EVALUATION OF FUNCTIONAL OUTCOME IN METACARPAL FRACTURE FIXED WITH CLOSED REDUCTION AND INTERNAL FIXATION WITH KIRSCHNER-WIRE

by

DR. ABHI SHARMA, M.B.B.S.

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

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Under the Guidance of

DR. ARUN H.S., MBBS, M.S. ORTHO

PROFESSOR & HEAD,

DEPARTMENT OF ORTHOPAEDICS,

SRI DEVARAJ URS MEDICAL COLLEGE,

TAMAKA, KOLAR-563101

2022

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

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Date:

Place:

Dr. ABHI SHARMA
Postgraduate
Department of Orthopaedics
Sri Devaraj Urs Medical College
Tamaka, Kolar.

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

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Date:

Place: Kolar

Dr. ARUN H.S.

Professor and Head

Department of Orthopaedics

Sri Devaraj Urs Medical College

Tamaka, Kolar – 563101

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

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Date:

Place: Kolar

Dr. ARUN.H. S, MS

Professor & HOD

Department of Orthopaedics

Sri Devaraj Urs Medical College

Tamaka, Kolar

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

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Signature of the Head Of Department
Dr. ARUN H S
Professor
Department of Orthopaedics
Sri Devaraj Urs Medical College
Tamaka, Kolar – 563101

Date:
Place: Kolar

Signature of the Principal
Dr. SREERAMULU P N
Principal
Sri Devaraj Urs Medical College
Tamaka, Kolar – 563101

Date:
Place: Kolar

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

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Ethical Committee
Sri Devaraj Urs Medical College
Tamaka, Kolar – 563101

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Date: ***Dr Abhi Sharma***

Place:

ABSTRACT

Background: Metacarpal fractures occurs very frequently. Many a times these fractures are missed or treated as minor injuries which can lead to major disability and deformity. Percutaneous pinning with Kirschner wires (K-wires) is a widely used surgical option for extra-articular metacarpal fractures. It is less invasive, versatile, and requires less operative time as compared with other techniques.

Material and Methods: A prospective, observational and hospital-based study conducted at R. L. Jalappa Hospital and Research Centre, Sri Devaraj Urs Medical College, Tamaka on patients with closed metacarpal fractures from October 2019 to April 2021. Clinical data was collected and evaluated with post-procedure functional outcomes with disabilities of the arm, shoulder and hand score (DASH score), range of motion at metacarpo-phalangeal using joint total active motion (TAM) and pain using Visual Analog Score.

Results: In the study majority of subjects were in the age group <30 years (33.3%) with 82.1% were males and 17.9% were females. most common mode of injury was RTA in 74.4%, most common part of Metacarpal involved was shaft (56.4%). VAS score at the end of 6 month 53.8% had mild pain, 2.6% had moderate pain and 43.6% had no pain. 43.6% had excellent, 46.2% had good had poor range of motion. At the end of 6 months DASH score was 15.03 ± 4.869. Median score was 15, minimum score was 10 and maximum score was 30.

Conclusions: Restoration of total normal function of hand in treatment of hand fractures is extremely important and conservative or minimally invasive treatment procedures have been observed to aid in this than surgical interventions. It was noticed in the study that

Intramedullary K-wire fixation which is a minimally invasive method for stabilizing metacarpal fractures is the best treatment option for metacarpal fractures as it provides excellent functional outcome with less complications. The technique does not affect gliding properties of surrounding soft tissue which is required for restoration of normal function of hand.

Keywords: metacarpals, K-wire, Closed Reduction, VAS Score, TAM Score, DASH Score.

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LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
AO	ARBEITSGEMEINSCHAFT FÜR OSTEOSYNTHESEFRAGEN
AP	ANTERIO- POSTERIOR
BP	BLOOD PRESSURE
MCP	METACARPO-PHALANGEAL JOINT
CRIF	CLOSED REDUCTION AND INTERNAL FIXATION
I.V.	INTRAVENOUS
ORIF	OPEN REDUCTION AND INTERNAL FIXATION
POP	PLASTER OF PARIS
ROM	RANGE OF MOTION
RTA	ROAD TRAFFIC ACCIDENT
TAM	TOTAL ACTIVE MOTION
DASH SCORE	DISABILITY OF ARM,SHOULDER AND HAND SCORE
VAS	VISUAL ANALOG SCALE
K- WIRE	KIRSCHNER'S WIRE
R.L.J.H.	R.L. JALAPPA HOSPITAL
SDUMC	SRI DEVARAJ URS MEDICAL COLLEGE

INTRODUCTION

INTRODUCTION

The hand has been recognized as the symbol of man's power, outward reflection of his inner mind, the precise instrument of his perception, in fact the indispensable tool of his inheritance and independent livelihood.

Hand is a specialized structure interacting with the environment and is prone for functional impairment.

Hand can be used as a hook, as in tilting a book from shelf, grasp, as in holding glass, pinch, as in holding a pen. The loss or diminution of any of these functions causes major disability.

The incidence of metacarpal fractures is most common in males between an age group of 10 to 40 years, a time when athletic and industrial exposure is the greatest.

Metacarpal fractures constitutes around 14-28% of all visits to the hospital following trauma by various means like assault, road traffic accidents, industrial accidents, agricultural accidents etc. [1]

Many times metacarpal fractures are missed or undertreated which results in major disability, deformity with permanent disability and handicap. [2, 3]

Metacarpal fractures can lead to deformity if left untreated, stiffness from over treatment and both deformity and stiffness from poor treatment. Fracture healing in the hand alone shall not be the only goal as functional outcomes have equal importance. [4, 5]

Too often these fracture are treated as minor injuries which results in major disability as stated by Lipscomb. [6]

Selection of the optimum treatment depends on a number of factors, including fracture location (intra- articular versus extra- articular), fracture geometry (transverse, spiral or oblique, comminuted), deformity (angular, rotational, and shortening) whether they are open or closed, whether they have associated osseous and soft tissue injuries and fracture stability.

Factors like hand dominance, age, occupation shall be kept in mind while deciding between the different treatment options to achieve the goals of good functional outcome and finally restoring the hand functions. Stable un-displaced fractures are treated conservatively with good results. Conservative method of treatment of unstable displaced fractures is associated with increased incidence of loss of reduction of fracture alignment. Plates and screws provide excellent stability but require marked soft tissue dissection and may cause extensor tendon adhesions with a scar dorsally over the hand. Intra-medullary fixation provides sufficient stability at the fracture site with minimal soft tissue dissection and potentially less tendon irritation.[7]

Most of the open fractures, closed oblique or comminuted fractures in the hand need surgical stabilization Percutaneous pinning with K-wires under image intensifier is a widely used surgical option for extraarticular metacarpal fractures. It is less invasive and versatile as compared with other techniques.[8]

Metacarpal shaft fractures are commonly observed after a punch or direct trauma. Many of them can be treated conservatively with an intrinsic plus position cast. [9]

Earlier metacarpal fractures were treated with open reduction and internal fixation (ORIF) with Kirschner-wire (K-wire) although operative time was shorter, the incidence of loss of reduction, penetration to the metacarpo-phalangeal joint were higher.

With improved materials, implant designs and instrumentation, ORIF with plates and screws has gained popularity. Plates for the metacarpals are low profile, easy to contour and come in a variety of configurations.

Early and appropriate physiotherapy other than accurate reduction and fixation affect recovery of hand mobility and function.

NEED FOR THE STUDY

The aim of every orthopaedic surgeon is to achieve adequate fracture healing along with satisfactory functional outcome.

Many factors, such as delicate handling of tissues, preservation of gliding planes for tendons, prevention of infection, early and appropriate physiotherapy other than accurate reduction and fixation affect recovery of good mobility.

Our hospital is a tertiary Care hospital in rural area where most of the patients belong to economically challenged background and cannot afford expensive surgeries.

Closed reduction and internal fixation with K-wire is relatively less expensive and can be afforded by rural population.

There is paucity of documented literature showing functional outcome of metacarpal fracture treated with closed reduction and internal fixation with K-wire.

In this prospective study we will evaluate various metacarpal fractures and functional outcome following surgical treatment with closed reduction and internal fixation with K-wires.

AIMS & OBJECTIVES

AIMS AND OBJECTIVE

To evaluate functional outcome of the metacarpal fractures managed with closed reduction and internal fixation with K-wire using:

- Disability of Arm, Shoulder and Hand score
- Evaluation of level of pain using Visual Analog pain scale.
- Measuring range of motion at metacarpo- phalangeal joint using goniometer (Total Active Motion)

REVIEW OF LITERATURE

REVIEW OF LITERATURE

ANATOMY OF METACARPALS

The hand skeleton is divisible into three elements of descending order of specialization:

- The thumb and its metacarpal have a wide range of motion at the carpo-metacarpal joint. Four extrinsic muscles and five intrinsic muscles are specifically influential on thumb positioning and activity.
- The index finger with independence of action within the range of motion allowed by its joints and ligaments. Three intrinsic and four extrinsic muscles allow such digital independence.
- The third, fourth and fifth fingers with their metacarpals. This unit functions as a stabilizing vise to grasp objects for manipulation by the thumb and index finger or in concert with the other hand units in powerful grasp

Metacarpal:

Metacarpal bones are the intermediate part of the hand skeleton, located between the fingers distally and the carpus which forms the connection to the forearm.

These are the 5 miniature cylindrical long bones of hand. They are numbered from lateral to medial side. Parts of metacarpal are:

1. Base or carpal extremity

2. Body or shaft

3. Head or digital extremity

Base of metacarpal:

It is cuboid. Its dorsal and volar surfaces are rough for attachment of ligaments. It articulates with distal carpal bones and adjacent metacarpals, with minimal motion at 2nd and 3rd carpo-metacarpal joints and increasing mobility from the fourth to the fifth carpometacarpal joints. [10]

Shaft:

The metacarpal narrows distally as a shaft with three longitudinal surfaces: volar-radial and volar-ulnar surfaces (for attachment of interossei muscles) and a flat dorsal surface (to accommodate extensor tendons).

Head:

It is oblong; broader extends upward on volar aspect than on dorsal aspect. The tubercle on either side gives attachment to collateral ligaments of metacarpo-phalangeal ligaments. Dorsal surface is smooth and support extensor tendons, it is grooved for flexor tendons volarly. It articulates with base of proximal phalanx.[10]

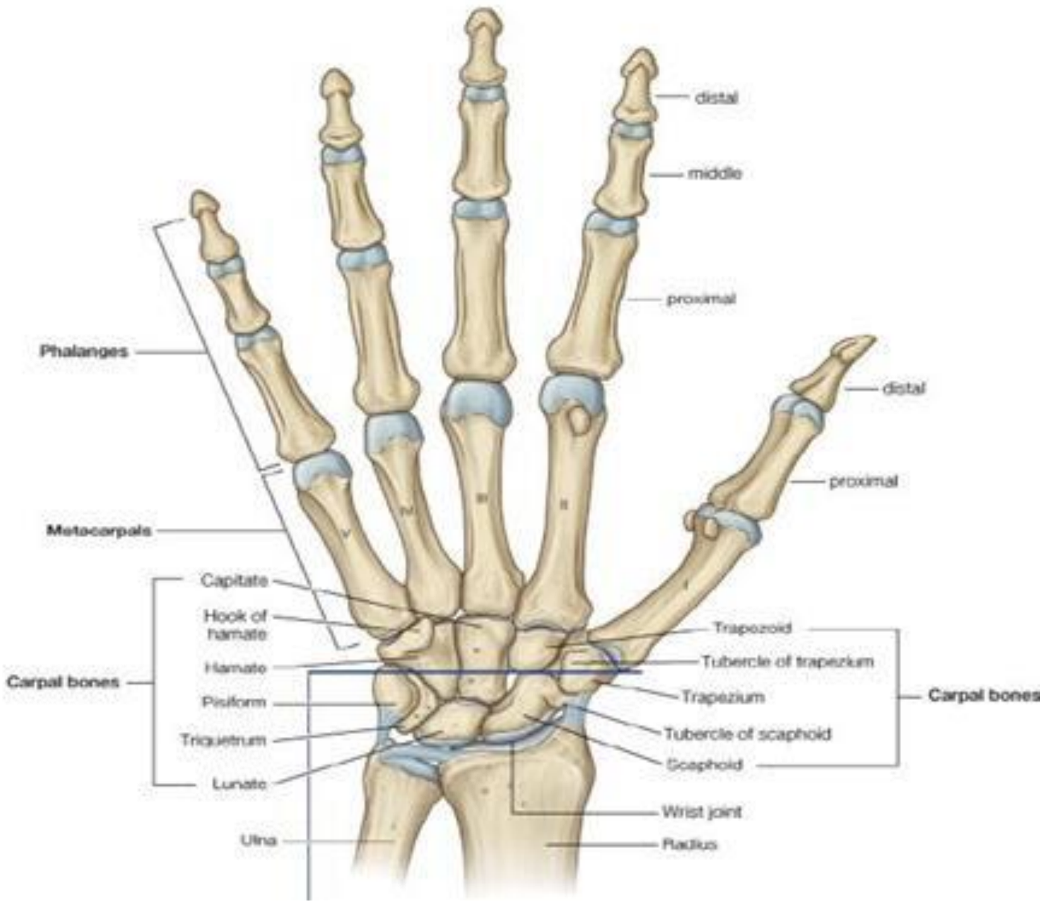


FIGURE 1: ANATOMY OF METACARPALS [10]

INDIVIDUAL METACARPAL BONES

First metacarpal (os metacarpale 1; metacarpal bone of the thumb)

The first metacarpal bone is shorter and stouter than the others, diverges to a greater degree from the carpus, and its volar surface is directed toward the palm.

The body is flattened and broad on its dorsal surface and does not present the ridge which is found on the other metacarpal bones; its volar surface is concave from above downward. On its radial border is inserted the opponens pollicis muscle, its ulnar border gives origin to the lateral head of the first interosseus dorsalis.

The base presents a concavo-convex surface, for articulation with the greater multiangular; it has no facets on its sides, but on its radial side is a tubercle for the insertion of the abductor pollicis longus. The head is less convex than those of the other metacarpal bones and is broader from side to side than from before backward. On its volar surface are two articular eminences, of which the lateral surface is the larger, for the two sesamoid bones in the tendons of the flexor pollicis brevis muscle.

The second metacarpal bone

The second metacarpal bone has the longest shaft and largest base, of the four remaining bones. Its base is prolonged upward and medial ward, forming a prominent ridge. It presents four articular facets: three on the upper surface and one on the ulnar side.

Of the facets on the upper surface the intermediate is the largest and is concave from side to side, convex from backward; the lateral is small, flat and oval. The medial, on the summit of the ridge, is long and narrow for articulation with the capitate.

The facet on the ulnar side articulates with the third metacarpal. The extensor carpi radialis longus muscle is inserted on the dorsal surface and the flexor carpi radialis longus muscle is inserted on the dorsal surface and the flexor carpi radialis muscle on the volar surface of the base.[10]

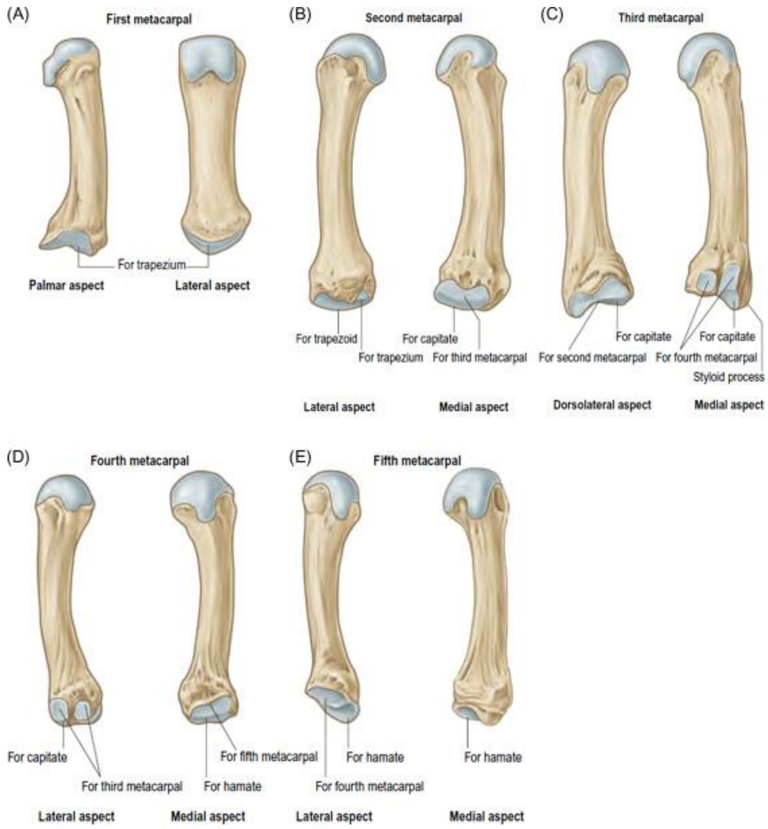


FIGURE 2: METACARPALS SHOWING PALMAR AND LATERAL ASPECT[10]

Third metacarpal /metacarpal of middle finger

It is shorter than second. The dorsal aspect of its base presents on its radial side a pyramidal eminence, the styloid process, which extends upwards behind the capitat; immediately distal to this is a rough surface for the attachment of the extensor carpi radialis brevis muscle.

The carpal articular facet is concave behind, flat in front and articulates with the capitates. On the radial side is a smooth, concave facet for articulation with the second metacarpal and on the ulnar side two small oval facets for the fourth metacarpal.

Fourth metacarpal/metacarpal of ring finger

It is shorter than third. Base is small and quadrilateral; its superior surface presents two facets, a large one medially for the articulations with the hamate and a small one laterally for the capitate. On the radial side are two oval facets, for the articulation with the third metacarpal; and on the ulnar side a single concave facet, for the fifth metacarpal.

Fifth metacarpal/metacarpal of little finger

Base has one facet on its superior surface, which is concavo-convex and articulates with the hamate, and one on its radial side which articulates with the fourth metacarpal. On its ulnar side is a prominent tubercle for the insertion of the tendon of the extensor carpi ulnaris muscle.

The dorsal surface of the body is divided by an oblique ridge, which extends from near the ulnar side of the base to the radial side of the head. The lateral part of this surface serves for the attachment of the fourth interosseous dorsalis; the medial part is smooth, triangular and covered by the extensor tendons of the little finger.

Metacarpals are key elements in forming three arches of hand. These are two transverse arches one at carpo-metacarpal joint level, other at metacarpo- phalangeal level. Third is longitudinal arch with broad convex dorsal surface formed by the metacarpals themselves.[10]

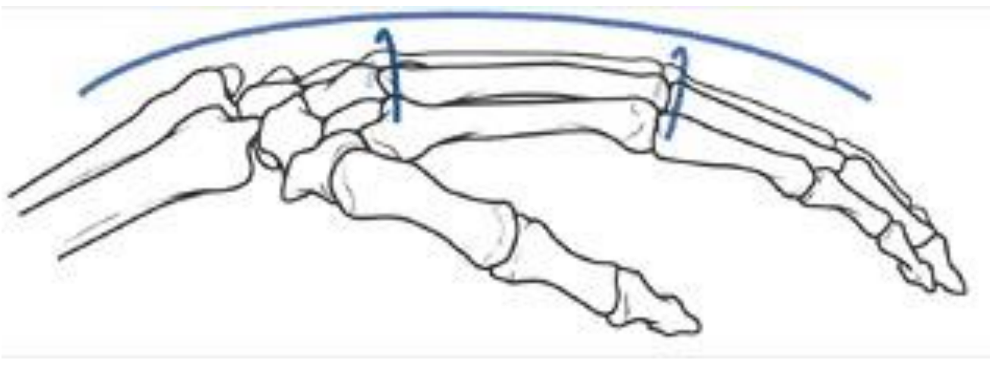


FIGURE 3: LONGITUDINAL ARCH OF METACARPAL[10]

FIGURE 4: TRANSVERSE ARCH AT CARPOMETACARPAL AND METACARPO-PHALANGEAL JOINT[10]

Ossification of hand skeleton

Each metacarpal ossifies from a primary centre for the shaft and a secondary centre which is in the base of the first metacarpal and in the heads of the other four.

Centre for the second to fifth metacarpal heads appear in second year in females and between 1.5 to 2.5 years in males. They unite with the shafts by the fifteenth or sixteenth year in females, eighteenth or nineteenth in males.

The first metacarpal base begins to ossify late in the second year in females, early in the third year in males, uniting before the fifteenth year in females and seventeenth in males. Sometimes the styloid process of the third metacarpal is a separate ossicle.

The thumb metacarpal ossifies like a phalanx. Some authorities therefore consider that the thumb skeleton consists of three phalanges. Others believe that the distal phalanx represents fused middle and distal phalanges, a condition occasionally observed in the fifth toe. [11]

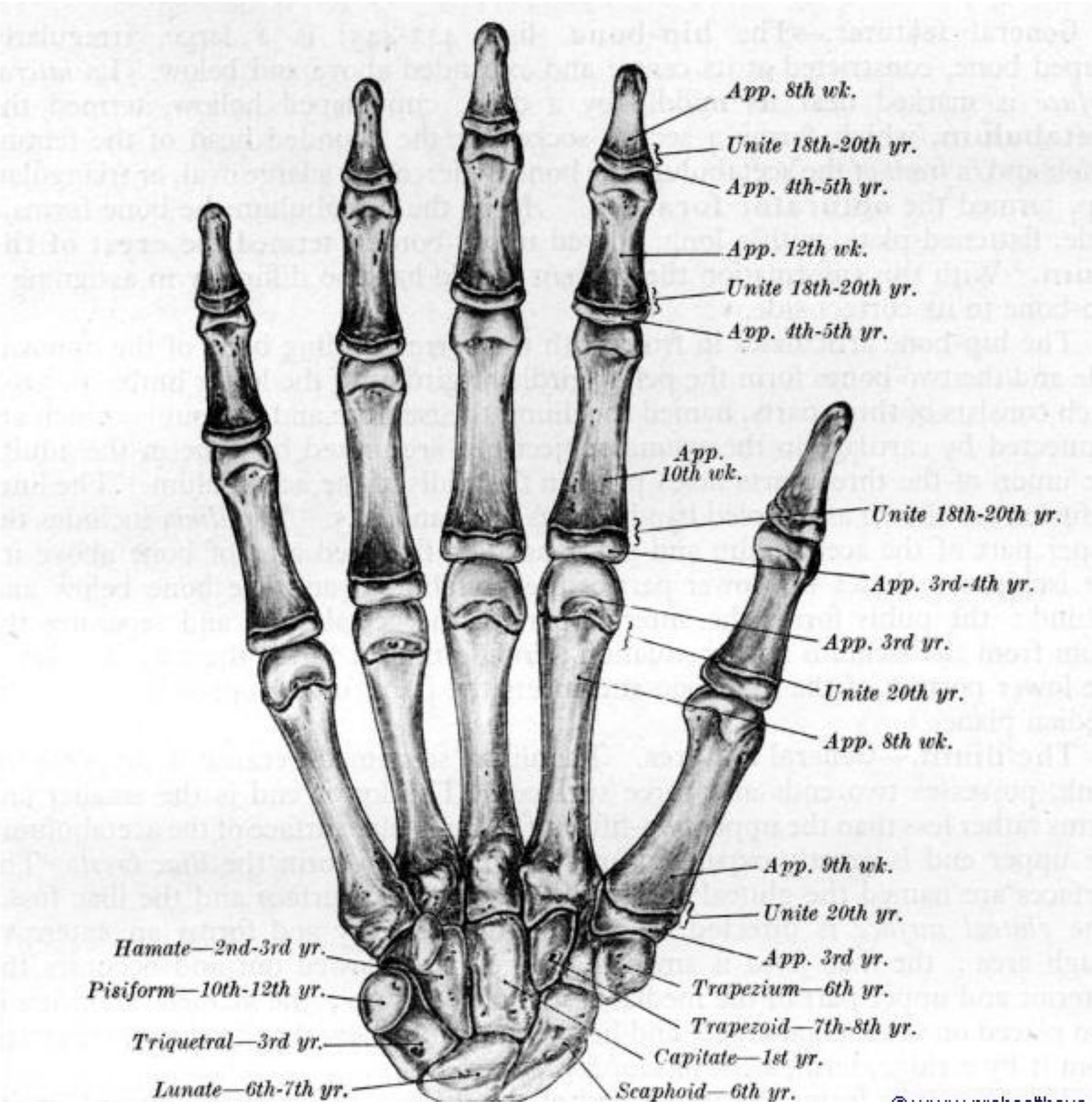


FIGURE 5: OSSIFICATION OF HAND [11]

CARPOMETACARPAL JOINTS

CARPO-METACARPAL JOINT OF THE THUMB

Articulating surfaces: The carpometacarpal joint of the thumb is a sellar (saddle) joint between the first metacarpal base and trapezium. It has wide mobility due to its extensive articular surfaces and their topology.

Ligaments: The first metacarpal and trapezium are connected by lateral, anterior and posterior ligaments and a fibrous capsule. The broad lateral ligament runs from the lateral surface of the trapezium to the radial side of the metacarpal base. The palmar and dorsal ligaments are oblique bands which converge to the ulnar side of the metacarpal base from the palmar and dorsal surfaces of the trapezium respectively. Synovial membrane lines the joint capsule and is separate from it.

Vascular supply: The carpo-metacarpal joint of the thumb receives its blood Supply from the radial artery and its first dorsal metacarpal branch.

Innervations: The carpometacarpal joint of the thumb is innervated by articular twigs from the posterior inter osseous nerve.

Joint movements: Except at initiation, flexion is accompanied by medial rotation; conversely, medial rotation involves flexion. Linkage of movements is due largely to the shape of the articular surfaces (which impose some conjunct rotation), and to the obliquity of the dorsal ligament (which, when taut, anchors the ulnar side of the metacarpal base while its radial side continues to move). Contraction of flexor pollicis brevis, assisted by opponens pollicis, Thus produces medial rotation with flexion; combined with abduction this brings the thumb pulp into contact with the pulps of the slightly flexed fingers, a movement termed opposition. (The flexed fingers have varying degrees of lateral metacarpo phalangeal rotation, which is minimal in the index, but maximal in minimus.) Conversely, full extension of the thumb metacarpal entails slight lateral rotation, attributable to the seller form of the joint and to the action of the palmar ligament (which is similar to that of the dorsal ligament in flexion). [10]

Muscles producing movements: The muscles producing movements at the carpo metacarpal joint of the thumb are as follows:

Flexion: Flexor pollicis brevis and opponens pollicis, aided by flexor pollicis longus when the other joints of the thumb are flexed. Flexion entails medial rotation.

Extension: Abductor pollicis longus and extensors pollicis brevis and longus. In full extension extensor pollicis longus, owing to its oblique pull and the disposition of the palmar ligament, rotates the thumb laterally and draws it dorsally, i.e. slightly adducts it.

Abduction: Abductors pollicis brevis and longus. When abduction is maximal the digit and metacarpal are not in line, and the thumb is abducted at both metacarpo-phalangeal and carpo-metacarpal joints.

Adduction: Adductor pollicis alone.

Opposition: Opponens pollicis and flexor brevis pollicis simultaneously flex and medially rotate the abducted thumb, interpulpal pressure, or that generated by digital grasping, is increased by adductor pollicis and flexor pollicis longus.

Circumduction: Extensors, abductors, flexors and adductors acting consecutively in this or reverse order

SECOND TO FIFTH CARPOMETACARPAL JOINT

The second to fifth carpo-metacarpal joints are synovial ellipsoid joints between the carpus and second to fifth metacarpals. Although widely classed as plane, they have curved articular surfaces which are often of complex sellar shape. The bones are united by articular capsules, dorsal, palmar and inter osscous ligaments.[10]

METACARPOPHALANGEAL JOINTS

The metacarpo phalangeal joints are usually considered ellipsoid. However, the metacarpal heads are adapted to shallow concavities on the phalangeal base. They are not regularly convex but partially divided on their palmar aspects and thus almost bicondylar

Fibrous capsule: The metacarpophalangeal joints all have fibrous capsules

Ligaments: Each metacarpo-phalangeal joint has a palmar and two collateral ligaments.

- **Palmar ligaments:** The palmar (volar plates) ligaments are unusual. They are thick, dense and fibro-cartilaginous, sited between and connected to, the collateral ligaments. They are attached loosely to the metacarpals but firmly to the phalangeal bases. Their palmar aspects are blended with the deep transverse palmar ligaments and are grooved for the flexor tendons, whose fibrous sheaths connect with the sides of the grooves.

Their deep surfaces increase articular areas for the metacarpal heads.

- **Collateral ligaments:** The collateral ligaments are strong, round cords which flank the joints. Each is attached to the posterior tubercle and adjacent pit on the side of its metacarpal head and each passes distal and anteriorly to the side of the anterior aspect of its phalangeal base. The metacarpo-phalangeal joints are lined by a synovial membrane.

- **Deep transverse metacarpal ligament:** the deep transverse metacarpal ligament are three short, wide, flat bands which connect the palmar ligaments of the second to fifth metacarpo-phalangeal joints. They are related anteriorly to the lumbricals and digital vessels and nerves and posteriorly to the interossei. Band from the digital slips of the central palmar aponeurosis join their palmar surface.

On both side of the third and fourth metacarpo-phalangeal joints, but only the ulnar side of the second and radial side of the fifth, transverse bands of the dorsal digital expansions join the deep transeverse ligaments. The lumbricals and the phalangeal attachments of the dorsal interossei lie anterior to this band and remaining attachments of dorsal interossei and palmar interossei are posterior to it.

Vascular supply: The metacarpophalangeal joints receive their blood supply from the dorsal and palmar metacarpal arteries, the arteria princeps pollicis and the arteria radialis indicis.

Innervation: The metacarpo-phalangeal joints are innervated by the branches from the palmar digital branches of the median nerve, the deep terminal branch of the ulnar nerve and the posterior interosseous nerve.

Joint movements: Flexion, extension, adduction, abduction, circumduction and limited rotation all take place at the metacarpo-phalangeal joints. Rotation cannot occur in isolation, but may accompany flexion-extension. Flexion is almost 90, whereas extension is only a few degrees. Both movements are limited mostly by antagonistic muscles. Flexion is often terminated by the resistance offered by a grasped object.

The metacarpo-phalangeal joint of the thumb has a flexion-extension range of 60 degree, which is almost entirely flexion. Other movements are adduction-abduction (maximal range 25°), which invariably accompanies the corresponding carpo-metacarpal movements and increases their combined range, and slight conjunct rotation, but greater adjunct rotation, which accompanies flexion-extension. Of the second to fifth metacarpo-phalangeal joints, the second is most mobile in adduction-abduction followed by the fifth, fourth and third.

Muscles producing movements:

The muscles producing movements at the metacarpophalangeal joints are as follows

Flexion: Flexors digitorum superficialis and profundus, assisted by the lumbricals and interossei and, in the minimus, flexor digiti minimi brevis. In the thumb, flexors pollicis longus and brevis and the first palmar interosseous. Slight lateral rotation accompanies digital flexion of digits 3-5. Flexion of the index finger may be accompanied by minimal lateral rotation or no rotation: a small degree of medial rotation is frequently observed.

Extension: Extensor digitorum, assisted in the second and fifth digits by extensor indicis and extensor digiti minimi respectively. In the thumb, extensors pollicis longus and brevis.[10]

Adduction: In extended fingers, it is by palmar interossei, In the thumb, limited metacarpophalangeal adduction is possible and may be attributable to adductor pollicis and the first palmar interosseous.

Abduction: In extended fingers, dorsal interossei assisted by the long extensors (except in the middle finger), and abductor digiti minimi in the little finger. In the thumb, abductor pollicis brevis (which also contributes to opposition). When the fingers are flexed at the IP joints, active abduction is impossible. If the long digital flexors are inactive, passive abduction is free. Inability to abduct actively in this position may be due to shortening of the dorsal interossei and abductor digiti minimi by flexion. However the altered line of pull of the interossei relative to the axis of movement is probably the determining factor in digital extension the axis of lateral movements is antero-posterior, whereas in flexion it is proximo-distal, and the line of pull of the interossei is then nearly parallel to the axis.

INTRINSIC MUSCLES OF THE HAND

The intrinsic muscles of the hand are organized into three groups plus a superficial muscle.

- Flexor pollicis brevis, abductor pollicis brevis, opponens pollicis, adductor pollicis all act on the thumb and are known collectively as the thenar muscles.
- Abductor digiti minimi, flexor digiti minimi brevis and opponens digiti minimi all act on the little finger and are known collectively as hypothenar muscles.
- Interossei and lumbricals act on the fingers.
- Palmaris brevis is a superficial muscle which lies beneath the ulnar palmar skin.

Four thenar muscles-

Abductor pollicis brevis – abducts the thumb.

Flexor pollicis brevis – flexes metacarpo-phalangeal joint of thumb.

Opponens pollicis – opposes the thumb towards the medial four fingers.

These three thenar muscles are innervated by median nerve.

Adductor pollicis – adducts the thumb and is innervated by deep branch of ulnar nerve.

Four hypothenar muscles-

Abductor digiti minimi – abducts the little finger

Flexor digiti minimi – flexes the little finger

Opponens digiti minimi – pull forward the 5^{th} metacarpal as incupping the palm

These three hypothenar muscles are innervated by deep branch of ulnar nerve

Palmaris brevis – wrinkles skin thus improving the grip of palm and is innervated by superficial branch of ulnar nerve. [12]

Lumbricals-

They are four in number and arise from tendons of flexor digitorum profundus. They cause flexion at the metacarpo-phalangeal joints and extends the interphalangeal joints of 2nd to 5th digits. 1st and 2nd lumbricals are innervated by median nerve while the 3rd and 4th lumbricals are innervated deep branch of ulnar nerve.

Palmar interossei-

They are four in number and adduct the fingers towards the centre of middle finger and is supplied by deep branch of ulnar nerve.

Origin and insertion:

1st Palmar interossei– arises from medial side of base of 1st metacarpal and inserts into the medial aspect of base of proximal phalanx of thumb.

2nd Palmar interossei- arises from medial side of base of 2nd metacarpal. It inserts into the dorsum of base of distal phalanx of index finger via extensor expansion.

3rd Palmar interossei – arises from lateral side of 4th metacarpal. It inserts into the dorsum of base of distal phalanx of ring finger via extensor expansion.

4th Palmar interossei – arises from lateral side of 5th metacarpal and is inserted into dorsum of base of distal phalanx of little finger via extensor expansion

Dorsal interossei :

They are four in number and abduct the fingers from centre of the middle finger. In addition, it flexes the metacarpo-phalangeal joints and extends the inter-phalangeal joints. These are innervated by deep branch of ulnar nerve.

Origin and insertion:

1^{st} Dorsal interossei – arises from adjacent sides of 1^{st} and 2^{nd}metacarpals

2^{nd} Dorsal interossei – arises from adjacent sides of 2^{nd} and 3^{rd}metacarpals

3^{rd} Dorsal interossei – arises from adjacent sides of 3^{rd} and 4^{th}metacarpal

4^{th}Dorsal interossei – arises from adjacent sides of 4^{th} and 5^{th}metacarpal

All these four dorsal interossei are inserted into dorsum of base of distal phalanx of 2^{nd}, 3^{rd} and 4^{th} digits via extensor expansion.[12]

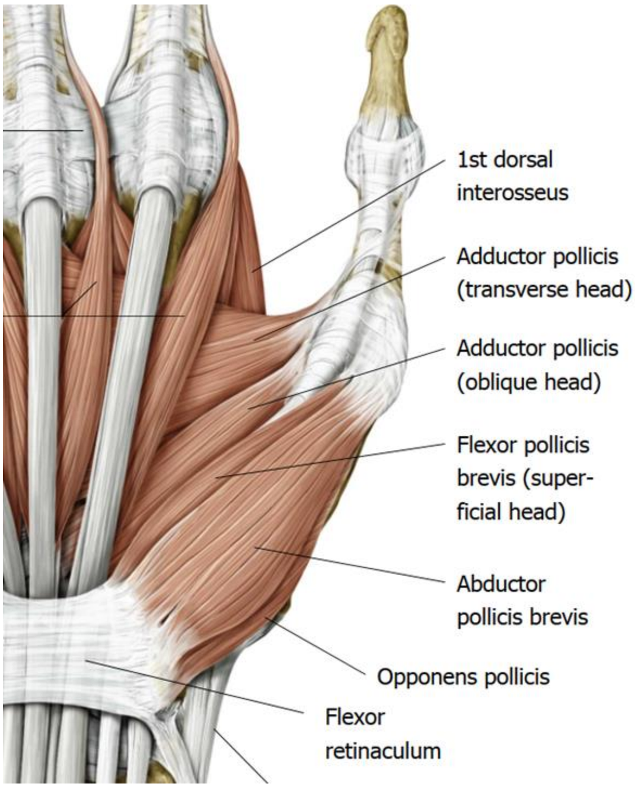


FIGURE 6: THENAR MUSCLES[12]

FIGURE 7: HYPOTHENAR MUSCLES[12]

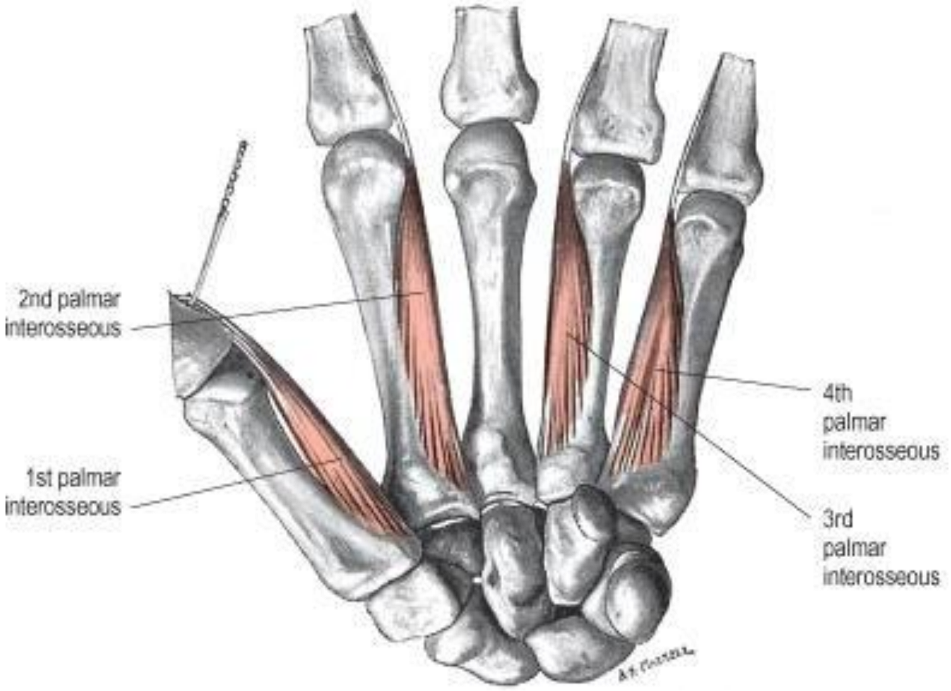


FIGURE 8: PALMAR INTEROSSEI [10]

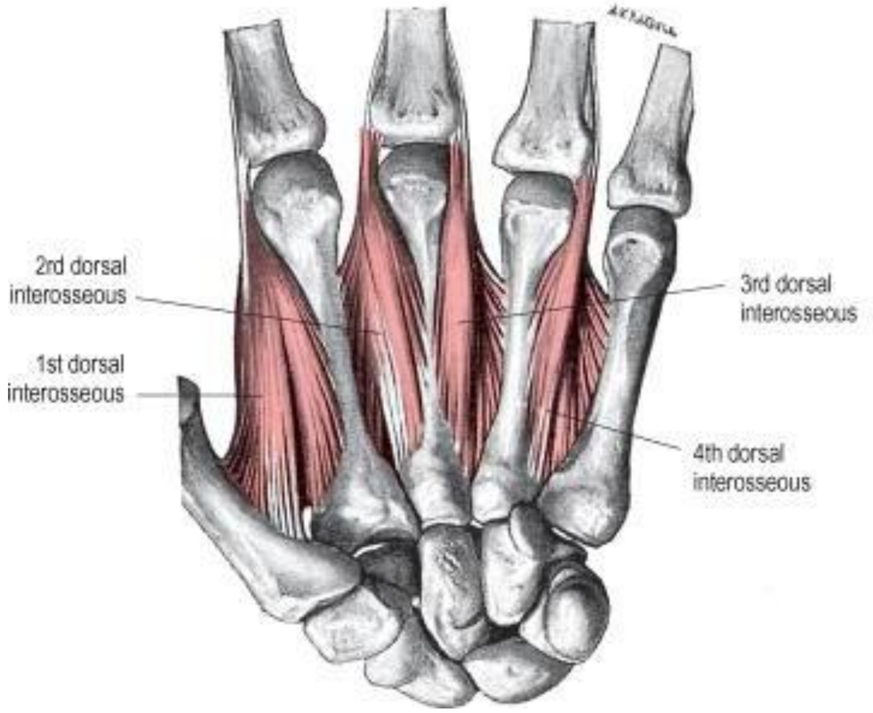


FIGURE 9: DORSAL INTEROSSEI[10]

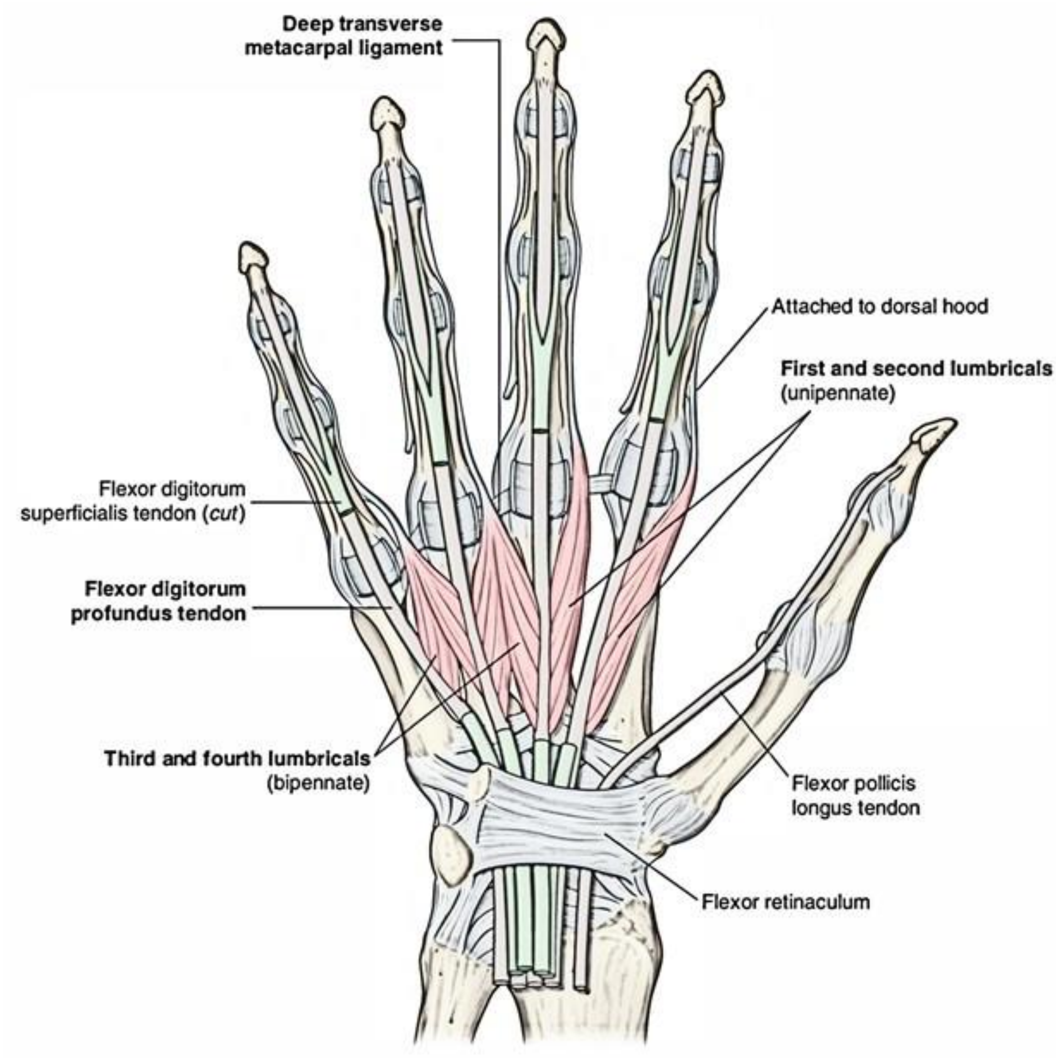


FIGURE 10: LUMBRICALS [12]

ARTERIAL SUPPLY OF HAND

Vascular supply of hand is by terminal branches of ulnar and radial arteries. superficial and deep palmar arch supplies Volar aspect of hand.

Superficial palmar arch:

It is formed by direct continuation of ulnar artery (superficial palmar branch) and joined on lateral side by superficial branch of radial artery. It gives four digital branches for medial three and half fingers and lateral three digital branches joined by palmar metacarpal arteries which arises from deep palmar arch.

Deep palmar arch:

It forms the 2nd channel connecting the radial and ulnar arteries in the palm and is situated deep to long flexor tendons. It is formed by terminal part of radial artery and completed medially by deep palmar branch of ulnar artery. It gives off Three palmar metacarpal arteries that supply medial four metacarpals, Three perforating arteries that passes through medial three interosseous spaces with dorsal metacarpal arteries.

Recurrent branch which arises from concavity of the arch passes proximally and supplies carpal bones and joints.

Dorsum of hand – is supplied by branches of radial artery and includes

1st dorsal metacarpal artery

Princeps pollicis artery

Radialis indicis artery. [10]

NERVE SUPPLY OF HAND

Ulnar nerve – It is also known as musician's nerve. It gives of two primary branches – superficial and deep branch.

Superficial branch – Is subcutaneous. It gives muscular branch to Palmaris brevis and cutaneous branch to medial one and half fingers.

Deep branch – It gives muscular branch that supplies muscles of hypothenar eminence, medial two lumbricals, both palmar and dorsal interossei and adductor pollicis. Wrist joint is supplied by its articular branch.

Median nerve – It is also known as labourer's nerve. It controls the movement of the thumb which is crucial in the mechanism of gripping by hand. It gives muscular branch to all thenar muscles except adductor pollicis and 1st and 2nd lumbricals. It gives sensory branch to lateral three and half digits.

Radial nerve – Superficial branch of radial nerve gives four digital branches which supplies the skin of digits and lateral and medial side of thumb, lateral side of index finger.[10]

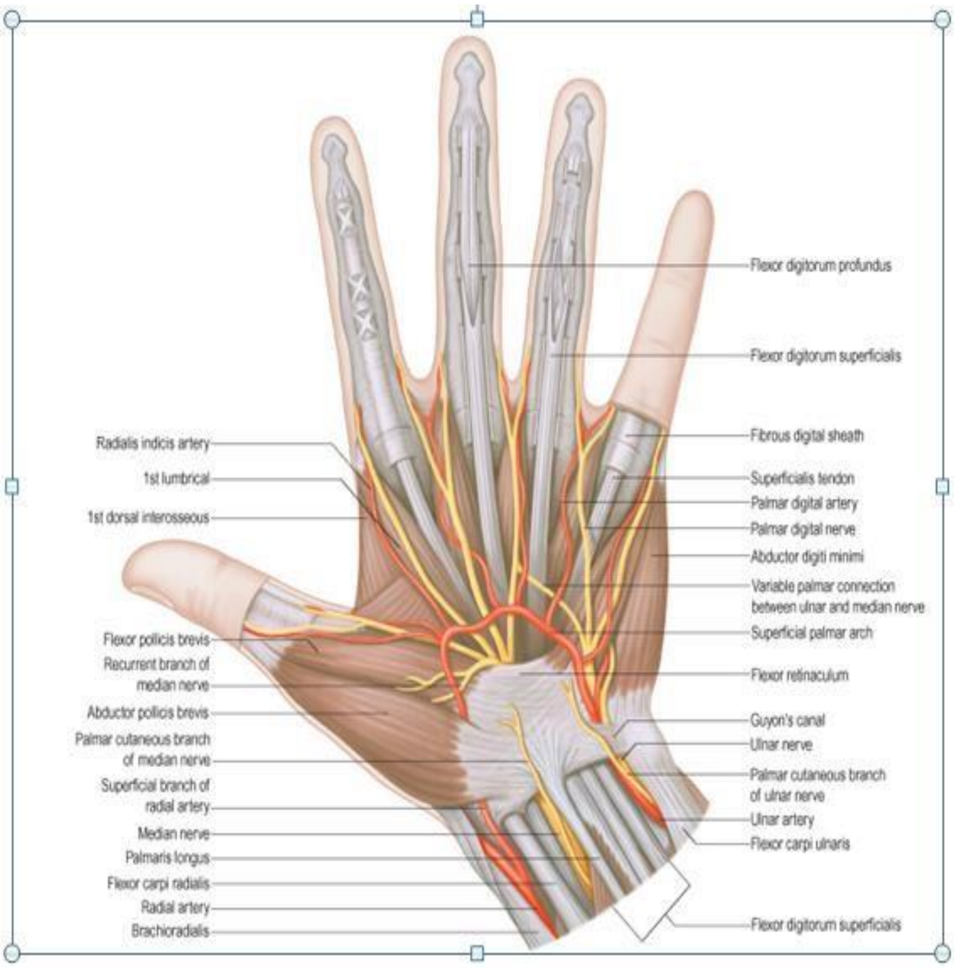


FIGURE 11: BLOOD SUPPLY AND NEVE SUPPLY OF HAND[10]

SPECIAL FUNCTIONS OF THE HAND

POSITION OF THE REST

The hand has a well recognized position of rest, with the wrist in extension and the digits in some degree of flexion. Precise position of the rest appears to be rather variable. Typically it is considered as the midpoint between maximal palmar abduction and maximal retroposition. In this position the carpo metacarpal joint lies within 0 degrees of radial abduction and 30 degree of palmar abduction and from clinical observations it seems that the metacarpo-phalangeal joint lies within 40 degrees of flexion and the inter phalangeal joint between extension and 10 degrees of flexion.

GRIPS

From different positions from the arc of circumduction, numerous, different types of pinch grips are possible. In clinical practice these have been classified into two main types: tip pinch and lateral pinch.

Power grip: In the power grip, the fingers are fixed around an object, with counter pressure from the thumb. Any skill in wielding the object derives from the limb, including the wrist. Thumb and fingers are not involved relatively.

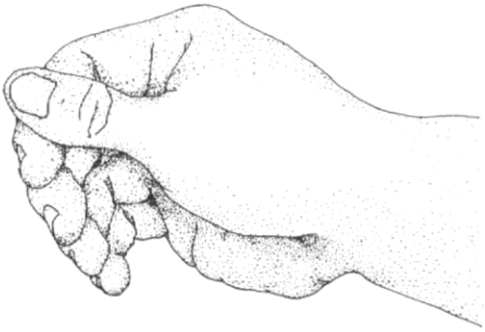
Precision grip: It varies considerably with the task, stabilizes the object between tips of the one more fingers and the thumb. The gross position of the object may be adjusted by the movements at wrist, elbow or even shoulder, but the most skilled manipulations are carried out by the digits themselves, e.g. in advancing a thread through the eye of a needle

Hook grip: The hook grip is used to suspend or to pull open objects. The fingers are flexed around the object; the thumb may not be involved. It is a grip for the transmission of forces, not for skillful manipulation.

Lateral pinch group: Powerful opposition of the thumb radially to the index finger produces a lateral pinch group, e.g. to hold a door key; here the object is larger than a key and all the fingers are involved.

hook grip

Power grip



Precision grip

lateral pinch grip

FIGURE 12: GRIPS OF HAND[12]

FUNCTIONAL POSITION OF THE HAND

The metacarpal fractures of the hand are best managed by immobilizing it in the functional position.

The position of function is assumed by the hand when all muscles are in relaxed balance.

Functional position of the hand is that position, in which the hand has the most function and is least susceptible to develop joint stiffness and contractures.

The injured hand usually tend to stiffen in a position of non-function i.e. flexion of the wrist, extension of the metacarpo-phalangeal joints and flexion of proximal and distal inter-phalangeal joints and adduction of the thumb. This is mainly due to the greater strength of the collateral and flexors as compared to the antagonist muscles and ligaments aided by edema, fibrosis and stiffness.

The chief targets are the metacarpo-phalangeal joints. Following trauma, synovial fluid increases in the joint. Metacarpo-phalangeal joints go into a position just short of full extension. As, flexor tone is greater than extensor tone, the proximal and distal inter phalangeal go into flexion. Flexor power of the wrist being stronger, the wrist goes into flexion.

TYPE OF METACARPAL FRACTURES AND METHODS OF TREATMENT

Metacarpal fractures are one most common fractures of upper extremity. 18–44 % of all hand fractures have metacarpals fracture.[13]

Treatment of metacarpal fracture is based on its anatomic location, whether it is stable or unstable and the degree of comminution.

Fractures of the metacarpal may be classified according to their anatomic location:

- Metacarpal head
- Metacarpal neck
- Metacarpal shaft

- Base of the metacarpal

Fractures which required operative fixation depends on many factors like

- Fracture geometry – transverse, oblique, spiral or comminuted
- Fracture location – extra articular or intra articular
- Fracture with deformity – angular, rotational or shortening
- Open fractures
- Associated osseous and soft tissue injury
- Intrinsic fracture stability

In general, risk of permanent stiffness should be prevented by avoiding prolonged immobilization. However, aggressive attempts of internal fixation leads to tendon adhesion, soft tissue damage, infection and need for implant removal.

Ultimate outcome depends on judicious selection of cases for operative fixation which gives better outcome than non operative management.

Indications for operative fixation of metacarpal fixation include:

- Displaced fracture like angulated transverse fracture, malrotated oblique and spiral fracture, shortened comminuted fractures
- Intra articular and peri articular fractures
- Open fracture
- Fracture with segmental bone loss
- Multiple hand fractures
- Fracture with soft tissue injury like vessel, tendon, nerve and skin.

Closed metacarpal fractures, surgery are indicated for failure to achieve successful closed reduction with residual malrotation and substantial shortening.[14]

In spite of numerous treatment modalities SWANSON states “Hand fractures are commonly complicated by deformity from no treatment, stiffness from overtreatment, poor treatment causes both.

METACARPAL HEAD FRACTURES

These are rare intra articular fractures and are mostly comminuted. Commonly present in index metacarpal because of relatively immobile carpo-metacarpal joint presumably because it is a border digit and its metacarpal base is fixed to the carpus. These are usually associated with complex dorsal metacarpo-phalangeal dislocation.

Radiological evaluation is done with AP, lateral and oblique view. Special view called Brewerton view is used to asses fracture geometry. Brewerton view is taken with metacarpo-phalangeal joint flexed to 65 degrees and dorsum of fingers lying flat on x-ray plate and x-ray tube angled to 15 degrees in ulnar to radial direction. This view gives better appreciation of articular contour. [15]

Half of the patients with communited fractures had loss of more than 45 degree of flexion at MCP joint.

Treatment:

Usually these fractures are treated by open reduction and internal fixation

Osteochondral and avulsion fractures are treated with open reduction and internal fixation with a single lag screw placed through dorsal approach.

Comminuted intra-articular fractures with metaphyseal impaction are managed by skeletal traction. But this treatment modality is associated with complication like stiffness from extensor tendon adhesion and avascular necrosis of head (common in index and middle fingers) Two part coronal, saggital and oblique intra-articular fractures are best managed by ORIF with K- wires or inter-fragmentary screws.

Stiffness is the most common complication of intra-articular metacarpal head fractures. This may result from extensor tendon adhesions, collateral ligament or dorsal capsular contracture or articular incongruity.

METACARPAL NECK FRACTURES

Metacarpal neck fractures are common and usually involve the ring and small finger metacarpals

Also known as boxers fracture. But it is a misnomer since it is rarely seen in professional boxers and is more commonly seen in brawlers and people who hit solid objects such as walls.

These fractures invariably occur when clenched MCP joint strikes a solid object and angulate with its apex dorsal. [16]

This fracture presents with problems of:

- Palpable metacarpal head in palm
- Restricted range of motion
- Loss of metacarpal head prominence

The classic deformity in metacarpal neck fractures is dorsal angulation of apex due to:

- Impaction occurs on dorsum of head
- More comminution in volar aspect
- Action of intrinsic muscle on volar aspect causing flexion of metacarpal head

Treatment

Depends on following factors:

Rotational deformity – least tolerated by index and middle metacarpal than ring and little finger metacarpal because of relatively immobile carpo-metacarpal joint of index and middle finger.

Angular deformity - up to 40 degrees is tolerated by little and ring finger whereas 10-15 degree of angulation is not accepted in index and middle metacarpals.

Various treatment modalities:

Closed reduction and cast immobilization

Closed reduction and percutaneous pinning

Closed reduction and antegrade intramedullary fixation–bouquet osteosynthesis

Open reduction and internal fixation

Closed reduction and cast immobilization (Reduction maneuver – JAHSS MANEUVER)

This method takes advantage of the anatomic fact that the collateral ligaments of the metacarpo-phalangeal joint are tight when flexed at 90 degrees.

Metacarpal neck fracture can be reduced by closed method by flexing the metacarpo-phalangeal joint to 90 degrees which relaxes intrinsic muscle and tight collateral ligaments then proximal phalanx is pushed dorsally against metacarpal head thus correcting dorsal angulation. [17]

Because of the inherent instability of this fracture, reduction is maintained in plaster with finger flexed in 90 degrees at the PIP joints (intrinsic plus position).

Closed reduction and percutaneous pin fixation

Closed reduction is achieved by JAHSS maneuver and reduction stabilized with K-wire applied longitudinal or criss cross fashion or transverse fixation to adjacent metacarpals. The pins are generally left in place for 3-4 weeks, during which time the patient may be allowed to use the hand. The major advantage is that early motion can be started without external splinting.

Closed reduction antegrade intramedullary fixation (Bouquet osteosynthsis)

Here 3 prebent K wires are passed in antegrade manner through proximal metaphysis of metacarpal. This technique is relatively stable than K-wire fixation subcutaneously but is associated with complication like articular surface damage and neuritis due to ulnar sensory nerve. [18]

Open reduction and internal fixation (plate and screw)

In acute metacarpal neck fracture ORIF is rarely indicated and is reserved for those unusual instances in which the head has been displaced entirely from the shaft of the metacarpal.

Indicated in fractures with:

1. Dorsal angulation greater than 70 degrees
2. Any rotational malalignment
3. Open fractures
4. Pseudo-clawing – here there is compensatory hyperextenson of metacarpophalangeal joint with flexion of inter-phalangeal joints due to excessive metacarpal neck flexion.[19]

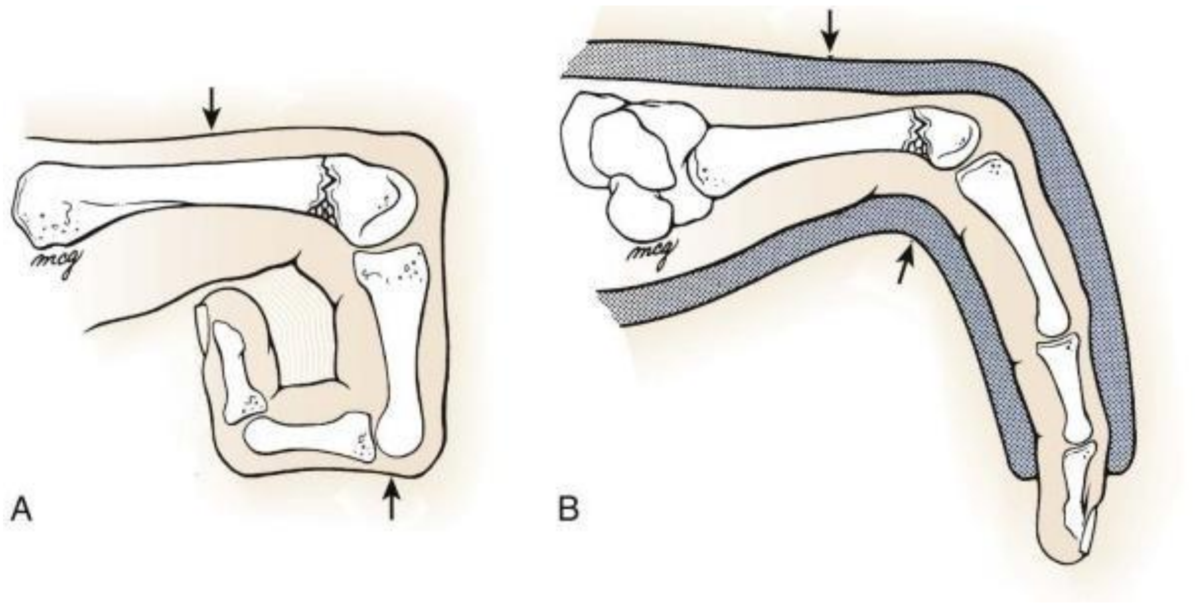


FIGURE 13: JHASS MANEUVER[17]

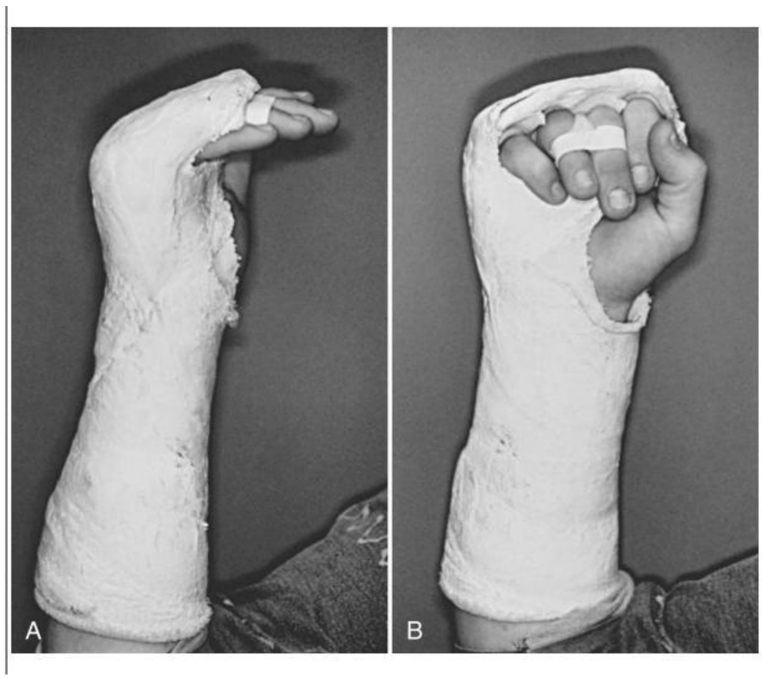


FIGURE 14: INTRINSIC PLUS CAST (FUNCTIONAL CAST) [17]

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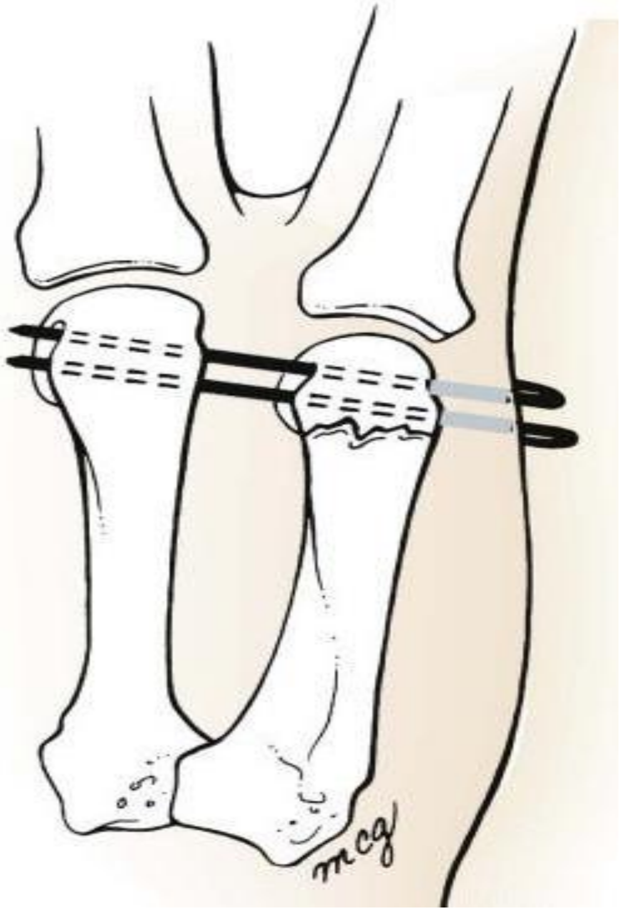


FIGURE 15: TRANS-FIXATION WITH K- WIRES [18]

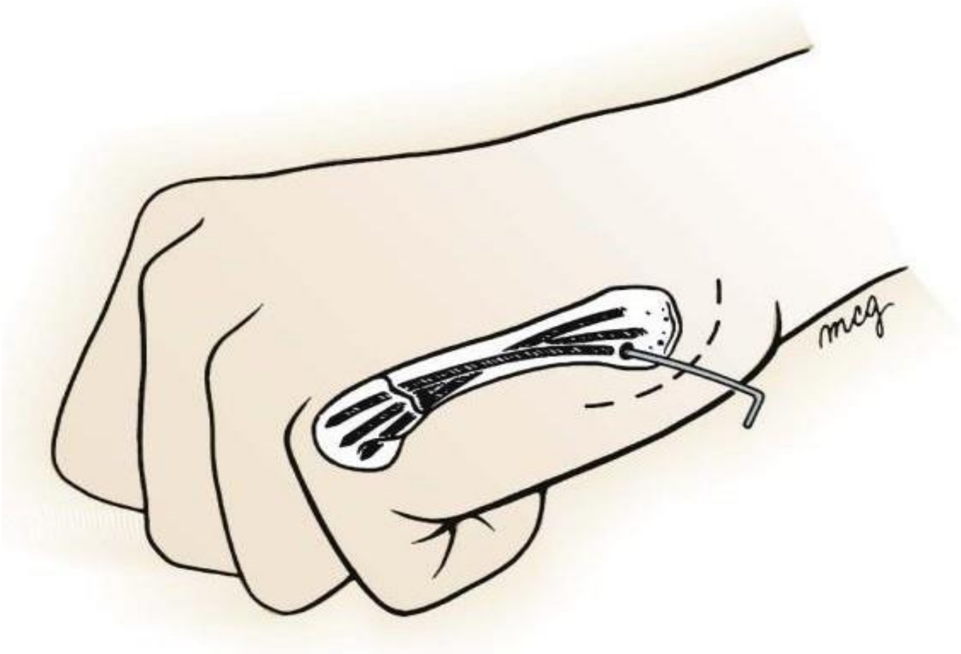


FIGURE 16: BOUQUET OSTEOSYNTHESIS [18]

METACARPAL SHAFT FRACTURES

Fractures of Metacarpal shaft are classified based on the fracture configuration:

- Transverse
- Oblique
- Spiral
- Comminuted

Metacarpal shaft fractures can deform in 3 ways:

- By rotation
- Angulation
- Longitudinal shortening

Transverse fractures

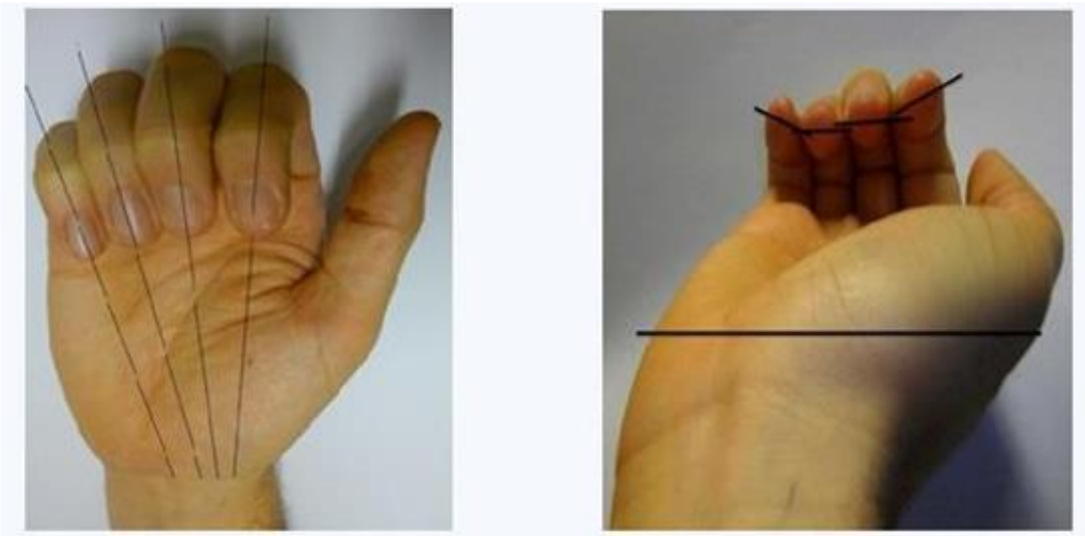
Transverse fractures are due to the result of axial loading mechanism and presents with classic deformity of dorsal apex angulation due to deforming force by interosseous muscle.

Reduction is needed when the angulation is more than 30 degree for little finger and more than 20 degree for ring finger and any amount of angulation for middle and ring finger.

Oblique and spiral fractures

These are due to torsion force mechanism and presents with classical deformity of rotational malalignment. This rotational malalignment is poorly tolerated and are hardly assessed by plain radiograph. Five degrees of malrotation in a metacarpal fracture can cause 1.5cm of digital overlap. This rotational malalignment is evident only by clinical examination by clenching the fist.

In normal patients the clenched fist shows all fingers pointing towards the scaphoid tubercle or assessed by scissoring of fingers .Normally in flexion, the digits will point to the distal pole of the scaphoid, but in metacarpal fractures with rotational deformity, there will be some degree of external rotation of the affected finger.[19]



Digits pointing scaphoid tubercle Nails being parallel to palmar surface

FIGURE 17: ASSESSMENT OF MAL-ALLIGNMENT[19]

Comminuted fractures

These are due to end result of direct impact and usually associated with soft tissue injury and presents as shortening of the finger.

Management:

Treatment options include:

- Closed reduction and plaster immobilization
- Closed reduction and percutaneous pinning
- Open reduction and K wire stabilization
- Open reduction with tension band or composite wiring
- Open reduction with plate osteosynthesis

Closed reduction and cast application

It works well for the majority of the metacarpal shaft fractures, and overtreatment is to be avoided. Many metacarpal fractures are inherently stable and may be treated with minimal or no immobilization.

a short arm cast is applied where the wrist is held in 30-40 degree of extension and metacarpophalangeal joint flexed to 80-90 degrees and interphalangeal joints extended with additional buddy strapping helping in controlling rotation. This position of immobilization is called intrinsic plus position or clam digger position. This position of immobilization relaxes the intrinsic muscles and has limited incidence of joint contractures. [20]

Closed reduction and percutaneous pinning

This treatment modality is applied in unstable metacarpal fracture. Here an awl is used to make a cortical window at the base of the metacarpal distal to the carpo-metacarpal joint. 3-4 prebent K wires (30 degree) are inserted and buried into the medullary canal. The advantages of percutaneous K wiring are, they are easy to insert, requires minimal dissection but lacks rigidity.

The pin may get loosened and distract the fracture and may lead to pin tract infection and may require additional external support in the form of splinting for initial 3 weeks. [(20)]

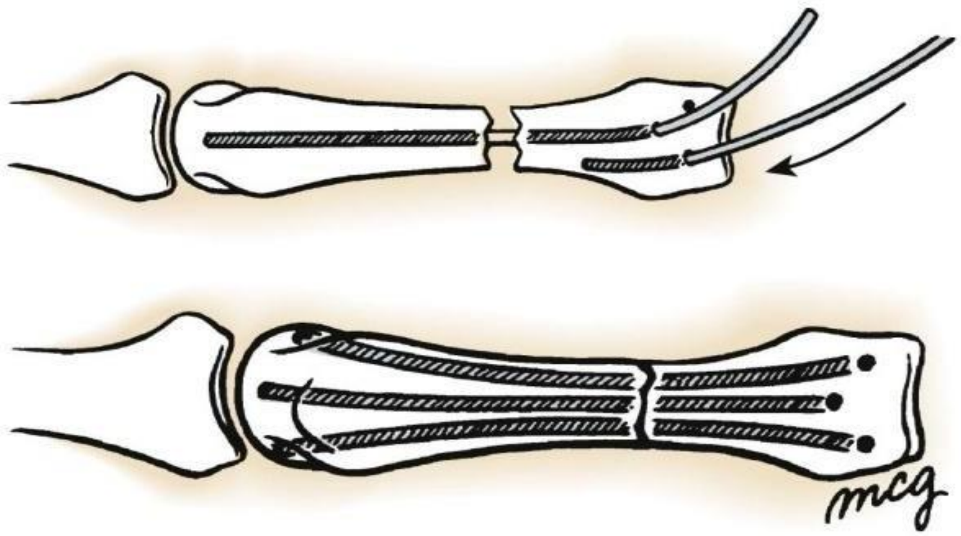


FIGURE 18: PERCUTANEOUS PINNING WITH PRE- BENT KWIRES [18]

OPEN REDUCTION

- Definitive indications for open reduction include:
- Open fractures: particularly those with associated bone loss, soft tissue injury, or additional regional fractures.
- Multiple fractures: in such cases the stabilizing effect of the adjacent metacarpal is lost.
- Unstable fractures: especially those that cannot be satisfactorily held by closed or percutaneous techniques. Fractures of the border metacarpals tend to be more unstable and more difficult to control than fractures of the central metacarpals because of the lack of support for soft tissue on both sides.
- Mal-alignment: rotational malalignment is unacceptable and is characteristically seen in spiral and oblique fractures. When correction of a rotational deformity by closed techniques or percutaneous pinning is unsatisfactory.

Open reduction and plate fixation

Open reduction is indicated in less than 5% percent of metacarpal and phalangeal fractures where closed manipulation fails. Various indications for open reduction are:

- An unstable fracture: Border metacarpals are more unstable due to lack of adjacent soft tissue support on both sides. Rigid fixation is not necessary but stable fixation is necessary for early rehabilitation
- Malaligned fractures: The rotational malalignment in spiral and oblique fractures is unacceptable which cannot be corrected by closed technique where an open reduction is needed
- Multiple metacarpal fractures: Here the stabilization effect of adjacent metacarpal is lost thus requiring open reduction
- Open fractures where there is bone loss, contamination and soft tissue injury. [21]

Complications of plate fixation include:

- Malunion
- Non-union
- Stiffness due to tendon adhesion when the periosteum could not be approximated
- Plate loosening
- Plate breakage
- Complex regional pain syndrome.[22]

OPEN REDUCTION AND INTERNAL FIXATION WITH COMPOSITE WIRING

This is a combination of Kirschner wire and monofilament stainless steel wire applied in a tension band fashion through transverse drill hole in proximal and distal fragment around crossed k wires. Gives superior strength and stiffness compared to crossed k wires. Fixation is rigid to allow early motion. It is indicated in transverse fracture with angulation. Contraindicated in fracture communition or bone loss. [23]

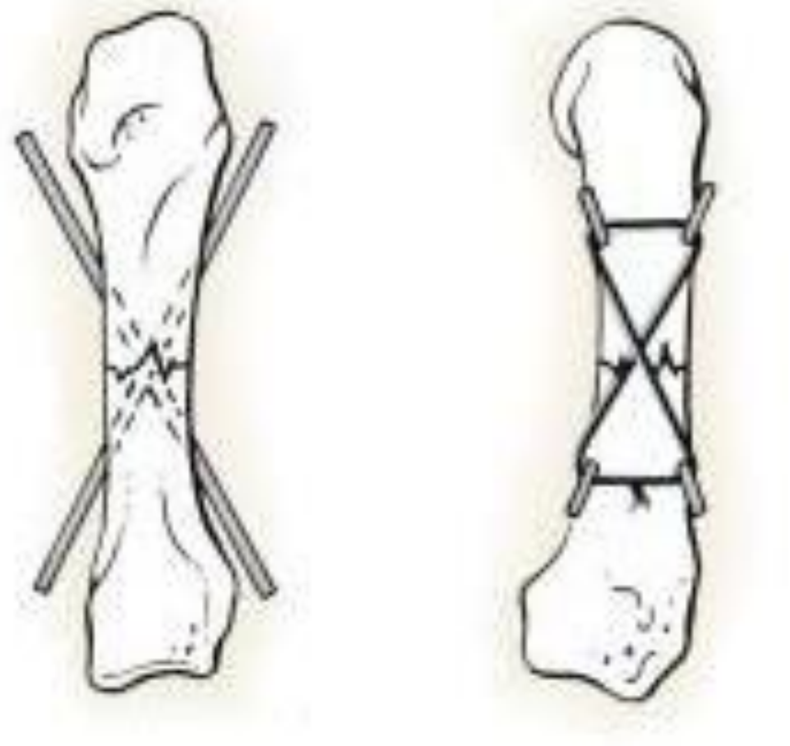


FIGURE 19: COMPOSITE WIRING [18]

Metacarpal base fractures

Isolated intra-articular fractures of the base of the second and third metacarpals are rare because of the lack of motion in these joints: hence, there is no consensus regarding optimal treatment. These are usually the result of a fall on a palmar flexed wrist

Avulsion fractures from the dorsal base of the index and/or middle metacarpals have been successfully managed both operatively and non-operatively. Justification for surgical reattachment includes restoration of the integrity of the extensor carpi radialis longus or brewis as a functional wrist extensor, reconstitution of the articular surface of the carpo-metacarpal joint, and elimination of a potentially irritating fragment of dorsal bone.

THUMB METACARPAL FRACTURES

These are classified as :

- Metacarpal head fractures
- Metacarpal shaft fractures
- Metacarpal base fractures: Rolando and bennet fractures
- Extra articular or epi-basal which is more common

Metacarpal Head Fractures

Metacarpal head fractures are unusual because the longitudinally directed force that produces them is usually dissipated at the proximal metaphysis or trapeziometacarpal joint. Displaced intra-articular fractures require anatomic reduction. Fixation can be obtained by fluoroscopically assisted percutaneous Kirschner pin placement or by open reduction.

Shaft Fractures

Fractures of the thumb metacarpal occur in three locations: shaft and base fractures and intra-articular fractures of the trapeziometacarpal joint.

Shaft fractures are uncommon because of the lack of firm fixation of the proximal portion of the bone and because stress applied to the thumb is usually well tolerated by the strong cortical shaft and is dissipated by the soft cancellous bone at its base.

Extra-articular fractures through the base are common and are usually transverse or mildly oblique. They generally occur at the proximal metaphyseal- diaphyseal junction and are referred to as epibasal. The fracture is angulated with its apex dorsal such that the distal fragment is adducted and flexed .

Closed reduction of an extra-articular metacarpal base fracture is usually easy to accomplish by longitudinal traction, downward pressure on the apex of the fracture mild pronation of the distal fragment and thumb extension. The reduction is usually stable and can be maintained in a thumb spica cast that excludes the distal phalanx.

In fractures angulated greater than 30 degrees, closed reduction and percutaneous pinning is preferred. Open reduction for transverse and oblique basilar thumb metacarpal fractures is rarely necessary.

Usual displacement of thumb metacarpal fractures is dorsal angulation. Abductor pollicis brevis and flexor pollicis brevis flexes the distal fragment while the abductor pollicis longus extends the proximal fragment.

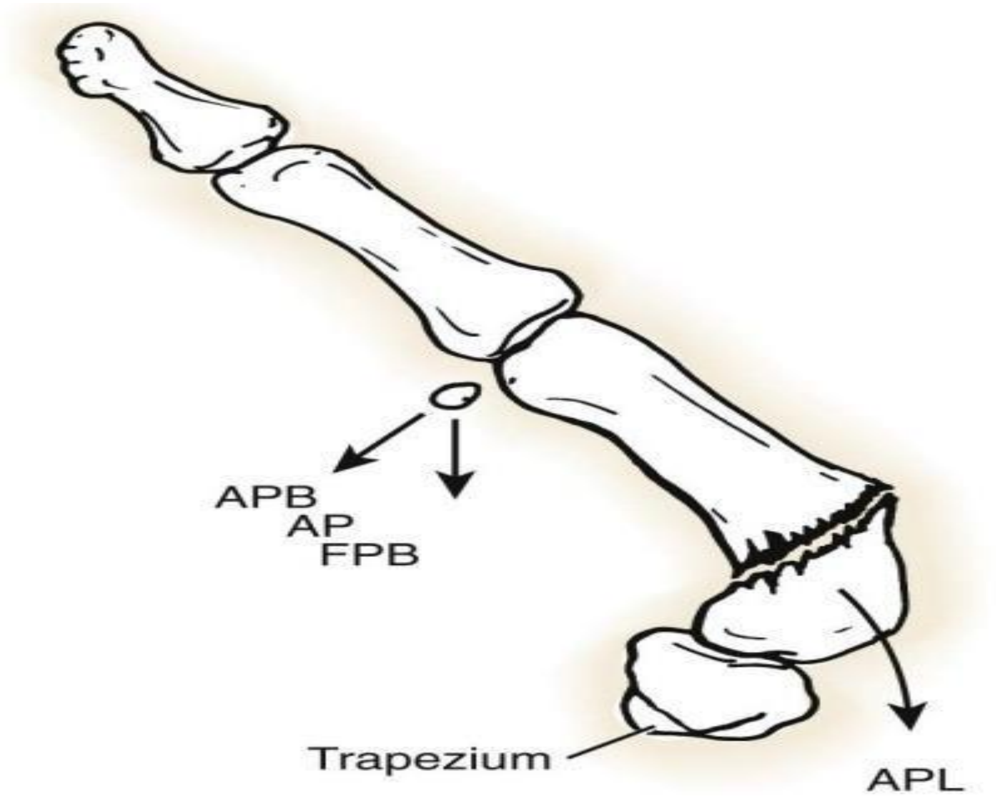


FIGURE 20: EPIBASAL FRACTURE OF THUMB METACARPAL [18]

BENNETT'S FRACTURE

It is an intra articular fracture dislocation of the base of the thumb metacarpal. Bennett fragment is a volar ulnar fragment which is held in its anatomical position by anterior oblique ligament attaching the fragment to trapezium. Remaining metacarpal base with shaft is displaced laterally, proximally and dorsally by the pull of abductor pollicis longus. [24]

This fracture is inherently unstable and always requires operative treatment. Treatment modalities are :

Closed reduction and percutaneous pinning

Reduction maneuver: – longitudinal traction is applied first. Then pressure is applied at thumb metacarpal base with pronation of thumb which reduces the fracture. Then the fracture is stabilized by percutaneous pinning of metacarpal base to trapezium. Pinning the bennett fragment is usually not indicated.[25]

Open reduction and K- wire fixation

Wagner's approach: incision is made on the subcutaneous border of the thumb metacarpal between abductor pollicis longus and thenar muscle. The joint capsule is incised and the Bennett fragment is reduced with metacarpal base using reduction clamp. Fracture fragment when sufficiently large shall be fixed with lag screw. smaller fragments are stabilized with K-wire.[26]

Complications of Bennett's fracture:

Painful arthritis – managed by trapezio metacarpal arthrodesis

First web space contracture (due to prolonged immobilization with thumb in adduction) – prevented by early mobilization.

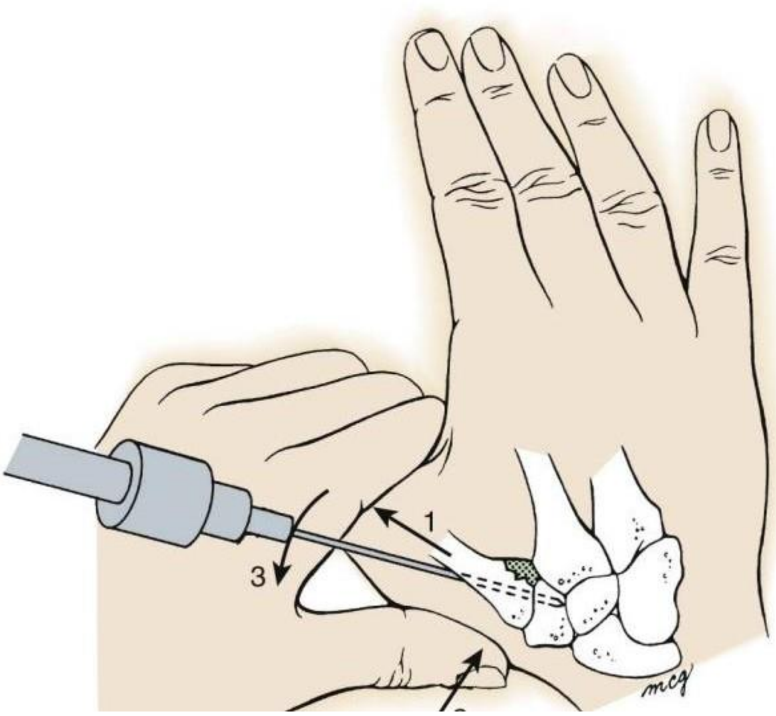


FIGURE 21: CLOSED REDUCTION AND PERCUTANEOUS PINNING

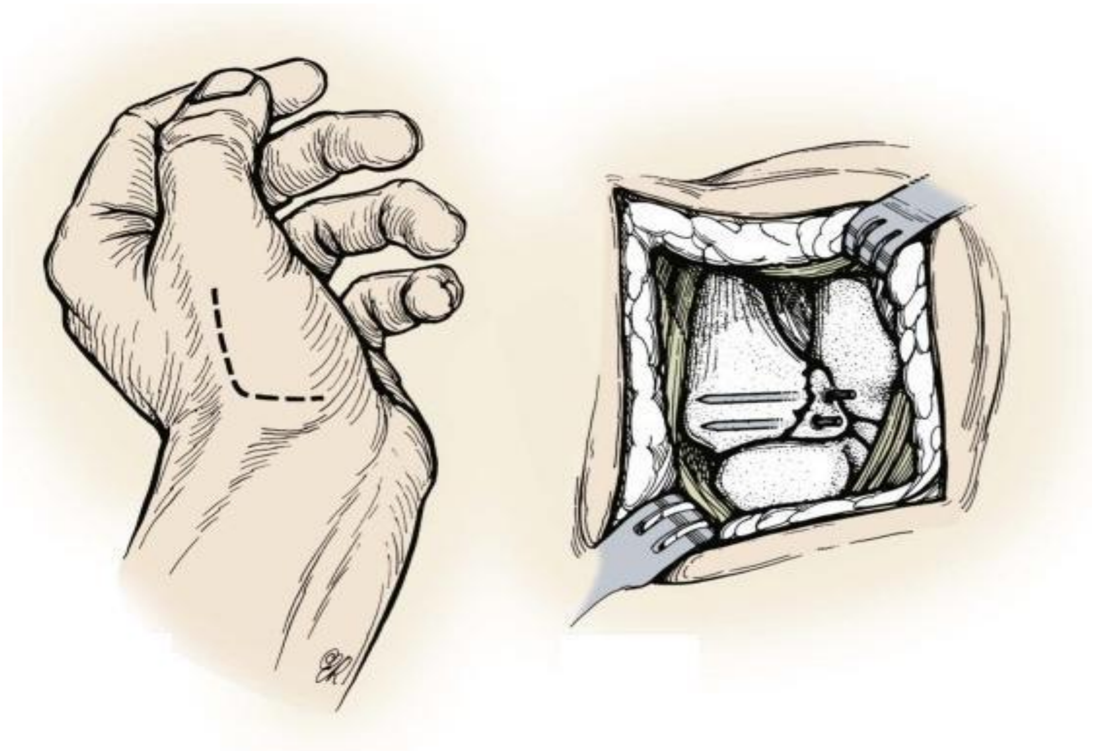


FIGURE 22: WAGNER'S APPROACH [26]

ROLANDO'S FRACTURE

It is intra articular comminuted fracture of thumb metacarpal base. They are of classically "Y" or "T" morphologies. Rolando fractures make up 15% to 20% of all metacarpal base fractures of thumb.

Rolando fractures are the result of compressive forces acting along the axis of the metacarpal shaft when the trapezo-metacarpal articulation is in a flexed position.

Indications for operative management:

Closed reduction and percutaneous pinning-

- In least comminuted two fragment fractures.
- Extra-articular fractures having more than 30 degrees of angulation following closed reduction
- Rolando fracture patterns with minimal (i.e., less than 1 mm) of displacement
- Comminuted fracture patterns not amenable to screw fixation

Open reduction and internal fixation with multiple K wires/plate osteosynthesis:

In fractures with comminuted fragments sufficiently large enough to hold the screws. Here fragments are reduced by longitudinal traction and provisional fixation done with K wires, articular congruency verified under fluoroscopy guidance and fracture stabilised with "T" or "L" configured plates and screws of 2.7 or 2mm diameter.[27]

Skeletal traction-THOREN'S TRACTION

This is an oblique skeletal traction applied in case of severely comminuted intra-articular fractures which cannot be fixed with plates and screws.

Procedure – 1cm longitudinal incision made on radial aspect of thumb metacarpal distal to the insertion of abductor pollicis longus and 1mm K wire is drilled obliquely in thumb metacarpal in distal to proximal direction then proximal end of pin is bent to 90 degrees. Wound is then closed. Then a forearm cast with bango outrigger applied excluding thumb web with rubber band traction applied for 4 to 6 weeks. This procedure is simple and associated with low complication rate. [28]

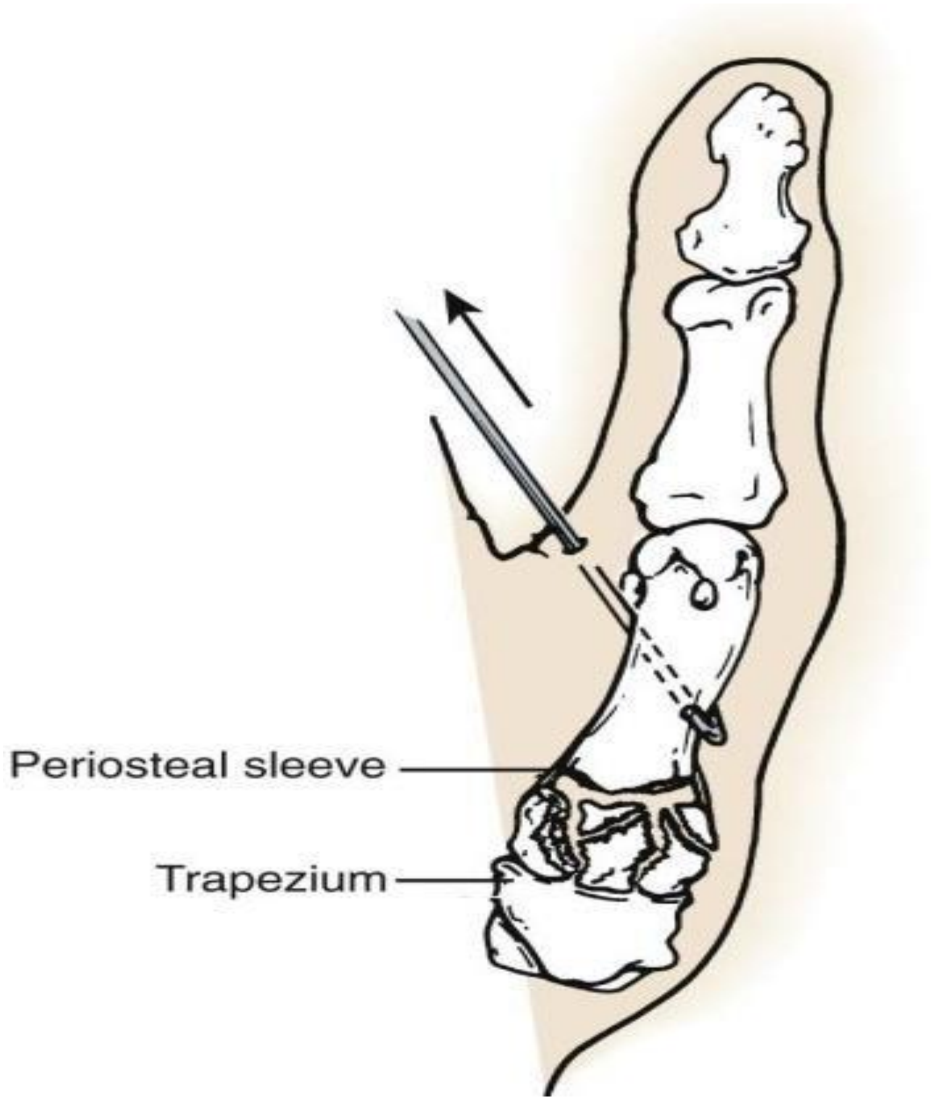


Figure 23: THOREN'S TRACTION [18]

REVERSE BENNETT FRACTURE

It is otherwise known as BABY BENNETT FRACTURE. It is a intraarticular fracture dislocation of fifth metacarpal base. It is an unstable fracture like Bennett fracture. Extensor carpi ulnaris tendon is inserted in the 5^{th} metacarpal base on the dorsal aspect which pulls the distal fragment proximally and ulnarly, whereas the small fragment on radial volar aspect is held in position by the ligament attaching the fragment to the hamate and the base of 4^{th} metacarpal.

As this fracture is inherently unstable, treatment of this fracture is closed reduction followed by percutaneous pinning. And then a protective forearm castis applied for 4 to 6 weeks.[29]

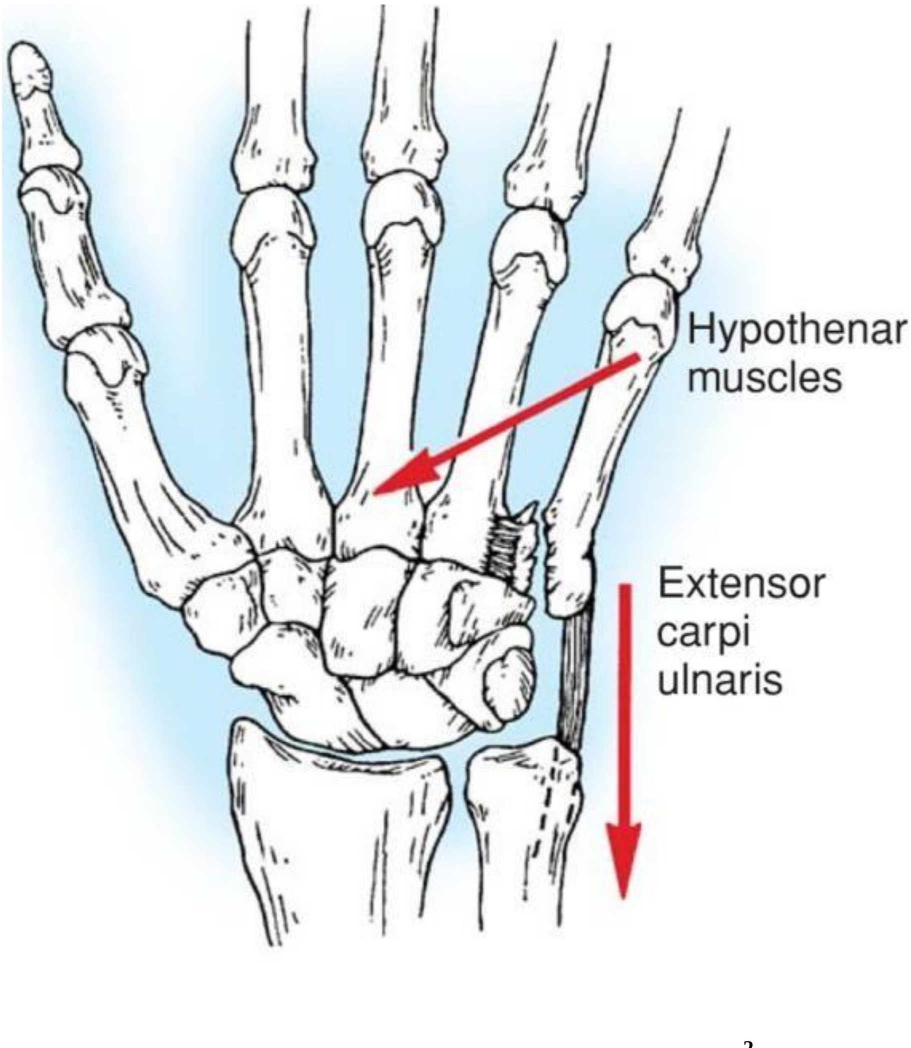


FIGURE 24: REVERSE BENNET FRACTURE [2]

LITERATURE REVIEW

Hand injuries mainly metacarpal injuries are being treated, since time immemorial.

Bennet in 1882 described the fracture at the base of first metacarpal, which bears now his name.[30]

Kirschner Wire(1909) were the mainstay of operative treatment for metacarpal fracture for many years.[31]

Lambotte(1913) described first a method of open reduction and internal fixation of the fragments with a fine nail, in the treatment of Bennet's fracture.[32]

Roberts(1938) in 73 cases of Bennet's fracture of which average of the patients was 36 and 91% of them were male explained that subluxation in these fractures can be reduced painlessly using traction and local pressure. A position of extreme abduction and extension is required for maintaining the reduction. Extra articular fracture of the base of thumb are prone for angular deformity and if left untreated, these fracture malunite with backward angulation which limits the abduction of the thumb. Reduction in these fractures are achieved by forcible manipulation under general anaesthesia and reduction is maintained by a dorsal plaster case incorporating the thumb as far as the interphalangeal joint. In his study he concluded that conservative methods of splitage and manipulation will yield good results and are much more important than any operative measures for reconstruction or osteotomy of a metacarpal fracture.[33]

Jahss S.A.(1938) introduced a new method of reduction and immobilization for metacarpal fractures. In which he explained that any one of the four inner metacarpals can be reduced by upward or dorsal pressure on the flexed distal fragment, with the metacarpophalangeal and proximal interphalangeal joints of the involved finger held at 90 degrees of flexion. This position at the metacarpophalangeal joint relaxes the interosseous muscles and at the same time tenses the collateral ligaments, permitting extension (correction of the angulation) of the distal fragment through upward or dorsal pressure on the flexed proximal interphalangeal joint. This correction can be best maintained if the plaster-of-Paris dressing is applied in two sections: the first, to immobilize the proximal fragment; and the second, to maintain the correction. But later this was modified by many surgeons, as that method was itself carrying some inherent complications of immobilization.[34]

In 1960's 809 patients (280 with fractures of metacarpals and 529 with phalangeal fractures) were reviewed by Wright. He made a distinction between unstable injuries which must be immobilized and stable fractures in which early movement gave better results for long term.[35]

Hunter (1970) in conducted a study of 133 cases with fifth metacarpal fractures. Patients hands were immobilized in functional slab for 10 days which was followed by mobilization and early use of the hand. He concluded that this method of treatment leads to early return to the duty with full functional hand. He further added that in fracture of head and neck with angulation more than 40 degree, reduction should be attempted an angulation upto 70 degree is acceptable as long as there is no rotation deformity. Fracture of fifth metacarpal neck with considerable angulation is compatible with an early resumption of function. For many years they were treated by bandaging over a roller bandage with further finger flexed.[36]

Hein Piefler (1974) author of small fragments set manual claimed that, "Rigid internal fixation enables us to achieve much better results than other procedures"[37]

Wilhelm K and Kreusser T, (1990) has found that surgical treatment is better than conservative management of splinting, immobilization and POP applications. They further added that surgical management depends on the patients compliance, the type of fracture and its localization, type of fracture (open fractures), fractures with dislocation, fractures involving the joint, condylar fractures. Special attention must be focused on defective position in axis and rotation of the fractured phalanx. Distal phalanx fractures can be treated conservatively. [38]

Lowka k (1990) of the various types of hand fractures, metacarpal fractures occur quite frequently, especially in younger people. In order to maintain hand function man's most important tool, the treatment of choice in recent years has shifted from predominantly conservative measures to more surgical management. From 1980 to 1988, 33 patients with metacarpal fractures were treated: 66% received surgical and 34% conservative treatment. They reported that the result of hand function, length of unemployment, patient's subjective complaints and the pre and post operative complications were less. [39]

Mennen U (1990) in his study fixed 15 metacarpal fractures with clamp on plate of size micro 5 (smallest available plate). Fracture was reduced; plate was placed over the fracture and held in position by pushing with the finger on the plate. Plate removing forceps were used to crimp the teeth of the plate around or inside the bone. Volar splint was used post operatively for 2 days to immobilize the wrist. All fractures were united by the end of 6 weeks. They concluded that internal fixation of metacarpal fractures has high complications rate, however, some fractures do need internal stabilization. Use of clamp on plate, which is simple to use, has very low complication rate and allows immediate immobilization.[40]

Ashkenaze D.M. and Ruby L.K. (1992) stated that Most of metacarpal fractures can be treated successfully by closed reduction and cast or splint immobilization. However unstable fractures require internal fixation. They further added to their conclusion that metacarpal dislocations are difficult to diagnose and treat than metacarpal fractures. Good results depend on the careful evaluation. [41]

D M Kahler (1995) in a review study about fractures and dislocation of base of thumb stated that these injuries are best treated surgically with exception of extra- articular fractures of metacarpal base. Closed reduction with percutaneous fixation should generally be attempted, with open reduction being reserved for cases in which residual joint incongruity persists following attempts at closed reduction. Pronation of the distal fragment is important for reduction of Bennett's fracture, as well as for apposition of the volar oblique ligament in trapezial fractures and trapeziometacarpal dislocations. The optimal treatment method for Rolando's fracture has not been established, although external fixation with limited internal fixation of the metacarpal base appears promising. [42]

Foucher(1995) introduced the "Bouquet" technique of closed antegrade nailing of metacarpal fractures using multiple small pre-bent K-wires. In his study 82 patients were treated with this technique. Sixty-two patients had fractures of the fifth metacarpal neck; two had fractures of the fifth and fourth metacarpal necks with a small skin laceration; three patients had fractures of the second metacarpal neck and one had a fracture of the distal shaft of the third metacarpal. After a follow-up period of 4.5 years, all patients were pain-free. Six patients presented an average 10 degree metacarpo- phalangeal joint extension lag and six patients had an average 15 degree MP joint flexion lag. Only one patient complained of the decreased motion. There was an average 12 degree extension lag in three PIP joints with no flexion deficit. All the patients, returned to full activity. Strength was normal in 61 cases and decreased by an average 1l % in the remaining cases. He concluded that "bouquet" osteosynthesis is a simple technique that provides enough stability for early mobilization and gives excellent functional results in the majority of patients. [43]

Kirsch B, et al (1997) in his of study of 61 patients who were treated utilizing different osteosynthesis techniques demonstrates out-standing long-term results. uncomplicated and minimally dislocated fractures can be treated conservatively. For serial fractures and fractures involving joints, however, there is no alternative to osteo-synthesis. [44]

M Schlageter, R Winkel, R Porcher, H G Haas (1997) in their study operated 61 patients with metacarpal fractures over a period of 6years with intramedullary pinning technique, which involves a Kirschner wire which is bent at one end. Apart from reducing the fracture, the pre-set Kirschner wire serves as a buttressing internal fixator. The elastic clamping of the wire acts as an internal wire spring splint, permitting early mobilisation. Anatomic reduction was achieved in 50 of 62 fractures. In the follow-up of 32 fractures, four complications i.e. one infection, two paraesthesias, and one non-union were observed. [45]

Prokop A, et al (1999) conducted analysis of treatment of metacarpal fractures for last 12 years in which 1602 metacarpal fractures were included. 522 of these fractures received surgical management (K-wire, screw fixation or external fixator). Rest all patients received conservative management. They concluded that in both conservative or surgical management 85% patients had excellent or good outcomes. Fractures with dislocations more than 30 degrees, a shortening of more than 5 mm, rotational displacement more than10 degrees, articular incongruency and significant soft tissue trauma requires primary surgical procedures. The immobilization of metacarpal fractures over a period of more than 3-4 weeks is not necessary. [46]

Thompson N s, Nolan PC and Calderwood J.W. (2000) conducted a prospective study in which 20 displaced transverse midshaft fractures of the 2nd, 3rd and 4th metacarpals treated with new technique for the fixation of fractures i.e. antegrade intramedullary fixation. In this technique after closed reduction of the fracture a blunt tipped , 1.6mm diameter K-wire was prebent. A small stab incision was made in the proximal metaphysis on the dorso ulnar aspect of the metacarpal and periosteum was elevated. The metacarpal bone was fenestrated with 2mm drill bit, which facilitates manual introduction of the K-wire into the diaphysis and across the fracture site and then impacted into the metacarpal head. All the patients in the study had good radiological and functional outcome. They concluded that above defined technique is safe method of metacarpal fracture stabilization that allows early hand mobilization with excellent clinical and radiological outcomes.[47]

Thomas B McNemar, Julianne Wright Howell, Eric Chang (2003) in their review article concluded that Operative procedures, although they may lead to excellent radiographic reduction of fractures, often lead to debilitating stiffness from the inflammatory reaction of the surgical procedure. Operative fixation must be employed judiciously and offered only when confident that non-operative therapy can be improved on with operative intervention. The temptation to pursue an anatomic reduction, at the sacrifice of function, should be avoided.[48]

Kenji Kawamura, Kevin C Chung (2006) in their review study evaluated the functional outcomes of unstable, closed, oblique phalangeal and metacarpal fractures treated by a variety of fixation techniques, like closed reduction with percutaneous pinning, transfixation with K- wires, lag screw fixation, tension band wiring and plate fixation. TAM score was used evaluate functional outcome. Authors concluded that Percutaneous K-wire fixation is a useful technique for closed oblique phalangeal and metacarpal fractures when an adequate closed reduction can be achieved. Lag screw fixation may be the best choice for open fixation of long oblique phalangeal and metacarpal fractures. For short oblique fractures, plating or tension band wiring is recommended.[49]

H Gregory Bach, Mark H Gonzalez, Robert F Hall Jr (2006) reviewed the results of the ten patients who underwent intramedullary nailing of the metacarpal for low velocity gun shot wounds. Autogenous bone grafting was used in 9 of the 10 fractures. The follow-up period averaged 26 months. The parameters evaluated included angulation, rotational alignment, shortening of the digit, postoperative metacarpophalangeal (MCP) range of motion, and time to union. They concluded that Locked intramedullary nailing of the metacarpal with autogenous iliac crest bone graft is an effective technique for treating low-velocity gunshot metacarpal fractures associated with bone loss and comminution. Locked implants maintain the satisfactory reduction until the graft incorporation and bone healing occurs. [50]

Hopfner MS, Wild M, Windolf J , Linhart W(2007) studied thirty patients with displaced neck fractures of the fifth metacarpal who received operative treatment. Fifteen patients had antegrade intramedullary splinting and fifteen patients had retrograde percutaneous pinning. Then they preferred antegrade intramedullary splinting as it avoids adhesions of the extensor hood and provide intramedullary stability. This technique seems to be advantageous in comparison with traditional retrograde percutaneous crossed pinning.[51]

Hyder Ali et al (2007) conducted a prospective study in 120 patients with 226 metacarpal fractures. For fixation of fractures Kirschner wires (K-wire) were used in 89.36% cases. The study concluded that fractures of the hand are common injuries that need early recognition and treatment. A prompt decision on the nature of therapy and the surgical technique to be adopted, will prevent many complications. Infection, segmental bone loss and associated soft tissue injuries were predisposed to non union in small percentage of cases.[52]

Gupta R, Singh R, Siwach RC, sangwan ss (2007) in evaluating 41 fractures of digit in 31 patients managed surgically with ORIF with K- wires, plates and screws and CRIF with percutaneous K- wire. Unstable metacarpal and phalangeal fractures, intraarticular fractures, avulsion fractures, fracture dislocations and open fractures with sharp and clean wounds were included in the study. The fractures were divided into four groups depending on the type of internal fixation. Group I (n=5): The closed reduction and percutaneous Kirschner wire fixation, Group II (n=10): Open/closed reduction and external fixation was performed for open fractures with sharp and clean wounds, Group III (n=26): Open reduction and Kirschner wire fixation was done in fractures where closed reduction was not possible, Group IV: Here open reduction with plate and/or screw fixation was performed for long oblique or spiral fractures of both metacarpals and phalanges. The functional outcome was assessed using TAM score. Study concluded that surgical stabilization of metacarpal and phalangeal fractures of hand seems to give good functional outcome as compared to conservative management. Many factors, such as delicate handling of tissues, preservation of gliding planes for tendon, prevention of infection and early and appropriate physiotherapy other than accurate reduction an fixation affect recovery of good mobility.[53]

Hin keung Wong, Choyee Lam, Kam- Yiu Wong(2008) in their review study concluded that Undisplaced metacarpal head fractures can be treated conservatively with immediate active mobilization. Displaced metacarpal head fractures with mild comminution should be treated with open reduction and internal fixation with or without bone grafting. Open reduction and internal fixation, traction devices, external fixator and arthroplasty are the choices of treatment for fractures with severe comminution. Metacarpal neck fractures can usually be treated conservatively by closed reduction and immobilization with plaster slab or metacarpal brace. Closed reduction and intramedullary Kirschner wire fixation is indicated for displaced fifth metacarpal neck fractures. Undisplaced metacarpal shaft fractures can be treated with closed reduction and splintage. Closed reduction and intramedullary K- wire is the treatment of choice for the fifth metacarpal shaft. They further added that early mobilization is the key to good clinical outcome. Unstable fractures should be converted into stable fractures by fixation. [54]

Somboon Wutphiriya Angkul (2009), conducted randomized, controlled trial to compare K-wire and miniplate in the management of fractures involving metacarpals. In this study 112 patients with 122 metacarpal fractures were enrolled. Patients with fracture of metacarpals were prospectively randomized into two treatment groups either K-wire or mini-plate. The operative time, pain scale, success of union, time of union, total active range of motion

(ROM), total active motion (TAM) and complications were assessed. In their they concluded that the K-wire technique has similar effective results compared to the miniplate technique in the treatment of metacarpal and phalangeal fracture with shorter operative time. [55]

Kagan O, Syed Gillani, Allison W(2008) in their prospective study treated 52 closed displaced, extra- artcular metacarpal fractures operatively using 1 of 2 fixation methods: intramedullary nailing(IMN) or Plate and screw fixation. 38 patients received IMN fixation and 14 patients received plate and screw fixation. Mean follow-up time was 18 weeks in the IMN group and 19 weeks in the PS group. The outcomes were evaluated using total active motion of the digit and Disabilities of the Arm, Shoulder, and Hand score. They concluded that there was no significant difference in the clinical outcomes using either technique. Although operative time was shorter in intramedullary nail group than in plate- screw group incidences of loss of reduction, penetration to the metacarpal-phalangeal joint and secondary surgeries for hardware removal in the operating room were much higher in the Intra-meullary nailing group.[56]

S.Facca et.al (2010) in their prospective study treated 38 metacarpal fractures operatively. 18 were managed by locking plate (group I) and 20 by intramedullary K-wire (group II). Outcomes were analyzed using pain score, DASH score and strength. It was observed that there is No significant differences were found for pain, DASH, strength, time off work or head displacement at last follow-up. Active mobility however, was significantly greater in the K-wire group. It was concluded that metacarpal fractures treated with Locking plates with immediate mobilization paradoxically provided poorer mobility at end of follow-up than intramedullary K-wire with 6 weeks' immobilization. The extra cost of locking plates was thus not justified by results. They further suggested Intramedullary K-wire nailing, the reference technique for the management of displaced fracture of the fifth metacarpal neck. [57]

Ramsey H. Chammaa, Peter, B. M. Thomas, Ali Khalil during 2010 stabilized 110 metacarpal fractures in 89 patients using percutaneous intramedullary wire. Functional outcomes were evaluated using DASH score. Mean DASH score was 4.6. They concluded that above mentioned technique is simple, reliable and effective for metacarpal fractures that are transverse and off-ended, angulated transverse or short oblique, multiple transverse or short oblique. This technique is not recommended for long oblique or rotationally malaligned fractures [58]

Hassan bousakri, Mohammed Elidrissi etal (2014) reviewed the results of 28 patients with fifth fracture treated with A single Kirschner wire (K-wire) pre-bent in a lazy-S fashion with a mild bend at approximately 5 millimeters. The average follow-up period was 20 months. Parameters like angulation, rotational alignment, postoperative metacarpophalangeal (MCP) range of motion and time to union were evaluated in this study. At the end of the study they recommended this percutaneous intramedullary nailing using a single in all boxers' fractures, especially when severe swelling of the hand is present. It is associated with good functional results and low morbidity. [59]

Jiaming XU, Changquing Zhang et al (2014) in their meta-analysis which compared the therapeutic effect of mini-plate versus Kirschner wire (K-wire) internal fixation on the treatment of metacarpal fractures. A total of 18 studies involving 1,375 metacarpal or phalangeal fracture patients (709 cases and 666 controls) were included in the meta-analysis. In this meta-analysis they concluded that the mini-plate fixation was more suitable than the K-wire fixation for the treatment of metacarpal and phalangeal fractures when considering the factors like healing time, postoperative infection, complications and hospital stays.[60]

Gajanan Deshmukh, Steve Rocha et al (2014) conducted prospective study of metacarpal fractures which were treated surgically. 50 patients with metacarpal fractures were treated operatively with various surgical techniques like closed reduction and internal fixation with K –wires and plate and screw fixation. Post operative follow-up was done at 6th weeks, 3rd months, 6th months, 1st year. Radiological outcome was assessed with X-rays; functional outcomes were assessed with DASH score, VAS score and range of motion. Study concluded that operative intervention is the treatment of choice in early recovery and mobilization of metacarpal fractures. [61]

Kangana sarathy, et al (2015) in their prospective study operated 15 boxers fractures with k-wires. Patients with open fractures, pediatric fractures, associated with other metacarpal fractures, patients with poly trauma were excluded. All the 15 patients were reviewed post-operatively at 1st week, 4th week, 8th week and at 6th month. Clinical assessment was done using pain, handgrip strength and range of motion. Radiological assessment was done by determining the palmar tilt and metacarpo-phalangeal angle. They concluded that this technique is useful method of treatment in metacarpal fractures. It is a minimally invasive method, with faster recovery time, as opposed to the time taken for healing of soft tissues after dissection, as in plate osteosynthesis. Minimal surgical scar is more cosmetically acceptable by patients than that result from plating. [62]

E. M. van Bussel et al (2017) conducted retrospective study in which 27 patients with 34 metacarpal fractures were included. Mean outpatient follow-up was 11 weeks (range 4–24 weeks). The mean interval for functional assessment was 30 months. Functional outcome was assessed with the Patient-rated wrist/hand evaluation (PRWHE) and Disabilities of the Arm, Shoulder, and Hand score (DASH) questionnaire after a minimum follow-up of 6 months. They concluded that, the antegrade intramedullary K-wire fixation technique results in low complication rates and excellent functional outcome, in surgically treated metacarpal fractures.[63]

Eisenschenk et al (2019) conducted randomized controlled trial around 12 tertiary care centers. A total of 290 patients with acute displaced fractures of the fifth metacarpal neck were randomized to either intramedullary single K-wire (n = 146) or dual-wire fixation (n = 144). DASH score was used to evaluate the outcomes at the end of the 6^{th} month. A single thick K-wire is sufficient for intramedullary fixation of acute displaced subcapital fractures of the fifth metacarpal neck. The less technically demanding single-wire technique produces non-inferior clinical and radiological outcomes compared with the dual-wire approach. [64]

Zulfiqar Ahmed et al (2020) conducted randomized control trial to evaluate the outcomes of K-wire and miniplate use in treating metacarpal and phalangeal fractures. Seventy-five patients were included in this study and randomly assigned into two groups. One group was treated with K-wire fixation, and the other group was treated with miniplate fixation. Functional outcome was assessed using TAM score and range of motion, concluded that both techniques K-wire fixation and miniplate fixation are equally effective in terms of TAM, ROM and complications when used to treat metacarpal and phalangeal fractures.[65]

Saloni malik et al (2021) in her review study concluded that treatment for a Boxer's fracture varies based on whether the fracture is open or closed, characteristics of the fracture including the degree of angulation, shortening, and rotation, and other concomitant injuries. Immobilization with an ulnar gutter splint may be the definitive treatment for closed, non-displaced fractures without angulation or rotation, while open fractures, significantly angulated or malrotated fractures or those involving injury to neurovascular structures may require operative fixation. [66]

Langqing Zeng et al (2021) conducted a retrospective study in 78 patients with isolated displaced fifth metacarpal neck fracture which were treated with closed reduction and percutaneous antegrade elastic intramedullary nailing . Thirty-three patients were treated with single antegrade elastic intramedullary nailing (single nail group). Thirty-four patients were treated with dual antegrade elastic intramedullary nailing (dual nails group). The patients were followed up at 2, 4 and 6 weeks and at 3, 6 and 12 months. For radiological assessments, dorsal angulation and metacarpal length were radiologically measured for clinical assessment, Disabilities of the Arm, Shoulder, and Hand questionnaire (Quick-DASH score) was used. In the study they concluded that both single and dual AEIMN fixations are safe and effective treatment options for fifth metacarpal neck fractures. Dual antegrade intramedullary nailing fixation provided better MCP extension and radiological outcomes than single antegrade intramedullary nailing fixation.[67]

MATERIAL & METHODS

MATERIALS AND METHODS

Study site: This study was conducted in the department of at R.L. Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Tamaka, Kolar.

Study population: Patients admitting in orthopaedics ward from O.P.D. and casualty at R.L.Jalappa Hospital and research centre, attached to Sri Devaraj Urs Medical College , meeting the inclusion and exclusion criteria.

Study Design: The current study prospective, observational and hospital-based study.

Sample size: Sample size is estimated based on overall functional outcome results as 64% in a study by dr. Rahmat ali et al, considering margin of error as 15% the estimated sample size is 39 cases of metacarpal fractures.

Formula

$$n = \frac{Z^{2}_{1-\alpha/2}\, p(1-p)}{d^{2}}$$

Where,

p : Expected proportion

d : Absolute precision

$1-\alpha/2$: Desired Confidence level

Study duration: The data collection for the study was done between October2019 to April 2021.

Ethical considerations: Study was approved by the institutional ethics committee. Informed written consent was obtained from all the study participants, and only those participants willing to sign the informed consent were included in the study. The risks and benefits involved in the study and the voluntary nature of participation were explained to the participants before obtaining consent. Confidentiality of the study participants was maintained.

Inclusion criteria:

Patients aged between 18-60 years with single/multiple metacarpals bone fracture presenting to the OPD or casualty within 2 weeks.

Exclusion Criteria:

- Metacarpal fracture associated with phalanx fracture.
- Comminuted fractures.
- Compound fractures.
- Pathological fractures.

Data collection tools: All the relevant parameters were documented in a structured study proforma.

Methodology

Patients of age between 18 to 60 years presenting to R.L. Jalappa Hospital attached to Sri Devaraj Urs Medical College with isolated Fracture of metacarpal will be taken up for the study.

After obtaining the informed consent from the patients who agree to be part of study, demographic data, history, clinical examination and details of investigations will be recorded in study proforma and patient will undergo closed reduction and internal fixation with Kirschner wire under wrist block and aseptic precautions

Pre operative evaluation: The fractures will be evaluated on the basis of comminution, transverse, spiral, vertical split, presence or absence of displacement, presence or absence of deformity on pre reduction AP and oblique radiograph.

Post operative evaluation: post op evaluation by x-ray (AP and oblique view), measuring range of motion with goniometer at metacarpo-phalangeal joint(TAM score), pain with VAS and functional outcome with DASH score.

The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire:

It is a self-administered region-specific outcome instrument developed as a measure of self-rated upper-extremity disability and symptoms.

The main part of the DASH is a 30-item disability/symptom scale concerning the patient's health status. The items ask about the degree of difficulty in performing different physical activities because of the arm, shoulder, or hand problem (21 items), the severity of each of the symptoms of pain, activity-related pain, tingling, weakness and stiffness (5 items), as well as the problem's impact on social activities, work, sleep, and self-image (4 items). Each item has five response options.

The scores for all items are then used to calculate a scale score ranging from 0 (no disability) to 100 (most severe disability). [68]

Calculation of DASH scores:

dash score= ([sum of n responses/ n]-1) x 25

N- it is the number of completed response.

A Dash score cannot be calculated if there are greater than 3 missing items.

	No Difficulty	Mild Difficulty	Moderate Difficulty	Severe Difficulty	Unable
1. Open a tight or new jar.	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
2. Write	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
3. Turn a key	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
4. Prepare a meal	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
5. Push open a heavy door	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
6. Place an object on a shelf above your head	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
7. Do heavy household chores (e.g., wash walls, floors, etc.).	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
8. Garden or do yard work	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
9. Make a bed	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
10. Carry a shopping bag or briefcase.	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
11. Carry a heavy object (over 10 lbs)	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
12. Change a light bulb overhead	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
13. Wash or blow dry your hair	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
14. Wash your back.	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
15. Put on a pullover sweater	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
16. Use a knife to cut food.	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.)	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
18. Recreational activities in which you take some force or impact through your arm, shoulder, or hand (e.g., golf, hammering, tennis, etc.)	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
19. Recreational activities in which you move your arm freely (e.g., playing frisby, badminton, etc.)	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
20. Manage transportation needs (getting from one place to another)	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5
21. Sexual Activities	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5

	Not At All	Slightly	Moderately	Quite A Bit	Extremely
22. During the past week, to what extent has your arm, shoulder, or hand problem interfered with your normal social activities with family, friends, neighbors, or groups?	☐ +1	☐ +2	☐ +3	☐ +4	☐ +5

Figure 25: DASH score

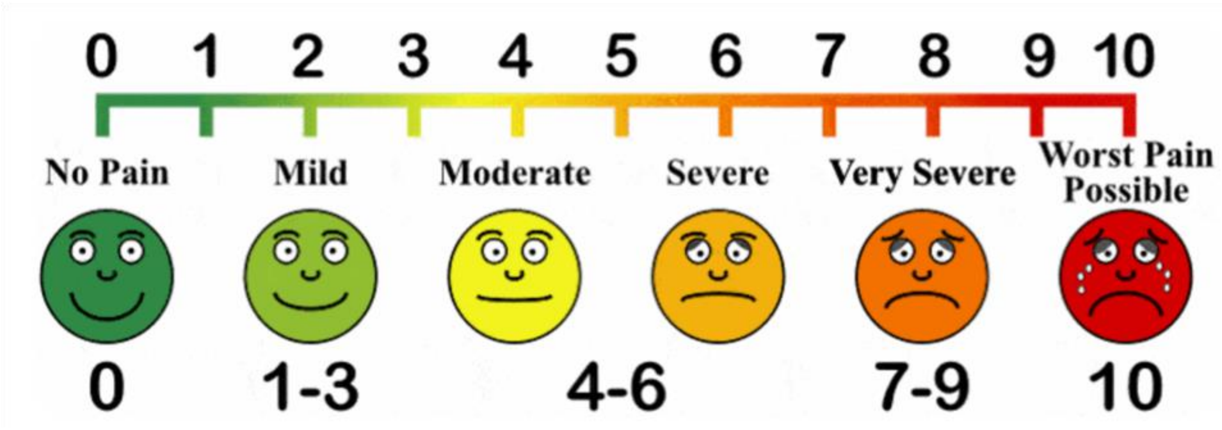


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Figure 26: VAS scale

PROCEDURE

Hand and distal half of the forearm was scrubbed with betadine scrub and savlon. Pneumatic or Esmarch's rubber tourniquet was used in all patients after exsanguination of blood.

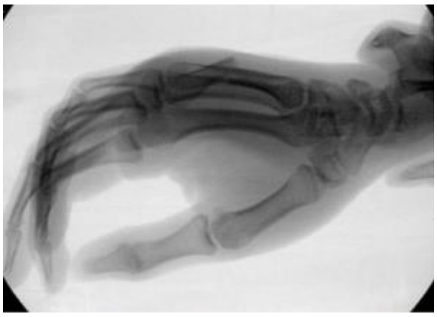
Operative side painted with betadine solution. Affected limb was placed over side arm rest. Sterile draping done.

Technique for retrograde insertion of K- wire

The fracture was reduced using the closed Jahss reduction maneuver. the metacarpophalangeal and proximal interphalangeal joints are flexed to an angle of 90, and upward pressure is applied on the flexed finger to correct dorsal angulation.

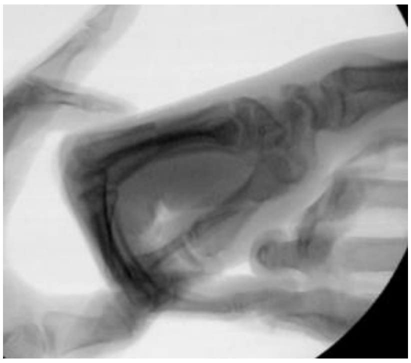
Once the fracture was reduced, a K-wire, mounted in a wire driver drill, was inserted through the metacarpal head in the retrograde direction, while reduction with the Jahss maneuver was maintained. The wire was inserted into the volar third in the sagittal plane of the metacarpal head, and the wire was advanced in a slightly dorsal direction to emerge at the carpometacarpal joint without penetrating the carpal bone. Then, after checking the location of the wire under an image intensifier, the wire was advanced across the fracture site into the medullary cavity of the proximal fragment. The wire was advanced to the proximal end of the metacarpal with the use of a hammer.

Proper rotational alignment was determined in relationship to the other fingers by flexing the other fingers to see that it points the scaphoid tubercle. [69]



Intra-op C-arm images

Reduction of fracture with Jhass maneuver



reduction confirmed under C- arm

placement of wire using drill

Kirschner wire was advanced using a hammer

Figure 27: retrograde insertion of K- wire

Technique for antegrade insertion of K- Wire

Mohammed Farook et al- described a single K-wire is prebent in a lazy S manner with a mild bend approximately 5 mm and a longer smooth curve bent in opposite direction.

Depending on the metacarpal dimensions, either a 1.6 or a 2.0 mm K –wire is used. Under image intensifier, an initial entry point is made at the base of the involved metacarpal using a 2.5mm drill wire by hand.

A T- piece mounted K- Wire is then inserted blunt end first in an antegrade manner into the medullary canal after fracture reduction. The advancing end of the wire in the form of a hockey club can be used to aid reduction of the fracture and the wire is then passed across the fracture site. Final position of the reduction is checked on the fluoroscopy and the wire is cut with the tip left out of the skin.[63]

Post operative management:

- IV fluids
- IV antibiotics consisting of third generation of cephalosporin and amikacin
- Analgesics
- Half hourly T.P.R.
- Limb was elevated for 24-48 hours.
- Distal neurovascular examination was done.
- Active movements of fingers were advised as early as possible.

The wound was inspected on 2nd post operative day. Sutures were removed on 14th day depending on the condition of the wound.

Mean while post-operative check X- ray was taken and POP slab applied in functional position of hand and immobilized with sling.

The patient was discharged after suture removal with the instructions to do active movements of fingers and to wear sling continuously.

Follow up

Patients were assessed with DASH score and VAS (visual analogue scale) for pain, TAM score for range of motion at metacarpo-phalangeal joint with goniometer post-procedure period of immediate post operation, 1 month, 2 month and 6 months. A reduction in DASH score and VAS score for pain and improvement in TAM score suggestive of improvement in the patient's condition.

STATISTICAL METHODS

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Non normally distributed quantitative variables were summarized by median and interquartile range (IQR).

Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as 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.

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

RESULTS

RESULTS

A total of 39 subjects were included in the final analysis.

Table 1: Age distribution of subjects

		Count	%
Age	<30 years	13	33.3%
	31 to 40 years	12	30.8%
	41 to 50 years	9	23.1%
	51 to 60 years	5	12.8%
	Total	39	100.0%

In the study majority of 33.3% subjects were in the age group <30 years, followed by 30.8% were aged between 31 to 40 years, 23.1% were aged between 41 to 50 years and 12.8% were aged between 51 to 60 years. (table 1)

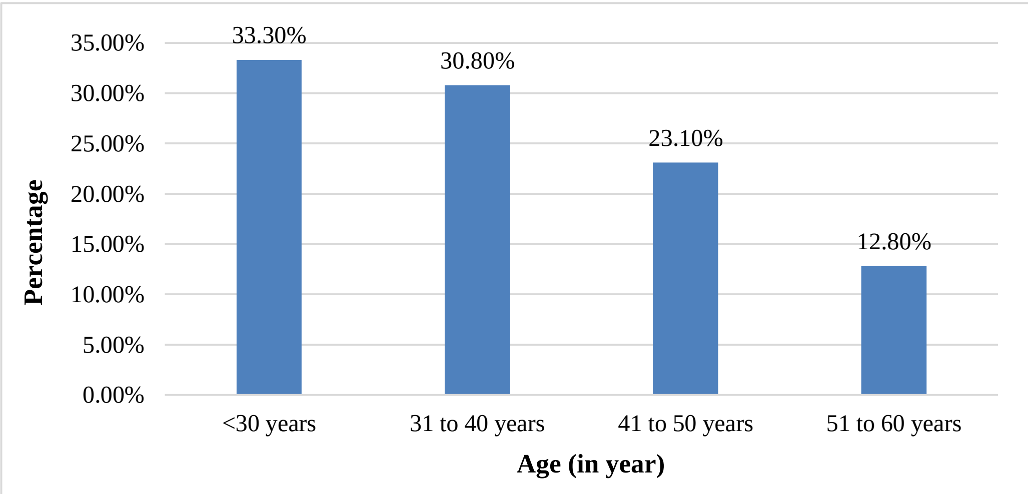


FIGURE 28: BAR DIAGRAM SHOWING AGE DISTRIBUTION OF SUBJECTS

Table 2: Gender distribution of subjects

		Count	%
Gender	Female	7	17.9%
	Male	32	82.1%
	Total	39	100.0%

In the study 82.1% participants were males and 17.9% participants were females. (table 2)

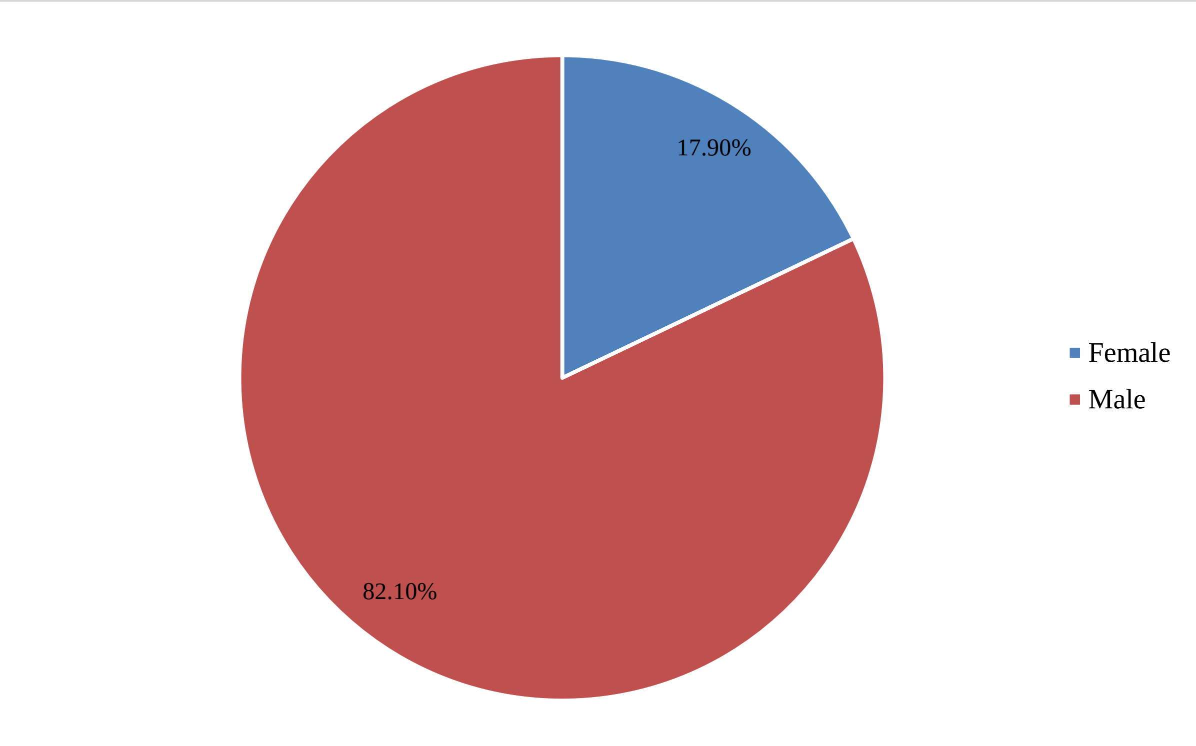


Figure 19 : PIE DIAGRAM SHOWING GENDER DISTRIBUTION OF SUBJECT

Table 3: Mode of Injury distribution

		Count	%
Mode of Injury	Assault	6	15.4%
	Fall	2	5.1%
	Punch	2	5.1%
	RTA	29	74.4%
	Total	39	100.0%

In the study most common mode of injury was RTA in 74.4%, assault in 15.4%, fall and Punch in 5.1%. (table 3)

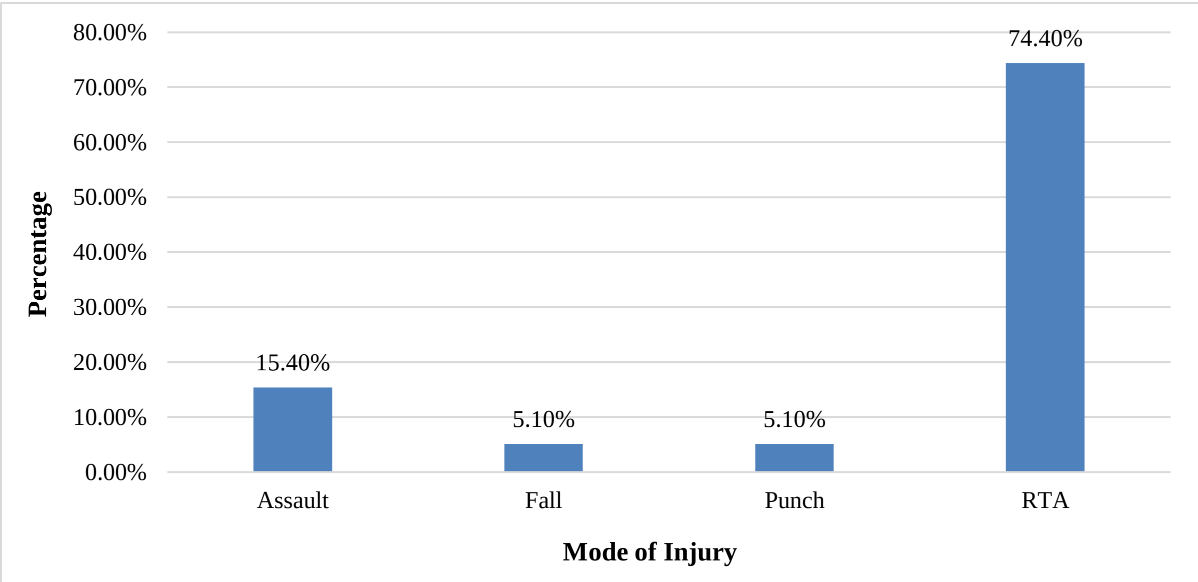


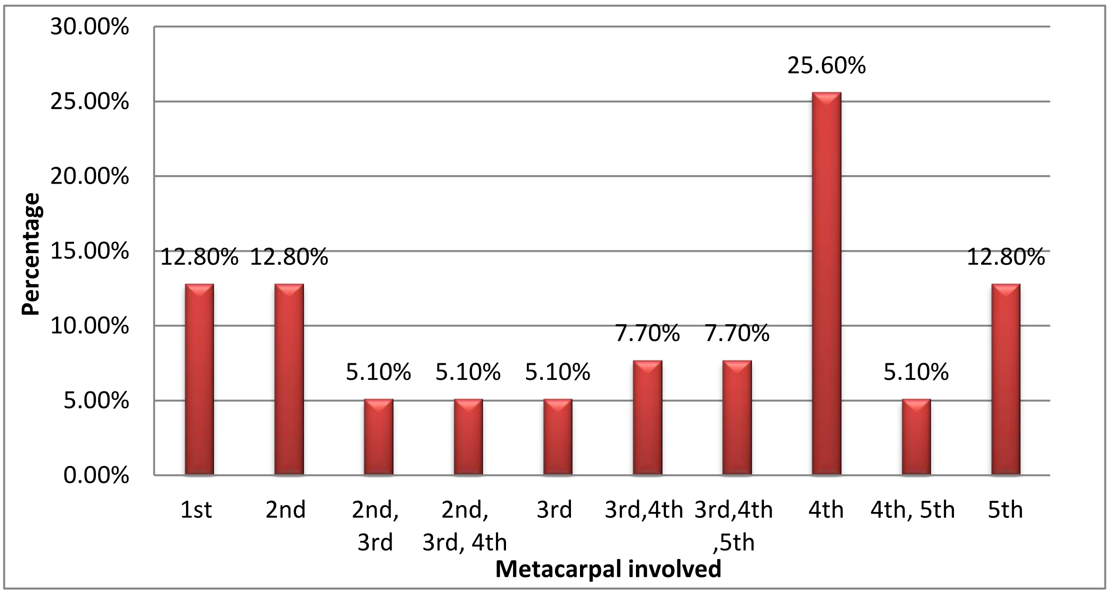
FIGURE 30: BAR DIAGRAM SHOWING MODE OF INJURY DISTRIBUTION

Table 4: Metacarpal involved distribution

		Count	%
Metacarpal involved	1st	5	12.8%
	2nd	5	12.8%
	2nd, 3rd	2	5.1%
	2nd, 3rd, 4th	2	5.1%
	3rd	2	5.1%
	3rd,4th	3	7.7%
	3rd,4th ,5th	3	7.7%
	4th	10	25.6%
	4th, 5th	2	5.1%
	5th	5	12.8%
	Total	39	100.0%

In the study most common metacarpal involved was 4th Metacarpal (25.6%), followed by 1st, 2nd and 5th metacarpal in 12.8% respectively. (Table 4)

FIGURE 31: BAR DIAGRAM SHOWING METACARPAL INVOLVED



DISTRIBUTION

Table 5: Part involved distribution

		Count	%
Part involved	Base	5	12.8%
	Head	3	7.7%
	Neck	3	7.7%
	Shaft	22	56.4%
	Shaft, Base	2	5.1%
	Shaft, Neck	2	5.1%
	Shaft, Base, Base	2	5.1%
	Total	39	100.0%

In the study most common part of metacarpal involved was shaft (56.4%). Followed by, base involved was 12.8%, head and neck was 7.7% for each respectively. (Table 5)

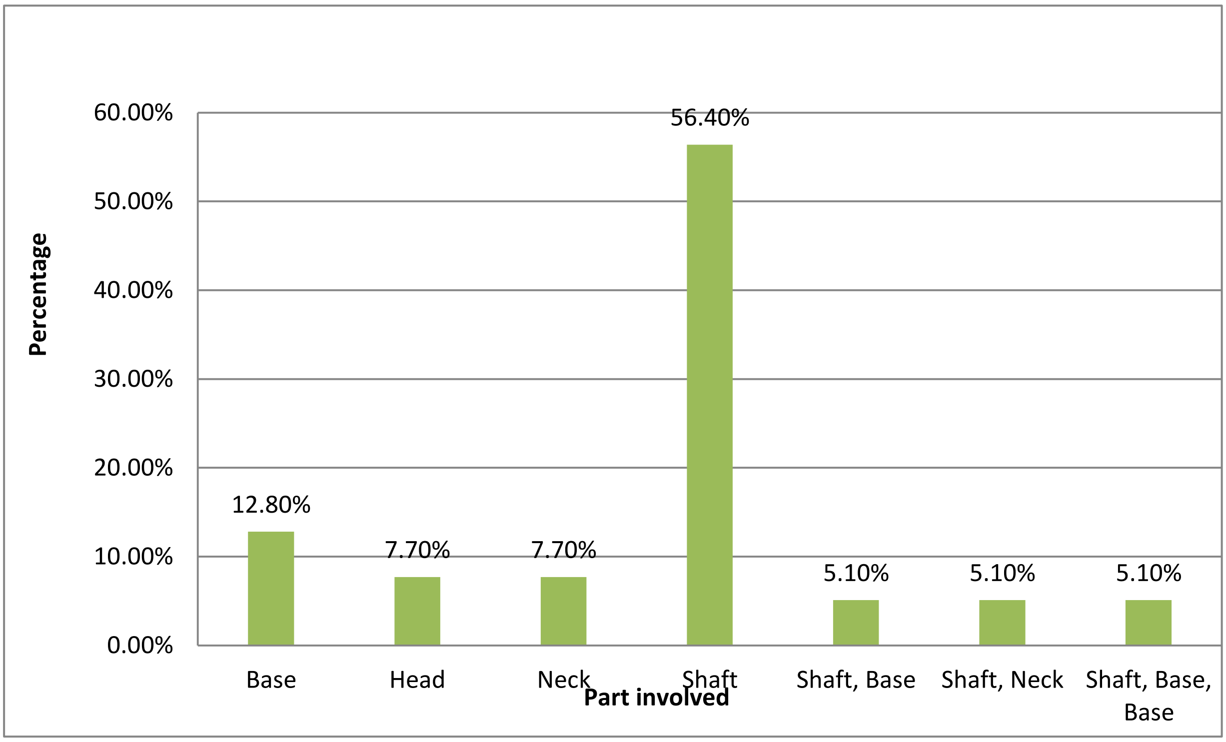


FIGURE 32: BAR DIAGRAM SHOWING PART INVOLVED DISTRIBUTION

Table 6: Side distribution

		Count	%
Side distribution	Left	22	56.4%
	Right	17	43.6%
	Total	39	100.0%

Out of 39 participants, 56.4% were left side and 43.6% were right side fracture. (Table 6)

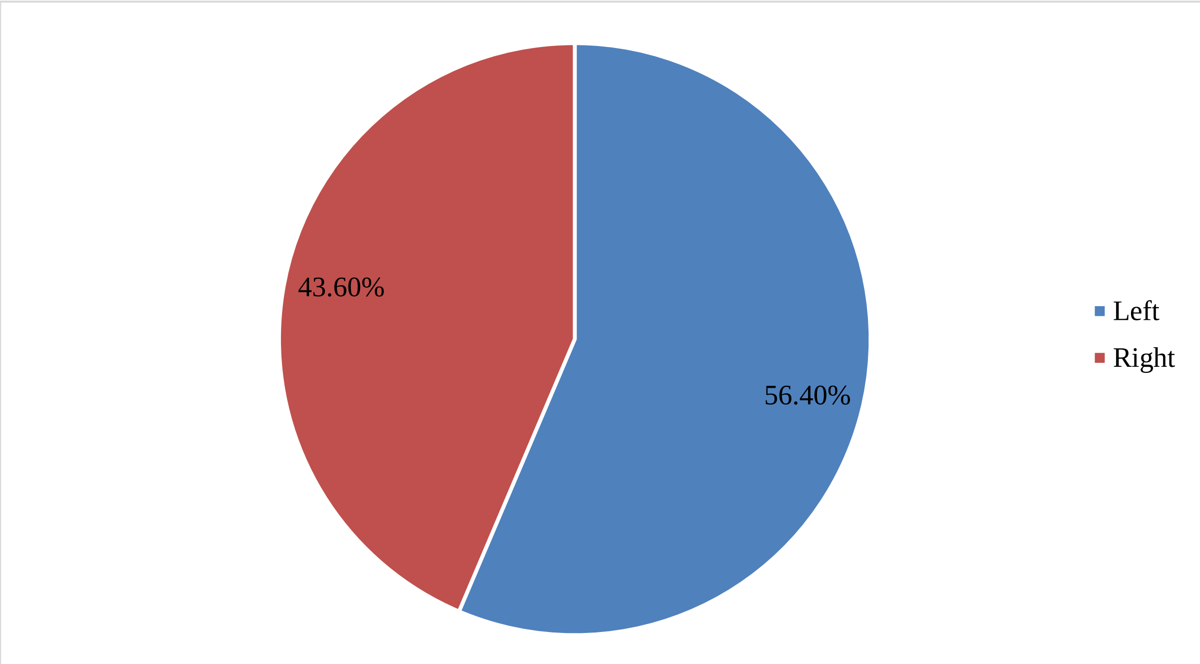


FIGURE 33: PIE DIAGRAM SHOWING SIDE DISTRIBUTION

Table 7: Associated injury distribution

		Count	%
Associated injury	Nil	31	79.5%
	Head Injury	2	5.1%
	Left Femur Shaft Fracture	2	5.1%
	Right Distal End Radius fracture	1	2.6%
	Right Humerus Shaft fracture	1	2.6%
	Right Tibia Shaft Fracture	2	5.1%
	Total	39	100.0%

In the study most common associated injury was head injury and left femur shaft fracture and Right Tibia shaft fracture in 5.1% respectively. (table 7)

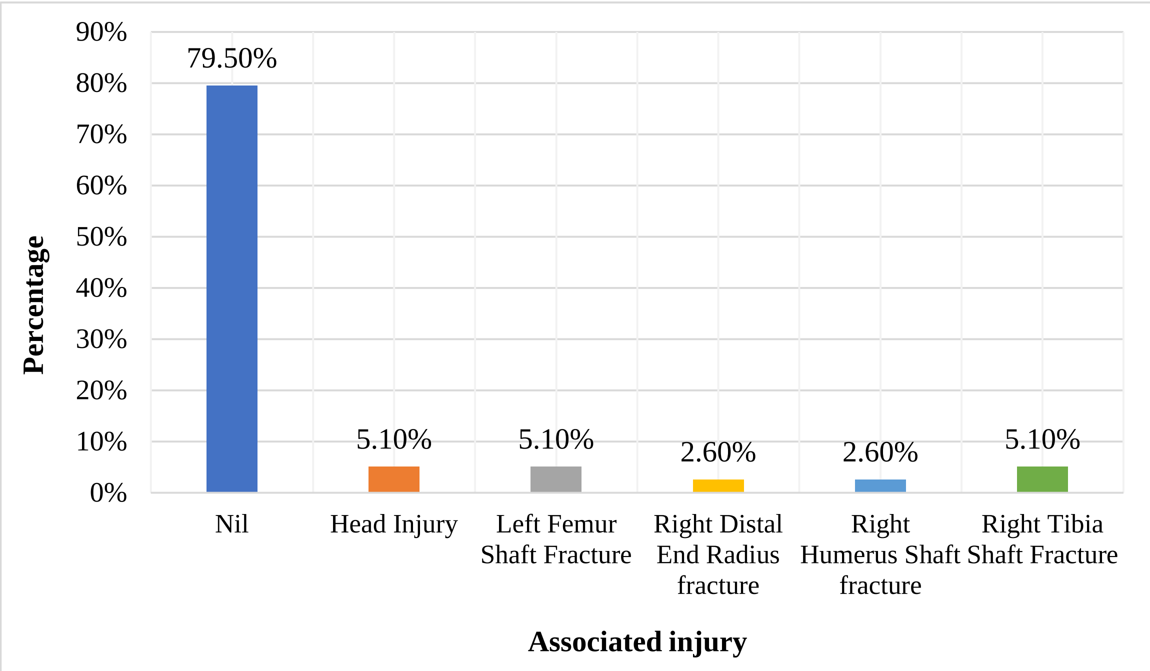


Figure 34: Bar diagram showing Associated injury distribution

Table 8: Anaesthesia given distribution

		Count	%
Anaesthesia	GA	6	15.4%
	wrist block	33	84.6%

Among the study population, 84.6% were given wrist block and 15.4% were given GA. (table8)

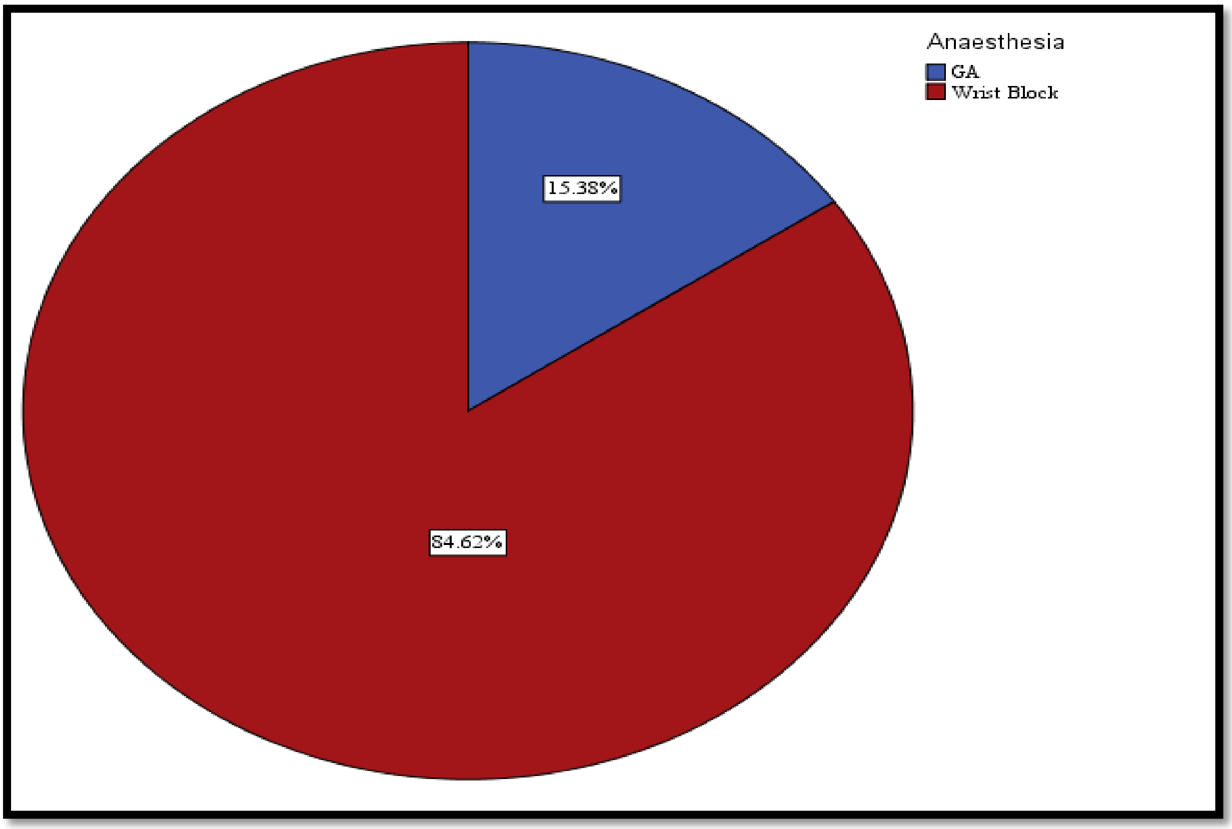


Figure35: Pie diagram showing Anaesthesia given distribution

Table 9: Procedure distribution

		Count	%
Procedure	Antegrade	7	17.9%
	Criss Cross	3	7.7%
	Retrograde	29	74.4%
	Total	39	100.0%

The majority of 74.4% participants underwent retrograde procedure, 17.9% participants underwent antegrade procedure and 7.7% participants underwent Criss cross procedure. (Table 9)

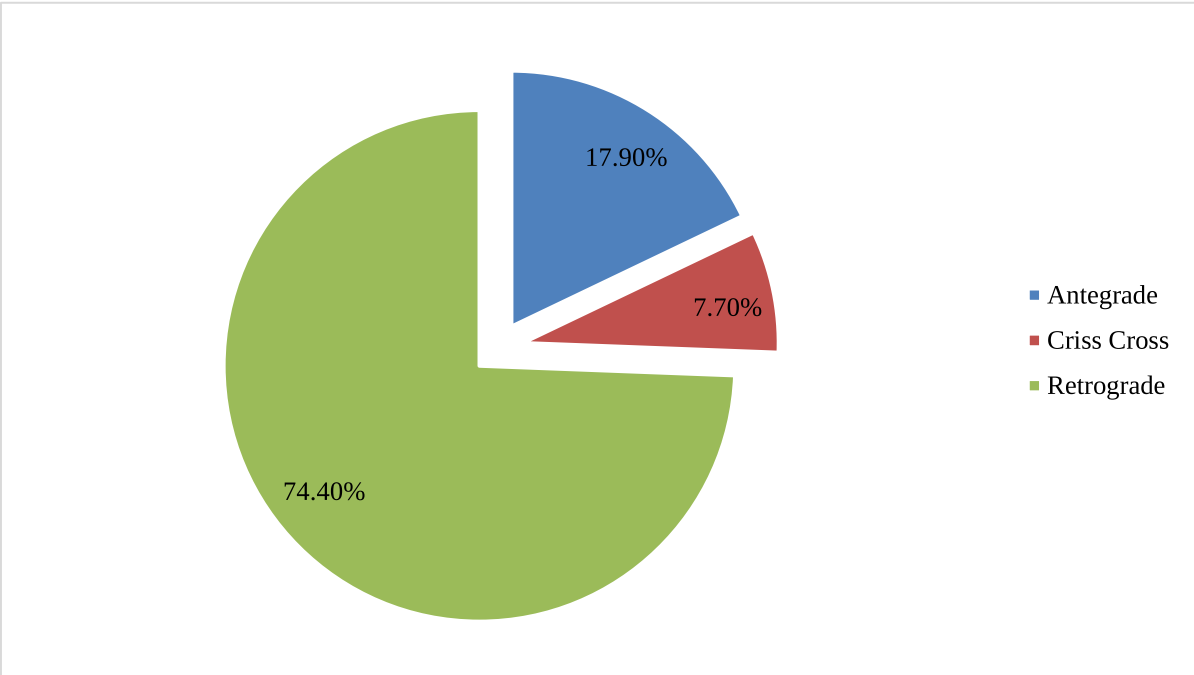


FIGURE 36: PIE DIAGRAM SHOWING PROCEDURE DISTRIBUTION

Table 10: Implant removal (Weeks) distribution

		Count	%
Implant removal (Weeks)	5	5	12.8%
	6	27	69.2%
	7	1	2.6%
	8	6	15.4%
	Total	39	100.0%

In the study the implant were removed at 5 weeks in 12.8%, at 6 weeks in 69.2%, at 7 weeks in 2.6% and at 8 weeks in 15.4%. (Table 10)

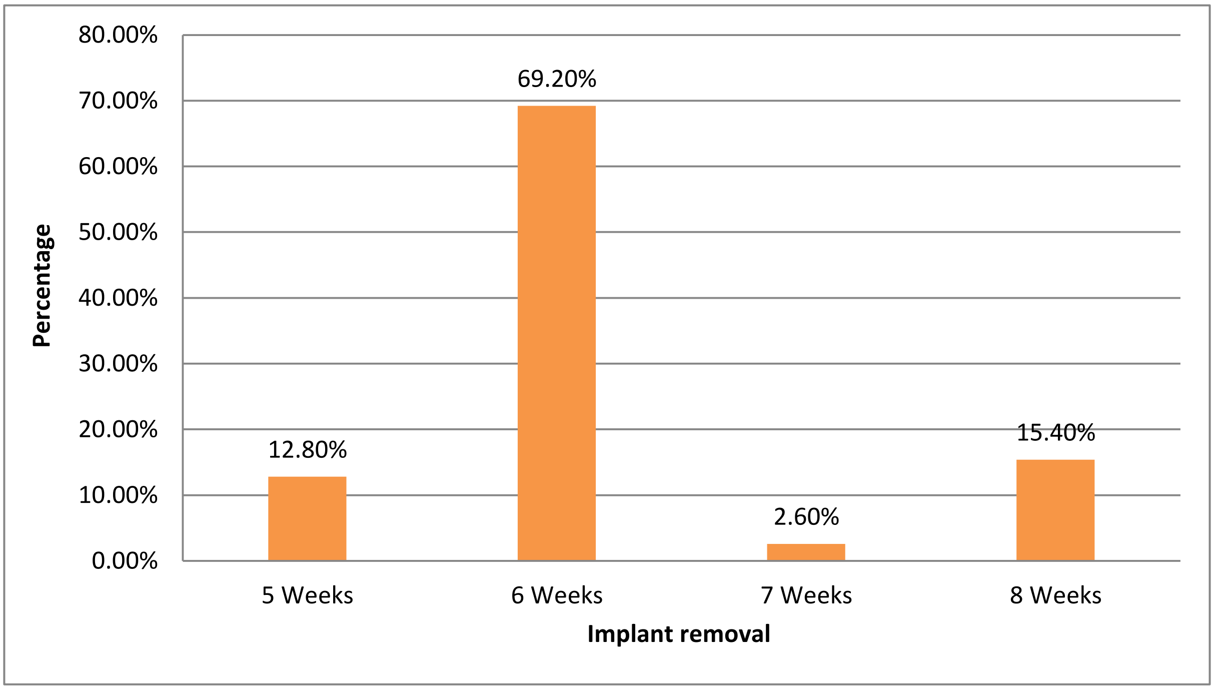


FIGURE 37: BAR DIAGRAM SHOWING IMPLANT REMOVAL (WEEKS) DISTRIBUTION

Table 11: Pain assessment (VAS Score) distribution

		Count	%
Pain assessment (VAS Score)	Mild Pain	21	53.8%
	Moderate Pain	1	2.6%
	No Pain	17	43.6%
	Total	39	100.0%

Out of 39 participants, 53.8% participants had mild pain, 2.6% participants had moderate pain and 43.6% participants had no pain. (table 11)

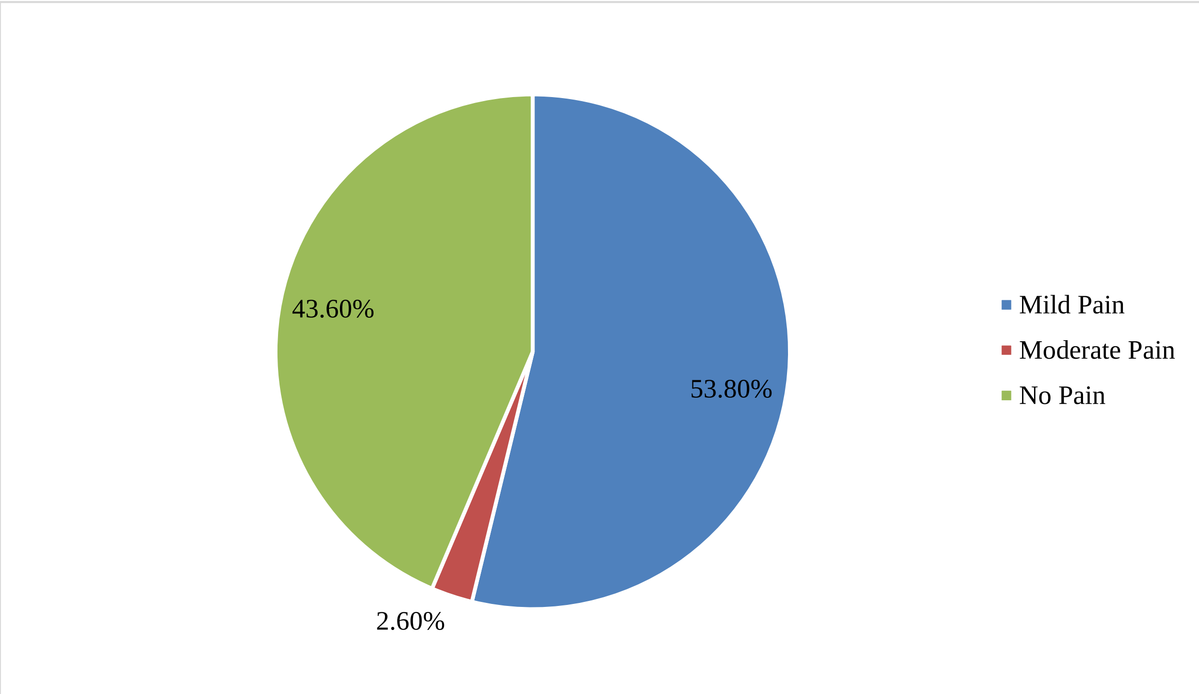


FIGURE 38: PIE DIAGRAM SHOWING PAIN ASSESSMENT (VAS SCORE) DISTRIBUTION

Table 12: Active range of motion (TAM) at MCP joint distribution

		Count	%
Active range of motion (TAM) at MCP joint	Excellent	17	43.6%
	Good	18	46.2%
	Fair	3	7.7%
	Poor	1	2.6%

Among the study population, 43.6% had excellent, 46.2% had good, 7.7% had fair and 2.6% had poor range of motion. (Table 12)

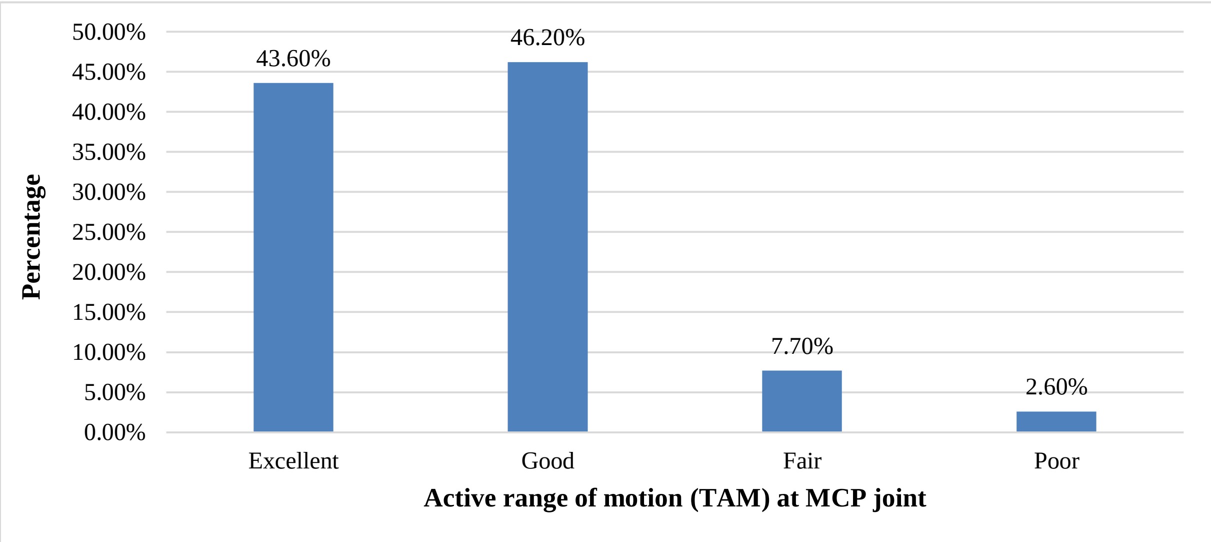


FIGURE 39: BAR DIAGRAM SHOWING ACTIVE RANGE OF MOTION (TAM) AT MCP JOINT DISTRIBUTION

Table 13: Functional Assessment (DASH SCORE)

Functional Assessment (DASH SCORE)					
N	Mean	Std. Deviation	Median	Minimum	Maximum
39	15.03	4.869	15.00	10	30

In the study mean DASH score was 15.03 ± 4.869. Minimum score was 10 and maximum score was 30. (Table 13)

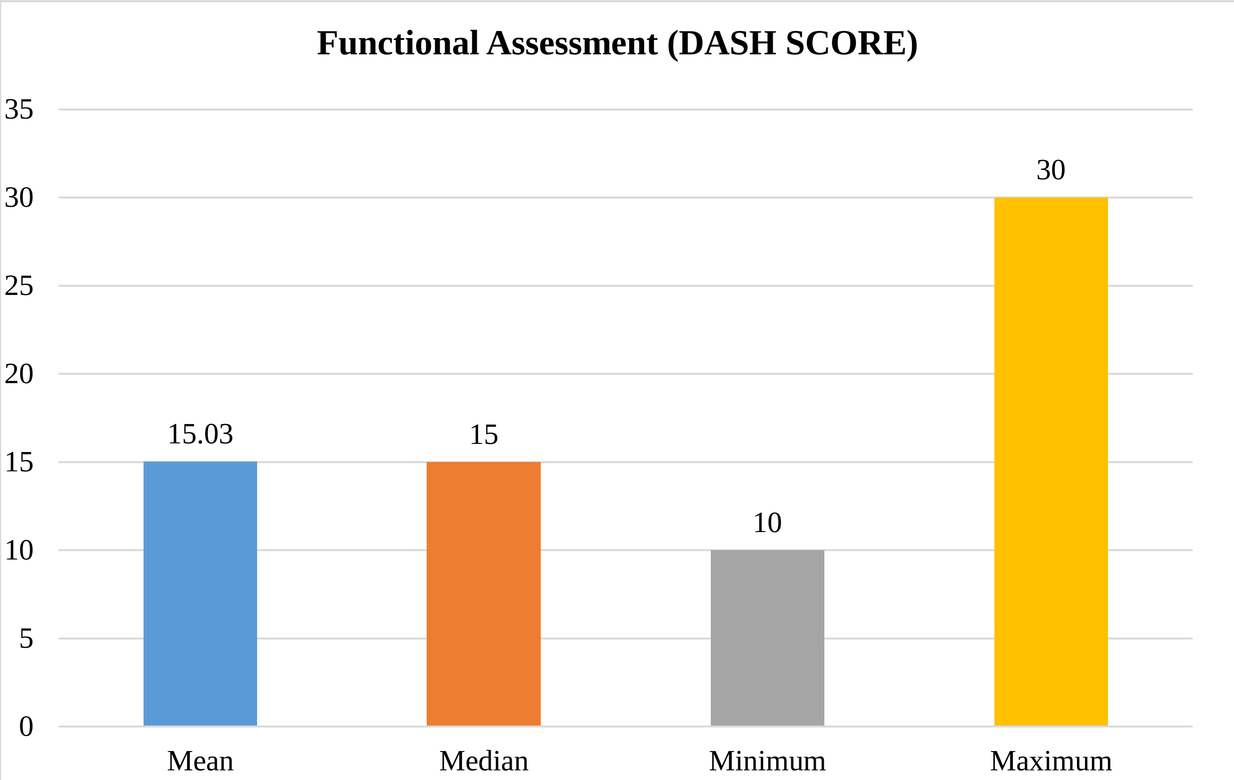


Figure 40: Bar diagram showing Functional Assessment (DASH SCORE)

Table 14: Complications distribution

		Count	%
Complications	Nil	35	89.7%
	Pain with Stiffness	1	2.6%
	Stiffness	1	2.6%
	Superficial Pin Tract Infection	2	5.1%
	Total	39	100.0%

In the study 2.6% had pain with stiffness, stiffness respectively and 5.1% had Superficial Pin Tract Infection. (table 14)

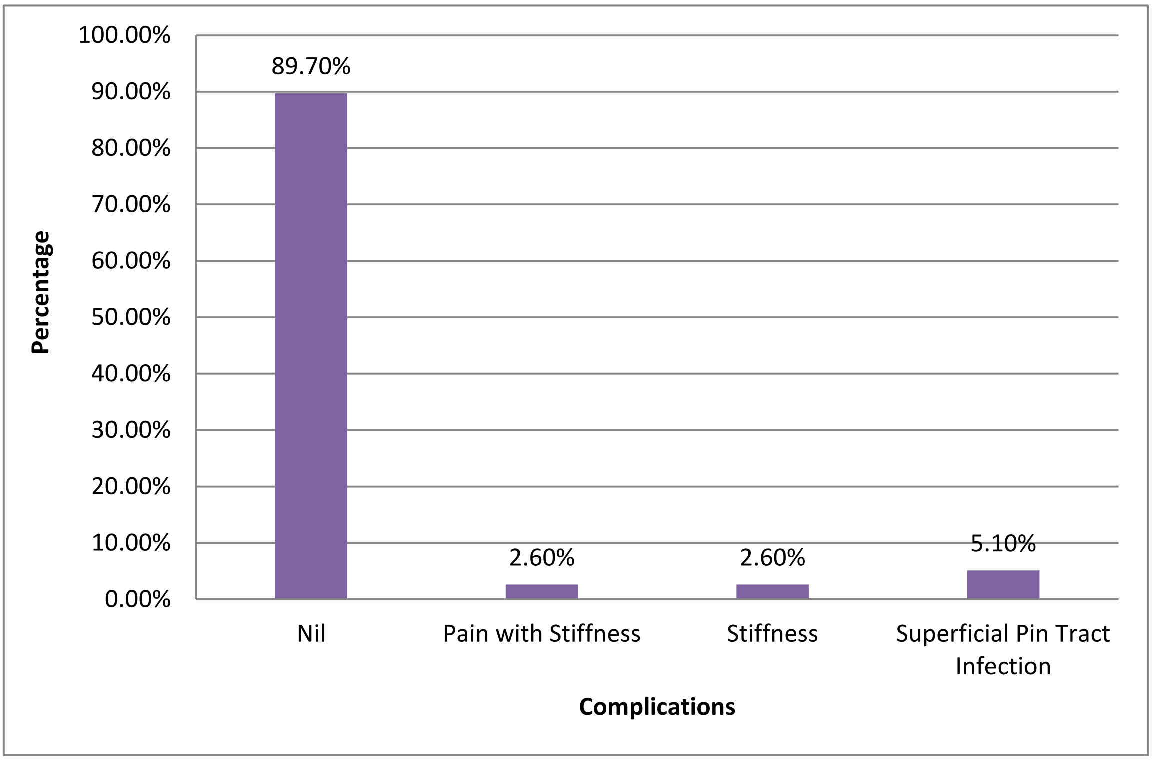


FIGURE 41: BAR DIAGRAM SHOWING COMPLICATIONS DISTRIBUTION

DISCUSSION

DISCUSSION

Functional outcome is very important for fractures of small bones of hand and this depends to an extent on management of fractures. Metacarpal fractures of hand account for 18 to 44% of all hand and wrist fractures.[70]

Non-thumb metacarpal fractures account for 88% of all metacarpal fractures. Restoring good mobility of hand depends on delicate handling of tissues, preservation of gliding planes or tendons, prevention of infection, early and appropriate physiotherapy in combination with accurate reduction and fixation. [71]

Metacarpals are most commonly fractured bones because hand is used to provide protection from trauma due to fall. Among metacarpals the fifth metacarpal is frequently fractured carpal. [5] Management of metacarpal fractures must be done carefully because long term function of hand depends on angulation and rotation of fractures. Metacarpal fractures can be treated with Kirschner wire, screws or intraosseous wiring or hand plates. [72]

K- wire fixation method is considered to be least invasive technique for fixation after closed reduction and it is found to restore maximum long term function.[73]

The appropriate management technique for metacarpal fractures should be aimed at obtaining normal digital alignment, pain-free status and normal range of motion which will allow the patient to restore the normal functioning of his or her hand and return to their activities normally. Fractures will be often associated with varying degrees of soft tissue damage. Normal function can be restored only when there is healing of surrounding soft tissue along with fracture.

For restoration of normal function of surrounding tissue which depends on its gliding properties appreciable movement is required whereas healing of bone requires immobilization. This becomes possible only when fingers are allowed to move as soon as possible after treatment of fracture. Operative management of metacarpal fractures has 64% rate of complications and stiffness is one of the most commonly manifested complication. It was observed that many patients (around 91%) who underwent operative management of metacarpal fractures had to undergo secondary surgery for treatment of stiffness.[74]

The surgery for reduction of stiffness in turn has a very low success rate. Hence minimally invasive treatment of metacarpal fractures is the best treatment option. The K-wire fixation method which is minimally invasive also is found to have very less effect on surrounding gliding soft tissue. Based on above observations this study aims to evaluate various metacarpal fractures and functional outcome following surgical treatment with closed reduction and internal fixation with Kirschner-wire fixation.

A total of 39 subjects were included in the final analysis. In the study majority of participants (33.3%) subjects were in the age group <30 years, followed by 30.8% in the age group of 31 to 40 years, 23.1% were aged between 41 to 50 years and 12.8% were aged between 51 to 60 years. This observation of majority of participants with metacarpal fractures being in the age group of less than 30 years was similar to that found in three similar studies. In one study on evaluation of surgical management of metacarpal fractures by Raghavendra, V., et al.[71] 40% of participants were in the age group of 20 to 30 years, in another study by Fusetti, C., et al. [22]the median age was 33 years and in another study by Kelsch, G., et al. [73]the median age of 24 years. In the study 82.1% participants were males and 17.9% participants were females. This observation was also similar to that found in study by Raghavendra, V., et al. [71] in which 80% of participants were males, in study by Fusetti, C., et al. [22]in which 79% of participants were males and in study by Kelsch, G., et al. [73] 82% of participants were males.

Mode of injury in majority of cases was road traffic accidents. 74.4% of participants had road traffic accident, 15.4% suffered fracture due to assault and 5.1% suffered fracture due to fall and punch. This observation of majority of participants suffering metacarpal fracture due to road traffic accident is similar to that found in study by Raghavendra, V., et al.[71] in which 50% of participants were involved in road traffic accidents, and contrary to that found in study by Kelsch, G., et al. [73]in which 45% of participants suffered fracture due to fall on outstretched hand.

Table 15: Mode of injury

Mode of injury	Present study	Other studies
Road traffic accidents	74.4%	50%- Raghavendra, V., et al.[71]
Fall	5.1%	45%- Kelsch, G., et al. [73]

In the study most common metacarpal involved was 4th Metacarpal (25.6%), followed by 1st, 2nd and 5th metacarpal in 12.8% respectively. This observation is slightly different than that reported in literature. The fifth metacarpal is the most commonly fractured among all the metacarpals.[75]

In the study most common part of metacarpal involved was shaft (56.4%). Followed by, base which was involved in 12.8% of participants and 7.7% participants has involvement of head and neck of metacarpal. This observation of shaft involvement in majority of cases is similar to that reported in study by Raghavendra, V., et al.[71] in which 66% of cases has metacarpal shaft fracture and in another study by Gupta R., et al.[53] in 60% of participants had metacarpal shaft fracture. Many studies suggest that for metacarpal shaft fractures, simple closed reduction and immobilization may be used to treat stable fractures. Metacarpal head fractures can also be managed non-operatively if the joint involvement is <20%. Closed reduction can be accomplished for metacarpal neck fractures. Stabilization of metacarpal with closed reduction and fixation with intramedullary k-wire produces good long-term functional results.

Table 16: Part of metacarpal involved

Part of metacarpal involved in fracture	Present study	Other studies
Shaft	56.4%	Raghavendra, V., et al.[71] - 66% Gupta R., et al.[53] - 60%

Out of 39 participants, 56.4% were left side and 43.6% were right side fracture. This observation of involvement of left side in a greater number of participants than right side is slightly different from that reported in similar studies. In a study by Raghavendra, V., et al.[71] 73.32% of participants had involvement of right hand and in another study by Fusetti, C., et al. [22]74% of participants had involvement of right hand.

Table 17: Side involvement

Left/right hand involvement	Present study	Other studies
Left hand Right hand	56.4% 43.6%	73.32%- Raghavendra, V., et al.[71] 74%- Fusetti, C., et al. [22]

The majority of participants (74.4%) underwent retrograde procedure, 17.9% participants underwent antegrade procedure and 7.7% participants underwent Criss cross procedure. This may be because of the fact that retrograde wires provide better stability in comparison with antegrade procedure.

In the study the implant was removed at 5 weeks in 12.8%, at 6 weeks in 69.2%, at 7 weeks in 2.6% and at 8 weeks in 15.4%. The removal of K-wire after 6 weeks which was done in majority of participants is similar to that done in a study by Van Bussel, E, M., et al. [63]in which K-wire was removed after 6 weeks in 81% of participants.

In the study mean DASH score was 15.03 ± 4.869. Minimum score was 10 and maximum score was 30. The Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire is a 30-item questionnaire that looks at the ability of a patient to perform certain upper extremity activities. higher scores indicate a greater level of disability and severity, whereas, lower scores indicate a lower level of disability with a score range between 1 to 100 [76]. The mean dash score of 15 observed in this study is slightly more than that observed in study by Van Bussel, E, M., et al.[71] in which the mean DASH score was 5, in another study by Ozer et al.[56] the mean DASH score was 5. In another study by Schädel-Höpfner et al.[77] for the fifth metacarpal neck fractures the mean DASH score was 8 after 17 months. Nevertheless, considering the range of DASH score a score of 15 indicates good functional outcome.

Table 18: DASH score

	Present study	Other studies
DASH Score (average)	15.03	5- Van Bussel, E, M., et al.[71] 5- Ozer et al.[56] 8- Schädel-Höpfner et al.[77]

Among the study population, 43.6% had excellent, 46.2% had good, 7.7% had fair and 2.6% had poor range of motion. Overall, around 90% of participants had good total active range of motion (TAM). This observation of majority of participants having good TAM on closed reduction and K-wire fixation is similar to that reported by Gupta R. et al.[53] in which 60% of participants reported excellent TAM. Two other studies one by Belskey et al.[78] and another by Green and Anderson[79] also reported similar results. In a study by Raghavendra, V., et al.[71] all the patients who underwent closed reduction and k-wire fixation of metacarpal fracture reported excellent range of motion. Studies by Pun et al.[80], Page and stern[81], and Tan., et al.[82] observed that open fractures had poor final TAM as compared to closed fractures.

Table 19: TAM score

Total active range of motion (TAM)	Present study	Other studies
Excellent	43.6%	60%- Gupta R., et al.[53], Belskey et al.[78], Green and Anderson[79] 100%- Raghavendra, V., et al.[71]
Good	46.2%	–

Out of 39 participants, 53.8% participants had mild pain, 2.6% participants had moderate pain and 43.6% participants had no pain. In the study 2.6% had pain with stiffness, stiffness respectively and 5.1% had superficial pin tract infection. stiffness of finger and pin tract infection are reported to be more with k-wire fixation by some studies.

CONCLUSION

CONCLUSION

This study was a hospital based prospective study centered in Department of Orthopaedics at R.L Jalappa Hospital and Research Centre, Kolar, from October 2019 to April 2021in which 39 patients with Metacarpal fractures treated with Percutaneous K-Wires.

At the end of our study, following conclusions could be drawn Metacarpal fractures are increasing with the increase in Road traffic accidents. These fracture need optimum treatment as most of them involved the Productive men (20-40yrs).

Metacarpal fractures treated by CRIF with K wires gives stable fixation following which early mobilization of joints of hand can be done early, thereby preventing stiffness. Multiple metacarpal fractures treated surgically gives better results than those treated conservatively.

Restoration of total normal function of hand in treatment of hand fractures is extremely important and conservative or minimally invasive treatment procedures have been observed to aid in this than surgical interventions. It was noticed in the study that Intramedullary K-wire fixation which is a minimally invasive method for stabilizing metacarpal fractures is the best treatment option for metacarpal fractures as it provides excellent functional outcome with less complications. In the study around 90% of participants had good total active range of motion after treatment. Mean DASH score in the study was 15 which reflects good functional outcome.The technique does not affect gliding properties of surrounding soft tissue which is required for restoration of normal function of hand.
Fractures treated with CRIF with K Wire show faster union, faster recovery of daily activities and lesser stiffness than treated conservatively.

There will be fewer chances of infection and early bone union in case of CRIF with K Wire fixation.

RECOMMENDATIONS

From the findings of the study it can be recommended that closed reduction and internal fixation with Kirschner-wire for metacarpal fractures is useful due to its excellent to good functional outcome, mild pain and minimal complications.

However, comparison with the standard treatment is needed to further justify the results. Hence, we also recommend for comparative randomized controlled trial to determine the real effect of closed reduction and internal fixation with Kirschner-wire for metacarpal fractures.

LIMITATIONS

1. In the present study no comparison group was included. Furthermore it has small sample size [Error rate was 15%] – which is due to ongoing covid pandemic. In this study mean time for union, Cost effectiveness were not studied

SUMMARY

SUMMARY

A prospective observational study was carried in Patients aged between 18-60 years with single/multiple metacarpals bone fracture presenting to the OPD or casualty within 2 weeks.at R.L.Jalappa Hospital and research centre, attached to Sri Devaraj Urs Medical College for a period of 2 years.

Intramedullary K-wire fixation is a minimally invasive method for stabilizing metacarpal fractures. The excellent long-term clinical results are due to the fact that the gliding tissue around the fracture will not be affected by the surgical procedure

1. In the present study majority of subjects were in the age group <30 years (33.3%). 82.1% were males and 17.9% were females.
2. Most common mode of injury was RTA in 74.4%, assault in 15.4%, fall and Punch in 5.1%. which involved mostly left side(56.4%)
3. Most common Metacarpal involved was 4th Metacarpal (25.6%), followed by 1st, 2nd and 5th metacarpal in 12.8% respectively, of which most common part of Metacarpal involved was shaft (56.4%).
4. In the present study 84.6% were given wrist block and 15.4% were given GA.
5. In the study 74.4% underwent retrograde procedure, 17.9% underwent antegrade procedure and 7.7% underwent Criss cross procedure.
6. Implants were removed at 5 weeks in 12.8%, at 6 weeks in 69.2%, at 7 weeks in 2.6% and at 8 weeks in 15.4%.
7. In the study 43.6% had excellent, 46.2% had good, 7.7% had fair and 2.6% had poor functional outcome at the end of 6 months.

8. In the study 53.8% had mild pain, 2.6% had moderate pain and 43.6% had no pain.
9. In the study 2.6% had pain with stiffness, stiffness respectively and 5.1% had Superficial Pin Tract Infection.

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BIBLIOGRAPHY

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ANNEXURES

ANNEXURE-I

INSTRUMENTS

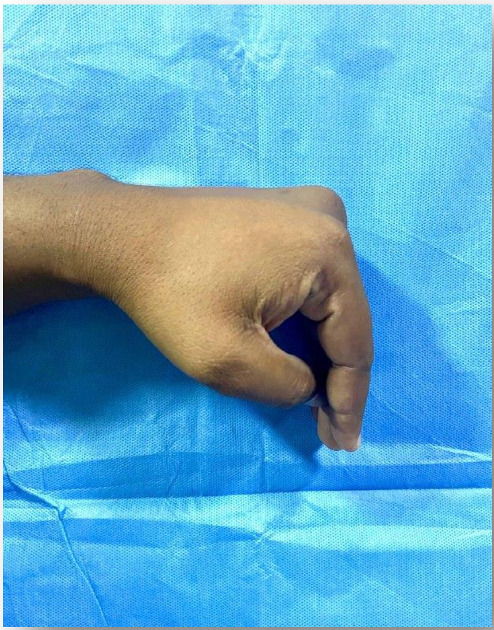
INSTRUMENTS FOR METACARPAL FIXATION WITH K-WIRE

RADIOGRAPHS AND CLINICAL IMAGES

Case 5:

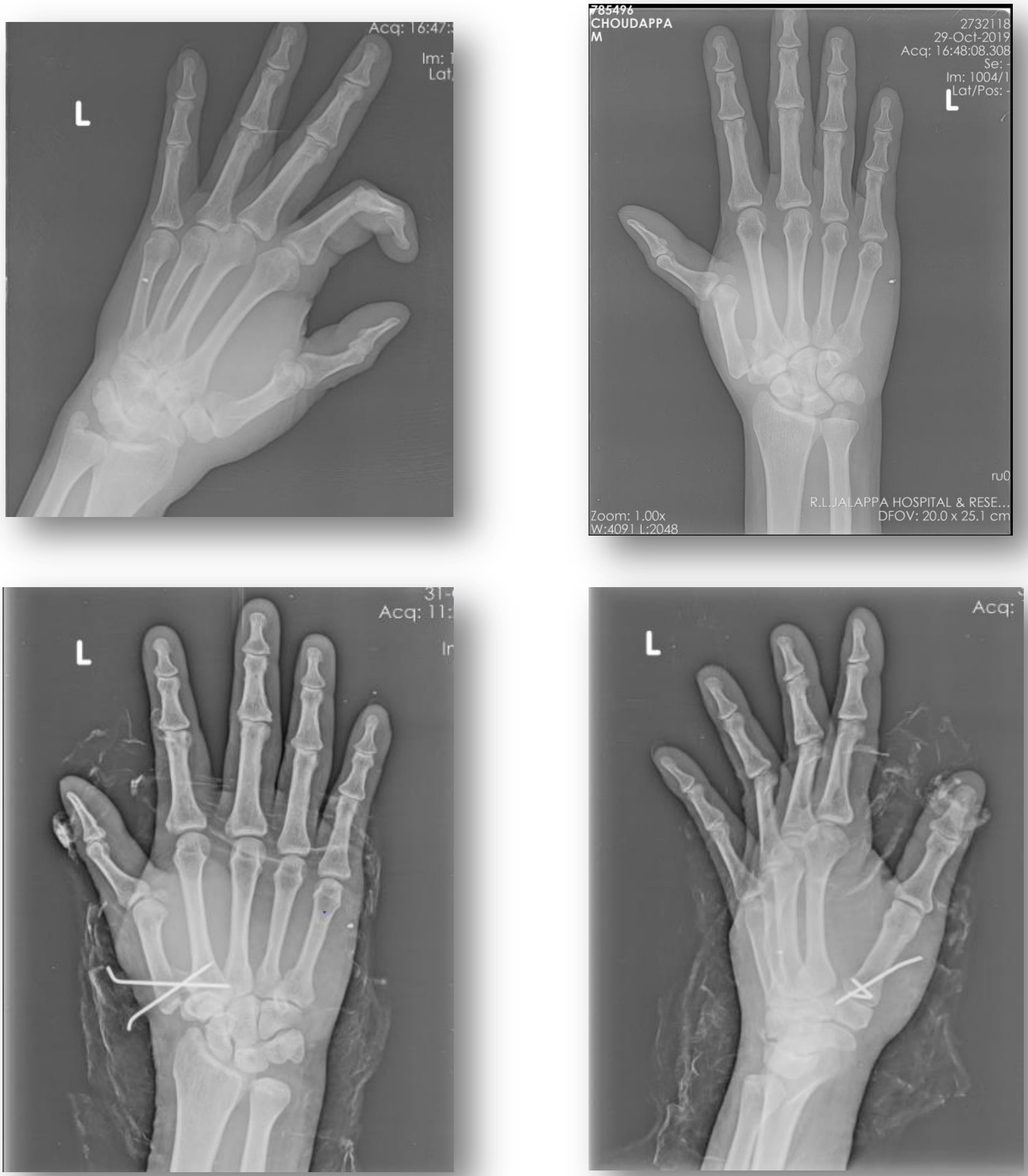
PRE-OP AND POST-OP X-RAY

CLINICAL IMAGE AT THE END OF 6TH MONTH



CLINICAL IMAGE AT THE END OF 6^{TH} MONTH

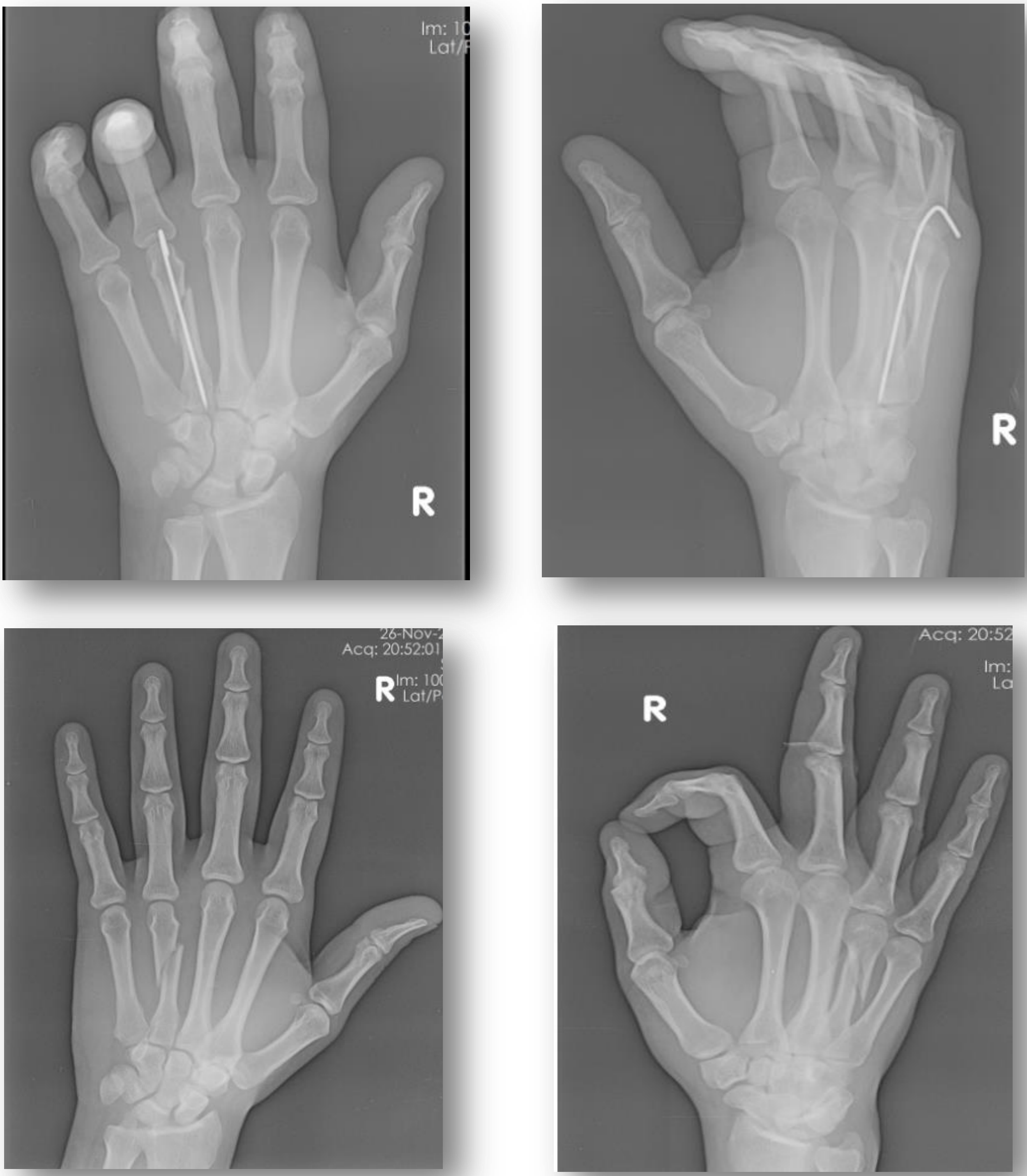
CASE 13:



PRE-OP AND POST- OP XRAYS OF CASE 2

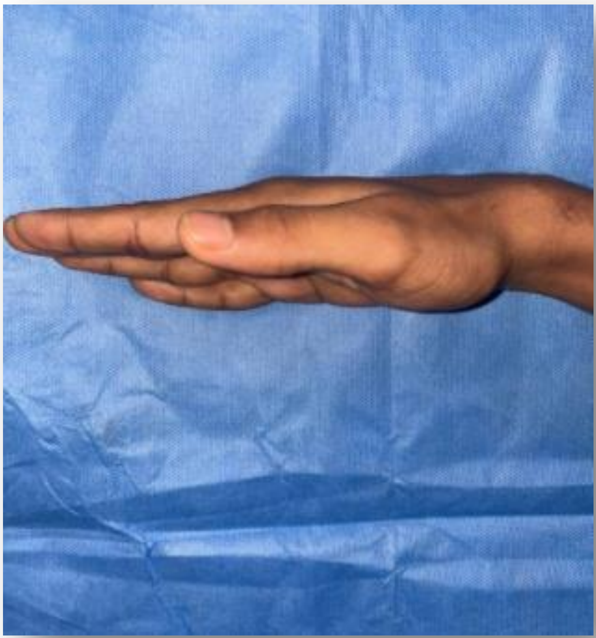
CLINICAL IMAGES AT THE END OF 6TH MONTH

CASE: 25

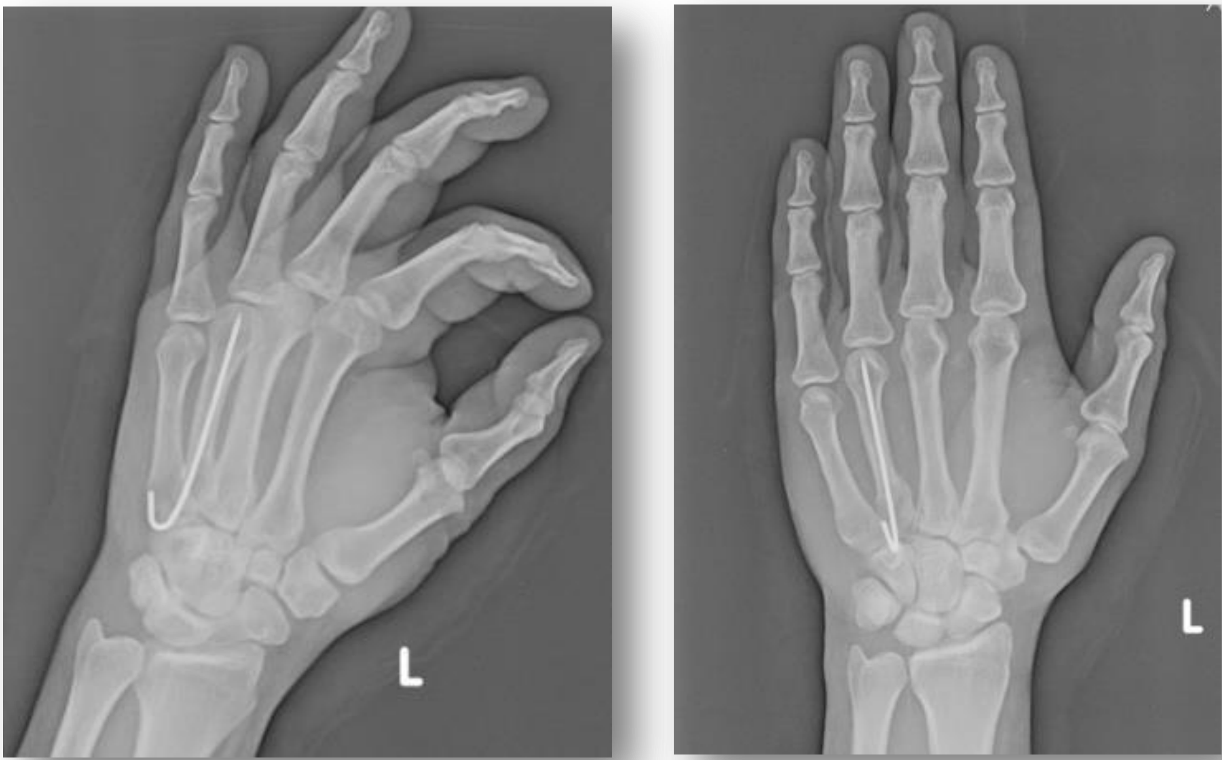


PRE-OP AND POST-OP XRAYS OF THE CASE 3

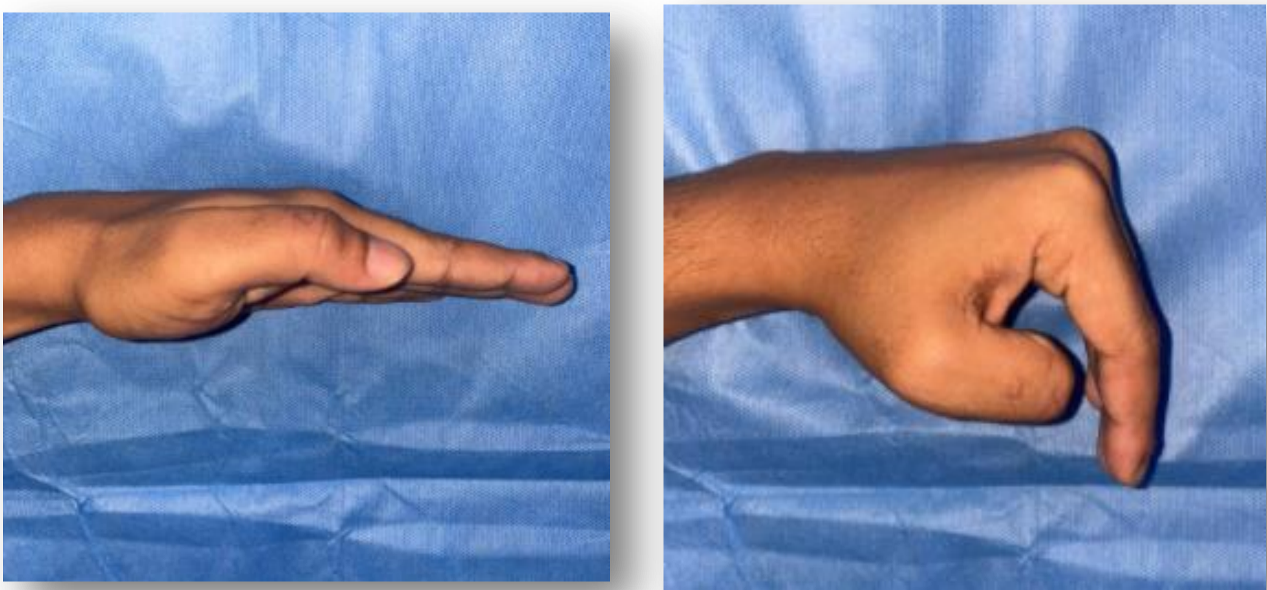
CLINICAL IMAGES AT THE END OF 6TH MONTH



CASE 37:



POST – OP X-RAYS OF CASE 4



CLINICAL IMAGES AT THE END OF 6 MONTHS

ANNEXURE II

PROFORMA

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA,

KOLAR - 563101.

PROFORMA

Case no:

UHID no:

TITLE:

"Evaluation of functional outcome in metacarpal fracture fixed with closed reduction and internal fixation with Kirschner-wire''

1. BASIC DATA

Name Age/Sex

Address

Mobile No.

Date of Procedure

Date of Admission/OP

Date of Discharge

History :

Mechanism of injury :

General physical examination :

Vitals: Pulse- B.P-

RR- Temp-

Systemic examination:

CVS-

RS-

PS-

CNS-

Pre existing systemic illness :

Diabetes/Thyroid disorder/ Cervical Spine/ CVS/RS/ CNS/ TB/ anaemia/ Hypertension/ malnutrition/others

Local examination:

Side	: Left/Right/Bilateral
Deformity	: Present/Absent
Swelling	: Present/Absent
Tenderness	: Present/Absent
Associated injuries	: Present/Absent
Wound	: Present/Absent

2. DIAGNOSIS:

3. INVESTIGATIONS:

- CBC, BT, CT, Blood grouping
- Blood urea, serum creatinine, RBS .
- Serum electrolytes
- FBS,PPBS,HbAIC (if needed)
- HIV, HBsAg status

X ray of hand AP and oblique view:

Any associated fractures:

4. OPERATION DETAIS:

Procedure-

Operation on-

Anaesthesia:

Immediate post operative assessment:–

1.Check X ray:

Reduction of metacarpal bones

2. Pain assessment:

3. Range of motion(TAM score):

4. Assessment with DASH SCORE:

Follow up: After

1st month :

1. Range of movements with the help of goniometer (TAM score):
2. Pain assessment (VAS score):
3. Assessment of functional outcome with (DASH SCORE):

2nd month:

1. Range of movements with the help of goniometer(TAM score):
2. Pain assessment with (VAS score):
3. Assessment of functional outcome with DASH SCORE:

6th month :

1. Range of movements with the help of goniometer(TAM score):
2. Pain assessment with (VAS score):
3. Assessment of functional outcome with (DASH SCORE):

INFORMED CONSENT FORM

Case no:

UHID no:

TITLE: “Evaluation of functional outcome in metacarpal fracture fixed with closed reduction and internal fixation with Kirschner-wire”

I, ____ aged _____________ ,after being explained in my own vernacular language about the purpose of the study and the risks and complications of the procedure, hereby give my valid written informed consent without any force or prejudice for closed reduction and percutaneous k-wire fixation for metacarpal fracture or any other procedure deemed fit, which is a diagnostic & / or therapeutic procedure / biopsy / transfusion / operation to be performed on me or _______ under any anaesthesia deemed fit. The nature and risks involved in the procedure (surgical and anaesthetical) have been explained to me to my satisfaction.

I have been explained in detail about the Clinical Research on “Study of functional outcome in metacarpal fracture fixed with closed reduction and internal fixation with K-wires**”** 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 the injection/ operative procedure, undergo investigations 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 & Name of Pt. Attendant) (Signature/Thumb impression & Name of patient)

(Relation with patient) Witness:

(Signature & Name of Research person /doctor)

ರೋಗಿಯ ತಿಳಿವಳಿಕೆಯ ಸಮ್ಮತಿ ನಮೂನೆ

ನಾನು ಶ್ರೀ /ಶ್ರೀಮತಿ.. ನನ್ನ ಸ್ವಂತ ಅರ್ಥವಾಗುವಂತಹ ಭಾಷೆಯಲ್ಲಿ ವಿವರಿಸಲಾಗಿದೆ. ನಾನು ನಡೆಸಿದ ಅಧ್ಯಯನದಲ್ಲಿ ಸೇರಿಸಲಾಗುವುದು. ಕ್ರಿಯಾತ್ಮಕ ಫಲಿತಾಂಶದ ಅಧ್ಯಯನ ಮೆಟಾಕಾರ್ಪಾಲ್ ಮುರಿತದಲ್ಲಿ ನಿವಾರಿಸಲಾಗಿದೆ ಮುಚ್ಚಲಾಗಿದೆ ಕಡಿತ ಮತ್ತು ಆಂತರಿಕ ಕೆ-ತಂತಿಗಳೊಂದಿಗೆ ಸ್ಥಿರೀಕರಣ ” . ಅಧ್ಯಯನದ ಉದ್ದೇಶ ಮತ್ತು ಕಾರ್ಯವಿಧಾನದ ಅಪಾಯಗಳು ಮತ್ತು ತೊಡಕುಗಳ ಬಗ್ಗೆ ನನ್ನ ಸ್ವಂತ ಭಾಷೆಯಲ್ಲಿ ವಿವರಿಸಲಾಗಿದೆ.ಅಧ್ಯಯನದ ಉದ್ದೇಶ ಮತ್ತು ಕಾರ್ಯವಿಧಾನದ ಅಪಾಯಗಳು ಮತ್ತು ತೊಡಕುಗಳ ಬಗ್ಗೆ ನನ್ನ ಸ್ವಂತ ಭಾಷೆಯಲ್ಲಿ ವಿವರಿಸಿದ ನಂತರ, ಮುಚ್ಚಿದ ಕಡಿತಕ್ಕೆ ಯಾವುದೇ ಬಲ ಅಥವಾ ಪೂರ್ವಾಗ್ರಹವಿಲ್ಲದೆ ನನ್ನ ಮಾನ್ಯ ಲಿಖಿತ ತಿಳುವಳಿಕೆಯ ಒಪ್ಪಿಗೆಯನ್ನು ನೀಡಿ ಮತ್ತು ಮೆಟಾಕಾರ್ಪಾಲ್ ಮುರಿತ ಅಥವಾ ಇನ್ನಾವುದೇ ಕೆ-ವೈರ್ ಸ್ಥಿರೀಕರಣ ಕಾರ್ಯವಿಧಾನವು ಫಿಟ್ ಎಂದು ಪರಿಗಣಿಸಲಾಗಿದೆ, ಇದು ರೋಗನಿರ್ಣಯವಾಗಿದೆ. ಯಾವುದೇ ಅರಿವಳಿಕೆ ಅಡಿಯಲ್ಲಿ ಫಿಟ್ ಎಂದು ಪರಿಗಣಿಸಲಾಗಿದೆ. ಕಾರ್ಯವಿಧಾನದಲ್ಲಿ (ಶಸ್ತ್ರಚಿಕಿತ್ಸೆ ಮತ್ತು ಅರಿವಳಿಕೆ) ಒಳಗೊಂಡಿರುವ ಸ್ವರೂಪ ಮತ್ತು ಅಪಾಯಗಳನ್ನು ನನ್ನ ತೃಪ್ತಿಗೆ ವಿವರಿಸಲಾಗಿದೆ.

• "ಮೆಟಾಕಾರ್ಪಾಲ್ ಮುರಿತದಲ್ಲಿ ಕ್ರಿಯಾತ್ಮಕ ಫಲಿತಾಂಶದ ಅಧ್ಯಯನವು ಮುಚ್ಚಿದ ಕಡಿತ ಮತ್ತು ಕೆ-ತಂತಿಗಳೊಂದಿಗೆ ಆಂತರಿಕ ಸ್ಥಿರೀಕರಣದೊಂದಿಗೆ ನಿವಾರಿಸಲಾಗಿದೆ" ಕುರಿತು ಕ್ಲಿನಿಕಲ್ ರಿಸರ್ಚ್ ಬಗ್ಗೆ ವಿವರವಾಗಿ ವಿವರಿಸಲಾಗಿದೆ. ನಾನು ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆಯನ್ನು ಓದಿದ್ದೇನೆ ಮತ್ತು ಯಾವುದೇ ಪ್ರಶ್ನೆ ಕೇಳುವ ಅವಕಾಶ ನನಗೆ ಸಿಕ್ಕಿದೆ. ನಾನು ಕೇಳಿದ ಯಾವುದೇ ಪ್ರಶ್ನೆಗೆ ಉತ್ತರಿಸಲಾಗಿದೆ ಶೈಕ್ಷಣಿಕ ಮತ್ತು ವೈಜ್ಞಾನಿಕ ಉದ್ದೇಶಕ್ಕಾಗಿ ಕಾರ್ಯಾಚರಣೆ / ಕಾರ್ಯವಿಧಾನ ಇತ್ಯಾದಿಗಳನ್ನು ವೀಡಿಯೊ ಗ್ರಾಫ್ ಮಾಡಬಹುದು ಅಥವಾ **hed** ಾಯಾಚಿತ್ರ ಮಾಡಬಹುದು. ಎಲ್ಲಾ ಡೇಟಾವನ್ನು ಯಾವುದೇ ಶೈಕ್ಷಣಿಕ ಉದ್ದೇಶಕ್ಕಾಗಿ ಪ್ರಕಟಿಸಬಹುದು ಅಥವಾ ಬಳಸಬಹುದು. ಕಾರ್ಯವಿಧಾನ / ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ಯಾವುದೇ ಅಹಿತಕರ ಪರಿಣಾಮಗಳಿಗೆ ನಾನು ವೈದ್ಯರು / ಸಂಸ್ಥೆ ಇತ್ಯಾದಿಗಳನ್ನು ಹೊಣೆಗಾರರನ್ನಾಗಿ ಮಾಡುವುದಿಲ್ಲ.ಭಾಗವಹಿಸುವವರಿಗೆ ಈ ತಿಳುವಳಿಕೆಯುಳ್ಳ ಒಪ್ಪಿಗೆ ನಮೂನೆ

ಮತ್ತು ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆಯ ನಕಲನ್ನು ಒದಗಿಸಲಾಗಿದೆ. ಈ ಅಧ್ಯಯನದ ನನ್ನ ಪಾಲ್ಗೊಳ್ಳುವಿಕೆಯು ಸಂಪೂರ್ಣವಾಗಿ ಸ್ವಯಂಪ್ರೇರಿತವಾಗಿರುವುದನ್ನು ನಾನು ವಿವರಿಸಿದ್ದೇನೆ. ಮತ್ತು ಯಾವುದೇ ಸಮಯದಲ್ಲಿ ನಾನು ಈ ಅಧ್ಯಯನದಿಂದ ಹಿಂತೆಗೆದುಕೊಳ್ಳಬಹುದು ಮತ್ತು ಇದು ನನ್ನ ವೈದ್ಯರೊಂದಿಗೆ ನನ್ನ ಸಂಬಂಧವನ್ನು ಅಥವಾ ನನ್ನ ಕಾಯಿಲೆಯ ಚಿಕಿತ್ಸೆಗೆ ಪರಿಣಾಮ ಬೀರುವುದಿಲ್ಲ.

• ನನ್ನ ಸ್ವಂತ ಅರ್ಥವಾಗುವ ಭಾಷೆಯಲ್ಲಿ ವಿವರಿಸಲಾಗಿದೆ. ಅನುಸರಣೆ ವಿವರಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಯೋಜನಗಳು ಮತ್ತು ವಿಪತ್ತುಗಳ ಬಗ್ಗೆ ನನಗೆ ವಿವರಿಸಲಾಗಿದೆ.

• ವಿಚಾರಣೆಗಾಗಿ ನಾನು ಪ್ರಧಾನ ತನಿಖಾಧಿಕಾರಿ ಮೊಬೈಲ್ ಸಂಖ್ಯೆಯನ್ನು ಹೊಂದಿದೆ.

• ನಾನು ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ಸಮ್ಮತಿಯನ್ನು ನೀಡುತ್ತೇನೆ.

• ಈ ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸುವವರಿಗೆ ತಿಳುವಳಿಕೆಯುಳ್ಳ ಒಪ್ಪಿಗೆ ನಮೂನೆ ಮತ್ತು ರೋಗಿಯ ಮಾಹಿತಿ ಹಾಳೆಯ ನಕಲನ್ನು ಒದಗಿಸಲಾಗಿದೆ.

• ರೋಗಿಯ ಸಹಿ / ಹೆಬ್ಬೆರಳಿನ ಗುರುತು

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• ಹೆಸರು:

PATIENT INFORMATION SHEET

STUDY TITLE: "Evaluation of functional outcome in metacarpal fracture fixed with closed reduction and internal fixation with Kirschner-wire"

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

Details- Patients diagnosed with fracture metacarpals 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,FBS,PPBS,HBA1C, SERUM ELECTROLYTES,BLOOD GROUPING,HIV& HBSAG), CHEST X RAY, ECG AND X-RAY OF HAND –AP/PA AND LATERAL VIEW.

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. Abhi Sharma(Post Graduate),

Department Of ORTHOPAEDICS,

SDUMC ,Kolar

CONTACT NO : 7349457147

ರೋಗಿಯ ಮಾಹಿತಿ ನಮೂನೆ

ಅಧ್ಯಯನ ಶೀರ್ಷಿಕೆ : ಕ್ರಿಯಾತ್ಮಕ ಫಲಿತಾಂಶದ ಅಧ್ಯಯನ ಮೆಟಾಕಾರ್ಪಾಲ್ ಮುರಿತದಲ್ಲಿ ನಿವಾರಿಸಲಾಗಿದೆ ಮುಚ್ಚಲಾಗಿದೆ ಕಡಿತ ಮತ್ತು ಆಂತರಿಕ ಕೆ-ತಂತಿಗಳೊಂದಿಗೆ ಸ್ಥಿರೀಕರಣ " ಅಧ್ಯಯನ

ಅಧ್ಯಯನ ಸ್ಥಳ: ಆರ್.ಎಲ್.ಜೆ. ಆಸ್ಪತ್ರೆ ಮತ್ತು ಸಂಶೋಧನಾ ಕೇಂದ್ರ, ಜೋಡಿಸಲಾದ ಶ್ರೀ ದೇವರಾಜ ಅರಸು ವೈದ್ಯಕೀಯ ಕಾಲೇಜು, ಟಮಕ, ಕೋಲಾರ.

ವಿವರಗಳು- ಆರ್.ಎಲ್.ಜೆ. ಆಸ್ಪತ್ರೆ ಮತ್ತು ಅಪಘಾತದಿಂದ ಮೂಳೆಚಿಕಿತ್ಸಕ ವಾರ್ಡ್‌ನಲ್ಲಿ ದಾಖಲಾದ ಕ್ರಿಯಾತ್ಮಕ ಫಲಿತಾಂಶದ ಅಧ್ಯಯನ ಮೆಟಾಕಾರ್ಪಾಲ್ ಮುರಿತದಲ್ಲಿ ನಿವಾರಿಸಲಾಗಿದೆ ಮುಚ್ಚಲಾಗಿದೆ ಕಡಿತ ಮತ್ತು ಆಂತರಿಕ ಕೆ-ತಂತಿಗಳೊಂದಿಗೆ ಸ್ಥಿರೀಕರಣ ರೋಗನಿರ್ಣಯ. ಹಾಸ್ಪಿಟಲ್ ಮತ್ತು ರಿಸರ್ಚ್ ಸೆಂಟರ್, ಶ್ರೀ ದೇವರಾಜ ಅರಸು ವೈದ್ಯಕೀಯ ಕಾಲೇಜು, ಟಮಕ, ಕೋಲಾರ. ದಾಖಲಾಗಿದ್ದಾರೆ.

ಈ ಅಧ್ಯಯನದ ರೋಗಿಗಳು ದಿನನಿತ್ಯದ ರಕ್ತ ತನಿಖೆಗೆ ಒಳಗಾಗಬೇಕಾಗುತ್ತದೆ (ಸಿಬಿಸಿ, ಆರ್‌ಎಫ್‌ಟಿ, ಎಫ್‌ಬಿಎಸ್, ಪಿಪಿಬಿಎಸ್, ಎಚ್‌ಬಿಎ 1 ಸಿ, ಸೀರಮ್ ವಿದ್ಯುದ್ವಿಚ್ ly ೇದ್ಯಗಳು, ರಕ್ತ ಗುಂಪು, ಎಚ್‌ಐವಿ

ದಯವಿಟ್ಟು ಈ ಕೆಳಗಿನ ಮಾಹಿತಿಯನ್ನು ಓದಿ ಮತ್ತು ನಿಮ್ಮ ಕುಟುಂಬ ಸದಸ್ಯರೊಂದಿಗೆ ಚರ್ಚಿಸಿ. ಅಧ್ಯಯನಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ನೀವು ಯಾವುದೇ ಪ್ರಶ್ನೆಯನ್ನು ಕೇಳಬಹುದು. ಅಧ್ಯಯನದಲ್ಲಿ ಭಾಗವಹಿಸಲು ನೀವು ಒಪ್ಪಿದರೆ ನಾವು ನಿಮ್ಮಿಂದ ಅಥವಾ ನಿಮ್ಮಿಂದ ಅಥವಾ ಇಬ್ಬರಿಗೂ ಜವಾಬ್ದಾರರಾಗಿರುವ ವ್ಯಕ್ತಿಯಿಂದ ಮಾಹಿತಿಯನ್ನು (ಪ್ರೊಫಾರ್ಮಾದ ಪ್ರಕಾರ) ಸಂಗ್ರಹಿಸುತ್ತೇವೆ. ಸಂಬಂಧಿತ ಇತಿಹಾಸವನ್ನು ತೆಗೆದುಕೊಳ್ಳಲಾಗುವುದು. ಸಂಗ್ರಹಿಸಿದ ಈ ಮಾಹಿತಿಯನ್ನು ಪ್ರಬಂಧ ಮತ್ತು ಪ್ರಕಟಣೆಗೆ ಮಾತ್ರ ಬಳಸಲಾಗುತ್ತದೆ.

ನಿಮ್ಮಿಂದ ಸಂಗ್ರಹಿಸಲಾದ ಎಲ್ಲಾ ಮಾಹಿತಿಯನ್ನು ಗೌಪ್ಯವಾಗಿಡಲಾಗುತ್ತದೆ ಮತ್ತು ಯಾವುದೇ ಹೊರಗಿನವರಿಗೆ ಬಹಿರಂಗಪಡಿಸುವುದಿಲ್ಲ. ನಿಮ್ಮ ಗುರುತು ಬಹಿರಂಗಗೊಳ್ಳುವುದಿಲ್ಲ. ಈ ಅಧ್ಯಯನವನ್ನು ಸಾಂಸ್ಥಿಕ ನೈತಿಕ ಸಮಿತಿಯು ಪರಿಶೀಲಿಸಿದೆ ಮತ್ತು ನೀವು ಸಾಂಸ್ಥಿಕ ನೈತಿಕ ಸಮಿತಿಯ ಸದಸ್ಯರನ್ನು ಸಂಪರ್ಕಿಸಲು ಮುಕ್ತರಾಗಿದ್ದೀರಿ. ಈ ಅಧ್ಯಯನವನ್ನು ಒಪ್ಪಿಕೊಳ್ಳಲು ಯಾವುದೇ ಬಲವಂತವಿಲ್ಲ. ನೀವು ಭಾಗವಹಿಸಲು ಬಯಸದಿದ್ದರೆ ನೀವು

ಪಡೆಯುವ ಕಾಳಜಿ ಬದಲಾಗುವುದಿಲ್ಲ. ಭಾಗವಹಿಸಲು ನೀವು ಸ್ವಯಂಪ್ರೇರಣೆಯಿಂದ ಒಪ್ಪಿಕೊಂಡರೆ ಮಾತ್ರ ನೀವು ಹೆಬ್ಬೆರಳು ಅನಿಸಿಕೆಗೆ ಸಹಿ / ಒದಗಿಸುವ ಅಗತ್ಯವಿದೆ

ಗೌಪ್ಯತೆ

ನಿಮ್ಮ ವೈದ್ಯಕೀಯ ಮಾಹಿತಿಯನ್ನು ಅಧ್ಯಯನ ವೈದ್ಯರು ಮತ್ತು ಸಿಬ್ಬಂದಿ ಗೌಪ್ಯವಾಗಿಡುತ್ತಾರೆ ಮತ್ತು ಸಾರ್ವಜನಿಕವಾಗಿ ಲಭ್ಯವಾಗುವುದಿಲ್ಲ. ನಿಮ್ಮ ಮೂಲ ದಾಖಲೆಗಳನ್ನು ನಿಮ್ಮ ವೈದ್ಯರು ಅಥವಾ ನೈತಿಕ ಪರಿಶೀಲನಾ ಮಂಡಳಿಯು ಪರಿಶೀಲಿಸಬಹುದು. ಹೆಚ್ಚಿನ ಮಾಹಿತಿಗಾಗಿ / ಸ್ಪಷ್ಟೀಕರಣಕ್ಕಾಗಿ ದಯವಿಟ್ಟು ಸಂಪರ್ಕಿಸಿ

ಡಾ. ಅಭಿ ಶರ್ಮಾ (ಸ್ನಾತಕೋತ್ತರ),

ಮೂಳೆ ಚಿಕಿತ್ಸೆ ಇಲಾಖೆ,

ಎಸ್ ಡಿ ಯು ಎಮ್ ಸಿ. ಕೋಲಾರ

ಮೊಬೈಲ್ ಸಂಖ್ಯೆ: 7349457147

KEY TO MASTER CHART

IP no. – In patient number

MOI- Mode of injury

MC- Metacarpal

RTA- Road traffic accident

M- Male

F- Female

GA- General anaesthesia

VAS- visual analog score

TAM- Total active motin

DASH- Disability of arm, shoulder and hand score

MASTER CHART

S.NO.	Age	Sex	IP no.	MOI	MC involved	part involved	Side	associated injury	anaesthesia	procedure	implant removal	VAS SCORE	TAM	DASH SCORE	COMPLICATIONS
1	52y	m	785496	RTA	1st	base	left	nil	wrist block	retrograde	6 weeks	no pain	execellent	10	nil
2	45y	m	793142	RTA	4th	shaft	left	nil	wrist block	retrograde	6 weeks	no pain	execellent	15	nil
3	30y	m	796958	RTA	4th	shaft	right	nil	wrist block	retrograde	8weeks	mild pain	execellent	10	nil
4	42y	m	798285	RTA	4th	shaft	left	nil	wrist block	retrograde	6 weeks	no pain	execellent	20	nil
5	30y	m	766767	RTA	3rd	shaft	left	nil	wrist block	antegrade	6weeks	mild pain	execellent	17	nil
6	20y	m	778901	RTA	1st	base	left	left femur shaft fracture	GA	Criss cross	6 weeks	mild pain	good	10	nil
7	35y	m	734549	assault	5th	head	right	nil	wrist block	retrograde	6 weeks	no pain	excellent	23	nil
8	45y	m	787501	punch	5th	neck	right	nil	wrist block	retrograde	6 weeks	no pain	excellent	20	nil
9	30Y	m	751539	RTA	2nd	shaft	right	nil	wrist block	retrograde	5weeks	mild pain	excellent	16	nil
10	20Y	m	741668	RTA	3rd, 4th	shaft, base	left	right humerus shaft fractue	GA	retrograde	8weeks	mild pain	good	15	nil
11	35y	m	775030	RTA	2nd, 3rd, 4th	shaft	right	nil	wrist block	antegrade	6weeks	mmild pain	good	10	nil
12	30y	m	746767	RTA	2nd, 3rd	shaft, neck	left	nil	wrist block	retrograde	6 weeks	mild pain	good	15	nil
13	35y	f	746823	RTA	2nd	neck	left	nil	wrist block	retrograde	6 weeks	mild pain	good	20	nil
14	47y	m	746992	assault	4th	shaft	right	nil	wrist block	retrograde	6weeks	mild pain	good	18	nil
15	45y	m	747893	RTA	4th	shaft	left	nil	wrist block	antegrde	8 weeks	mild pain	good	15	nil
16	46y	m	795966	Fall	3rd,4th	shaft	left	nil	wrist block	retrograde	7weeks	mild pain	execellent	25	nil
17	50y	m	811457	RTA	3rd,4th,5th	shaft,base,base	right	right tibia shaft fracture	GA	retrograde	5 weeks	mild pain	excellent	15	nil
18	54y	f	825358	RTA	2nd	shaft	left	nil	wrist block	retrograde	6 weeks	no pain	good	10	nil
19	35y	m	826079	assault	4th, 5th	shaft	right	nil	wrist block	retrograde	6 weeks	no pain	execellent	10	nil
20	32y	m	835824	assault	5th	head	left	head injury	wrist block	retrograde	6 weeks	no pain	fair	10	superficial pin tract infection
21	22y	f	896958	RTA	4th	shaft	right	nil	wrist block	retrograde	8weeks	mild pain	good	10	nil
22	25y	m	898387	RTA	4th	shaft	left	nil	wrist block	retrograde	6 weeks	no pain	excellent	20	nil
23	35y	m	826887	RTA	3rd	shaft	left	nil	wrist block	antegrade	6weeks	mild pain	good	17	nil
24	25y	f	827501	RTA	1st	base	left	left femur shaft fracture	GA	Criss cross	6 weeks	mild pain	excellent	10	nil
25	52y	m	921457	RTA	3rd,4th,5th	shaft,base,base	right	right tibia shaft fracture	GA	retrograde	5 weeks	mild pain	excellent	15	nil
26	35y	f	926358	RTA	2nd	shaft	left	nil	wrist block	retrograde	6 weeks	no pain	good	10	nil
27	40y	m	926879	assault	4th, 5th	shaft	right	nil	wrist block	retrograde	6 weeks	no pain	good	10	nil
28	25y	m	935424	assault	5th	head	left	head injury	wrist block	retrograde	6 weeks	no pain	good	10	superficial pin tract infection
29	47y	f	935418	RTA	4th	shaft	left	nil	wrist block	antegrade	8weeks	moderate pain	poor	30	pain with stiffness
30	31y	m	937412	fall	4th	shaft	left	nil	wrist block	retrograde	6weeks	no pain	excellent	15	nil
31	54y	m	937201	RTA	1st	base	right	nil	wrist block	retrograde	6 weeks	no pain	excellent	15	nil
32	35y	m	925501	RTA	1st	base(rolando)left		nil	wrist block	Criss cross	6weeks	no pain	good	12	nil
33	33y	f	967958	RTA	3rd,4th,5th	shaft	right	nil	wrist block	retrograde	6weeks	mild pain	good	12	nil
34	54y	m	987285	RTA	4th	shaft	left	nil	wrist block	antegrade	6 weeks	no pain	fair	20	stiffness
35	45y	m	987501	punch	5th	neck	right	nil	wrist block	retrograde	6 weeks	no pain	good	20	nil
36	30Y	m	951639	RTA	2nd	shaft	right	nil	wrist block	retrograde	5weeks	mild pain	good	16	nil
37	20Y	m	941768	RTA	3rd, 4th	shaft, base	left	right distal end radius fractue	GA	retrograde	8weeks	mild pain	fair	15	nil
38	35y	m	945030	RTA	2nd, 3rd, 4th	shaft	right	nil	wrist block	antegrade	6weeks	mmild pain	good	10	nil
39	30y	m	926767	RTA	2nd, 3rd	shaft, neck	left	nil	wrist block	retrograde	weeks	mild pain	excellent	15	nil