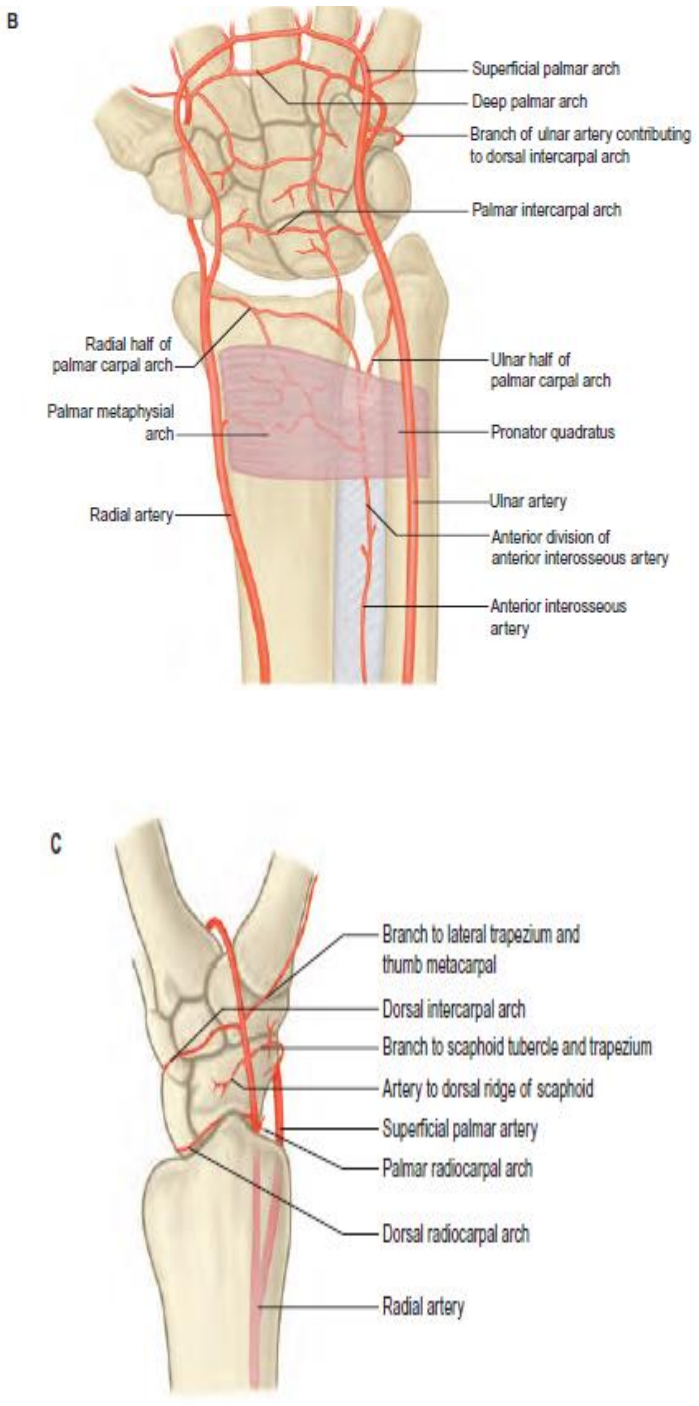


Figure 6A–C: The extraosseous blood supply to the distal end radius and ulna, the carpal bones.
(A)Dorsal aspect (B)Palmar aspect (C)Lateral aspect

Radial artery:

At the wrist, it passes on the posterior aspect of the carpal bone between the tendons of APL, EPB and the lateral carpal ligament (figure 7). It crosses the trapezium and scaphoid where again, its pulsation is obviously felt. When passing between the head of the first dorsal interosseous, it is crossed by EPL tendon. [44] In between the thumb extensors, the cephalic vein and radial nerve branches crosses the radial artery as shown in figure 8. Sometimes, this artery gives a dorsal carpal superficial branch which crosses extensor tendons at the wrist. The lateral cutaneous forearm branches run along its distal part when it curves round the carpal bone.[45,46,47]

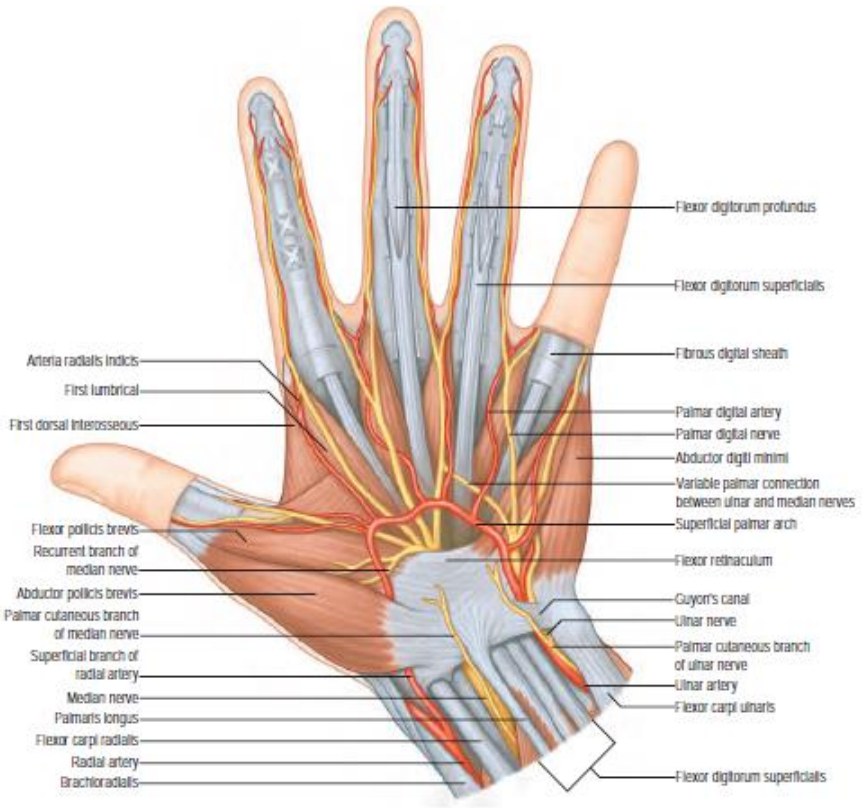


Figure 7: Radial artery

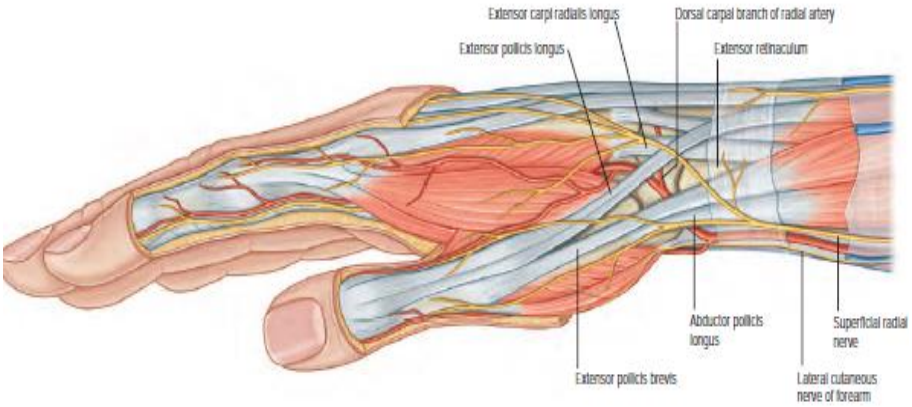


Figure 8: Dorsal carpal branch of radial artery

Ulnar artery:

At the wrist, the ulnar artery is underneath the superficial fasciae and palmaris brevis tendon. It lies between the layers of flexor retinaculum. Ulnar artery is lateral to ulnar nerve and pisiform. [45,48]

Dorsal cutaneous branch:

Distally, a constant dorso-ulnar perforating vessel is given off. It arises 2 –5 cm proximal to pisiform bone and runs along the dorsal branch of ulnar cutaneous nerve. This branch arises between tendons of extensor and flexor carpi ulnaris.[45,48]

Palmar carpal branch:

It crosses the distal third of ulna and lies deep to tendon of FDP and anastomoses with the palmar branch of the radial artery to make a palmar radiocarpal arch.[45,48]

Dorsal carpal branch:

It originates proximal to the pisiform bone. It obliquely runs underneath the tendon of flexor carpi ulnaris in order to reach the carpal bone on dorsal side and it crosses radially beneath wrist extensor tendons. By anastomosing with the dorsal branch of the radial artery it completes the dorsal carpal palmar arch. At its origin, it gives off a

small digital branch to run along the medial side of the 5th metacarpal bone and supplies the medial aspect of the 5th finger on the dorsal aspect. [45,48]

Deep palmar branch:

It is often double and passes between abductor and flexor digiti minimi tendon which is through or deep to opponens digiti minimi. Anastomosing with the radial artery to complete the deep palmar arch. It accompanies the deep branch of ulnar nerve as shown in Figure 9. [45]

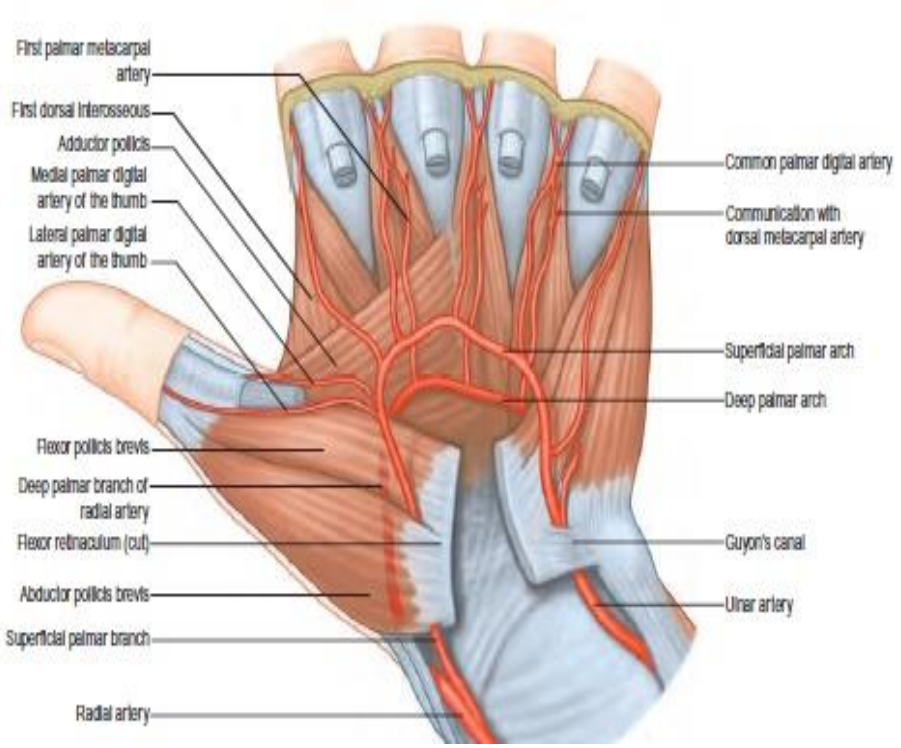


Figure 9: Ulnar artery & palmar arch

WRIST KINEMATICS

The wrist range of movements consists of palmarflexion, dorsiflexion, radial and ulnar deviation at the radio carpal joint. Axial rotation occurs at radio-ulnar joint. Radio carpal articulation acts as a universal joint by facilitating some degree of intercarpal movements around the longitudinal axis related to the rotation of the individual carpal bones. [42,49]

The forearm contributes for the movement of about 140° and supplies the hand with strength required for vigorous torque. The radiocarpal joint has near equal proportion of extension and flexion (85° each), ulnar and radial deviation of 45° and 20° respectively. [50]

This range of motion is possible because of complexity of two carpal rows. The direction of angulation of each row is same with almost same amplitude and also in a synchronized way during flexion and extension. During radio ulnar deviations, proximal row of carpal bones in the sagittal plane exhibits a secondary angulation which is in synchronous motion of coronal plane.[51]

Through the scapholunate ligament on its dorsal aspect this motion is transmitted initially to the lunate and then to the triquetrum, which flexes approximately 25°. The proximal row extends and supinates with respect to radius when the carpal bones moves to the neutral position and ulnar deviated position. [45,51]

Within a small area in capitate neck there lies the center of rotation of wrist in coronal plane. A line if drawn passing through the axis of rotation which is parallel to the anatomical axis of the forearm, with hand in neutral position, passes through the base and head of 3rd metacarpal.[51]

In a sagittal plane and in neutral flexion-extension position of the wrist. A line drawn passes through the long axis of the lunate, capitate and radius will show these to be

nearly in superimposed position. The scaphoid bone being a stabilizing strut of column supports the central column which is unstable. The interosseous membrane is relaxed in terminal supination & pronation and taut in neutral position. The triangular fibrocartilage complex limits the supination and pronation by its torque mechanism.[43,52]

Flexor carpi radialis is a weak pronator due to its oblique course. Supinator muscle in the extended elbow position acts in a unresisted and slower movement. Fast and forceful supination in a flexed elbow is due to biceps brachii. Pronation is weaker than supination.[43,53]

Movements of the wrist:

Wrist joint is an example for biaxial ellipsoidal joint. The movements at the wrist occurs in AP as well as in transverse axis. Wrist palmar and dorsi flexion affected through transverse axis. Radial and ulnar deviation AP axis. Circumduction of hand is by the combination of above stated movements along with supination and pronation of forearm. [27,54]

Radial and ulnar deviation are due to intercarpal and wrist joints movements. Normally, radial deviation is less than ulnar deviation. Contact of lunate bone with radial styloid during radial deviation along with ulnar collateral ligament restricts the radial deviation of the wrist. [27,55]

Wrist range of movements	**Normal range**
Palmarflexion	$0\text{-}85^0$
Dorsiflexion	$0\text{-}85^0$
Abduction (radial deviation)	$0\text{-}20^0$
Abduction (ulna deviation)	$0\text{-}40^0$

Supination and pronation occur at forearm at proximal radio ulnar joint, interosseous membrane and distal radio ulnar joint.

Normal range:

- Supination: $0\text{-}90^0$
- Pronation: $0\text{-}90^0$

Flexor carpi ulnaris, flexor carpi radialis, extensor carpi ulnaris, extensor carpi radialis brevis and longus controls the wrist motion. Radiocarpal is a hinge joint but it is functionally similar to ball and socket joint.[56]

Muscles producing movements: [42,57]

Wrist palmar flexion is by

- Flexor carpi ulnaris
- Flexor carpi radialis

Wrist dorsi flexion is by

- Extensor carpi radialis brevis & longus
- Extensor carpi ulnaris

Ulnar deviation of the wrist is by

- Extensor carpi ulnaris
- Flexor carpi ulnaris

Radial deviation of the wrist is by

- Extensor carpi radialis brevis & longus
- Extensor pollicis brevis
- Flexor carpi radialis
- Abductor pollicis longus

MECHANISM OF INJURY

Most distal radius fractures result from a fall onto an outstretched hand from standing height. Higher energy injuries occur in falls from height, direct injury to wrist, motor vehicle accidents, industrial injuries but these remain a small proportion of distal radius fractures.[58,59]

Fall on outstretched hand with the wrist between 40 and 90 degrees of dorsiflexion often results in distal end radius fractures.

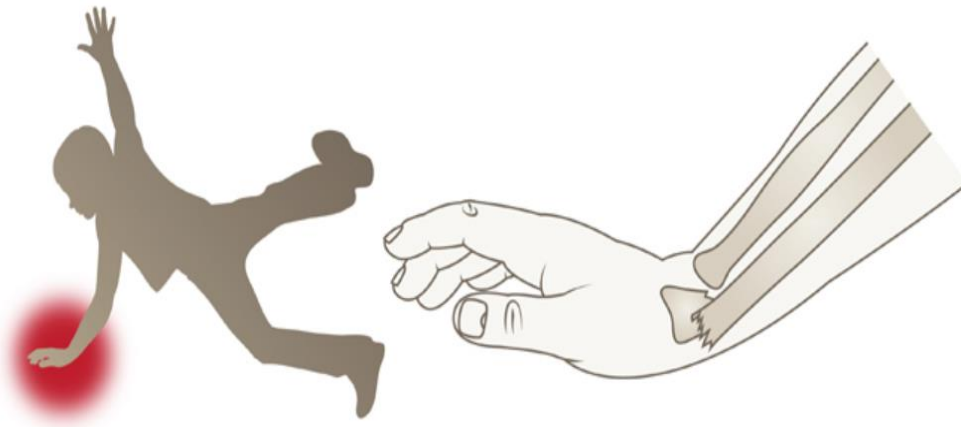


Figure 10: Fall on outstretched hand

Volar shearing and volar displaced distal radius fractures occur with the wrist in volar flexion.[60,61]

In addition to the mechanism of injury, increased fracture severity has been proven to be associated with poor bone quality. There is a linear correlation between Dual-energy x-ray absorptiometry (DXA) T-scores and early instability and malunion.[62,63]

RADIOGRAPHY

Posteroanterior / Anteroposterior and lateral x-rays were used to analyze the suspected fracture of the distal end radius.

PA View:

Assessment included[52]

- Radial length in mm
- Radial inclination
- Fracture pattern and location
- Fracture of carpal bones
- DRUJ

Lateral View:

Assessment included-

- Dorsal tilt or volar tilt
- Comminution

It is crucial to measure dorsal or volar tilt on a true lateral view of the wrist x-ray, because the malposition with rotation of the radial styloid with respect to the radius shaft has a significant effect on the apparent alignment.

The radiological parameters are-

Radial Length:

Measured on the PA view of x-ray wrist as depicted in figure 10A. Two lines perpendicular to the shaft of radius drawn- one along the articular surface and the other line along the styloid tip. The distance between the lines is the radial length measured in millimeters as depicted in figure 11A. Normal range is 8-18mm.[64,65]

Radial Inclination:

Measure on the PA view of x-ray wrist as depicted in figure 10B. The angle between the distal radial articular surface with respect to a perpendicular line to the longitudinal axis of radius shaft as depicted in figure 11B. Normal range is 12-25 degrees.[64,65]

Dorsal/Volar Tilt:

Measured on the lateral view (true lateral) of x-ray wrist as depicted in figure 10C. the angle between two lines i.e., one drawn along the distal radius articular surface and other perpendicular the long axis of the shaft of radius as depicted in figure 11C. Normal range is 0-28 degrees.[64,65]

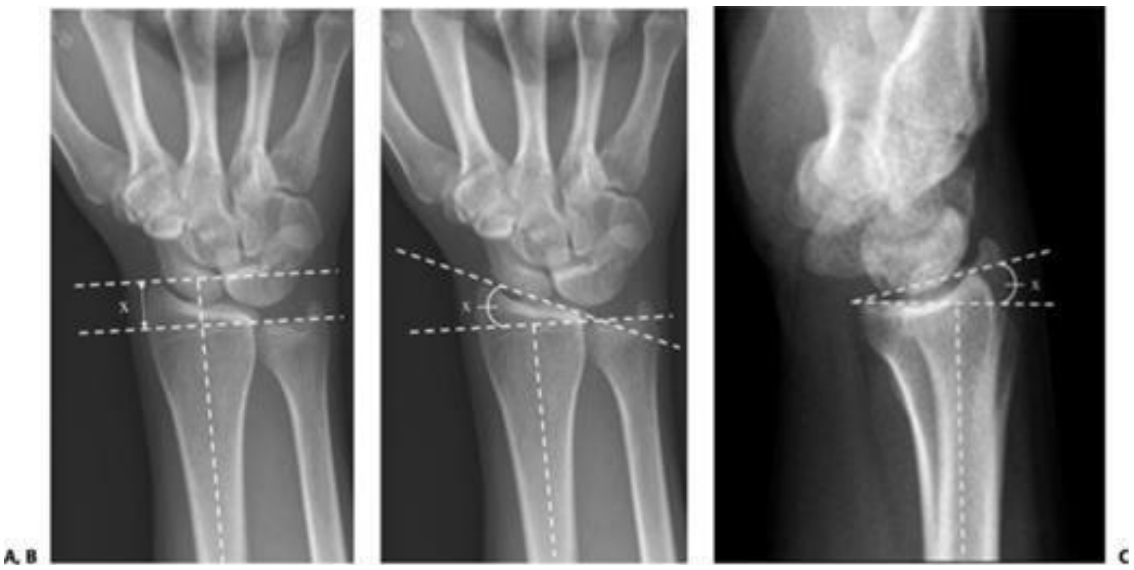


Figure 11: x-ray representation of radiological parameters
Figure 11 A: The average radial height (X) is 11 to 12 mm from the distal radioulnar joint (normal range 8–18 mm). **B:** The average radial inclination (X) is 21 to 25 degrees (normal range 12–25 degrees).**C:** The average volar tilt (X) is 11 to 22 degrees (normal range 0 to 28 degrees).[65]

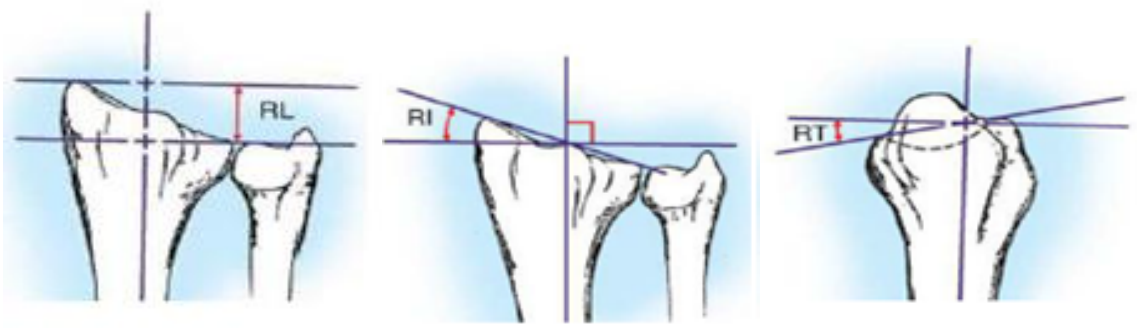


Figure 12: Pictorial representation of radiological parameters
12A Radial height, 12B Radial inclination, 12C Radial tilt

VARIANTS OF DISTAL RADIUS FRACTURES

Many eponyms are commonly used to describe distal radius fractures. While they are useful for giving surgeons a general idea of the fracture pattern, they provide little in terms of determining treatment or prognosis.

Colles' fracture: Who first described the pattern of a dorsally angulated, apex volar metaphyseal distal radius fracture in 1814. It is meant to refer to extra-articular fractures, but is frequently used as general descriptor of dorsally displaced fractures. It involves the distal articular surface and it can extend into the distal radiocarpal joint or the distal radioulnar joint with or without association of styloid fracture.[66]

Classical displacements in a Colles' fracture:

1. Impaction
2. Lateral displacement
3. Lateral tilt
4. Dorsal displacement
5. Dorsal tilt
6. Supination

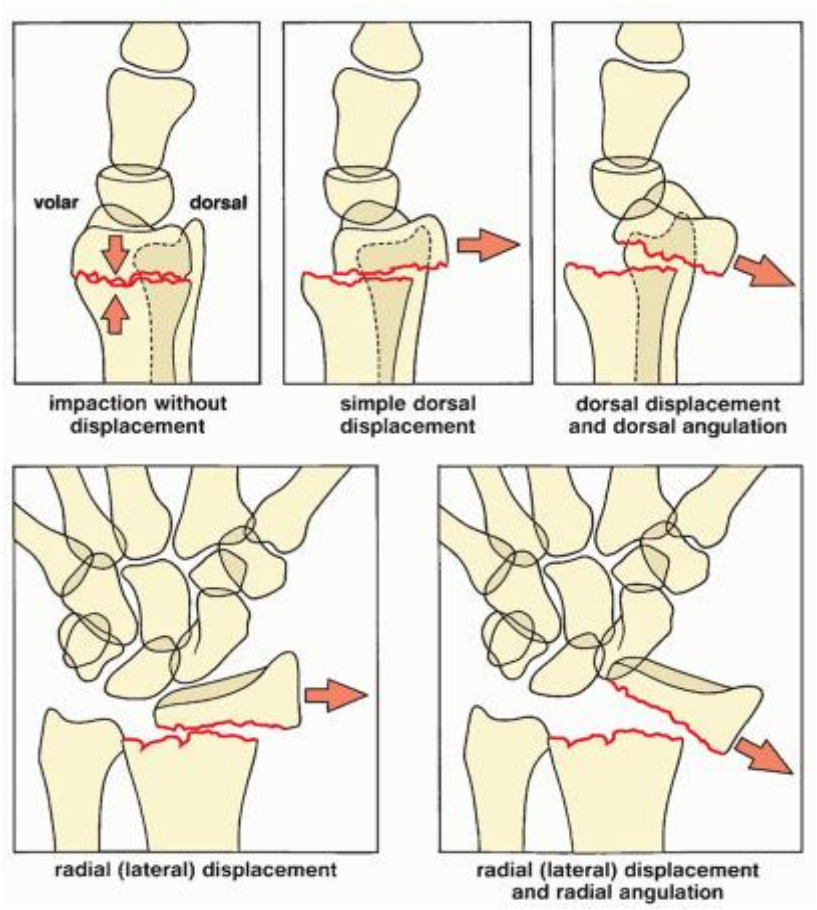


Figure 13: Displacements in Colles' fracture

Stable Colles' fracture: Are usually extra-articular with minimal displacement, when the fracture is reduced, they do not tend to redisplace to the original deformity.

Unstable Colles' fracture: Have an inherent capacity for loss of reduction or shortening or both.[66]

Smith fracture: It is opposite to Colles' fracture, which is described as volarly angulated, apex dorsal metaphyseal distal radius fracture.[67]

Barton fracture: refers to an intra-articular distal radius fracture extending through the dorsal cortex of the radius, often with subluxation or dislocation dorsally involving the radiocarpal joint. A volar or reverse Barton describes a fracture that extends out the volar

aspect (cortex) of the distal radius and there could be subluxation or dislocation in that direction.[68]

Chauffeur's fracture: Is an isolated intra-articular fracture of the radial styloid, so named because it was caused by the engine backfiring while chauffeurs were starting the earliest generation of automobiles with a hand crank on the front.[69]

CLASSIFICATIONS OF DISTAL RADIUS FRACTURES

1.FRYKMAN CLASSIFICATION (1967):

Frykman classified distal radius fractures based on intra-articular involvement, association with ulna fractures, it includes children fracture equivalent. But did not include variations for comminution, shortening, or overall displacement. This classification helps to provide treatment recommendations.[71,72]

Fractures	Distal ulnar fractures	
	Absent	Present
Extra articular	I	II
Intra articular involving distal radio-carpal joint	III	IV
Intra articular involving distal radio-ulnar joint	V	VI
Intraarticular, involving both distal radioulnar and radiocarpal joint	VII	VIII

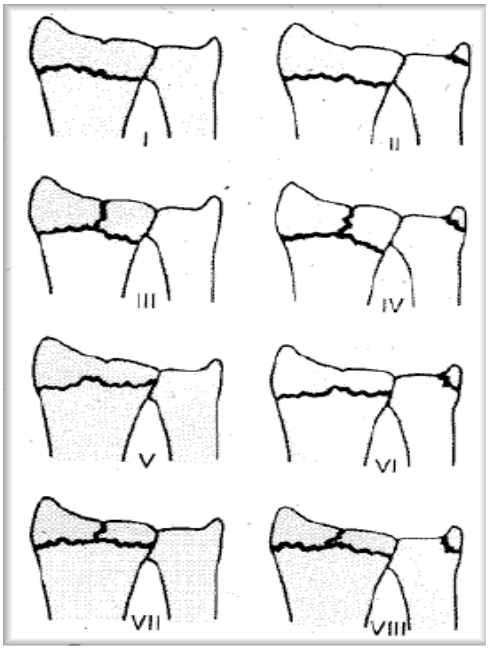


Figure 14: Pictorial representation of Frykman classification of distal end radius

2.GARTLAND AND WERLEY (GW) (1951):

This classification was based on deformity, intraarticular extension and comminution of the distal radius metaphysis. But it did not consider fracture displacement. [72]

Group 1: Simple Colles' fracture

Group 2: Comminuted Colles' fracture, undisplaced intraarticular fragment

Group 3: Comminuted Colles' fracture, displaced intraarticular fragment

3.AO CLASSIFICATION:

The AO classification, originally described in 1990, was adopted by the Orthopaedic Trauma Association to become the AO/OTA classification in 2007. It remains the mostly widely used classification system and is the primary system referred to in current research studies. It considers the severity of fracture and lay down basis for evaluation & treatment.[70,71,72]

Type A: Extra-articular

Type B: Partial articular

Type C: Complete articular

Each type is further divided into 3 sub-groups.

A1: Extraarticular ulna with radius intact

A2: Extraarticular radius with ulna intact

A3: Extraarticular with multifragmentary radius fracture

B1: Sagittal plane

B2: Coronal, Dorsal rim (Barton's)

B3: Coronal, Volar rim (Reverse Barton's)

C1: Articular simple with metaphyseal simple fractures

C2: Articular simple with metaphyseal multifragmentary fractures

C3: Articular multifragmentary

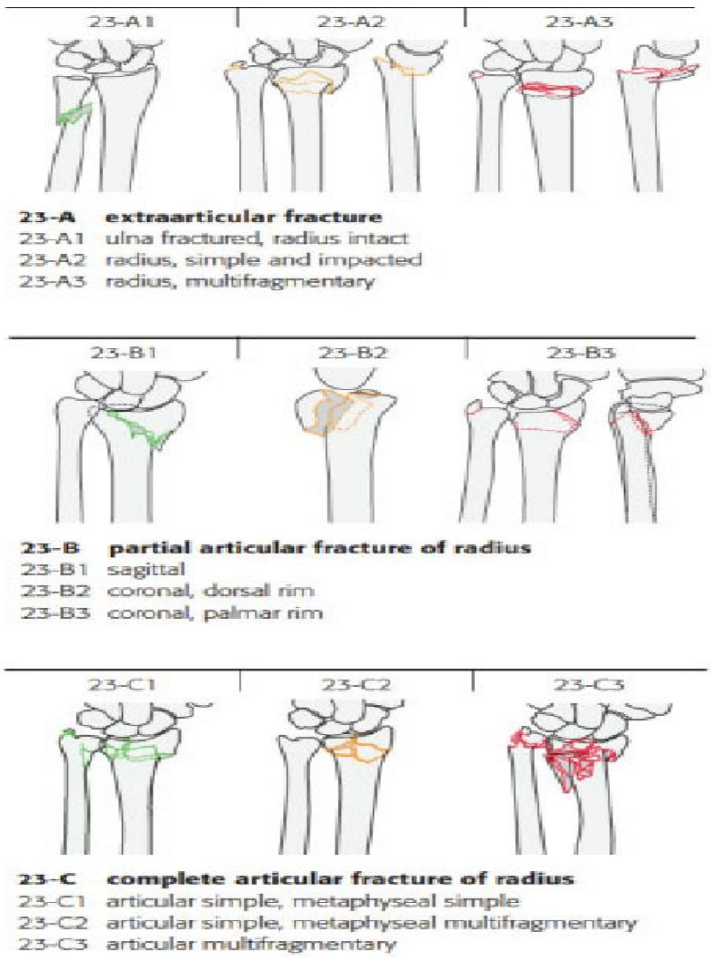


Figure 15: AO classification of distal radius fractures

4.FERNANDEZ CLASSIFICATION (1987):

Considered mechanism of injury to classify distal radius fractures. This classification provides information about DRUJ lesions. This classification was based on analyzing the outcome of fracture based on mechanism of injury.[71,72,73]

Type 1 (Bending): One cortex of the metaphysis fails because of tensile stress; opposite cortex with some comminution

Type 2 (Shearing): Fracture of the joint surface

Type 3 (Compression): Fracture of the surface of the joint with impaction of subchondral and metaphyseal bone, intraarticular comminution

Type 4 (Avulsion): Fracture of the ligament attachments of the radial and ulnar styloid process, radiocarpal fracture-dislocation

Type 5 (Combination): High-velocity injuries

5.COONEY (1990) UNIVERSAL CLASSIFICATION: [71]

This was a simple classification which was attractive to guide the orthopaedic surgeon during treatment of the distal radius fracture. It was based on articular involvement and displacement of the fracture. [72]

Type 1: Extraarticular, undisplaced

Type 2: Extraarticular, displaced

Type 3: Intraarticular, undisplaced

Type 4: Intraarticular, displaced

MATERIALS AND METHOD

Source of data: Patients admitted in orthopaedics ward from outpatient department and casualty at R.L. JALAPPA HOSPITAL AND RESEARCH CENTRE, attached to SRI DEVARAJ URS MEDICAL COLLEGE affidavit to SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, Kolar from December 2018 to September 2020 meeting the inclusion criteria and exclusion criteria as cited below.

Inclusion criteria:

1. Patients with radiologically confirmed fractures of distal end radius - extraarticular and extraarticular fracture with simple intraarticular extension
2. Patients greater than 18years of age
3. Patients presenting with injuries not older than 2 weeks
4. Patients who are medically fit and willing to give consent for the study

Exclusion criteria:

1. Distal radius fracture associated with neurovascular deficit
2. Distal end radius fracture associated with carpal bone fractures
3. Compound fractures of distal end radius
4. Ipsilateral fractures in the same limb proximal to the wrist
5. Open fractures of distal radius
6. Pathological fractures

Study Design: Prospective comparative study

Sample Size: Sample size was estimated based on functional outcome between cast application versus K-wire & cast application for distal end radius fracture by a study done by Sunit pal et al. A difference of 30% in the functional outcome of excellent and good was observed; expecting a 40% difference in excellent and good functional outcome

between the methods in the present study with 95% confidence interval with power of 80%. The required sample size per group was 22. So final sample size of 44.

Sampling Method: Sampling was done by simple randomization of the cases according to a computer-generated simple randomization protocol.

Method of collection of data: It was a prospective study consisting of 44 patients. The patients were allocated into two groups as described in sampling method. Group one was managed by closed reduction and cast application. Group two was managed by closed reduction with percutaneous K-wire fixation and cast application.

Collection of the data is by- history taking, physical examination, radiological investigations like X-ray of wrist – AP/PA and lateral view, CT scan (if required) and relevant investigations for preop evaluation.

Methodology:

Pre-operative evaluation: Following admission history was taken regarding mode of injury. All patients were examined thoroughly including general physical examination, vitals, systemic examination and local examination of the affected limb. All the findings were duly recorded in the proforma.

Local examination involved inspection of swelling, deformity. Palpation of underlying bone for tenderness, crepitus, relation of ulnar and radial styloid process, abnormal mobility. Wrist and hand range of movements were elicited. Distal neuro-vascularity was assessed. The affected forearm and wrist were immobilized by applying below elbow slab and the affected limb elevation was maintained. Analgesics and anti-inflammatory medications were given. All routine investigations like haemoglobin, blood group and Rh typing, random blood sugar, renal function tests, bleeding and clotting

time, HIV, HbSAg, HCV were sent. If patient was diabetic then FBS, PPBS, HbA1C and urine analysis were done. ECG and chest x-ray were taken.

Radiographic evaluation:

Radiographs of injured wrist in

1. Posteroanterior view / Anteroposterior view
2. Lateral view

The following radiographic parameters were noted-

1. Radial inclination in PA view
2. Radial length in PA view
3. Palmar tilt in Lateral view

Following radiograph of the involved wrist, classification of fracture according to Frykman classification method was done.

Anaesthesia – General anaesthesia or regional anaesthesia (Supraclavicular block) was used.

Technique for management of distal radius fracture by closed reduction and cast application: Following induction of anaesthesia, closed reduction was done by traction-counter traction method. The orthopaedic surgeon holds the affected hand so as if to shake the hand. The initial step was disimpaction of the fractured fragments which was done by sustained traction in longitudinal direction of the upper limb against the counter traction given by an assistant grasping the distal arm just above the flexed elbow. Then the distal fragments were pressed into palmar flexion of wrist and ulnar deviation by the help of thumb. As this was done, the patient's hand is brought into pronation, palmarflexion and ulnar deviated position. A plaster of paris (POP) cast is applied from below elbow to the distal palmar crease of the hand, with the wrist in palmarflexion and ulnar deviated position (Colles' cast).

Technique for management of distal end radius fracture by closed reduction with percutaneous K-wire fixation and cast application: Following induction of anaesthesia, closed reduction was done by traction- counter traction method. The reduction was checked under fluoroscopy and once acceptable reduction achieved; a 1.5 mm K-wires was passed through the styloid process of radius piercing till the ulnar side of radial cortex of proximal fragment. An additional K-wire was passed through medial (ulnar) side of the distal radius engaging the opposite cortex when deemed necessary by the operating surgeon. After satisfactory reduction with help of fluoroscopy, K-wires were first bent and then cut close to the skin. Sterile gauze applied around the cut end of K-wires. Plaster of paris (POP) cast was applied from below elbow to the distal palmar crease of the hand with wrist in neutral position.

Post-operative care and rehabilitation: Post operatively limb elevation, analgesic and antiedema measures taken. Injection Cefuroxime 1.5gm twice daily intravenous was given for three days followed by Tab Cefuroxime 500mg per oral, two times a day for a period of 5 days. Patients were instructed from post-op day one to perform active/ passive finger movements, active elbow and shoulder movements.

Follow-up: All cases were followed up on sixth week and sixth month. They were assessed radiologically for displacement of K-wires. After post-operative period of six weeks, cast and K-wires were removed. Check x-ray was taken to analyse radiological parameters. Following removal of the cast, patients were examined clinically for fracture union, wrist range of movements. Physiotherapy of wrist, hand was thought to the patients.Assessment of functional and radiological outcome was done at the end of 6 weeks and 6 months post operatively.

Clinical assessment based on Gartland and Werley (G&W) demerit point scoring system:[3,26]

Prominent ulnar styloid	1
Residual dorsal tilt	2
Residual elevation of hand	2-3
Point range	0-3
Subjective evaluation	
Excellent: no pain, disability, or limitation of motion	0
Good: occasional pain, limitation of motion, no disability	2
Fair: occasional pain, limitation of motion, feeling of weakness, activities slightly restricted	4
Poor: pain, limitation of motion, disability, activities more or less restricted	6
Point range	0-6
Objective evaluation	
Loss of dorsiflexion	5
Loss of ulnar deviation	3
Loss of supination	2
Loss of pronation	2
Loss of palmar flexion	1
Loss of radial deviation	1

Loss of circumduction	1
Pain at distal radioulnar joint	1
Grip strength – 60% or less of opposite side	1
Point range	0-5
Arthritic change	
Minimum	1
Minimum with pain	3
Moderate	2
Moderate with pain	4
Severe	3
Severe with pain	5
Nerve complications	1-3
Loss of finger motion due to cast	1-3
Point range	0-5
Excellent	0-2
Good	3-8
Fair	9-20
Poor	21 & above

Objective evaluation was based on ROM of wrist. The minimum ROM required for normal function: dorsi flexion 45 degrees, palmar flexion 30 degrees, radial deviation 15 degrees, ulnar deviation 15 degrees, pronation 50 degree and supination of 50 degrees.

The obtained functional outcome scores were then compared to ascertain for any statistically valid difference in outcome by an unpaired student's t test.

Radiological assessment: Assessment of the radiological outcome was based on the values of radial height, volar tilt and radial inclination in the PA and lateral x-ray of the wrist. They were individually assessed by unpaired student's t test to ascertain for any statistically valid difference between the radiological outcome between the two groups.

Statistical analysis: Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. **Chi-square test** was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation.[74] Continuous data was represented as mean and standard deviation. **Independent t test** was used as test of significance to identify the mean difference between two quantitative variables and qualitative variables respectively.

Graphical representation of data: MS Excel and MS word were used to obtain various graphs like bar diagram, pie diagram.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.[75,76]

Statistical software: MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

OPERATIVE PHOTOGRAPHS

Figure 16: C arm fluoroscopy

Figure 17: Instruments

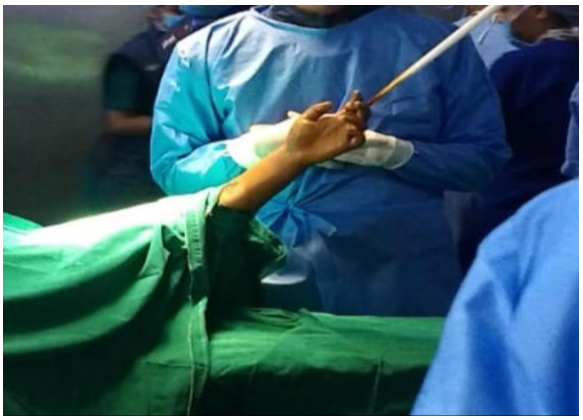


Figure 18: Draping position

Figure 19: Reduction of fracture by traction and counter traction

Figure 20: Reduction checked under fluoroscopy

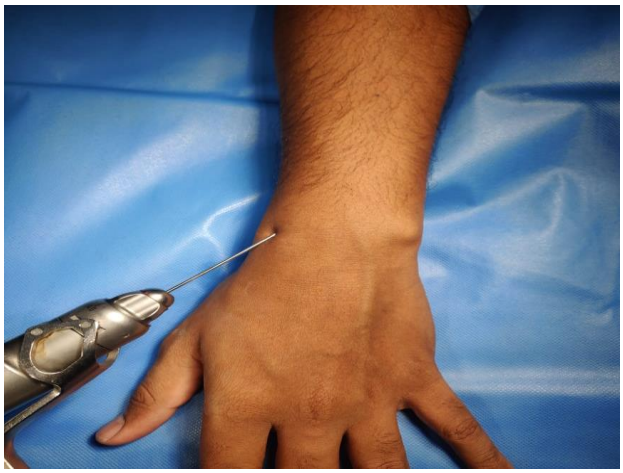


Figure 21: Insertion of 1st percutaneous K-wire

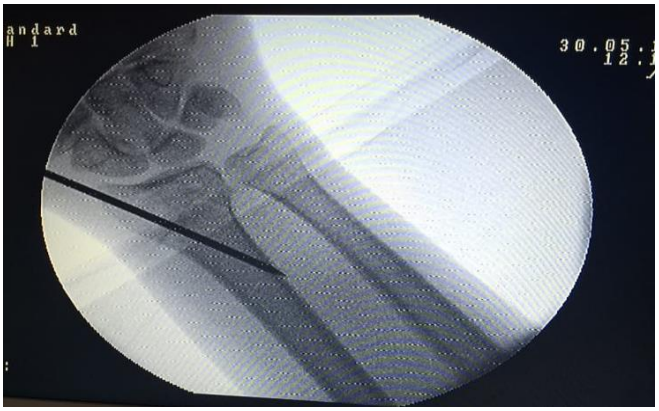


Figure 22: Position of 1st K-wire checked under fluoroscopy

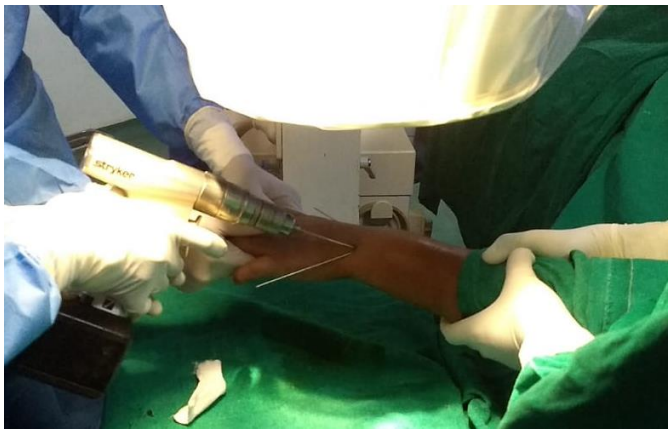


Figure 23: Insertion of 2nd percutaneous K-wire

Figure 24: 2nd K-wire checked under fluoroscopy

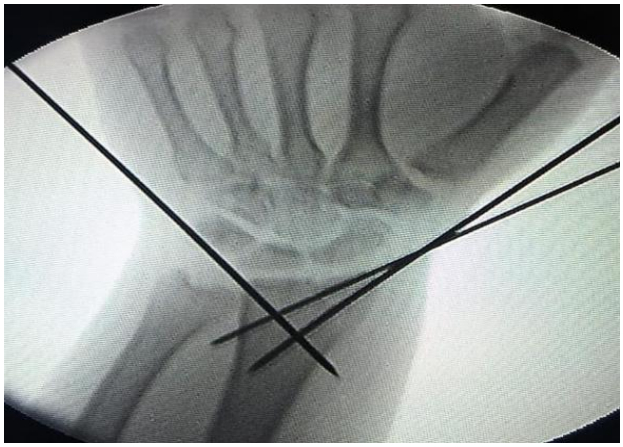


Figure 25: Insertion of additional K-wire (if needed), parallel to 1st wire

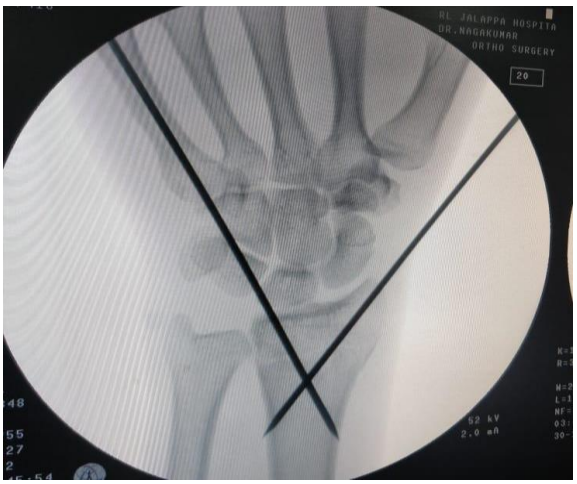


Figure 26: Final check under C-arm: AP view

Figure 27: Final check under C-arm: Lateral view

Figure 28: K-wires bent and cut close to the skin

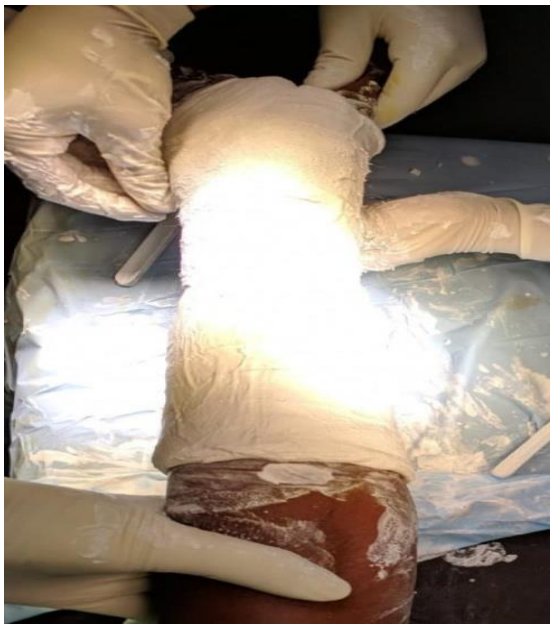


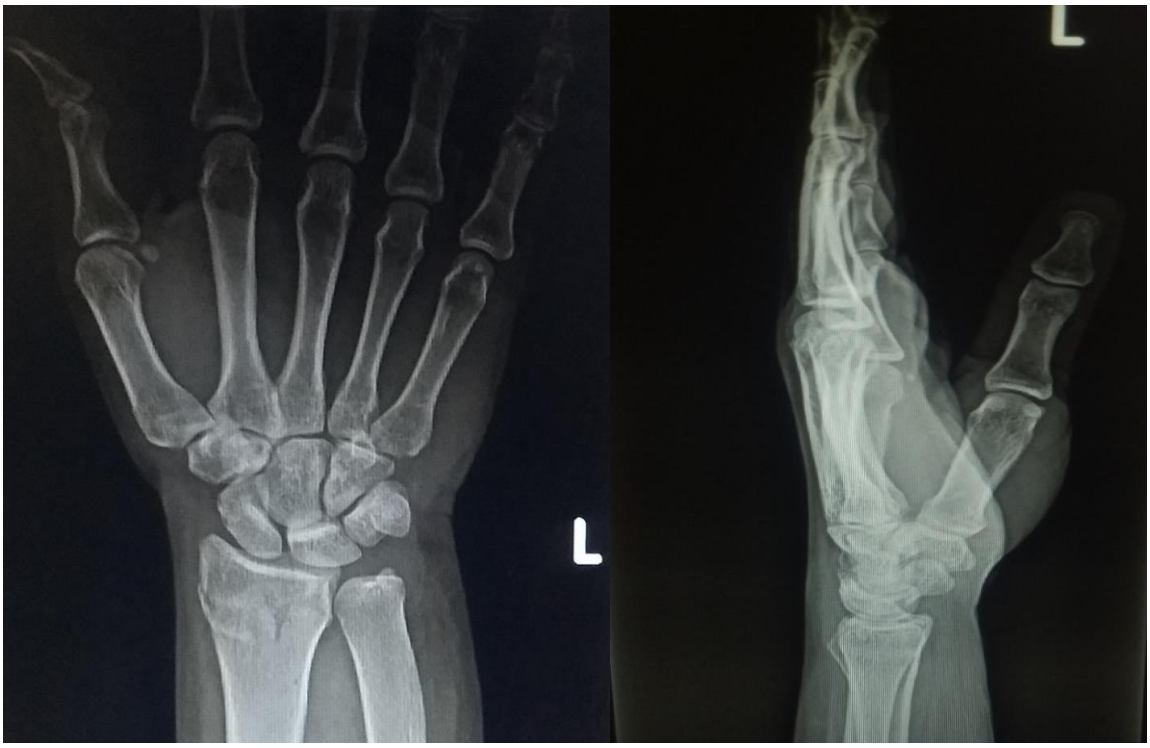
Figure 29: Application of below elbow (Colles) cast

Figure 30: Positioning of below elbow (Colles) cast

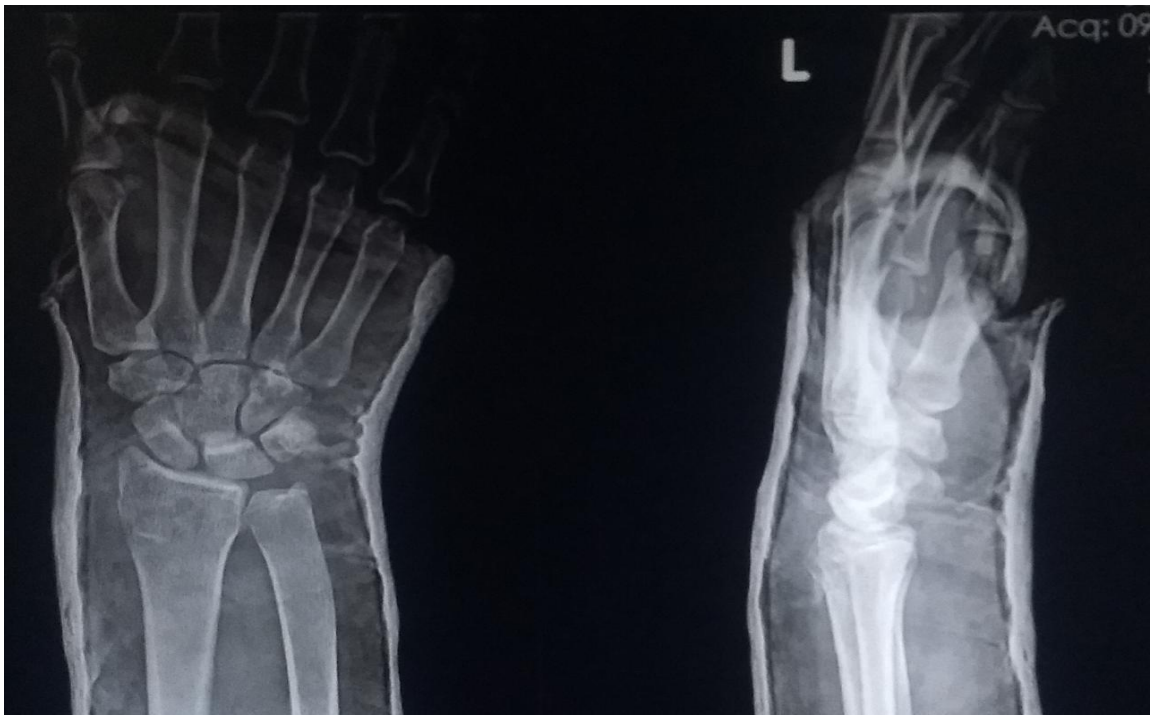
CLOSED REDUCTION AND CAST APPLICATION (GROUP 1)

Figure 31: Set of cases in group 1

CASE NO 16:



Pre reduction x-ray of left wrist



Post reduction x-ray of left wrist

6 months follow up x-ray of left wrist

CLINICAL PICTURES

Supination

Pronation

Dorsiflexion

Palmarflexion

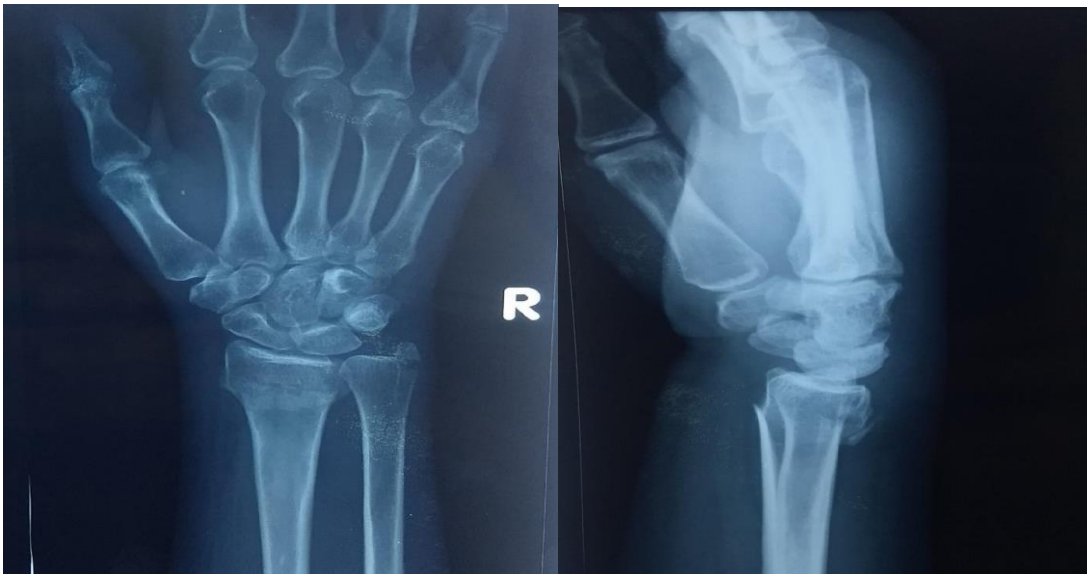
Radial deviation

Ulnar deviation

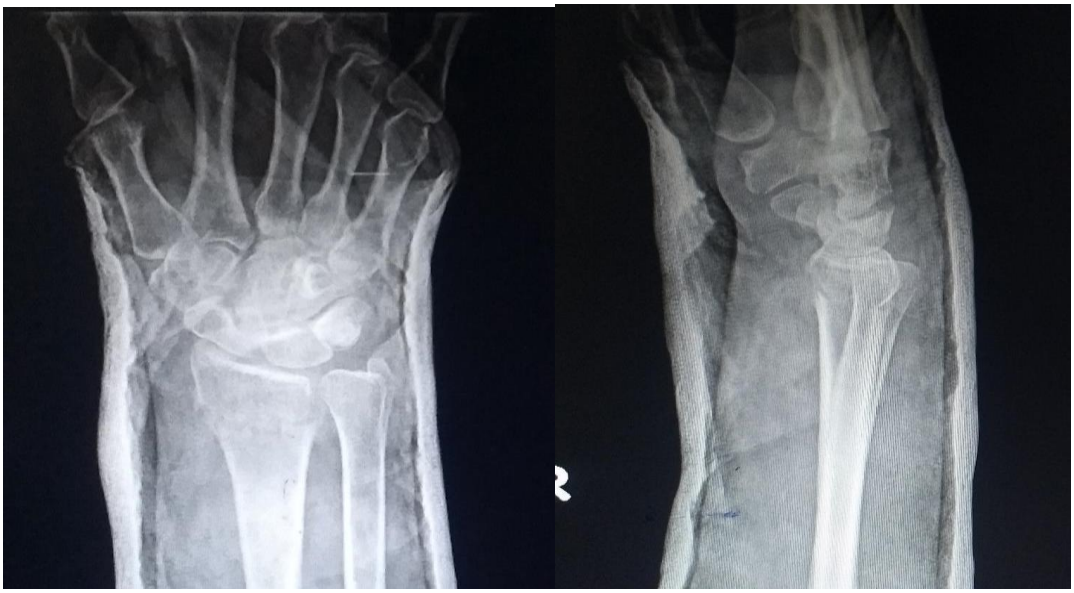
Hand dynomomter (grip strength)

Grip strength left hand (involved) **Grip strength right hand**

CASE NO: 5



Pre reduction x-ray of right wrist



Post reduction x-ray of right wrist

6 months follow up x-ray of right wrist

Clinical pictures

Dorsiflexion **Palmarflexion**

Supination

Pronation

Ulnar deviation

Radial deviation

Hand dynomomter (grip strength)

Grip strength right (injured) **Grip strength left hand**

CASE NO 1:

Pre reduction x-ray of left wrist

Post reduction x-ray of left wrist

6 months follow up x-ray of left wrist

Clinical pictures

Dorsiflexion

Palmarflexion

Supination

Pronation

Radial Deviation

Ulnar Deviation

Hand dynomomter (grip strength)

Grip strength left hand (involved) Grip strength right hand

Case no: 12

Pre reduction x-ray of right wrist

Post reduction x-ray of right wrist

6 months follow up x-ray of right wrist

Clinical pictures

Dorsiflexion **Palmarflexion**

Supination **Pronation**

Ulnar deviation **Radial devaition**

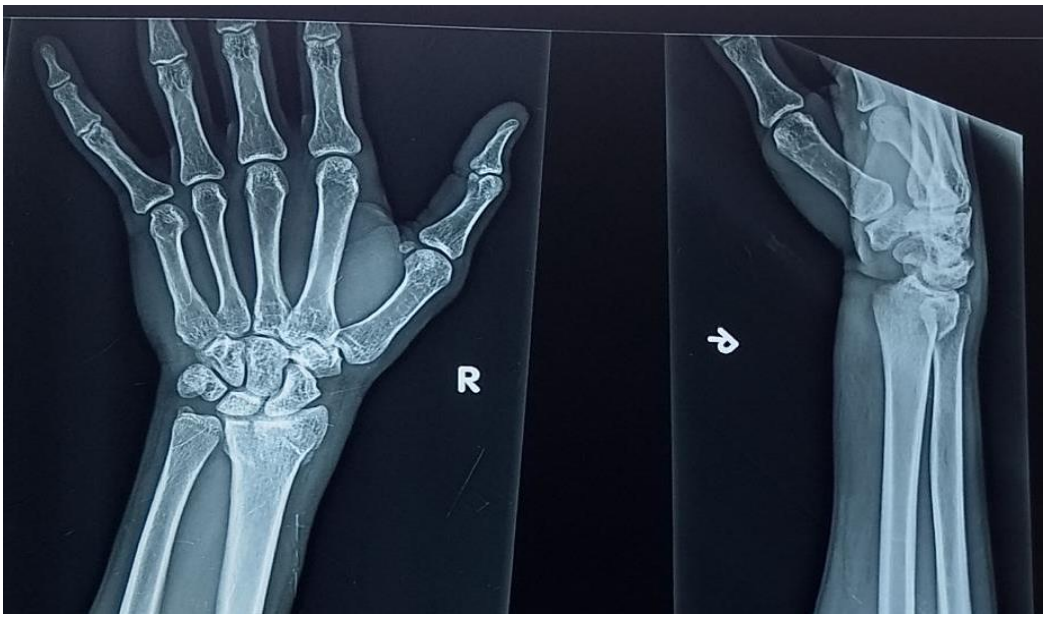
Hand dynomomter (grip strength)

Grip strength left hand **Grip strength right hand (involved)**

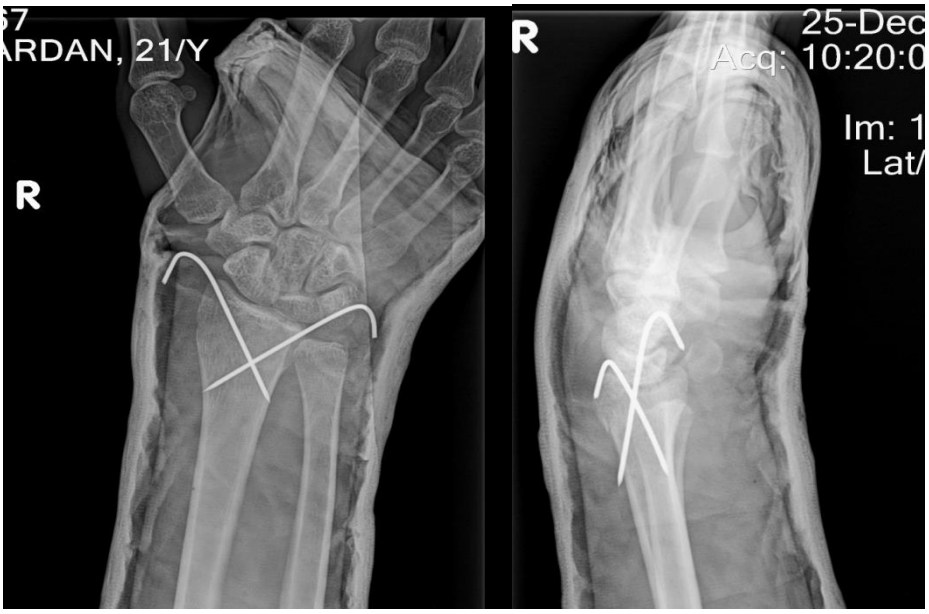
CLOSED REDUCTION, PERCUTANEOUS K-WIRE FIXATION AND CAST APPLICATION (GROUP 2)

Figure 32: Set of cases in group 2

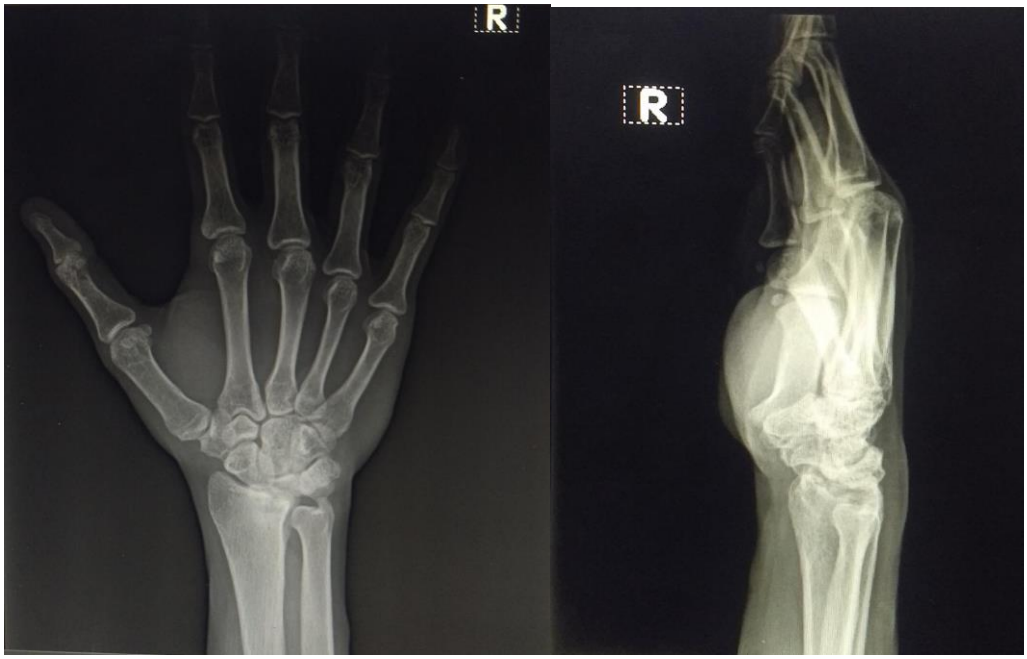
Case no: 1



Pre op x-ray of right wrist



Post op x-ray of right wrist



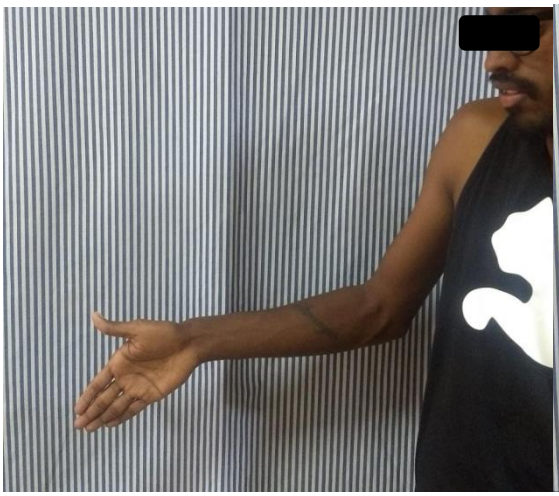
6months follow up x-ray of right wrist

Clinical pictures

Dorsiflexion **Palmarflexion**

Pronation

Supination



Ulnar deviation

Radial deviation

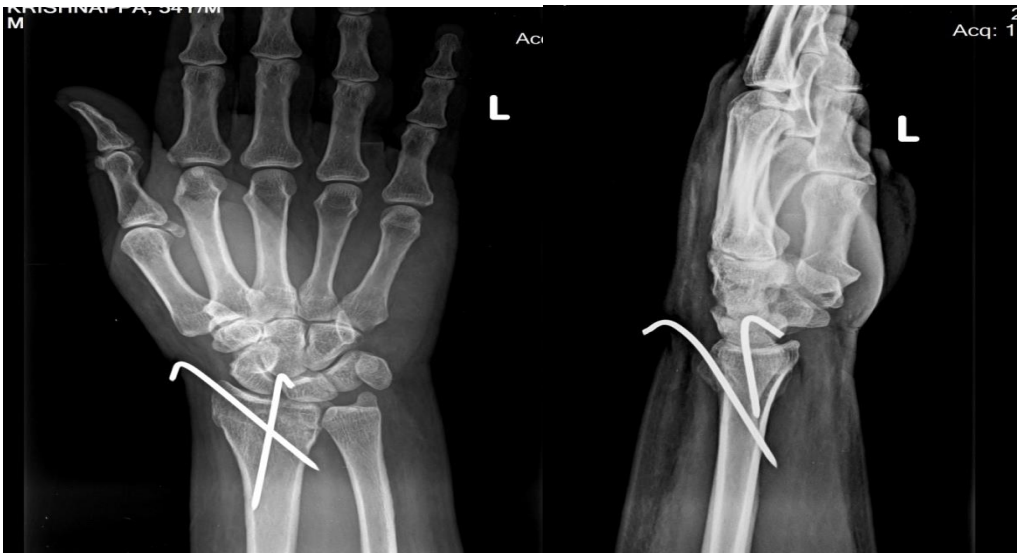
Hand dynomomter (grip strength)

Grip strength left hand **Grip strength right hand (involved)**

Superficial pin tract infection

Case no: 6

Pre op x-ray of left wrist



Post op x-ray of left wrist

6months follow up x-ray of left wrist

Clinical pictures

Dorsiflexion **Palmarflexion**

Supination **Pronation**

Ulnar deviation **Radial deviation**

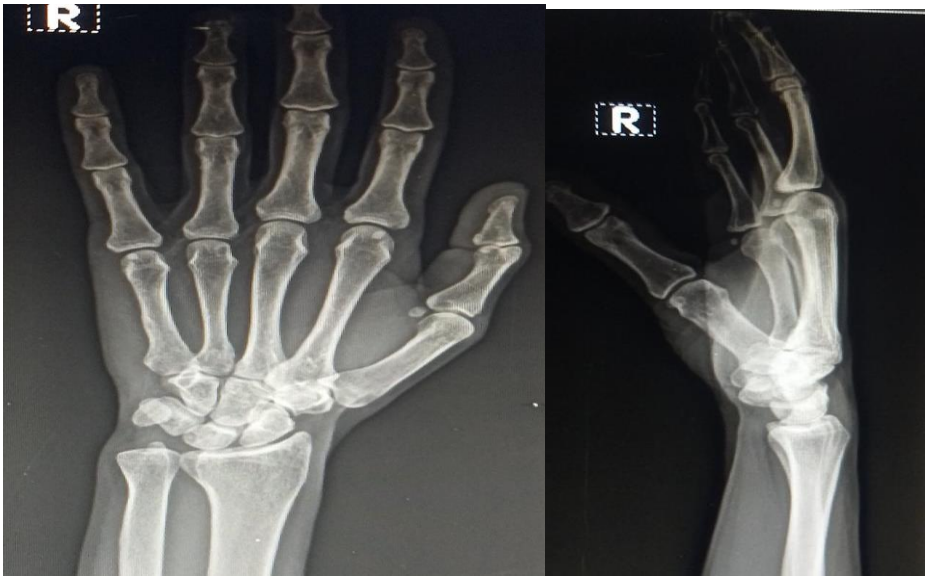
Hand dynomomter (grip strength)

Grip strength left hand(involved) **Grip strength right hand**

Case no: 18

Pre op x-ray of right wrist

Post op x-ray of right wrist

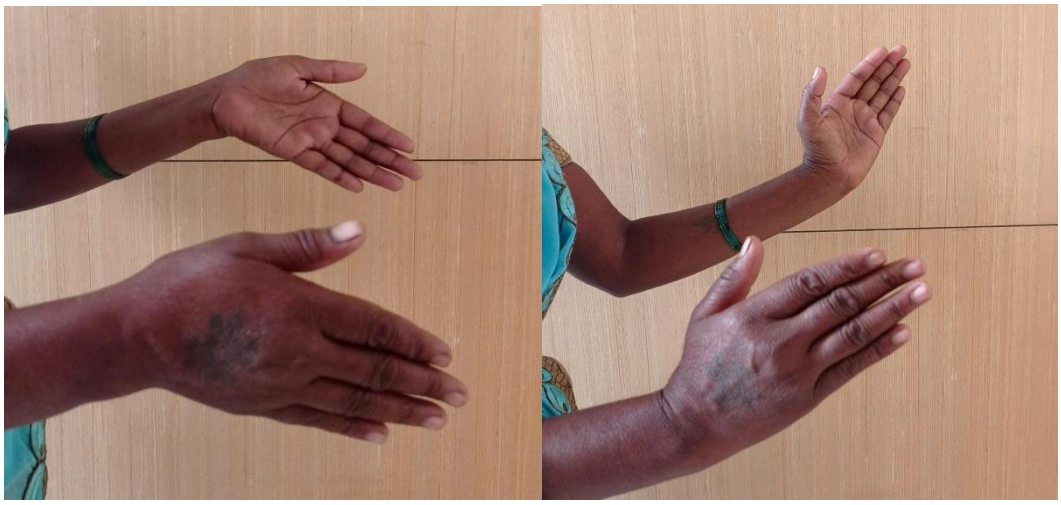


6 months follow up x-ray of right wrist

Clinical pictures

Dorsiflexion **Palmarflexion**

Supination **Pronation**

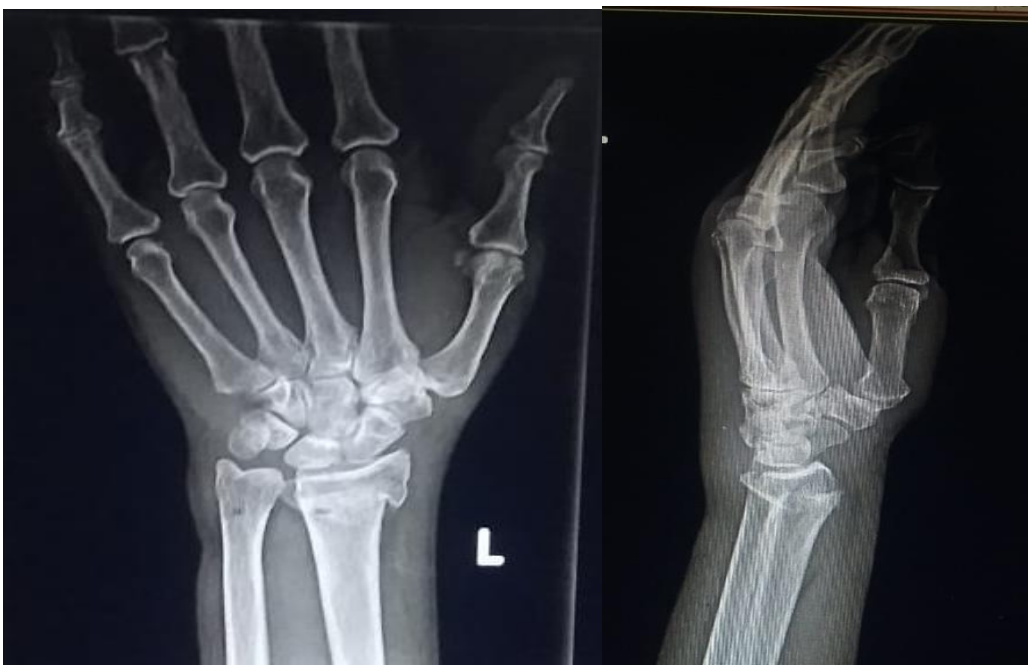


Ulnar deviaton **Radial deviation**

Hand dynomomter (grip strength)

Grip strength right hand (involved) **Grip strength left hand**

Case no: 4



Pre op x-ray of left wrist

Post op x-ray of left wrist

6 months follow up x-ray of left wrist

Clinical pictures

Dorsiflexion **Palmarflexion**

Supination **Pronation**

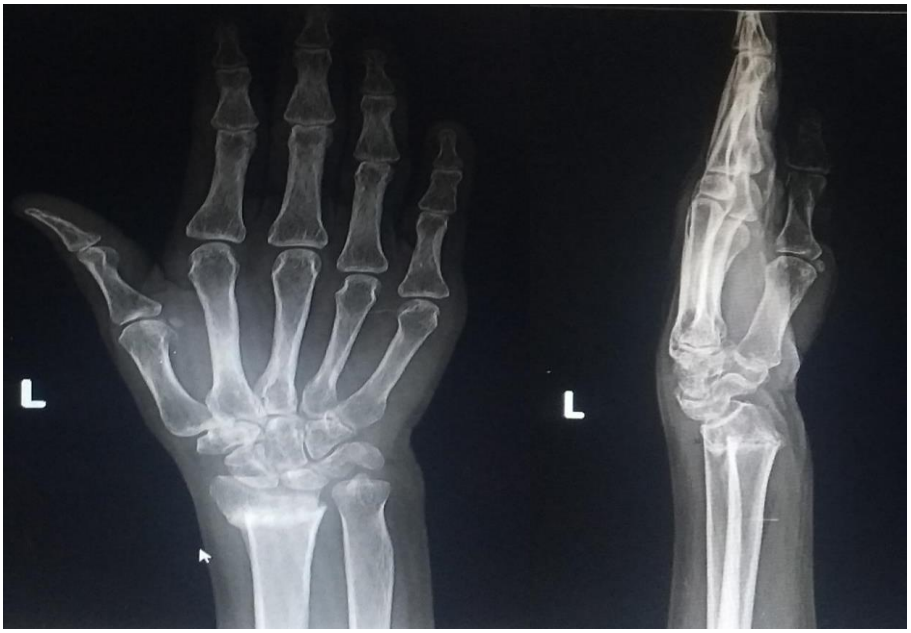
Radial deviation **ulnar deviation**

Finger stiffness

Hand dynomomter (grip strength)

Grip strength left hand(involved) **Grip strength right hand**

Case no 13:

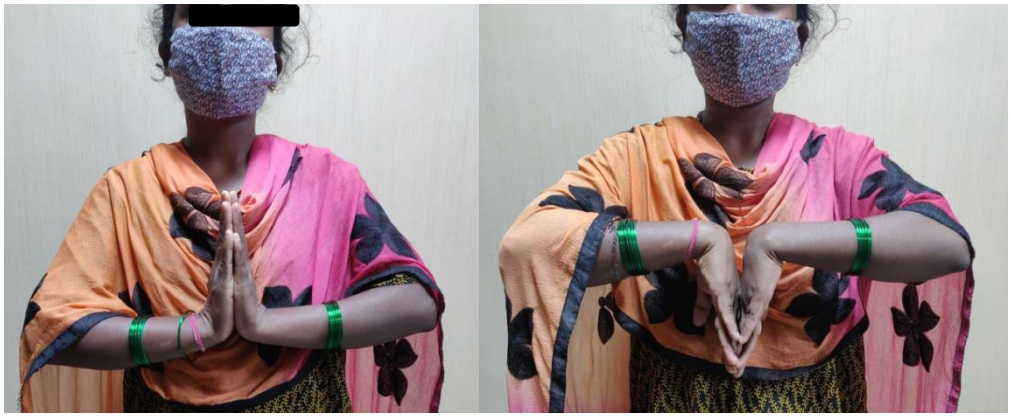


Pre op x-ray of left wrist

Post op x-ray of left wrist

6months follow up x-ray of left wrist

Clinical pictures



Dorsiflexion **Palmarflexion**

Supination **Pronation**

Radial deviation **Ulnar deviation**

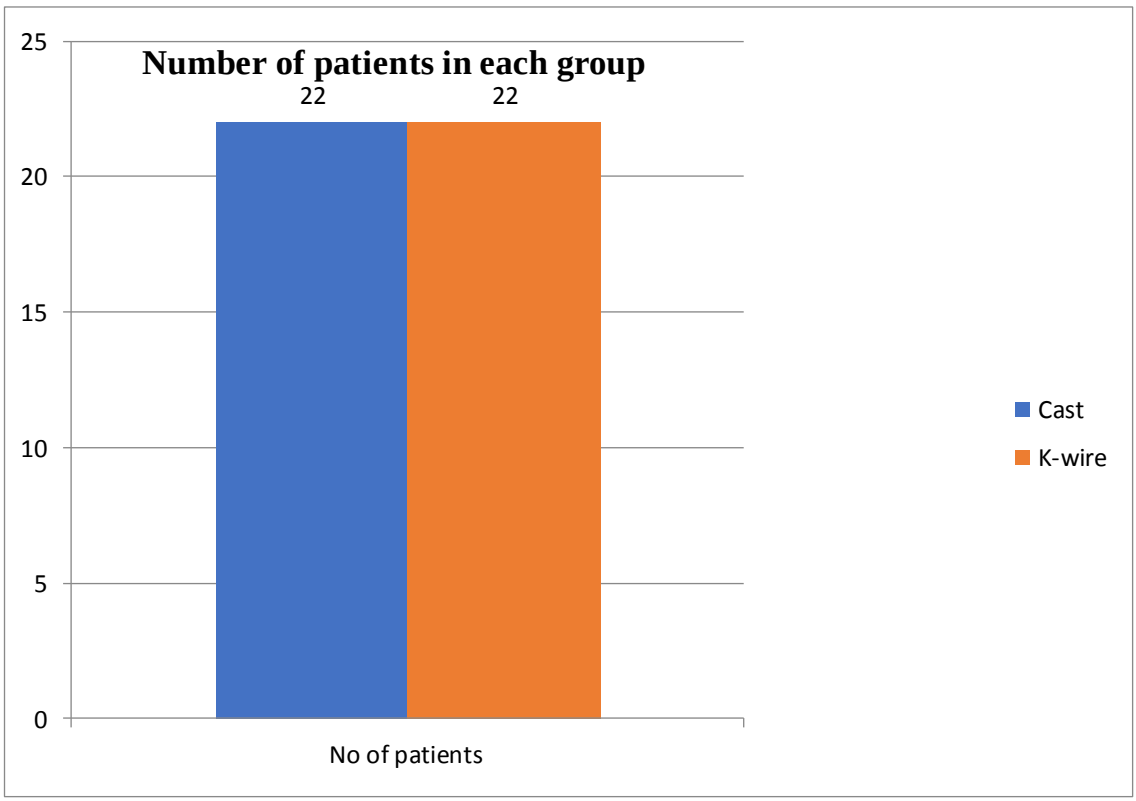
Hand dynomomter (grip strength)

Grip strength left hand(involved) **Grip strength right hand**

RESULTS

Table 1: Details of patients in each group

	Group		p value
	Cast	K-wire	
No of patients	22	22	
Men : Women	9:13	15:7	0.069
Right : Left	12:10	12:10	1.000
Frykman classification I:II:III	13:7:2	6:13:3	0.101
Age in years	45.09 ± 18.24	41.73± 18.68	0.549



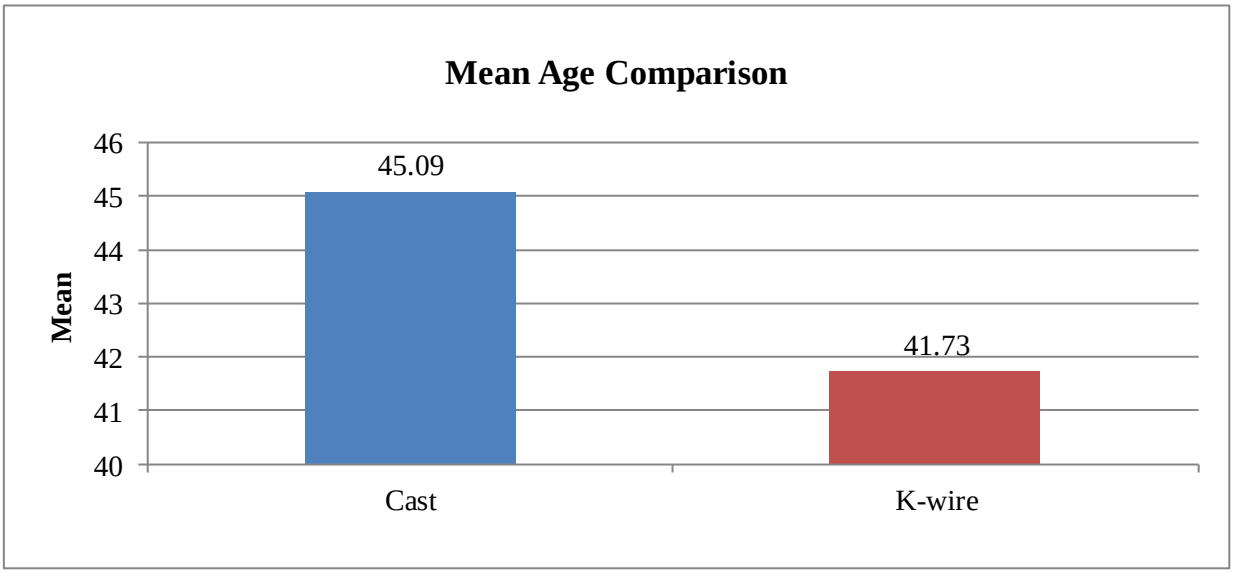
Graph 1: Number of patients in each group

Table 2: Mean age comparison between two groups

	Group				p value
	Cast		K-wire		
	Mean	SD	Mean	SD	
Age in years	45.09	18.24	41.73	18.68	0.549

Mean age in years in cast group was 45.09 ± 18.24 and in K-wire group was 41.73 ± 18.68.

As per the mean age in years comparison there was insignificant difference in two groups.



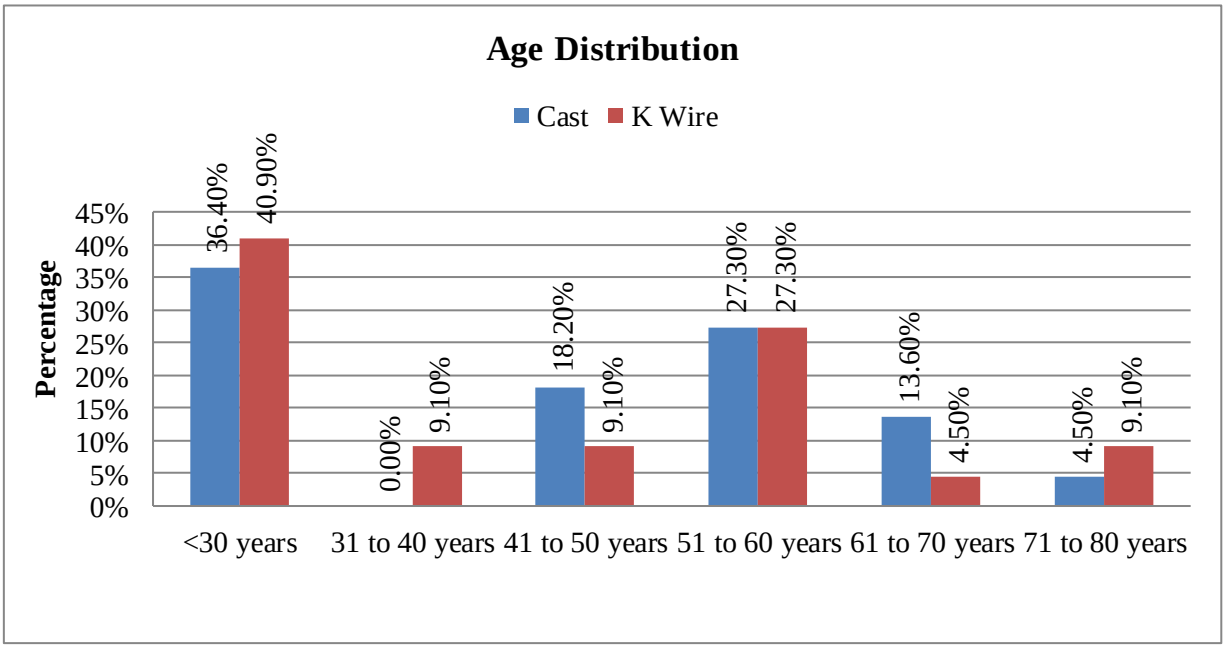
Graph 2: Bar diagram showing comparison between the mean age in years of two groups

Table 3: Age distribution comparison between two groups

		Group			
		Cast		K-wire	
		Count	%	Count	%
Age	<30 years	8	36.4%	9	40.9%
	31 to 40 years	0	0.0%	2	9.1%
	41 to 50 years	4	18.2%	2	9.1%
	51 to 60 years	6	27.3%	6	27.3%
	61 to 70 years	3	13.6%	1	4.5%
	71 to 80 years	1	4.5%	2	9.1%
	Total	22	100.0%	22	100.0%

$\chi 2 = 4.059$, df = 5, p = 0.541

In cast group, majority of subjects belonged to age group <30 years (36.4%) and in K-wire group, majority of subjects belonged to age group <30 years. There was no significant difference in age distribution between two groups.



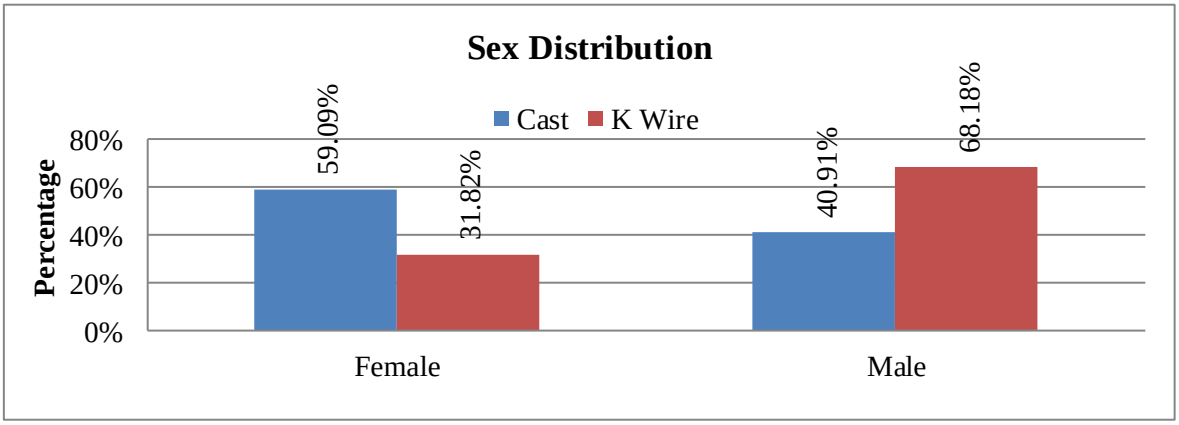
Graph 3: Bar diagram showing age distribution comparison between two groups

Table 4: Sex distribution between two groups

		Group			
		Cast		K-wire	
		Count	%	Count	%
Sex	Female	13	59.09%	7	31.82%
	Male	9	40.91%	15	68.18%

$\chi 2 = 3.3$, df = 1, p = 0.069

In cast group, 59.09% were female and 40.91% were male. In K-wire group, 31.82% were female and 68.18% were male. There was insignificant difference in sex distribution between two groups.



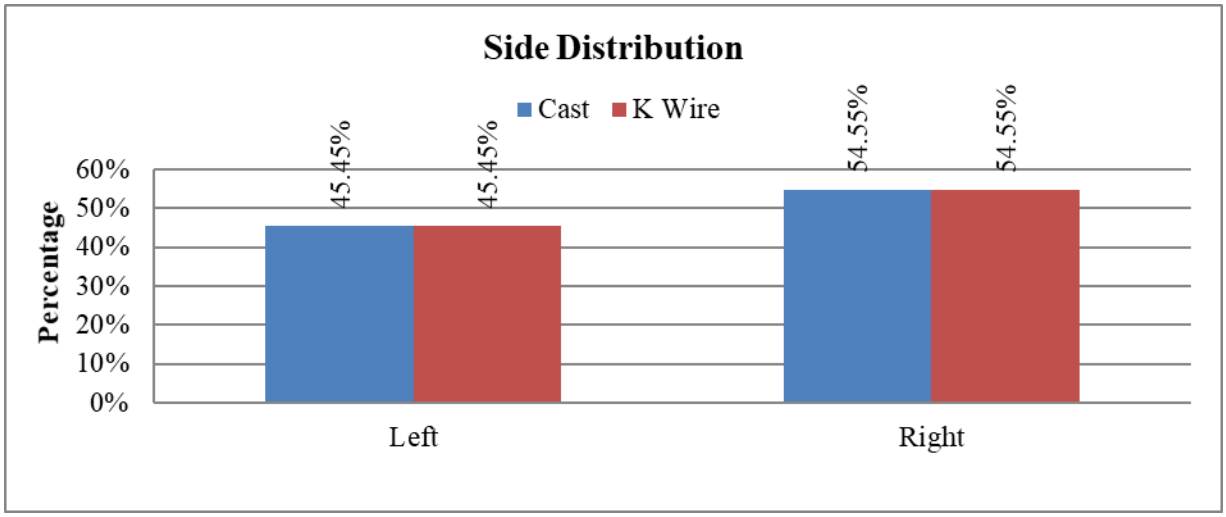
Graph 4: Bar diagram sex distribution between two groups

Table 5: Side distribution between two groups

		Group			
		Cast		K-wire	
		Count	%	Count	%
Side	Left	10	45.45%	10	45.45%
	Right	12	54.55%	12	54.55%

$\chi 2 = 0.000$, df = 1, p = 1.000

In cast group, about 45.45% sustained injury to left wrist and 54.55% to right wrist. In K-wire group, 45.45% sustained injury to left wrist and 54.55% to right wrist. There was insignificant difference in side distribution between two groups.



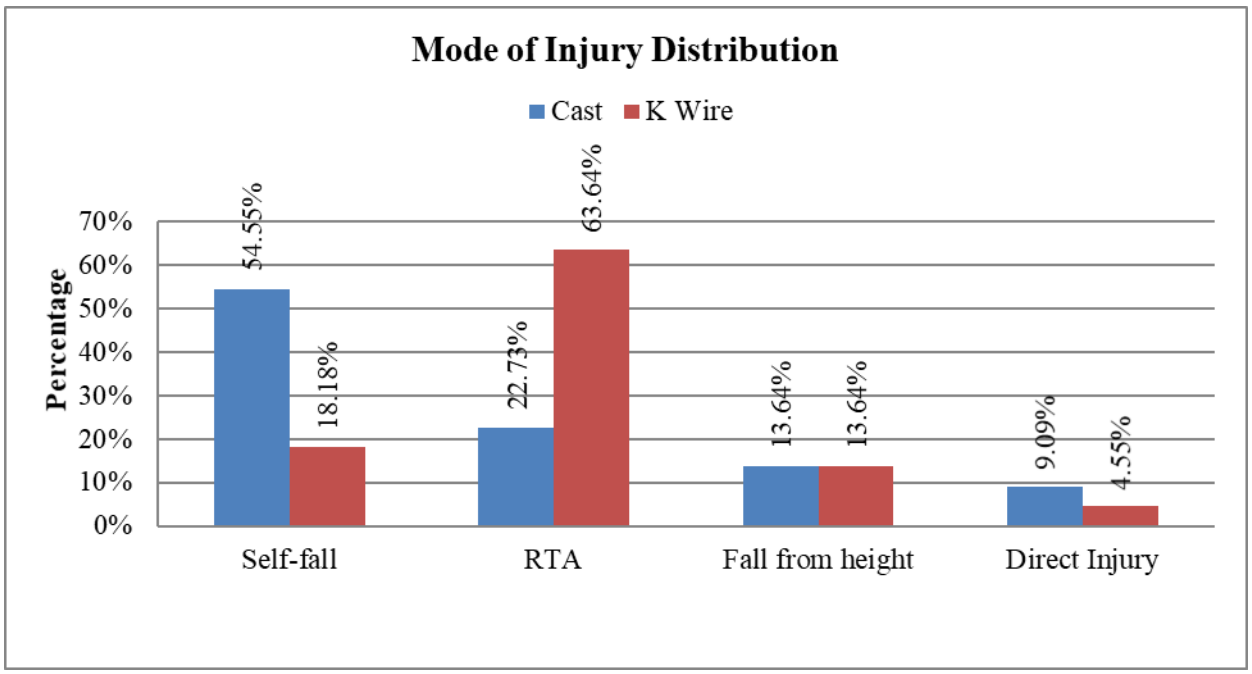
Graph 5: Bar diagram showing side distribution between two groups

Table 6: Mode of injury distribution between two groups

		Group			
		Cast		K-wire	
		Count	%	Count	%
Mode of injury	Self-fall	12	54.55%	4	18.18%
	RTA	5	22.73%	14	63.64%
	Fall from height	3	13.64%	3	13.64%
	Direct Injury	2	9.09%	1	4.55%

$\chi 2 = 8.596$, df = 3, p = 0.035*

In cast group 54.55% had self fall, 22.73% had RTA, 13.64% fall from height and 9.09% had direct injury. In K-wire group, 18.18% had self fall, 63.64% had RTA, 13.64% fall from height and 4.55% had direct injury. There was a significant difference (p value) in mode of injury distribution between two groups.



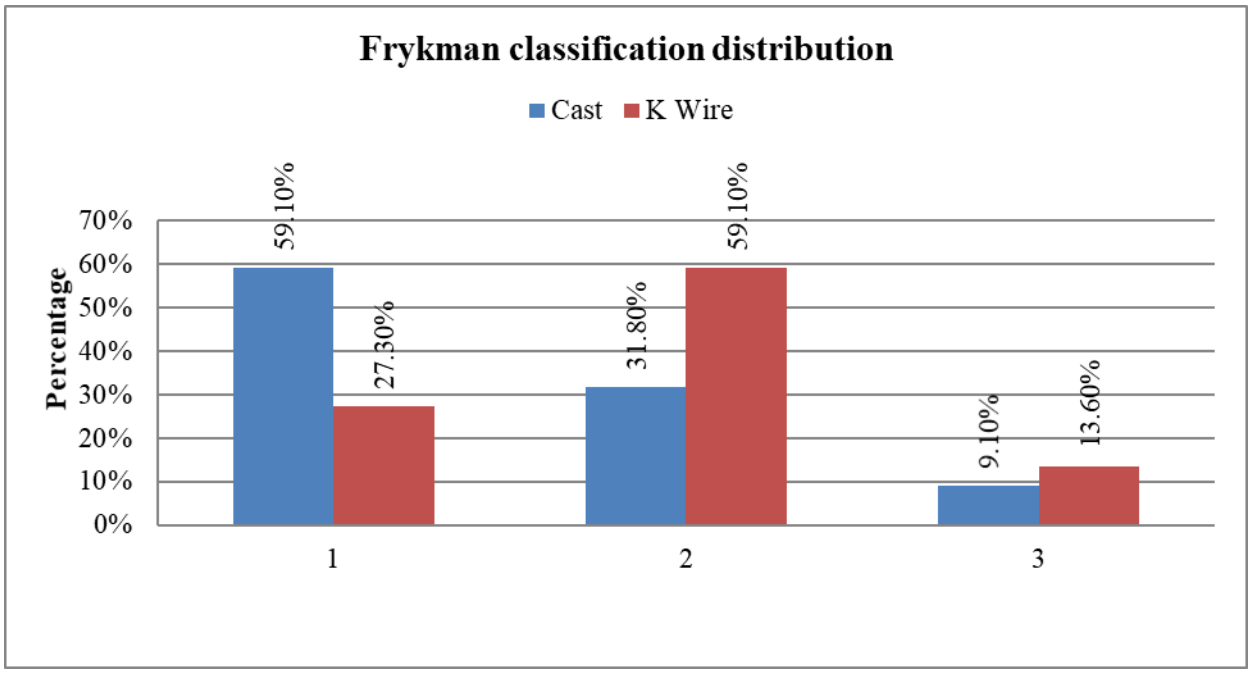
Graph 6: Bar diagram showing mode of injury distribution between two groups

Table 7: Frykman classification distribution between two groups

		Group			
		Cast		K-wire	
		Count	%	Count	%
Frykman classification	1	13	59.1%	6	27.3%
	2	7	31.8%	13	59.1%
	3	2	9.1%	3	13.6%

$\chi 2 = 4.579$, df = 2, p = 0.101

In cast group, 59.1% had grade 1, 31.8% had grade 2 and 9.1% had grade 3. In K-wire group, 27.3% had grade 1, 59.1% had grade 2 and 13.6% had grade 3. There was insignificant difference in Frykman classification between two groups.



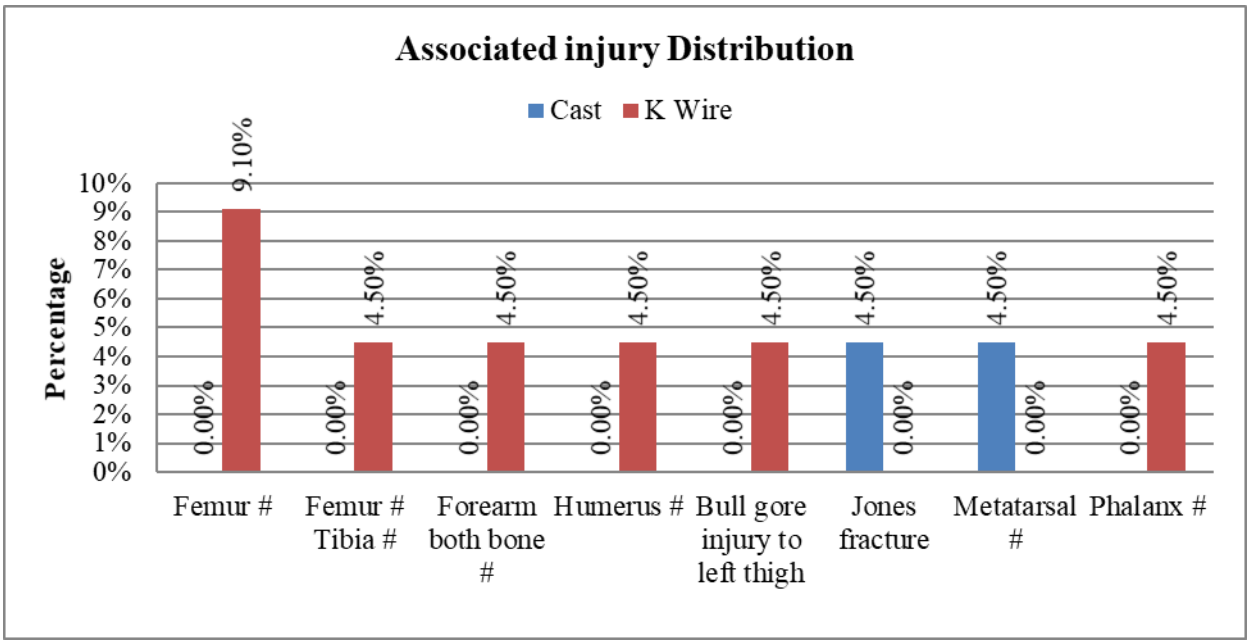
Graph 7: Frykman classification distribution between two groups

Table 8: Associated injury distribution between two groups

		Group			
		Cast		K-wire	
		Count	%	Count	%
Associated injury	Femur #	0	0.0%	2	9.1%
	Femur # & Tibia #	0	0.0%	1	4.5%
	Forearm both bone #	0	0.0%	1	4.5%
	Humerus #	0	0.0%	1	4.5%
	Jones fracture	1	4.5%	0	0.0%
	Metatarsal #	1	4.5%	0	0.0%
	Phalanx #	0	0.0%	1	4.5%
	Other	0	0.0%	1	4.5%
	Nil	20	90.9%	15	68.2%

$\chi 2 = 9.714$, df = 8, p = 0.286

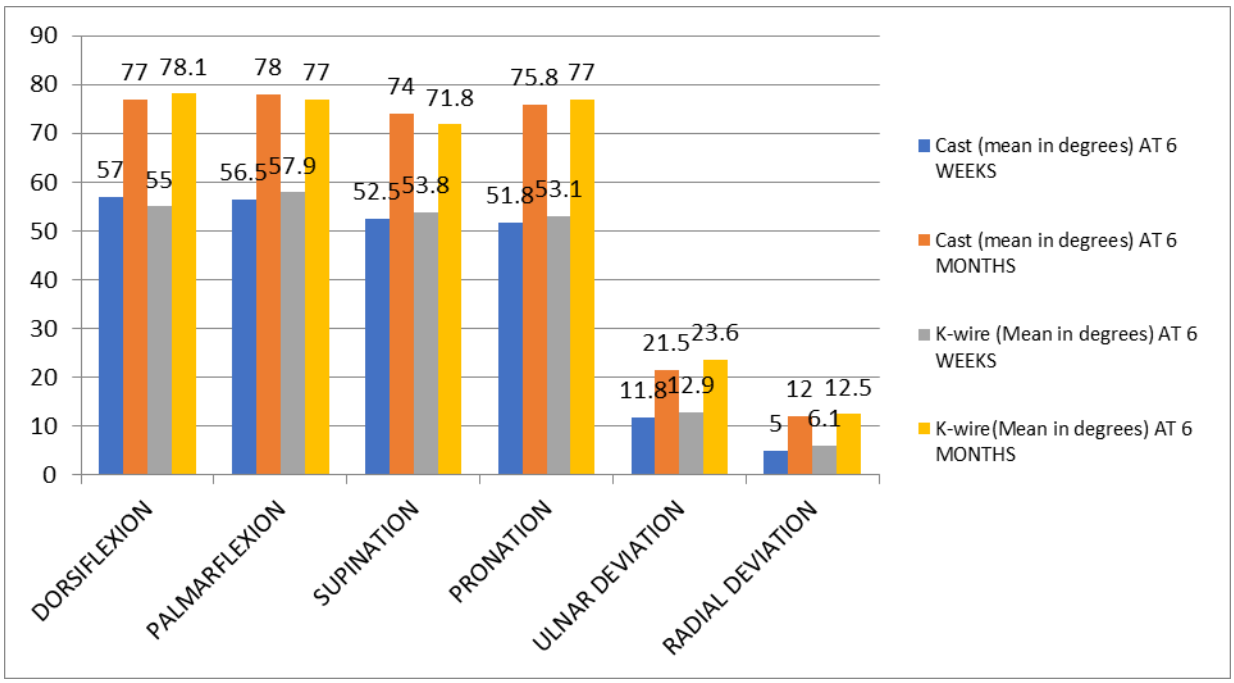
In cast group, 4.5% had jones # and metatarsal # respectively. In K-wire group, 9.1% had femur #, 4.5% had femur # & tibia #, forearm both bone #, humerus #, bull gore injury to left thigh and phalanx # respectively. There was insignificant difference in associated injury between two groups.



Graph 8: Bar diagram showing associated injury distribution between two groups

Table 9: Mean range of movements table

MOVEMENTS	Cast (mean in degrees)	Cast (mean in degrees)	K-wire (mean in degrees)	K-wire (mean in degrees)
	6 WEEKS	6 MONTHS	6 WEEKS	6 MONTHS
Dorsiflexion	57	77	55	78.1
Palmarflexion	56.5	78	57.9	77
Supination	52.5	74	53.8	71.8
Pronation	51.8	75.8	53.1	77
Ulnar deviation	11.8	21.5	12.9	23.6
Radial deviation	5	12	6.1	12.5



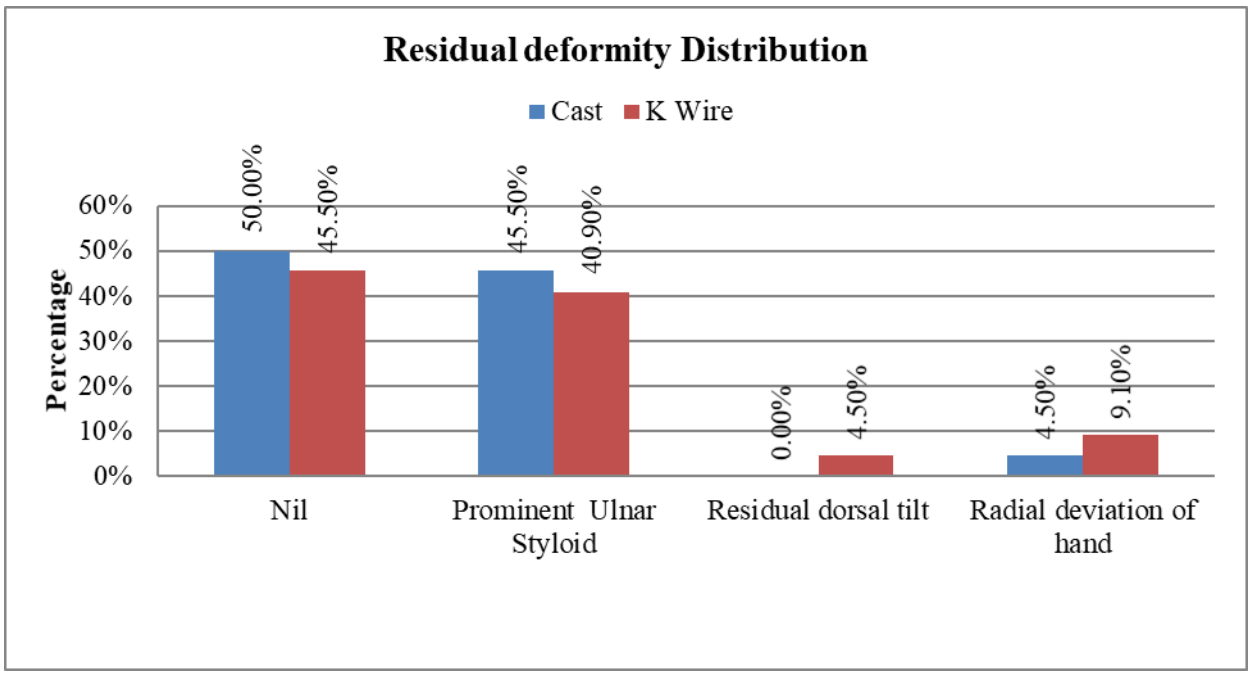
Graph 9: Mean range of movements table

Table 10: Residual deformity comparison between two groups

		Group			
		Cast		K-wire	
		Count	%	Count	%
Residual deformity	Nil	11	50.0%	10	45.5%
	Prominent ulnar styloid	10	45.5%	9	40.9%
	Residual dorsal tilt	0	0.0%	1	4.5%
	Radial deviation of hand	1	4.5%	2	9.1%

$\chi 2 = 1.434$, df = 3, p = 0.698

In cast group - 45.5% had prominent ulnar styloid, 4.5% had radial deviation of hand and in K-wire group - 40.9% had prominent ulnar styloid, 4.5% had residual dorsal tilt and 9.1% had radial deviation of hand. There was insignificant difference in residual deformity between two groups.

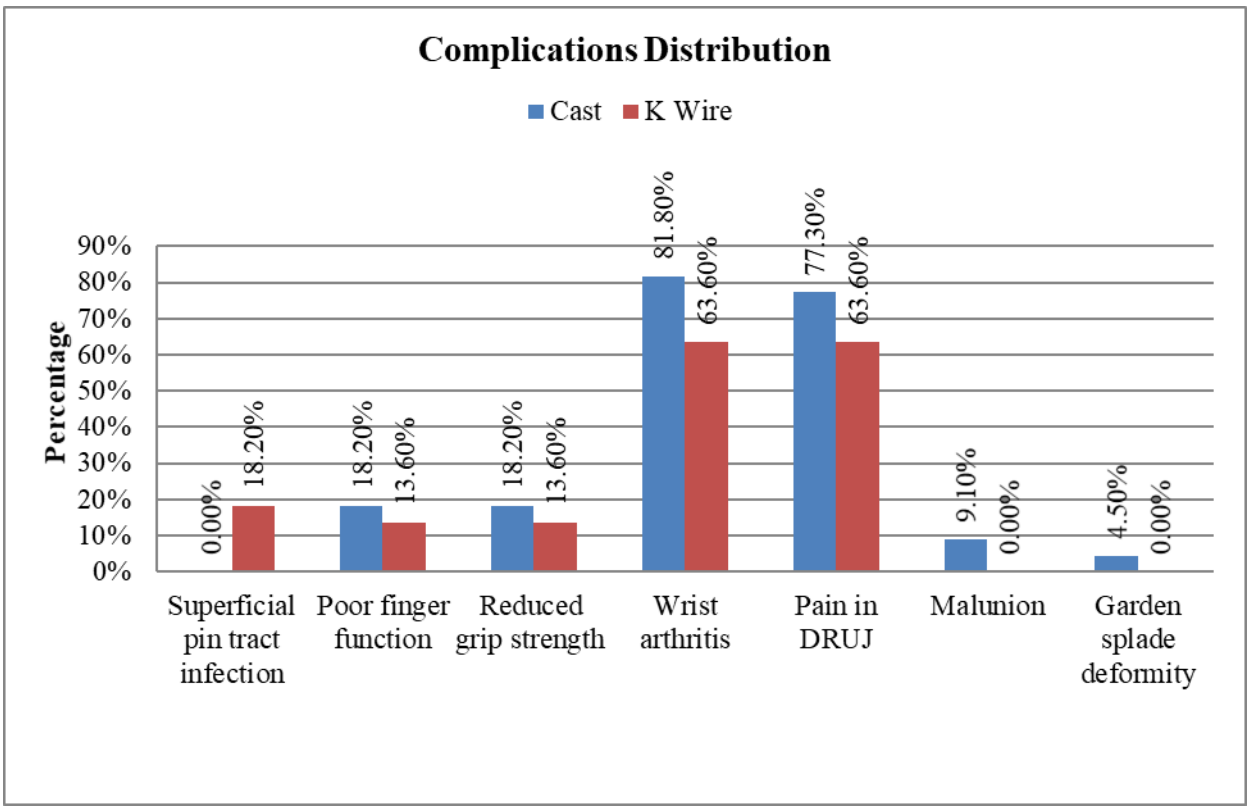


Graph 10: Bar diagram showing residual deformity comparison between two groups

Table 11: Complications comparison between two groups

	Group				p value
	Cast		K-wire		
	Count	%	Count	%	
Superficial pin tract infection	-	-	4	18.2%	0.035*
Poor finger function	4	18.2%	3	13.6%	0.680
Reduced grip strength	4	18.2%	3	13.6%	0.680
Wrist arthritis	18	81.8%	14	63.6%	0.176
Pain in DRUJ	17	77.3%	14	63.6%	0.322
Malunion	2	9.1%	0	0.0%	0.147
Garden spade deformity	1	4.5%	0	0.0%	0.313

In cast group, 18.2% had poor finger function and reduced grip strength respectively. 81.8% had wrist arthritis, 77.3% had pain in DRUJ, 9.1% had malunion and 4.5% had garden spade deformity. In K-wire group, 18.2% had superficial pin tract infection, 13.6% had poor finger function and reduced grip strength. 63.6% had wrist arthritis and pain in DRUJ respectively.

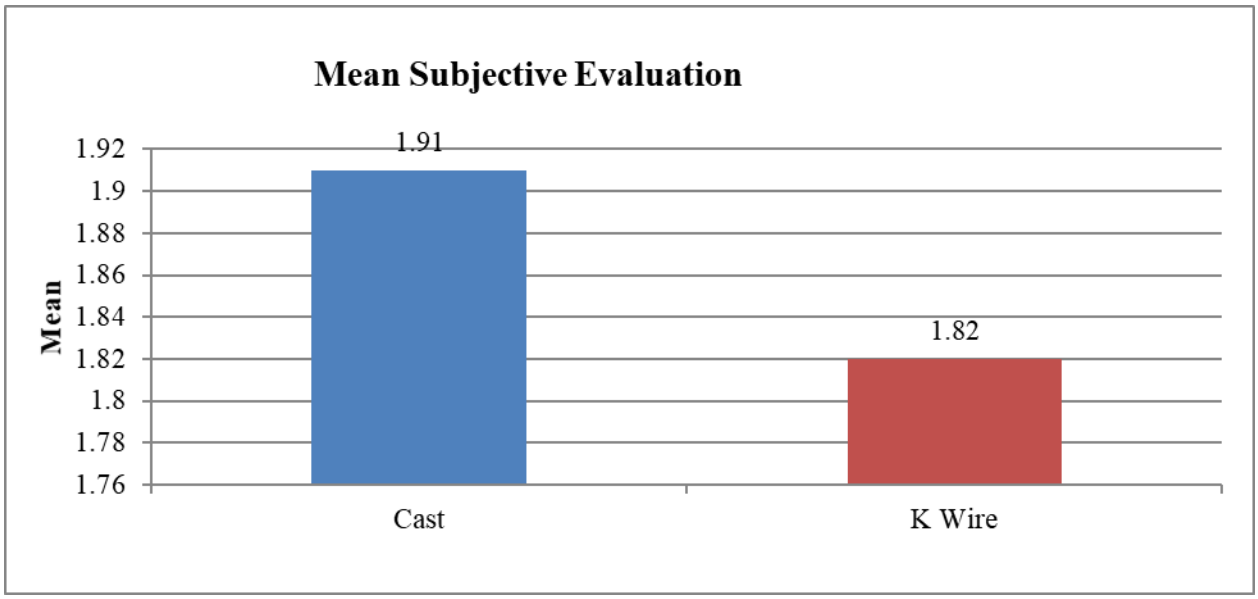


Graph 11: Bar diagram showing complications comparison between two groups

Table 12: Mean subjective evaluation comparison between two groups

	Group				p value
	Cast		K-wire		
	Mean	SD	Mean	SD	
Subjective Evaluation	1.91	1.69	1.82	1.5	0.851

Mean subjective evaluation in cast group was 1.91 ± 1.69 and in K-wire group was 1.82 ± 1.5. There was insignificant difference in mean subjective evaluation comparison between two groups.

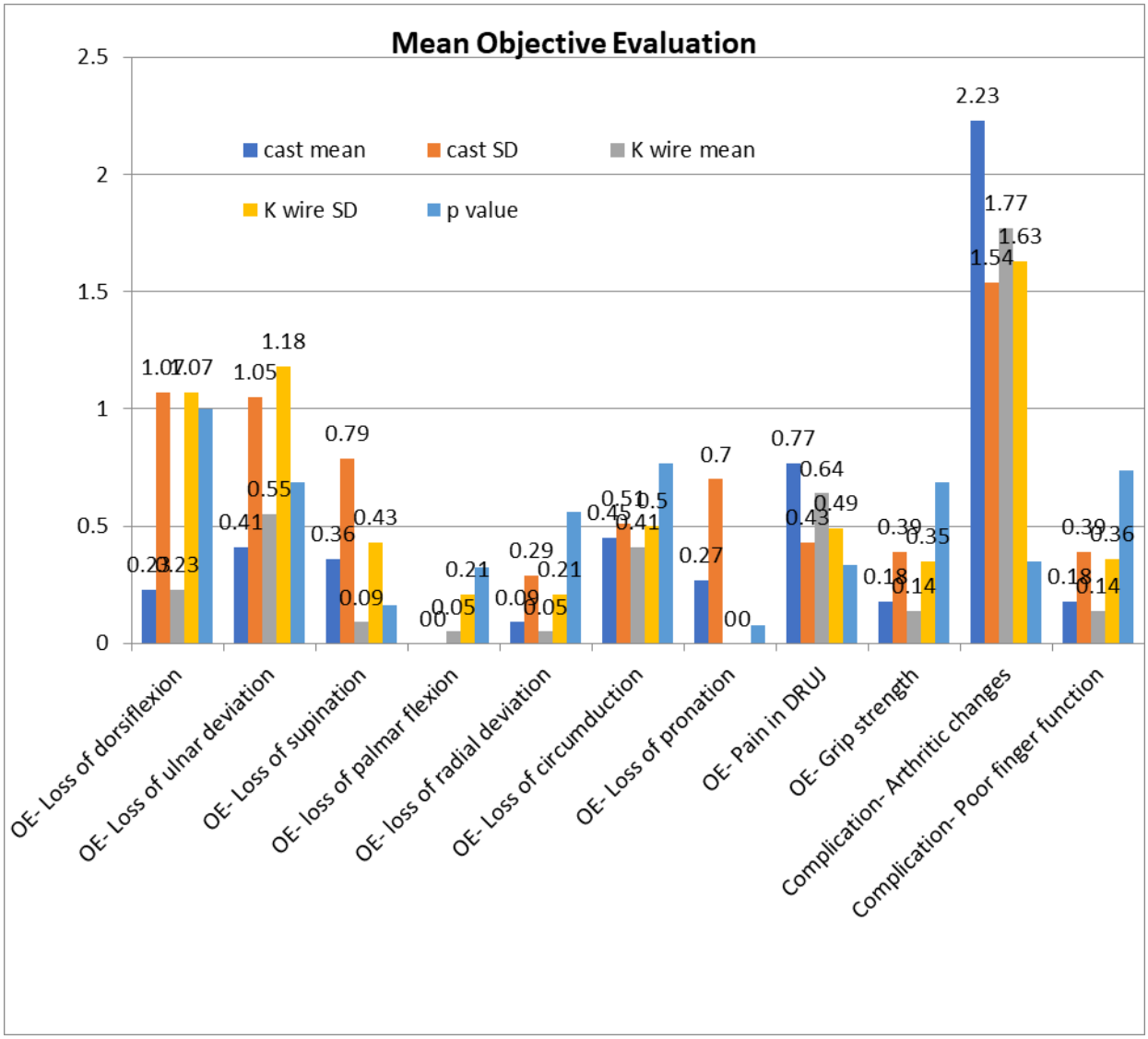


Graph 12: Bar diagram showing mean subjective evaluation comparison between two groups

Table 13: Mean objective evaluation

	Group				p value
	Cast		K-wire		
	Mean	SD	Mean	SD	
OE- Loss of dorsiflexion	0.23	1.07	0.23	1.07	1
OE- Loss of ulnar deviation	0.41	1.05	0.55	1.18	0.689
OE- Loss of supination	0.36	0.79	0.09	0.43	0.161
OE- loss of palmar flexion	0	0	0.05	0.21	0.323
OE- loss of radial deviation	0.09	0.29	0.05	0.21	0.561
OE- Loss of circumduction	0.45	0.51	0.41	0.5	0.767
OE- Loss of pronation	0.27	0.7	0	0	0.076
OE- Pain in DRUJ	0.77	0.43	0.64	0.49	0.333
OE- Grip strength	0.18	0.39	0.14	0.35	0.689
Complication- Arthritic changes	2.23	1.54	1.77	1.63	0.347
Complication- Poor finger function	0.18	0.39	0.14	0.36	0.737

Mean objective evaluation - Loss of dorsiflexion in cast group was 0.23 ± 1.07 and in K-wire group was 0.23 ± 1.07. Loss of ulnar deviation in cast group was 0.41 ± 1.05 and in K-wire group was 0.55 ± 1.18. Loss of supination in cast group was 0.36 ± 0.79 and in K-wire group was 0.09 ± 0.43. Loss of palmar flexion in cast group was 0 and in K-wire group was 0.05 ± 0.21. Loss of radial deviation in cast group was 0.09 ± 0.29 and in K-wire group was 0.05 ± 0.21. Loss of circumduction in cast group was 0.45 ± 0.51 and in K-wire group was 0.41 ± 0.5. Loss of pronation in cast group was 0.27 ± 0.7 and in K-wire group was 0. Pain in DRUJ in cast group was 0.77 ± 0.43 and in K-wire group was 0.64 ± 0.49. Grip strength in cast group was 0.18 ± 0.39 and in K-wire group was 0.14 ± 0.35. Arthritic changes in cast group was 2.23 ± 1.54 and in K-wire group was 1.77 ± 1.63. Poor finger function in cast group was 0.18 ± 0.39 and in K-wire group was 0.14 ± 0.36. There was statistically insignificant difference in mean objective evaluation when compared between two groups.

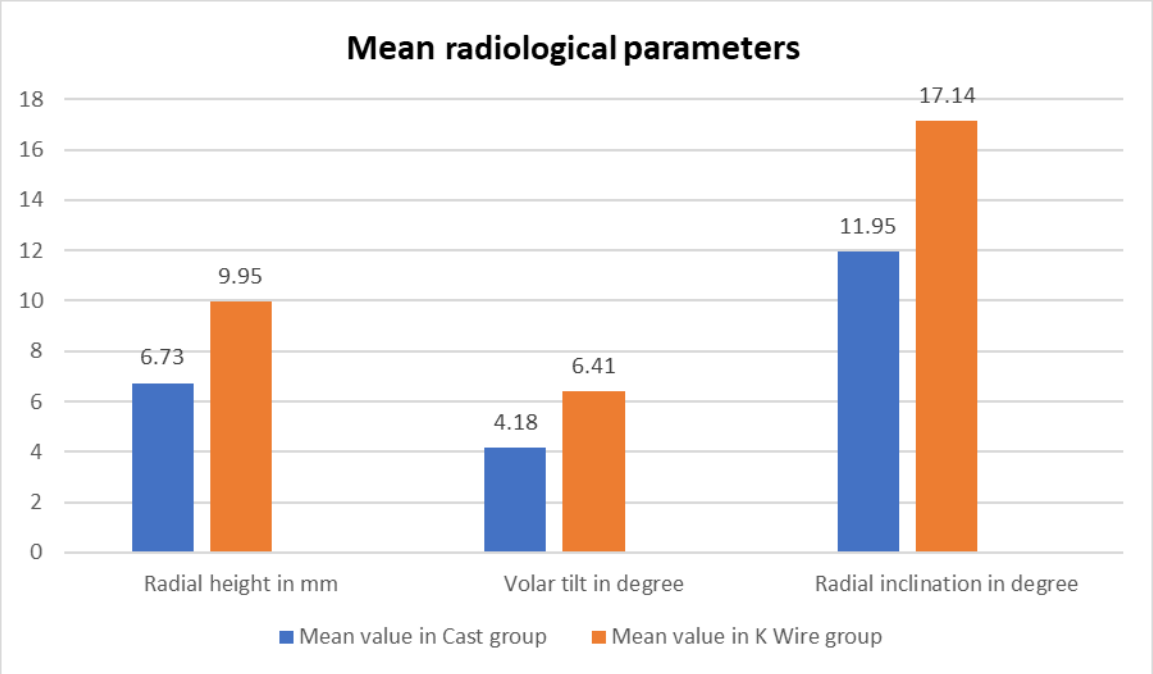


Graph 13: Bar diagram showing mean objective evaluation comparison between two groups

Table 14: Mean radiological parameters evaluation

	Group				p value
	Cast		K-wire		
	Mean	SD	Mean	SD	
Radial height in mm	6.73	1.67	9.95	1.29	< 0.001*
Volar tilt in degree	4.18	1.44	6.41	1.74	< 0.001*
Radial inclination in degree	11.95	2.42	17.14	2.4	< 0.001*

Mean radial height in mm in cast group was 6.73 ± 1.67 and in K-wire group was 9.95 ± 1.29. Mean volar tilt in degree in cast group was 4.18 ± 1.44 and in K-wire group was 6.41 ± 1.74. Mean radial inclination in degree in cast group was 11.95 ± 2.42 and in K-wire group was 17.14 ± 2.4. There was statistically significant difference in mean radiological parameters when compared between two groups.



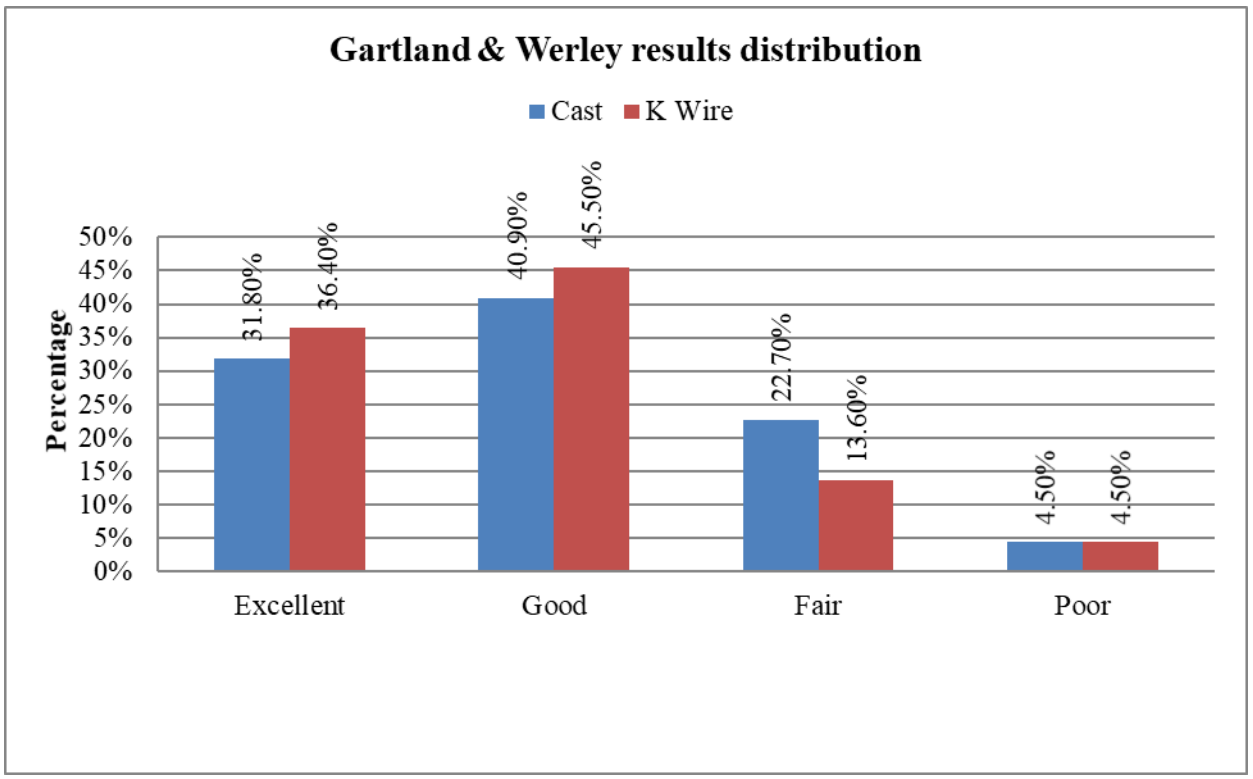
Graph 14: Mean radiological parameters evaluation

Table 15: Gartland & Werley results distribution between two groups

		Group			
		Cast		K-wire	
		Count	%	Count	%
Gartland & Werley results	Excellent	7	31.8%	8	36.4%
	Good	9	40.9%	10	45.5%
	Fair	5	22.7%	3	13.6%
	Poor	1	4.5%	1	4.5%

$\chi 2 = 0.619$, df = 3, p = 0.892

In cast group, 31.8% had excellent, 40.9% had good, 22.7% had fair and 4.5% had poor results and in K-wire group, 36.4% had excellent, 45.5% good, 13.6% fair and 4.5% poor results according to Gartland & Werley scoring system. There was statistically insignificant difference in Gartland & Werley results between two groups when compared.



Graph 15: Bar diagram showing Gartland & Werley results distribution between two groups

DISCUSSION

Fracture distal end radius is among the common fractures encountered in orthopaedics. With the rise in road traffic accidents the incidence of these fractures in younger age group is increasing. However distal radius fractures common among elderly population who sustained a low energy trauma, attributed to osteoporotic bone.

Age incidence:

The mean age in years in our study in cast group was 45.09 ± 18.24 and in K-wire group was 41.73 ± 18.68. The results were corresponding with various other studies. Adarsh et al, with a mean age was 51.27 years.[26] Sanjay and his colleague in their study had mean age in years of cast group was 57 years and K-wire group 60 years.[77] Hardik et al, in their study had mean age in years of cast group 60.03 years and K-wire group 58.9 years.[81] Mahendra et al, in their study had mean age in years of cast group 39.53 years and K-wire group 40.53 years.[79] We observed that the average decade of patients who sustained these fractures belong to 4^{th} and 5^{th} decade.

Gender incidence:

The gender incidence in our study in cast group, 13 (59.09%) were female and 9(40.91%) were male. In K-wire group, 7(31.82%) were female and 15 (68.18%) were male. There were total 20 female and 24 male patients in our study. There was insignificant difference in sex distribution between two groups. It was comparable with other studies Adarsh et al, who had 29 male and 23 female patients.[26] Modi Nikunj and his colleagues had 46 (86%) male and 7 (14%) female patients.[80] But Sanjay et al, had 19 (42.5%) male and 23 (57.5%) female patients.[77] Sunit Pal et al, had 45% male and 55% female patients

indicating that there was female predominance which was contradictory to our study as we had more male patients (54.54%).[78]

Side distribution:

In our study, about 45.45% sustained injury to left wrist and 54.55% to right wrist in both the groups. There was insignificant difference in side distribution between two groups. Total of 20 cases involving left side and 24 cases involving right side. Results were similar to Adarsh et al, which had 47 % involving left and 53% right side.[26] Sanjay et al, had 40 % involving left and 60% right side. [77] Modi Nikunj and his co-workers in their study had 38% left side and 62% right side.[80] Right distal radius fractures were commonly seen compared to left.

Mode of injury:

In our study, cast group 54.55% had self fall, 22.73% had RTA, 13.64% fall from height and 9.09% direct injury. In K-wire group, 18.18% had self fall, 63.64% had RTA, 13.64% fall from height and 4.55% direct injury. In a study by Adarsh et al, cast group had 38% self fall, 10% RTA and 1.6% direct injury where as in K-wire group 31% cases had self fall, 16% had RTA.[26] Hardik and his colleagues in their study had 85% cases with self fall and 15% had RTA.[81] Similarly Sunit pal et al, had 62% self fall and 38% rest other mode of injury.[78] But in our study RTA cases were common constituting 43%, whereas self fall had 26% cases which was similar to results observed from Modi Nikunj and his colleagues which had higher RTA cases i.e., 66% and 34% self fall cases.[80] Thereby, we conclude that distal radius fractures encountered in our comparative study was commonly due to RTAs.

Radiological parameters:

In our study there was statistically significant difference in mean radial height, volar tilt and radial inclination. Mean radial height in mm in cast group was 6.73 ± 1.67 and in K-wire group was 9.95 ± 1.29. Mean volar tilt in degree in cast group was 4.18 ± 1.44 and in K-wire group was 6.41 ± 1.74. Mean radial inclination in degree in cast group was 11.95 ± 2.42 and in K-wire group was 17.14 ± 2.4. Our study was similar to studies by Adarsh et al, Sandeep et al, Hardik et al, and Raghu et al, who had statistically significant difference in mean radial height, volar tilt and radial inclination.[3,25,26,81] Adarsh et al, had mean radial height of 5.06 mm, volar tilt of 2.86^0 and radial inclination of 9.16^0 in cast group. Mean radial height of 8.9 mm, volar tilt of 5.5^0 and radial inclination of 14.13^0 in K-wire group with p value being 0.001.[26] Sandeep patil et al, had mean radial height of 8.03 mm, volar tilt of 4.86^0 and radial inclination of 14.23^0 in cast group. Mean radial height of 11.78 mm, volar tilt of 7.5^0 and radial inclination of 19.1^0 in K-wire group with p value being 0.001 using unpaired student t test. Hardik et al, had mean radial height of 8.93 mm, volar tilt of 4.63^0 and radial inclination of 19.47^0 in cast group. Mean radial height of 11.33 mm, volar tilt of 7.67^0 and 22.87^0 radial inclination in K-wire group.[81] Raghu et al, had mean radial height of 8.03 mm, volar tilt of 4.86^0 and radial inclination of 14.23^0 in cast group. Mean radial height of 11.78 mm, volar tilt of 7.5^0 and radial inclination of 19.1^0 in K-wire group with p value of 0.001.[3] We with strong supporting evidences conclude that closed reduction, percutaneous K-wire fixation group had statistically significant radiological outcome when compared to closed reduction and cast application group.

Functional outcome using demerit point system of Gartland and Werley:

In our study we had statistically insignificant difference in the functional outcome when compared between two groups and it was supported by studies such as Adarsh et al, Sandeep patil et al, Raghu et al, Modi Nikunj et al. We had 7 (31.82%) excellent, 9 (40.91%) good, 5 (22.73%) fair, 1 (4.55%) poor result in cast group. 8 (36.36%) excellent, 10 (45.45%) good, 3 (13.64%) fair, 1 (4.55%) poor result in K-wire group with p value of 0.892. Adarsh et al, had 13 (43%) excellent, 9 (30%) good, 7 (23%) fair, 1 (3%) poor result in cast group. 11 (36%) excellent, 13 (43%) good, 5 (16%) fair, 1 (3%) poor result in K-wire group with p value of 0.746. [26] Sandeep patil et al and Raghu et al, had 13 (43.33%) excellent, 9 (30%) good, 7 (23.33%) fair, 1 (3.33%) poor result in cast group. 11 (36.66%) excellent, 13 (43.33%) good, 5 (16.66%) fair, 1 (3.33%) poor result in K-wire group with p value of 0.9816. [3,25] Modi Nikunj et al, had 5 (20%) excellent, 12 (48%) good, 6 (24%) fair, 2 (8%) poor result in cast group. 5 (20%) excellent, 13 (52%) good, 7 (16.66%) fair, 0 poor result in K-wire group which was statistically insignificant.[80] But our results were contradicting Hardik et all studies which had a p value of <0.01 i.e., statistically remarkable difference in the functional outcome between cast and K-wire group indicating K-wire group had better clinical outcome. They had 1 (3.33%) excellent, 9 (30%) good, 15 (50%) fair, 5 (16.67%) poor result in cast group. 6 (20%) excellent, 15 (50%) good, 9 (30%) fair, no poor result in K-wire group. [81] From our study, here by we conclude that the clinical or functional outcome of the fracture distal end radius managed by both groups had similar results which was statistically insignificant.

Complications observed:

In our study we had 4 cases of poor finger function and reduced hand grip in cast group. 3 cases in K-wire group. Poor finger function in the cast group was 0.18 ± 0.39 and in K-wire group was 0.14 ± 0.36. Mean OE- grip strength in cast group was 0.18 ± 0.39 and in K-wire group was 0.14 ± 0.35. There was statistically insignificant difference between the two groups. We had encountered most common complications as pain in DRUJ and arthritic changes of wrist in both the groups. Mean pain in DRUJ in cast group was 0.77 ± 0.43 and in K-wire group was 0.64 ± 0.49. Mean arthritic changes in cast group was 2.23 ± 1.54 and in K-wire group was 1.77 ± 1.63. But there was insignificant difference between the two groups. Superficial pin tract infections were seen in 4 cases of K-wire group and it was resolved with oral antibiotics. Malunion was seen in one case in the cast group. There were no cases of nerve complications or chronic regional pain syndrome. Deformity such as prominent ulnar styloid in 10 cases of cast group and 9 cases in K-wire group. 1 case of residual dorsal tilt in each group. Radial deviated hand seen in 1 case in cast and 2 cases in K-wire group. The complications which we had seen in our cases were similar to other study groups. Adarsh et al, had observed the complications of residual pain in 4 cases of cast group and 5 cases in K-wire group.[26] Wrist stiffness was seen in 6 cases of cast group and 7 cases in K-wire group. Reduced hand grip one in each group. Mahendra et al, had 10 cases of wrist stiffness in cast group and 1 in K-wire group; chronic regional pain syndrome was seen a single case of cast group, but we never had such complications in any of our cases.[79] Sunit Patil et al, had 12 cases of finger stiffness in their cast group, 10 cases in K-wire group.[78] Residual pain in DRUJ was seen in 5 and 6 cases in cast and K-wire group respectively. But they had 2 (10%) case of malunion in cast group and 5 (25%) malunion in K-wire group which was significant. Modi Nikunj et al, had 8% arthritis in his cast group and 4% in K-wire group, 2% wrist stiffness in cast

group, malunion of 3% in cast group. [80] Deformity like prominent ulnar styloid in 3 cases of cast group and 2 cases in K-wire group. Radial deviated hand seen in 2 cases in cast and 1 case in K-wire group which was statistically insignificant when compared to the two groups. We conclude that there was insignificant difference in the statistics when the complications were compared to each other in closed reduction and cast application group versus closed reduction, percutaneous K-wire fixation and cast application group.

CONCLUSION

We conclude that there is statistically insignificant difference in the functional outcome in terms of residual deformity, subjective evaluation, objective evaluation and complications associated with the treatment of fracture distal end radius (extraarticular and extraarticular with simple intraarticular extension) by closed reduction and cast application as compared to closed reduction with percutaneous K-wire fixation and cast application. However, there is a statistically significant difference in the radiological outcome in terms of mean radial height, volar tilt and radial inclination in the closed reduction, percutaneous K-wire fixation and cast application group in comparison to closed reduction and cast application group. Thereby, suggesting that percutaneous K-wire fixation provides additional stability which favors anatomic reduction of distal end radius fracture.

SUMMARY

The present study "A comparative study between closed reduction and cast application versus closed reduction, percutaneous K-wire fixation and cast application for fracture distal end of radius" was a prospective research study conducted at R.L.J.H and SDUMC Kolar. The study included 44 cases, 22 in each group of fracture distal end radius presenting to R.L.J hospital. All patients underwent thorough clinical examination, required x-rays were taken, routine blood investigations were done and patient were admitted to the respective orthopaedic ward.

Patients were selected as per inclusion and exclusion criteria. Computer generated simple randomization protocol was followed. Preoperative planning was done and patients were explained about the procedure. They were taken up for closed reduction and cast application or closed reduction with percutaneous K-wire and cast application.

After post-operative care, patients were discharged and followed up for clinical and radiological union of fracture, complications associated with the treatment and functional recovery. Observation and results were analysed using radiological parameters like radial height, radial inclination and volar tilt; functionally by demerit scoring system of Gartland and Werley.

Closed reduction and casting group had 7(31.82%) excellent, 9(40.91%) good, 5(22.73%) fair, 1(4.55%) poor functional results, with a mean of 7.64 ± 7.16.

Closed reduction, percutaneous K-wire fixation and cast group had 8(36.36%) excellent, 10(45.45%) good, 3(13.64%) fair, 1(4.55%) poor functional results, with a mean of 6.64±

6.7.The independent t test was used and the p value was 0.892, there was no significant difference in mean Gartland and Werley final score when compared between two groups.

The mean radial height in mm in cast group was 6.73 ± 1.67 and in K-wire group was 9.95 ± 1.29 indicating that there was a significant difference in mean radial height (in mm) when compared between two groups.

The mean volar tilt in degree in cast group was 4.18 ± 1.44 and in K-wire group was 6.41 ± 1.74 indicating that there was a significant difference in mean volar tilt (in degree) when compared between two groups.

The mean radial inclination in degree in cast group was 11.95 ± 2.42 and in K-wire group was 17.14 ± 2.4 indicating that there was a significant difference in the mean radial inclination (in degree) when compared between two groups.

Hence, we conclude that there is statistically insignificant difference in the functional outcome of the fracture distal end radius managed by both methods. But closed reduction, percutaneous K-wire fixation and cast application provides a better radiological outcome in fracture distal end radius cases.

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ANNEXURE I

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA, KOLAR - 563101.

PROFORMA

Serial no:-

TITLE:
"A COMPARATIVE STUDY BETWEEN CLOSED REDUCTION AND CAST APPLICATION VERSUS PERCUTANEOUS K-WIRE FIXATION AND CAST APPLICATION FOR FRACTURE DISTAL END OF RADIUS"

Name:

Age/Sex:

Address:

UHID/ O.P. No:

Date of Admission/OP :

Date of Discharge :

Mode of injury:-

A. Road traffic accident (R.T.A)

B. Fall on outstretched hand

C. Direct injury

D. Fall from height

Complaints:-

A. Pain:

B. Swelling:

C. Deformity:

D. Loss of function:

General physical examination: -

Vitals: Pulse- B.P-
RR- Temp-

Systemic examination: -

CVS-

RS-

PS-

CNS-

Preexisting systemic illness: -

Local examination:

A. Side:

B. Type of injury:

C. Swelling:

D. Deformity:

E. Level of styloid:

F. Associated injuries:

DIAGNOSIS:

RADIOLOGICAL EXAMINATION: -

Frykman's classification:

Dorsal angulation:

Radial shortening:

TREATMENT:

A. Closed reduction and cast application: -

B. Closed reduction with k-wire and cast application: -

C. Others: -

Radiological examination (Anatomical Evaluation): -

	Post reduction	At 6 weeks	At 6 months
A. Radial length:			
B. Volar tilt:			
C. Radial inclination:			

Range of movements Clinical Evaluation): -

	At 6 weeks	At 6 months
A. Palmar flexion		
B. Dorsiflexion		
C. Supination		
D. Pronation		
E. Ulnar deviation		
F. Radial deviation		
G. Finger grip		

GARTLAND AND WERLEY SCORING SYSTEM: -

	Points
Residual deformity	
Prominent ulnar styloid	1
Residual dorsal tilt	2
Radial deviation of hand	2-3
Point range	0-3
Subjective evaluation	
Excellent: No pain, disability or limitation of motion	0
Good: Occasional pain, slight limitation of motion, no disability	2
Fair: Occasional pain, some limitation of motion, feeling of weakness in wrist, no particular disability if careful, activities slightly restricted	4
Poor: Pain, limitation of motion, disability, activities more or less markedly restricted	6
Point range	0-6
Objective evaluation*	
Loss of dorsiflexion	5
Loss of ulnar deviation	3
Loss of supination	2
Loss of palmar flexion	1
Loss of radial deviation	1
Loss of circumduction	1
Loss of pronation	2
Pain in distal radioulnar joint	1
Grip strength - 60% or less of opposite side	1
Point range	0-5
Complications	
Arthritic change	
Minimum	1
Minimum with pain	3
Moderate	2
Moderate with pain	4
Severe	3
Severe with pain	5
Nerve complications (median)	1-3
Poor finger functions due to cast	1-2
Point range	0-5
End result point ranges	
Excellent	0-2
Good	3-8
Fair	9-20
Poor	21 and above

Total score-

Complications-

ANNEXURE II

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA, KOLAR - 563101.

PATIENT INFORMATION SHEET

STUDY TITLE: "A COMPARATIVE STUDY BETWEEN CLOSED REDUCTION AND CAST APPLICATION VERSUS PERCUTANEOUS K-WIRE FIXATION AND CAST APPLICATION FOR FRACTURE DISTAL END OF RADIUS"

Study location: R L Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Tamaka, Kolar.

Details- Patients diagnosed with fracture distal end of radius admitted in orthopaedics ward from opd and casualty at R.L.J. HOSPITAL AND RESEARCH CENTRE, attached to SRI DEVARAJ URS MEDICAL COLLEGE, TAMAKA, KOLAR

Patients in this study will have to undergo routine blood investigations (CBC, RFT,RBS , serum electrolytes,blood grouping,HIV& HBsAG), chest x ray, ecg and x-ray of wrist – AP/PA and lateral view; CT scan of wrist (if needed).
FBS,PPBS,HbA1c if diabetic

Please read the following information and discuss with your family members. You can ask any question regarding the study. If you agree to participate in the study we will collect information (as per proforma) from you or a person responsible for you or both. Relevant history will be taken. This information collected will be used only for dissertation and publication.

All information collected from you will be kept confidential and will not be disclosed to any outsider. Your identity will not be revealed. This study has been reviewed by the Institutional Ethics Committee and you are free to contact the member of the Institutional Ethics Committee. There is no compulsion to agree to this study. The care you will get will not change if you don't wish to participate. You are required to sign/ provide thumb impression only if you voluntarily agree to participate in this study.

CONFIDENTIALITY

Your medical information will be kept confidential by the study doctor and staff and will not be made publicly available. Your original records may be reviewed by your doctor or ethics review board. For further information/ clarification please contact.

Dr. SACHIN .C. THAGADUR (Post Graduate),
Department Of ORTHOPAEDICS,
SDUMC, Kolar
CONTACT NO : 9741388400

ಶ್ರೀ ದೇವರಾಜ್ ಅರಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಸಂಸ್ಥೆ,

ಟಮಕ, ಕೋಲಾರ - 563101.

ರೋಗಿಯ ಮಾಹಿತಿನ ಮೂನೆ

ಅಧ್ಯಯನ ಶೀರ್ಷಿಕೆ:- "ಮುಚ್ಚಿದ ಪುನರ್ವಸತಿ ಮತ್ತು ನಡುವೆ ಒಂದು ತುಲನಾತ್ಮಕ ಅಧ್ಯಯನ ಕ್ಯಾಸ್ಟ್ ಅರ್ಜಿ ಸುವ್ಯವಸ್ಥಿತವಾಗಿದೆ ಕೆ-ವೈದ್ಯೀಕರಣ ಮತ್ತು ಕ್ಯಾಸ್ಟ್ ಅರ್ಜಿ ಮುರಿತ ಕೊನೆಯಲ್ಲಿರುವ ಕೊನೆಯಲ್ಲಿ ತ್ರಿಜ್ಯದ ಫಾರ್ "

ವಿವರಗಳು- ಆದರ್ಶ ಮತ್ತು ಅಪಘಾತದಿಂದ ಆರ್ಥೋಪೆಡಿಕ್ಸ್ವಿಭಾಗದಲ್ಲಿ ದಾಖಲಾದ ತ್ರಿಜ್ಯದ ಮುರಿತ ಅಂತ್ಯದ ಕೊನೆಯಲ್ಲಿ ರೋಗನಿರ್ಣಯ ಮಾಡುವ ರೋಗಿಗಳು. ಆರ್.ಎಲ್.ಜೆ. ಆಸ್ಪತ್ರೆ ಮತ್ತು ಸಂಶೋಧನಾ ಕೇಂದ್ರ, ಜೋಡಿಸಲಾದ ಶ್ರೀ ದೇವರಾಜ ಅರಸು ವೈದ್ಯಕೀಯ ಕಾಲೇಜು, ಟಮಕ , ಕೋಲಾರ.

ಈ ಅಧ್ಯಯನದ ರೋಗಿಗಳು ವಾಡಿಕೆಯ ರಕ್ತದ ತನಿಖೆಗಳನ್ನು (ಸಿಬಿಸಿ, ಎಫ್ಬಿಎಸ್ ,ಫಿಫಿಬಿಎಸ್, ಎಚ್ಬಿಎ 1ಸಿ, ಸೀರಮ್ ಎಲೆಕ್ಟ್ರೋಲೈಟ್ಸ್, ರಕ್ತಗುಂಪು, ಎಚ್ಐವಿ ಮತ್ತು ಎಚ್ಬಿಎಸ್ಎಜಿ), ಎದೆಯ ಎಕ್ಸ್ರೇ, ಇ.ಸಿ.ಜಿ ಮತ್ತು ಮಣಿಕಟ್ಟಿನ ಎಕ್ಸ್-ರೇ ಮತ್ತು ಎಪಿಎ ಮತ್ತು ಪಾರ್ಶ್ವ ನೋಟ ; ಮಣಿಕಟ್ಟಿನ ಸಿಟಿ ಸ್ಕ್ಯಾನ್ (ಅಗತ್ಯವಿದ್ದರೆ).

ಕೆಳಗಿನ ಮಾಹಿತಿಯನ್ನು ಓದಿ ಮತ್ತು ನಿಮ್ಮ ಕುಟುಂಬ ಸದಸ್ಯರೊಂದಿಗೆ ಚರ್ಚಿಸಿ. ಅಧ್ಯಯನದ ಬಗ್ಗೆ ನೀವು ಯಾವುದೇ ಪ್ರಶ್ನೆಯನ್ನು ಕೇಳಬಹುದು. ನೀವು ಅಧ್ಯಯನದಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಲು ಒಪ್ಪಿಕೊಂಡರೆ ನಾವು ನಿಮ್ಮಿಂದ (ಮಾಹಿತಿಪ್ರಕಾರ) ಮಾಹಿತಿಯನ್ನು ಅಥವಾ ನಿಮ್ಮ ಅಥವಾ ಎರಡಕ್ಕೂ ಜವಾಬ್ದಾರರಾಗಿರುವ ವ್ಯಕ್ತಿಗಳನ್ನು ಸಂಗ್ರಹಿಸುತ್ತೇವೆ ಸಂಬಂಧಿತ ಇತಿಹಾಸವನ್ನು ತೆಗೆದುಕೊಳ್ಳಲಾಗುವುದು. ಸಂಗ್ರಹಿಸಿದ ಈ ಮಾಹಿತಿಯನ್ನು ಪ್ರೌಢಪ್ರಬಂಧ ಮತ್ತು ಪ್ರಕಟಣೆಗಾಗಿ ಮಾತ್ರ ಬಳಸಲಾಗುತ್ತದೆ.
ನಿಮ್ಮಿಂದ ಸಂಗ್ರಹಿಸಿದ ಎಲ್ಲಾ ಮಾಹಿತಿಯನ್ನು ಗೌಪ್ಯವಾಗಿರಿಸಲಾಗುವುದು ಮತ್ತು ಯಾವುದೇ ಹೊರಗಿನವರಿಗೆ ಬಹಿರಂಗ ಪಡಿಸಲಾಗುವುದಿಲ್ಲ. ನಿಮ್ಮ ಗುರುತನ್ನು ಬಹಿರಂಗಪಡಿಸಲಾಗುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನವು ಸಾಂಸ್ಥಿಕ ನೀತಿಶಾಸ್ತ್ರ ಸಮಿತಿಯಿಂದ ಪರಿಶೀಲಿಸಲ್ಪಟ್ಟಿದೆ ಮತ್ತು ನೀವು ಸಂಸ್ಥೆಯ ಎಥಿಕ್ಸ್ ಸಮಿತಿಯಸದಸ್ಯರನ್ನು ಸಂಪರ್ಕಿಸಲು ಮುಕ್ತವಾಗಿರುತ್ತೀರಿ. ಈ ಅಧ್ಯಯನಕ್ಕೆ ಒಪ್ಪಿಗೆ ನೀಡಲು ಯಾವುದೇ ಕಡ್ಡಾಯವಿಲ್ಲ. ನೀವು ಭಾಗವಹಿಸಲು ಬಯಸದಿದ್ದರೆ ನೀವು ಪಡೆಯುವ ಕಾಳಜಿ ಬದಲಾಗುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನದಲ್ಲಿ ನೀವು ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ಒಪ್ಪಿಕೊಳ್ಳುವುದಾದರೆ ಮಾತ್ರ ಹೆಬ್ಬೆರಳು ಅನಿಸಿಕೆಗೆ ನೀವು ಸಹಿ / ನೀಡಬೇಕಾಗಿದೆ.

ಗೌಪ್ಯತೆ

ನಿಮ್ಮ ವೈದ್ಯಕೀಯ ಮಾಹಿತಿಯನ್ನು ಅಧ್ಯಯನದ ವೈದ್ಯರು ಮತ್ತು ಸಿಬ್ಬಂದಿ ಗೌಪ್ಯವಾಗಿಡಲಾಗುವುದು ಮತ್ತು ಸಾರ್ವಜನಿಕವಾಗಿ ಲಭ್ಯವಿರುವುದಿಲ್ಲ. ನಿಮ್ಮ ಮೂಲದಾಖಲೆಗಳನ್ನು ನಿಮ್ಮ ವೈದ್ಯರು ಅಥವಾ ನೈತಿಕ ವಿಮರ್ಶೆಮಂಡಳಿ ಪರಿಶೀಲಿಸಬಹುದು. ಹೆಚ್ಚಿನ ಮಾಹಿತಿಗಾಗಿ / ಸ್ಪಷ್ಟೀಕರಣಕ್ಕಾಗಿ ದಯವಿಟ್ಟು ಸಂಪರ್ಕಿಸಿ

ಡಾ. ಸಚಿನ್. ಸಿ. ತಗದುರ್ (ಸ್ನಾತಕೋತ್ತರ ಪದವಿ),
ಮೂಳೆ ಶಾಸ್ತ್ರ ವಿಭಾಗ,
ಎಸ್ಡಿಯುಎಮ್ಸಿ.
ಟಮಕ, ಕೋಲಾರ
ಸಂಪರ್ಕ ಸಂಖ್ಯೆ:9741388400

ANNEXURE III

INFORMED CONSENT FORM

UHID / IP no:

TITLE:
"A COMPARATIVE STUDY BETWEEN CLOSED REDUCTION AND CAST APPLICATION VERSUS PERCUTANEOUS K-WIRE FIXATION AND CAST APPLICATION FOR FRACTURE DISTAL END OF RADIUS"

I, _____ aged _____, after being explained in my own vernacular language about the purpose of the study and the risks and complications of the procedure. I hereby give my written informed consent without any force or prejudice for closed reduction and cast application or closed reduction, percutaneous K-wire fixation and cast application for distal end radius, to be performed under any anaesthesia (general or regional anaesthesia) deemed fit. The nature and risks involved in the procedure (surgical and anaesthetical) have been explained to me.

I have been explained in detail about the Clinical Research on "A comparative study between closed reduction and cast application versus percutaneous k-wire fixation and cast application for fracture distal end radius**"** being conducted. I have read the patient information sheet and I have had the opportunity to ask any question. Any question that I have asked, have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research. I hereby give consent to provide my history, undergo physical examination, undergo investigations, undergo conservative / operative procedure and provide its results and documents etc. to the doctor / institute etc.

For academic and scientific purpose, the operation / procedure etc. may be video graphed or photographed. All the data may be published or used for any academic purpose. I will

not hold the doctors / institute etc. responsible for any untoward consequences during the procedure / study.

A copy of this Informed Consent Form and Patient Information Sheet has been provided to the participant.

Signature/Thumb impression & Name of patient -

Signature & Name of Pt. Attendant –

(Relation with patient)

Witness : -
(Signature & Name of Researcher) - Dr Sachin C Thagadur

<u>ಶ್ರೀ ದೇವರಾಜ್ ಅರಸ್ ಉನ್ನತ ಶಿಕ್ಷಣ ಮತ್ತು ಸಂಶೋಧನಾ ಸಂಸ್ಥೆ,</u>

<u>ಟಮಕ, ಕೋಲಾರ - 563101.</u>

ಮಾಹಿತಿಯುಕ್ತ ಸಮ್ಮತಿ ಪತ್ರ

ಐಪಿ ಸಂಖ್ಯೆ:

ಶೀರ್ಷಿಕೆ:- "ಮುಚ್ಚಿದ ಪುನರ್ವಸತಿ ಮತ್ತು ನಡುವೆ ಒಂದು ತುಲನಾತ್ಮಕ ಅಧ್ಯಯನ ಕ್ಯಾಸ್ಟ್ ಅರ್ಜಿ ಸುವ್ಯವಸ್ಥಿತವಾಗಿದೆ ಕೆ-ವೈದ್ಯೀಕರಣ ಮತ್ತು ಕ್ಯಾಸ್ಟ್ ಅರ್ಜಿ ಮುರಿತ ಕೊನೆಯಲ್ಲಿರುವ ಕೊನೆಯಲ್ಲಿ ತ್ರಿಜ್ಯದಫಾರ್ ".

ನಾನು, _____ ವಯಸ್ಸಿನ _____, ನನ್ನ ಅಧ್ಯಯನದ ಉದ್ದೇಶ ಮತ್ತು ಕಾರ್ಯ ವಿಧಾನದ ಅಪಾಯಗಳು ಮತ್ತು ತೊಡಕುಗಳ ಬಗ್ಗೆ ವಿವರಿಸಿದ ನಂತರ, ಇಲ್ಲಿಯವರೆಗೆ ಮುಚ್ಚಿದ ಕಡಿತ ಮತ್ತು ಎರಕಹೊಯ್ದ ಅರ್ಜಿಗಾಗಿ ಯಾವುದೇ ಬಲ ಅಥವಾ ಪೂರ್ವಾಗ್ರಹವಿಲ್ಲದೆ ನನ್ನ ಮಾನ್ಯ ಲಿಖಿತ ತಿಳುವಳಿಕೆಯನ್ನು ಒಪ್ಪಿಗೆ ನೀಡಿ /

ತ್ರಿಕೋನ ಮುರಿತದ ಅಂತ್ಯದ ಅಂತ್ಯಕ್ಕೆ ಅಥವಾ ಪೆರ್ಕ್ಯುಟನಿಯಸ್ ಕೆ ತಂತಿ ಸ್ಥಿರೀಕರಣ ಮತ್ತು ಎರಕ ಹಯ್ದ ಅರ್ಜಿ ಅಥವಾ ಯಾವುದೇ ಇತರ ಪ್ರಕ್ರಿಯೆಯ ಪರಿಗಣಿತ ಫಿಟ್, ಇದು ನನ್ನ ಮೇಲೆ ನಡೆಸಬೇಕಾದ ರೋಗ ನಿರ್ಣಯದ / ಅಥವಾ ಚಿಕಿತ್ಸಕ ಪ್ರಕ್ರಿಯೆ / ಬಯಾಪ್ಸಿ / ವರ್ಗಾವಣೆ / ಕಾರ್ಯಾಚರಣೆ ಅಥವಾ ಯಾವುದೇ ಅರಿವಳಿಕೆಗೆ ಯೋಗ್ಯವಾದ ಯಾವುದೇ ಅಡಿಯಲ್ಲಿ _____ ಆಗಿದೆ. ಕಾರ್ಯವಿಧಾನದಲ್ಲಿ (ಶಸ್ತ್ರಚಿಕಿತ್ಸಾ ಮತ್ತು ಅನಾಸ್ಥೆಟಿಕಲ್) ಒಳಗೊಂಡಿರುವ ಸ್ವಭಾವ ಮತ್ತು ಅಪಾಯಗಳು ನನ್ನ ತೃಪ್ತಿಗೆ ನನಗೆ ವಿವರಿಸಲಾಗಿದೆ.

ನಾನು ಕ್ಲಿನಿಕಲ್ರಿಸರ್ಚ್ಗೆ ವಿವರವಾಗಿ ವಿವರಿಸಲಾಗಿದೆ "ಮುಚ್ಚಿದ ಕಡಿತ ಮತ್ತು ಎರಕಹೊಯ್ದ ಅನ್ವಯಗಳ ನಡುವಿನ ತುಲನಾತ್ಮಕ ಅಧ್ಯಯನಕ್ಕಾಗಿ ಪೆರ್ಕ್ಯುಟನಿಯಸ್ಕೆ-ವೈ ಸ್ಥಿರೀಕರಣ ಮತ್ತು ಎರಕಹೊಯ್ದ ಅನ್ವಯಿಸುವಿಕೆ

ತ್ರಿಜ್ಯದ ಮುರಿತ ಅಂತ್ಯದ ಕೊನೆಯಲ್ಲಿ " ನಡೆಸಲಾಗುತ್ತದೆ. ನಾನು ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆಯನ್ನು ಓದಿದ್ದೇನೆ ಮತ್ತು ಯಾವುದೇ ಪ್ರಶ್ನೆ ಕೇಳಲು ನನಗೆ ಅವಕಾಶವಿದೆ. ನಾನು ಕೇಳಿದ ಯಾವುದೇ ಪ್ರಶ್ನೆಯನ್ನು ನನ್ನ ತೃಪ್ತಿಗೆ ಉತ್ತರ ಮಾಡಲಾಗಿದೆ. ಈ ಸಂಶೋಧನೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳುವವರಾಗಿ ಭಾಗವಹಿಸಲು ನಾನು ಸ್ವಯಂ ಪ್ರೇರಣೆಯಿಂದ ಸಮ್ಮತಿಸುತ್ತೇನೆ. ನಾನು ಇದರ ನನ್ನ ಇತಿಹಾಸ ಒದಗಿಸಲು ಒಪ್ಪಿಗೆ, ದೈಹಿಕ ಪರೀಕ್ಷೆಗೆ ಒಳಗಾಗುವುದು ಇಂಜೆಕ್ಷನ್ / ಶಸ್ತ್ರಒಳಗಾಗಲು, ತನಿಖೆಗಳುಒಳಗಾಗಲು ಮತ್ತು ವೈದ್ಯ / ಸಂಸ್ಥೆಯೊಂದಕ್ಕೆ ಇತ್ಯಾದಿ ಅದರ ಫಲಿತಾಂಶಗಳು ಮತ್ತು ದಾಖಲೆಗಳನ್ನು ಇತ್ಯಾದಿ ಒದಗಿಸಲು

ಶೈಕ್ಷಣಿಕ ಮತ್ತು ವೈಜ್ಞಾನಿಕ ಉದ್ದೇಶಕ್ಕಾಗಿ ಕಾರ್ಯಾಚರಣೆ / ವಿಧಾನ, ಇತ್ಯಾದಿ ವೀಡಿಯೊವನ್ನು ಗ್ರಾಂಪ್ಡ್ ಅಥವಾ ಛಾಯಾಚಿತ್ರ ಮಾಡಬಹುದು. ಎಲ್ಲಾ ಡೇಟಾವನ್ನು ಯಾವುದೇ ಶೈಕ್ಷಣಿಕ ಉದ್ದೇಶಕ್ಕಾಗಿ

ಪ್ರಕಟಿಸಬಹುದು ಅಥವಾ ಬಳಸಬಹುದು. ಕಾರ್ಯ ವಿಧಾನ / ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ಯಾವುದೇ ಕೆಟ್ಟ ಪರಿಣಾಮಗಳಿಗೆ ನಾನು ವೈದ್ಯರು / ಸಂಸ್ಥೆಯೊಂದಕ್ಕೆ ಇತ್ಯಾದಿಗಳನ್ನು ಹೊಂದುವುದಿಲ್ಲ.

ಈ ಮಾಹಿತಿಯುಕ್ತ ಸಮ್ಮತಿಯ ನಮೂನೆಯ ಪ್ರತಿಯನ್ನು ಮತ್ತು ರೋಗಿಯ ಮಾಹಿತಿಶೀಟ್ ಅನ್ನು ಭಾಗವಹಿಸುವವರಿಗೆ ಒದಗಿಸಲಾಗಿದೆ.

ರೋಗಿಯ- ಸಹಿ / ಹೆಬ್ಬೆಟ್ಟಿನ ಗುರುತು & ಹೆಸರು

ಸಹಿ & ಹೆಸರು ರೋಗಿಯ. ಹಾಜರಾತಿ

(ರೋಗಿಯೊಂದಿಗೆಸಂಬಂಧ) ---------

ಸಾಕ್ಷಿ:----------
(ಸಹಿ ಮತ್ತು ಸಂಶೋಧನಾವ್ಯಕ್ತಿ / ವೈದ್ಯರ ಹೆಸರು) ----------

ANNEXURE IV

KEY TO MASTER CHART

- M- Male
- F-Female
- RTA- Road traffic accident
- OE- Objective evaluation
- DRUJ- Distal radioulnar joint
- G&W- Gartland and Werley demerit point system of evaluation of functional outcome
- mm- Millimeter

INTRODUCTION

AIMS & OBJECTIVES

REVIEW OF LITERATURE

MATERIALS AND METHODS

RESULTS

DISCUSSION

CONCLUSION

SUMMARY

BIBLIOGRAPHY

ANNEXURES

CAST GROUP							Gartland & Werley scoring system																Radiological evaluation			
Patient name	Age in years	Sex	UHID number	Side	Mode of injury	Associated injury	Frykman classification	Residual deformity	Subjective evaluation	OE- Loss of dosriflexion	OE- Loss of ulnar deviation	OE- Loss of supination	OE- loss of palmar flexion	OE- loss o radial deviation	OE- Loss of circumduction	OE- Loss of pronation	OE- Pain in DRUJ	OE- Grip strength	Complication- Arthritic changes	Complication- nerve complications	Complication- Poor finger function	G&W Final score	G&W result	Radial height in mm	Volar tilt in degree	Radial indination in degree
Ashok	28	M	678415	Left	RTA	Nil	1	0	2	0	0	0	0	1	0	0	1	0	3	0	0	7	Good	8	4	13
Kamalamma	75	F	670621	Right	Self fall	Nil	2	1	2	0	0	0	0	0	1	0	1	0	3	0	0	8	Good	7	5	12
Shankaramma	56	F	667992	Right	fall from height	Nil	2	1	4	0	3	0	0	0	1	0	1	0	4	0	0	14	Fair	5	2	9
Ghore Khan	23	M	788752	Right	Self fall	Nil	1	0	2	0	0	0	0	0	0	0	0	0	1	0	0	3	Good	8	5	12
Amarvathamma	53	F	709042	Right	Self fall	Nil	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	Excellent	8	6	16
Malathi	46	F	833542	Right	Self fall	Nil	2	1	2	0	0	0	0	0	1	0	1	0	3	0	0	8	Good	7	4	11
Vinayaka	60	M	680929	Right	RTA	nil	2	1	4	0	0	0	0	0	1	2	1	1	4	0	1	15	Fair	5	2	10
Narasamma	65	F	785104	Right	Self fall	Nil	1	0	2	0	0	0	0	0	0	0	1	0	1	0	0	4	Good	9	5	11
Munirathnappa	60	M	670421	Right	Self fall	Nil	2	1	4	0	0	2	0	1	1	0	1	0	4	0	0	14	Fair	4	2	9
Parvathamma	63	F	651888	Left	RTA	Nil	2	3	6	5	3	2	0	0	1	2	1	1	4	0	1	29	Poor	3	2	8
Sushma	21	F	673133	Left	Self fall	Nil	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Excellent	8	5	15
Geetha	49	F	839144	Right	Direct injury	Nil	1	0	2	0	0	0	0	0	0	0	1	0	3	0	0	6	Good	6	4	11
Narayanaswamy	60	M	679707	Right	Self fall	Nil	3	1	2	0	0	0	0	0	1	0	1	0	3	0	0	8	Good	7	5	11
Lakshmamma	63	F	709140	Left	RTA	Nil	3	1	2	0	0	2	0	0	1	2	1	1	4	0	1	15	Fair	4	2	10
Lakshmamma	60	F	709251	Left	Self fall	Nil	1	0	2	0	0	0	0	0	0	0	1	0	3	0	0	6	Good	6	4	10
Syed	22	M	763183	Left	RTA	etatarsal fract	1	1	2	0	0	0	0	0	1	0	1	0	1	0	0	6	Good	7	4	11
Divya	24	F	463821	Left	Self fall	Nil	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Excellent	8	6	14
Sukshith	19	M	826407	Left	Direct injury	Nil	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	Excellent	8	5	15
Anitha	47	F	838553	Right	Self fall	Nil	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	2	Excellent	9	6	14
Harshith Gowda	28	M	847978	Left	ll from heigh	ones fracture	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	Excellent	8	6	15
Meghana	20	F	798291	Right	Self fall	Nil	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	Excellent	7	5	16
Narayanappa	50	M	839777	Left	ll from heigh	Nil	1	1	4	0	3	2	0	0	1	0	1	1	4	0	1	17	Fair	6	3	10

K WIRE GROUP								Gartland & Werley scoring system																Radiological evaluation		
Patient name	Age in years	Sex	UHID number	Side	Mode of injury	Associated injuries	Frykman classification	Residual deformity	Subjective evaluation	OE- Loss of dosriflexion	OE- Loss of ulnar deviation	OE- Loss of supination	OE- loss of palmar flexion	OE - loss of radial deviation	OE- Loss of circumduction	OE- Loss of pronation	OE - Pain in DRJ	OE- Grip strength	Complication- Arthritic changes	Complication- nerve complications	Complication- Poor finger function	G&W Final score	G&W result	Radial height in mm	Volar tilt in degree	Radial inclination in degree
Govardhan	24	M	665567	Right	RTA	Nil	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	Excellent	11	9	19
Shankar	31	M	651150	Left	RTA	Nil	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Excellent	12	8	21
Rajanna	60	M	827197	Right	RTA	Closed right Intertrochanteric femur fracture	1	0	2	0	0	0	0	0	1	0	0	0	3	0	0	6	Good	9	6	16
Munirathnamma	55	F	828111	Left	Self fall	Nil	1	2	6	5	3	2	1	0	1	0	1	1	4	0	1	27	Poor	7	3	13
Srinivasaiah	35	M	822582	Right	RTA	Closed right neck of femur fracture	2	1	2	0	0	0	0	0	0	0	1	0	1	0	0	5	Good	10	8	16
Krishnappa	54	M	631707	Left	RTA	Nil	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	Excellent	10	8	20
Munilakshmamma	60	F	818246	Right	Direct inury	Bull gore injury to left thigh	2	1	2	0	3	0	0	0	1	0	1	1	4	0	1	14	Fair	8	5	13
Anand	27	M	636890	Right	RTA	Closed both bone fracture at middle third of left forearm	1	1	2	0	0	0	0	0	0	0	1	0	3	0	0	7	Good	10	8	16
Sabun	20	M	777670	Right	RTA	Nil	2	1	2	0	0	0	0	0	1	0	1	0	0	0	0	5	Good	11	8	18
Gowramma	75	F	739994	Right	Self fall	Nil	2	3	4	0	3	0	0	0	1	0	1	0	4	0	1	17	Fair	8	4	14
Manjunath	25	M	740012	Right	RTA	Nil	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Excellent	11	7	20
Madhukumar	24	M	836420	Left	RTA	Closed left midshaft femur fracture, Open type 2 midshaft left tibia fracture	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	good	10	6	17
Raadha	25	F	682540	Left	Self fall	Nil	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	Excellent	12	9	20
Shivanna	51	M	830994	Right	RTA	Nil	2	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2	Excellent	10	7	19
Srinivas	48	M	842876	Left	Fall from height	Nil	3	0	2	0	0	0	0	1	0	0	0	0	3	0	0	6	Good	11	6	18
Srinivas S	52	M	730010	Right	RTA	Nil	2	1	2	0	0	0	0	0	1	0	1	0	3	0	0	8	Good	10	6	17
Parvathamma	75	F	533159	Left	RTA	Nil	2	3	4	0	3	0	0	0	1	0	1	1	4	0	0	17	Fair	8	5	13
Mudamma	64	F	674352	Right	Self fall	Nil	2	1	2	0	0	0	0	0	0	0	1	0	3	0	0	7	Good	10	7	18
SHIVANNA P	50	M	776424	LEFT	RTA	NIL	3	1	2	0	0	0	0	0	1	0	1	0	3	0	0	8	Good	10	6	16
SANDEEP	21	M	863413	Left	Fall from height	proximal phalanx fracture of 1st finger of right hand	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	EXCellent	11	7	19
RENUKA	21	F	864444	Right	RTA	Nil	2	1	2	0	0	0	0	0	1	0	1	0	1	0	0	6	good	10	3	16
Praveen	21	M	864018	LEFT	Fall from height	Right distal humerus fracture	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	Excellent	10	5	18