"STUDY OF PROXIMAL ULNA FRACTURE TREATED BY VARIOUS MODALITIES"

By

DR. NILESH R. CHAREL

Dissertation submitted to the

S.B.K.S. MEDICAL INSTITUTE & RESEARCH CENTRE

SUMANDEEP VIDYAPEETH, PIPARIA, VADODARA.

In the partial fulfilment

of the requirements for the degree of

M.S.

In

ORTHOPAEDICS

Under the guidance of

DR. PARESH P. GOLWALA

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SBKS MEDICAL INSTITUTE & RESEARCH CENTRE

PIPARIA, VADODARA

YEAR 2015-18

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Ref: Your study synopsis entitled "Study of fracture of proximal ulna fracture treated by various modalities." Submitted to the SV IEC for approval.

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Dear Dr. Nilesh,

The Sumandeep Vidyapeeth Institutional Ethics Committee (SV IEC) is in receipt of your above mentioned study document and as the research study classifies in the minimal risk category; as recommended by HRRP SBKS MI&RC. The SV IEC approves your study to be conducted in the presented form.

The approval remains valid for a period of 1 year. In case the study is not initiated within one year, the Ethics Committee expects to be informed about the reason for the same and a fresh approval will have to be obtained subsequently.

The Sumandeep Vidyapeeth Institutional Ethics Committee expects to be informed about the progress of the study (every 6 months), any Serious Adverse Event (SAE) occurring in the course of the study, and if any changes are made in the protocol or patient information/informed consent the SVIEC needs to be informed about this in advance and an additional permission is required to be taken. The SV IEC also requires you to submit a copy of the final study report.

Dr. Niraj Pandit
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Date: 09th October 2017

Dr. Nilesh Charel
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1. **Your application letter no. SVIEC/IN/MEDI/BNPG16/D17132, 09th Oct 2017.**
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Dear Dr. Nilesh,

We have received your application requesting the SVIEC to allow change in the title of your dissertation study. The same has been recommended by your guide and HRRP coordinator of your college.

The matter has been reviewed by SVIEC. We are pleased to allow change in the title of your dissertation from **"Study of Fracture of Proximal Ulna Fracture treated by Various Modalities."** to **"Study of Proximal Ulna Fracture treated by Various Modalities."** since there is no other change in your dissertation as per synopsis submitted by you earlier.

The other terms and conditions shall remain the same as contained in the original permission letter under above mentioned reference no. 2.

Dr Niraj Pandit
Member Secretary
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This is to certify that your study entitled: "Study of Proximal Ulna Fracture treated by Various Modalities" Research Project was done by **"Dr. Nilesh Charel"** (PG Student, Dept of Orthopedics, S.B.K.S MI & RC, Dhiraj Hospital, Piparia, Waghodia road, Vadodara-391760, Gujarat) and it was conducted to the satisfaction of the Sumandeep Vidyapeeth Institutional Ethics committee.

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"STUDY OF PROXIMAL ULNA FRACTURE TREATED BY VARIOUS MODALITIES"** is a bonafide and genuine research work carried out by me under the guidance of Professor **DR. PARESH P. GOLWALA, M.S. (ORTHOPAEDICS)**.

Date: **Signature of the Candidate**

Place: Piparia, Vadodara **Dr.Nilesh R. Charel**

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled **"STUDY OF PROXIMAL ULNA FRACTURE TREATED BY VARIOUS MODALITIES"** is a bonafide research work done by **DR. NILESH R. CHAREL** under my guidance and in partial fulfilment of the requirement for the degree of **"MASTER OF SURGERY" in ORTHOPAEDICS.**

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ENDORSEMENT BY THE HOD, DEAN / HEAD OF THE INSTITUTION

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Dr. Nilesh R. Charel

ABSTRACT

INTRODUCTION

The elbow joint and superior radio-ulnar joint together form one of the most important joints of the body which help in various day to day activities of life. (1)

Proximal ulna fracture is among the most widely recognized by orthopaedic surgeons largely because of notoriously poor results associated with treatment of these injuries in adults.(2)

The goals of proximal ulna fracture management are to restore and maintain joint stability, articular congruity, strength, a pain free arc of functional elbow motion and to allow early mobilization so as to prevent stiffness of the elbow joint.

MATERIAL AND METHOD

This is a prospective cohort study of 20 patients treated at Dhiraj General Hospital forolecrenon fracture between APRIL, 2015 to 31st SEPTEMBER, 2017. Adult patients with traumatic isolated Proximal ulna fractures were enrolled in our study.

RESULT :

In our study, out of 20 patients, 15 were males & 5 were females . Average age of patients were 39.95 years. 18 Patients were treated with tension band wiring , 1 patient treated with Cannulated-cancellous screw and 1 patient treated with Rush pin. At final followup 15 (75%) patients treated by TBW with K-wire had excellent result, 3 (15 %)patients treated by TBW with K-wire had good result, 1 patient treated by TBW with K-wire (5 %) had fair result and 1 patient (5%) treated by TBW

with Rush pin had poor result . Superficial infection was seen in 2 patients, implant Impingement in 3 patients and stiffness of elbow joint was seen in 4 patients.

CONCLUSION

There was 100% union rate achieved at the end of 6 months. Treatment of choice for olecranon fracture depends on fracture type. Simple two-part transverse fracture is best treated with K-wiring and tension band wiring whereas oblique or comminuted fractures are best treated with platting.

KEYWORDS: proximal ulna fracture, Tension bandwire, Rushpin, Cannulated Cancellousscrew, Mayo`s Score, Mayo`s Classification.

INDEX

INTRODUCTION

The elbow joint and superior radio-ulnar joints together form one of the most important joints of the body which help in various day to day activities of life. Olecranon fractures are common injuries of the proximal ulna which constitute about 10% of all upper extremity lesions**.** Most olecranon fractures follow low-energy trauma such as a fall from a height of less than 2 meters, a direct blow to the elbow, or from forced hyperextension .A fall on a partially flexed elbow may generate an avulsion fracture of the olecranon from the pull of the triceps. The fractures are usually isolated but associated lesions can occur in complex injuries and polytrauma cases ***.(1)***

The proximal ulna fracture include olecranon fracture, isolated proximal ulna shaft fracture, monteggia fracture dislocation and elbow dislocation with proximal ulna fracture.

Proximal ulna fracture is among the most widely recognized injury by orthopaedic surgeons largely because of notoriously poor results associated with treatment of these injuries in adults. Various methods of osteosynthesis include open reduction and internal fixation with heavy duty plate and screws, tension band wiring, dynamic compression plate and screws, limited contact dynamic compression plate and screws and locking compression plates for fixation of ulnar fractures.(2)

Aim of the fracture treatment is to restore early, active, elbow motion in order to prevent joint stiffness. Undisplaced fractures (5% of total) are treated conservatively while displaced fractures (95% of total) are submitted to operative treatment.(2)

Tension band wiring (TBW) is the gold standard fixation for treating displaced transverse intra-articular olecranon fractures. This principle was first advocated by Weberand Vasly in 1963. ***(2)*** However, a number of complications such as infection, non union, malunion and ulnar nerve palsy could compromise the effect of operative treatment in up to 10% of cases ***(3)***

Plate fixation was reported to give adequate stability and achieve fracture union in simple and comminuted olecranon fractures**.** (1) Because of biomechanical

advantages, plate fixation of comminuted fractures is preferable than tension band wiring and therefore considered as the gold standard for treatment of comminuted fractures **.(1)**

Despite the excellent union rates, 20% of plates needed to be removed because of prominence under the skin. Due to dissatisfaction with reoperation rates for plate fixation, a prototype locked intra-medullary nail (IMN) was developed to provide internal fixation for such fractures. It was hypothesized that this IMN would result in a stiffer and stronger fixation than TBW fixations and that the interlocks would prevent hardware migration . In case of fracture comminution, stable and long-term reliable fixation is required .(1)

Thus, in order to study different modalities of fixation of proximal ulna fractures and define their outcome which might help streamline the protocol for management, we undertook this study of proximal ulna fracture.

AIM

The aim of this study is to seek which method of fixation fits best according to proximal ulna fracture type and postoperative outcome.

OBJECTIVES

To study fracture pattern and analyse the outcome and complications for each type with internal fixation

REVIEW OF LITERATURE

Before the era of aseptic surgery, the olecranon fractures were splinted in full extension for 4 to 6 weeks. This resulted in stiff elbow with loss of flexion. Hence as part of precautions mid flexion position was used, which led to non-union of olecranon due to separation of fragments. The goal of operative treatment is to restore stable elbow function allowing rapid mobilization to prevent permanent loss of motion, muscular wasting and fracture disease**(4)**

In1883, Joseph Lister pioneered internal fixation for the olecranon using a wire loop.(5)

Since Lister's work, a number of fixation methods have been employed, all with some success.

a) In 1993 McAtee device—a longitudinal fixation device(7)

b) In 1976Zuelzer hook plate (8)

c) Longitudinal intramedullary screws (12-14)
d) Tension band wiring (10,12-16)
e) Plate fixation (6,10,12,17,18)
f) Fragment excision with triceps reattachment for comminuted fractures and for fractures in elderly patients(6,21-25)

In 1982 P.Netz and L. Stromberg, treated olecranon fracture using a newly constructed pin instead of Kirschner wires in the traction absorbing wire (TAW) technique. The drawback of their procedure is extensive exposure of the fracture site which has to be repeated on removal of implant, hence came to conclusion that tension band wiring is better. (26)

In 1985, Donald Macko and Robert M. Szabo, treated 20 displaced fractures of olecranon using AO technique of tension-band wiring but have encountered technical complication related to the internal fixation device. The most frequent complication was symptomatic prominence of the Kirschner wires at the elbow and skin breakdown. Most of the complications related to this technique may be avoided by careful attention to surgical technique.(27)

In 1987 Wolfgang G, et al, confirm the conviction that the tension band wiring techniques yields good results in patients with displaced olecranon fracture. The method can yield excellent result even in difficult comminuted fracture dislocation.(28)

In 1991, Jupiter J.B et al stated that reduction of radiocapetellar dislocation and ulnar plating in posterior monteggia fracture dislocation yields relatively good results.(29)

In **1993,Chip,Routt ML** observed that maintenance of ulnar length is important for stability of forearm.(30)

In 1993, B.F. Morrey in current concepts in the treatment of fractures of the olecranon concluded that non comminuted, displaced, stable fractures can be effectively treated with Tension band wiring.(31)

In 1993, M. Ikdeda et al., in their study of 10 patients came to conclusion that comminuted olecranon fractures can be treated by multiple tension bind wiring and graft from iliac crest.(32)

Prayson et al. (1997) performed transverse osteotomies created in cadavers at the olecranon and stabilized with multiple techniques. One hundred cycles of loading were applied to achieve a peak flexion bending moment at the fracture of nine newton-meters with elbow flexion angle of seventy degrees. They found that when using a monofilament figure-eight loop with oblique Kirschner wire placement into the anterior ulnar cortex provided greater resistance to tensile force than intra-medullary Kirschner-wires. With intra-medullary Kirschner wire placement, 1.6-millimeter-diameter braided cable in both figure-eight and circular loop designs allowed less fracture displacement than did the 1.0-millimeter-diameter monofilament wire. The authors concluded that In transverse non comminuted olecranon fractures, fixation with monofilament wire is superior with Kirschner-wire placement into the anterior ulnar cortex than with intra-medullary Kirschner wires and discovered that fixation using braided cable was significantly improved over that with monofilament wire.(6,8,16)

In1998, Ring D et al, advocated that stable anatomic reduction of ulnar fracture results in anatomic reduction of radial head. The poor results of monteggia fracture in adults improved dramatically after development of modern techniques of dynamic compression plate and screws fixation for anatomic reduction , facilitating early mobilization(33)

In **1998, Ringet al**, stated that it is the character of ulnar fracture rather than direction of radial head dislocation that is useful in determining the optimal treatment of monteggia fracture in adults.(34)

Wu etal. (2000) used eight pairs of fresh cadaveric ulnae tested biomechanically. After transverse osteotomy of the olecranon, all left ulnae were fixed by the traditional modified AO technique with two Kirschner wires inserted through the anterior ulnar cortex and all right ulnae by the new technique with two Kirschner wires inserted into the marrow cavity from the olecranon to the ulnar styloid process .They found that there was no significant difference between the techniques. The maximal failure load by either technique was more than 80 kg. Even at testing failure, no Kirschner wires migrated proximally.(7,9) The authors concluded that the new technique may be applied widely to treat all olecranon fractures, because it is a technically easier and a safer technique, they assumed that this study may confirm indirectly the hypothesis that proximal migration of Kirschner wires was mainly due to triceps traction.

In **2001, Robin R.Richards** recommended that closed reduction of dislocation and early post operative intervention using limited contact dynamic compression plate is suitable implant for stabilization of fracture ulna.(35)

In 2000, David J. Haket al., in their study concluded that open reduction and internal fixation is the standard treatment for displaced intra-articular fractures. Stable internal fixation with figure of eight tension band wire fixation allows early motion to minimize stiffness .(36)

In 2001, John R. Williams stated that amongst coronoid, radial head, olecranon fractures and elbow dislocations a transverse intra articular fracture of proximal ulna are most common fractures. This fractures are best fixed using tension band principle

with two parallel K-wires and a loop of wire in figure of eight pattern. This technique allows early motion of elbow.(37)

In 2008, Byron E. Chalidiset al, reviewed 62 patients of isolated olecranon fractures and came to a conclusion that tension band wiring technique is the **"Gold standard"** for the treatment of olecranon fractures and leads to good elbow function and minimal loss of physical capacity (38)

In 2010,David Ring in surgical principles stated that : Realignment of the longitudinal axis of the olecranon as accurately as possible and with sufficient stability to allow early controlled motion. He preferred to repair the fractures to start confident active motion and functional use of limb. For simple non comminuted fractures without associated ligament injuries the author used tension bandwiring with K-wires.(39)

ANATOMY OF ELBOW JOINT

The elbow joint is a hinge variety of synovial joint. This includes two articulations. (40)

1) Humero-ulnar , between humeral trochlea and ulnar trochlear notch and

2) Humero-radial , between humeral capitellum and radial head .

It`s complexity is increased by continuity with the superior radio-ulnar joint within a continuous synovial cavity , this complex being the cubital articulation.

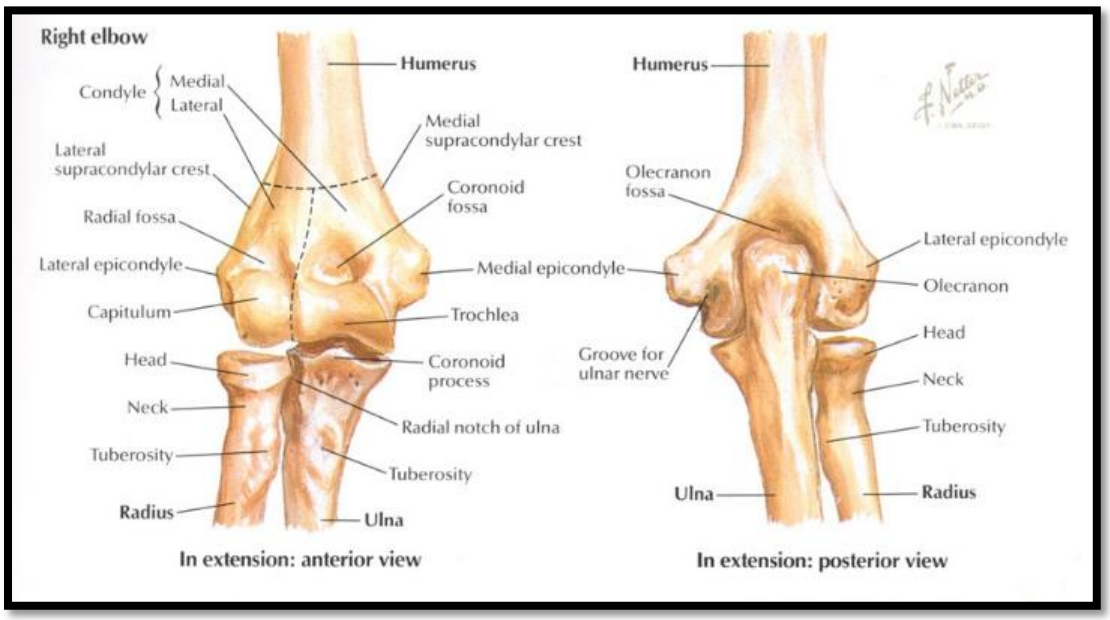


FIGURE :1 BONY ANATOMY OF THE ELBOW JOINT.

Ligaments of elbow joint

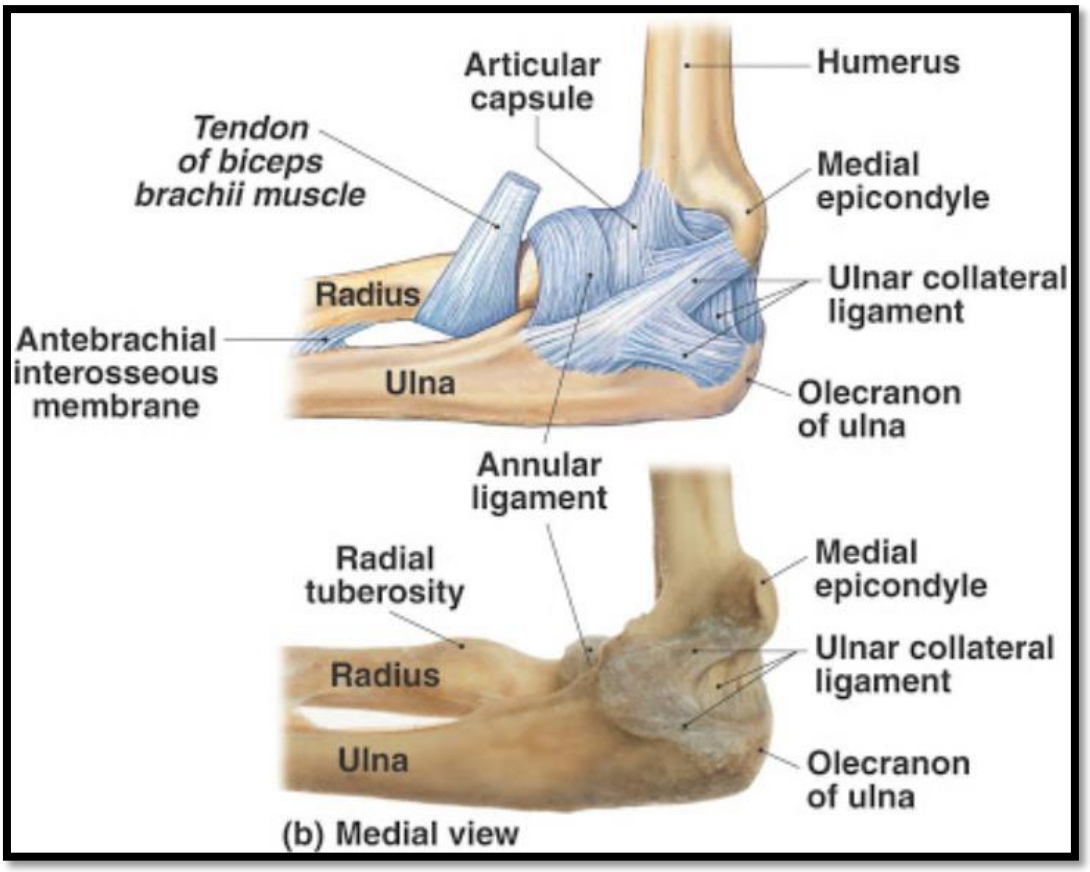


FIGURE: 2 LIGAMENTS OF ELBOW JOINT.

The humero-ulnar and humero-radial articulations form a largely uni-axial joint. The ligaments include capsular and the collaterals namely, ulnar and radial collateral. The collateral ligaments supplement the natural stability of the elbow joint .

THE JOINT CAPSULE :

It is anteriorly broad and thin , attached proximally to the humerus above the coronoid and radial fossae and to the front of medial epicondyle, and distally to the edge of the ulnar coronoid process and annular ligaments . On either sides it is continuous with the ulnar and radial collateral ligament.

The synovial membrane line the capsule deep surface extending from the humeral articular margins , lines the coronoid , radial and olecranon fossae, the flat medial trochlear surface and the lower part of the annular ligament.

a) THE ULNAR COLLATERAL (MEDIAL CUBITAL) LIGAMENT :

This is triangular band consisting of thick anterior,posterior and inferior parts limited by thin intermediate fibres. The anterior part is attached by it`s apex to the front of medial epicondyle and by it`s broad distal base to proximal tubercle on the medial coronoid margin . The posterior part is atttached on the back of medial epicondyle and to the medial margin of olecranon. The inferior or oblique part is a weak band extending between olecranon and coronoid processes. The ulnar collateral ligaments is related to triceps, flexor carpi ulnaris and ulnar nerve.

b) THE RADIAL COLLATERAL (LATERAL CUBITAL) LIGAMENT :

This is a fan shaped band, attached proximally to the lateral epicondyle and distally to the annular ligament. Some of it`s posterior fibres cross the ligament to the proximal end of the ulnar supinator crest. It is intimately blended with the attachment of supinator and extensor carpi radialis brevis.

B) PROXIMAL END OF ULNA AND RADIUS

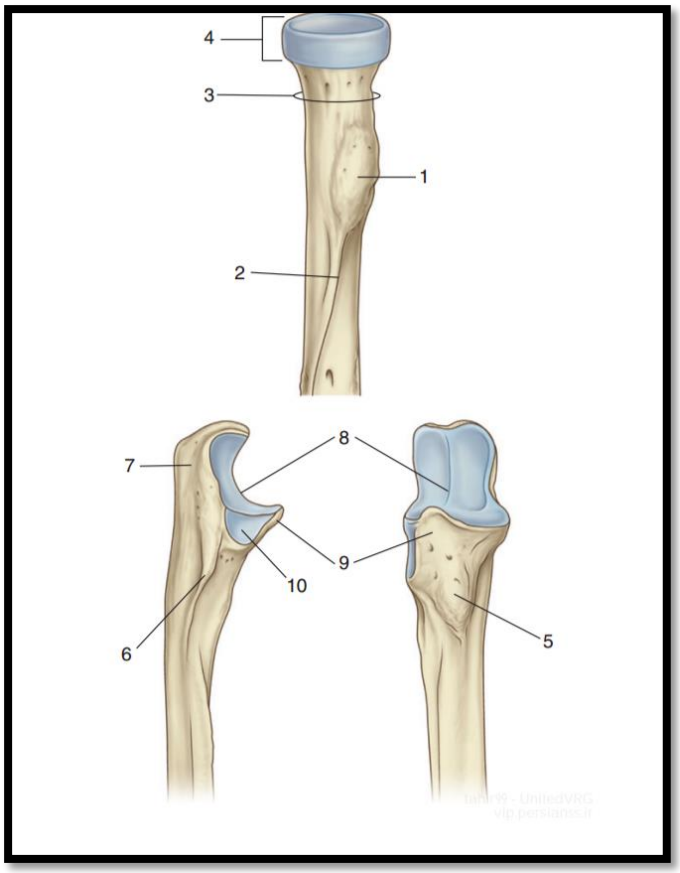


FIGURE :3 ANATOMY OF PROXIMAL END ULNA AND RADIUS

1. Radial tuberosity
2. Oblique line of radius
3. Neck of radius
4. Head of radius
5. Tuberosity of ulna
6. Supinator crest
7. Olecranon
8. Trochlear notch
9. Coronoid process
10. Radial notch

It consists of olecranon and coronoid process and trochlear and radial notches articulating with the humerus and radius. The olecranon, more proximal is bent forwards at it`s summit like a beak, which enters the humeral olecranon fossa in extension. The posterior surface of olecranon is smooth, triangular and is subcutaneously placed. it`s proximal border become the elbow`s point.

In extension it can be in the same line joining the humeral epicondyles, but in flexion it descends the three osseous points forming an isosceles triangle. The anterior surface of olecranon is the articular surface which forms the proximal part of trochlear notch. The base of olecranon is slightly constricted where it joins the shaft. The coronoid process projects anterioly distal to olecranon & it`s proximal aspect forms the distal part of the trochlear notch. Distal to coronoid process on the lateral surface is a shallow, smooth and oval radial notch for articulation with the radial head.

It is constricted at the junction of the olecranon and coronoid process where their articular surface may be separated by a narrow, rough, non-articular strip. A smooth part divides the notch into medial and lateral parts, medial filling the trochlear flange.

The proximal end of the radius is expanded and includes a head, neck and tuberosity. The head is discoid and it`s proximal surface is a shallow cup for the humeral capitellum. It`s smooth articular periphery is vertically deeper medially, where it articulates with the radial notch of ulna. The neck is the constriction distal to the head, which overhangs it, especially on the lateral side.

The tuberosity is distal to the medial part of the neck which is extraarticular and has a rough posterior portion for the insertion of biceps tendon.

MOVEMENTS :

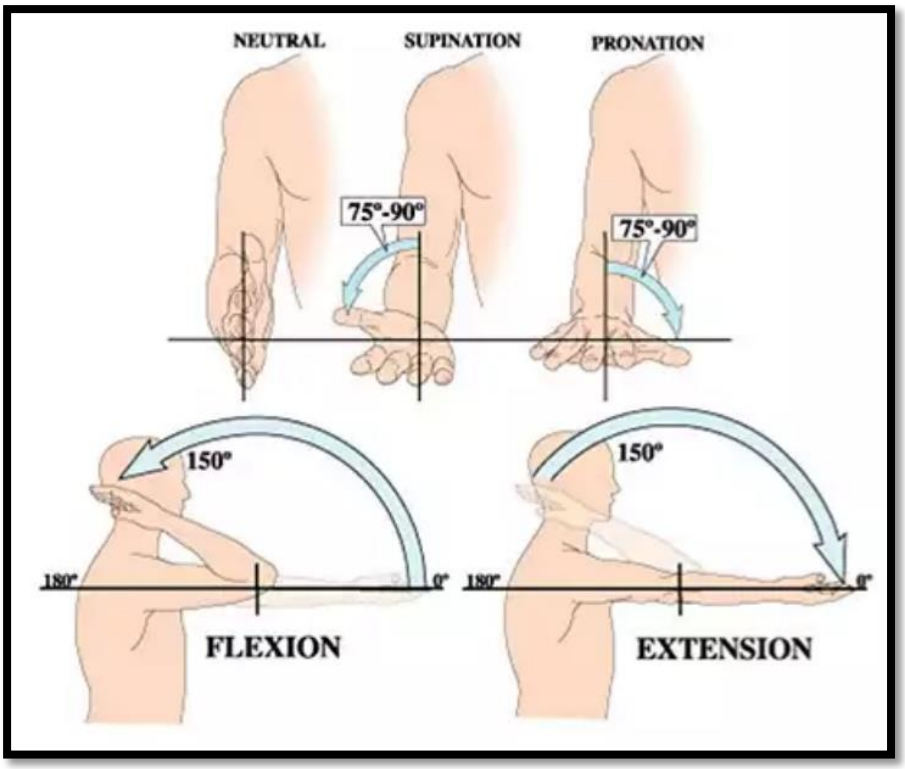


FIGURE : 4 ELBOW NORMAL RANGE OF MOTION

Elbow joint being a uni-axial joint allows flexion and extension with ulna moving on the trochlea and radial head on capitellum. However, ulnar flexion-extension is not a pure swing but accompanied by slight conjunct rotaion, the ulna being slightly pronated in extension and supinated in flexion.

The extension is limited by tension in the capsule and muscles anterior to the joint and the entry of tip of the olecranon into olecranon fossa.

The flexion is limited chiefly by apposition of soft parts, with the rim of radial head and the tip of ulnar coronoid process entering the radial and coronoid humeral fossae respectively. Accessory movements of elbow are limited to slight ulnar screwing, adduction, abduction and antero-posterior translation of the radial head on the humeral capitellum.

THE SUPERIOR RADIO-ULNAR JOINT :

This is uni-axial pivot between the circumference of the radial head and the osseofibrous ring made by the ulnar radial notch and annular ligaments. The annular ligaments is strong band that encircles the radial head holding it against the ulnar radial notch.

It forms about four-fifths of the ring and is attached anteriorly to the margin of radial notch and posterioly it is broadened and attached to rough ridge at or behind the posterior margin of radial notch. The proximal annular border blends with the cubital capsule and from the distal border a few fibres pass over reflected synovial membrane to attach loosely on the radial neck .

The annular ligament`s extensor surface blends with radial collateral ligament and is an attachment of part of supinator. Internally the ligament is thinly covered by cartilage where it is in contact with radial head.

MOVEMENTS :

Movements of the radio-ulnar joint complex, pronation and supination of the hand around vertical axis. The vertical axis of movement of the radius passes above, and through the ulnar attachment of articular disc below. This axis is not stationary because lower end of ulna is not fixed: it moves backward & laterally during pronation and forward & medially during supination. As a result of this movement, the axis is displaced laterally in pronation and medially in supination.

MUSCLES PRODUCING THE MOVEMENTS :

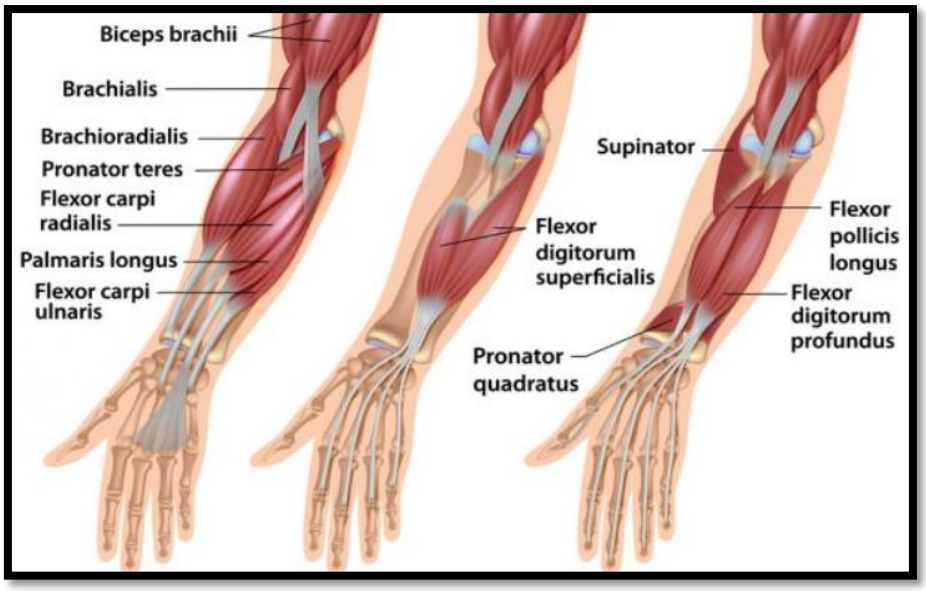


FIGURE :5 MUSCLES PRODUCING THE MOVEMENTS.

a) Pronation : Pronator quadratus , pronator teres and flexor carpi radialis.

b) Supination : Biceps and supinator .

BLOOD SUPPLY OF ELBOW JOINT :

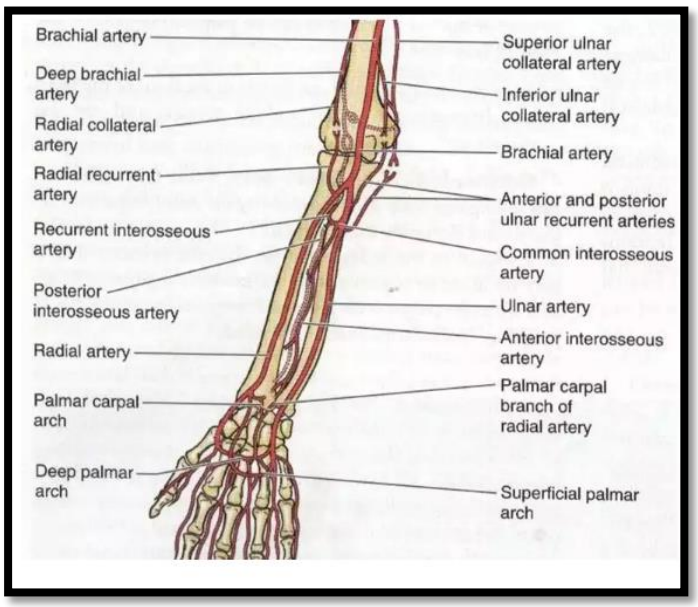


FIGURE : 6 BLOOD SUPPLY OF ELBOW JOINT

The elbow joint is supplied by the articular branches from the anastomotic networks around the joint . The anastomosis is formed by

a. Anterior descending and posterior descending branches of profundabrachii artery.

b. Radial recurrent branch of radial artery .

c. Inferior and Superior ulnar collateral branch of brachial artery.

d. Anterior and Posterior ulnar recurrent branches of ulnar artery.

NERVE SUPPLY OF THE ELBOW JOINT :

The elbow joint is supplied mainly from articular branches of musculocutaneous and radial nerves , but the ulnar , median and sometimes the anterior introsseous nerve also contribute . The articular branches from the musculocutaneous nerve arises from the nerve to brachialis and supply the anterior part of the capsule. The articular branches from the radial nerve arises from the nerve to anconeus and supply the posterior and anterolateral portion of the capsule .

BIOMECHANICS OF THE ELBOW

The elbow is a trocho-ginglymus joint with three articulations (the ulnohumeral, radiocapitellar, and proximal radioulnar joints) that acts as a link between the shoulder and the hand, and possesses two degrees of freedom: flexion-extension and pronation-supination. (41)

Elbow flexion normally ranges from 0 degrees or slight hyperextension, to 150 degrees of flexion . The radiocapitellar joint and proximal radioulnar joint provide 85 degrees of supination and 75 degrees of pronation. The axis passes through the center of the radial head and extends through the radial border of the distal ulna. There are 3 to 41 degrees of varus-valgus and axial laxity that occur with elbow flexion.

Maximal extension can be limited by impaction of the olecranon into the olecranon fossa anterior capsule and ligaments, and the flexor muscle tightness. Maximal flexion is limited by anterior muscle bulk, the impaction of the radial head and coronoid process into their corresponding fossa, and triceps muscle tightness.(41)

The elbow in full extension and supination has a relative valgus alignment called a carrying angle that measures 10 to 15 degrees in men and 5 degrees greater in women .(42)

CLASSIFICATION OF FRACTURE OLECRANON

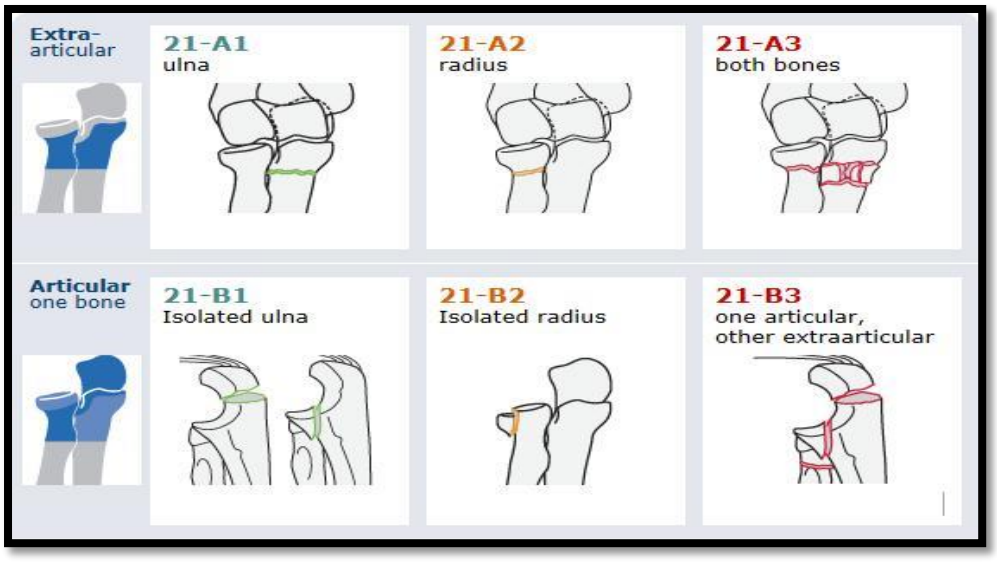
There are several classifications systems used for olecranon, proximal ulna, and radial fractures. No one classification is universally used

1) AO Classification (43)

Type A: Extra-articular fractures at the metadiaphysis level

Type B: Intra-articular fractures of either the radius or ulna

Type C: Complex fractures of both the proximal radius and ulna



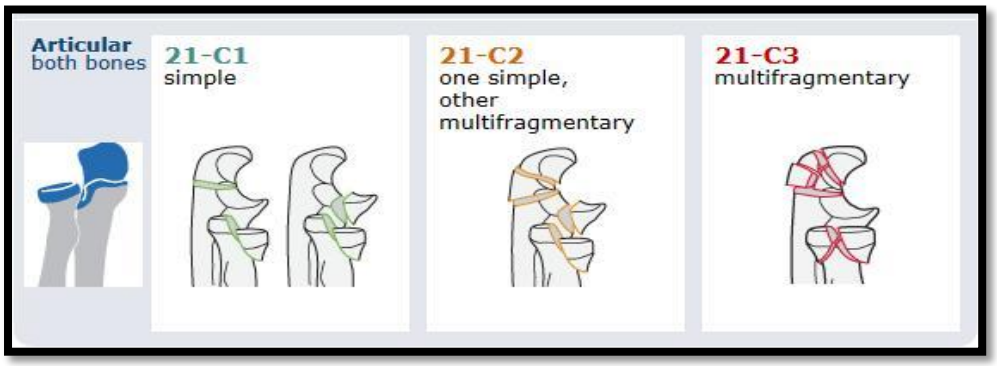


Fig.:7 showing a diagram of the AO classification for fracture olecranon (BucholzRWet.al 2005)

2) Mayo classification of olecranon fractures(44)

Morrey classified olecranon fractures according to criteria regarding stability, comminution, and displacement (Fig. 8). The Mayo Classification thus divides olecranon fractures into three types, provides a basis for a rational treatment algorithm by fracture type and subtype, and conveys prognostic value.

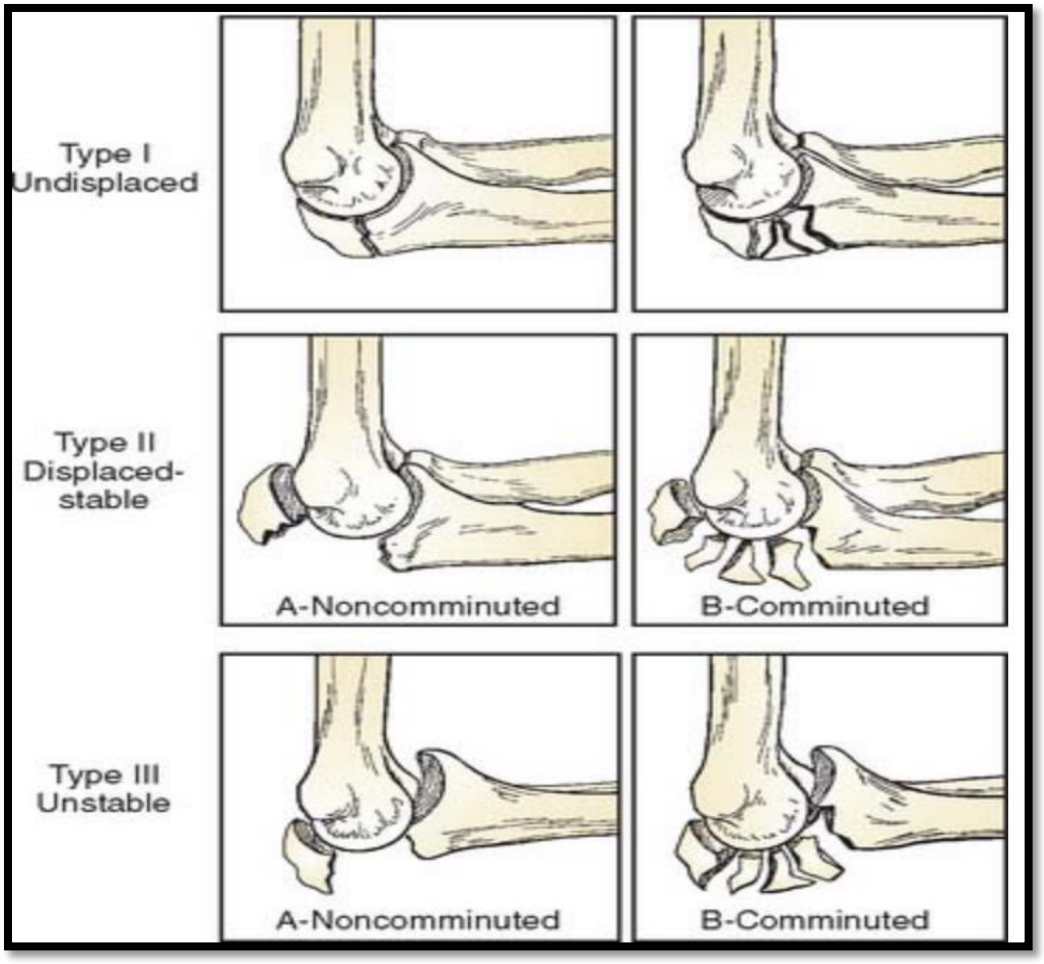


FIG : 8 SHOWING DIAGRAM OF MAYO`S CLASSIFICATION.

Mayo Type I

Mayo type I fractures are undisplaced fractures characterized by displacement of <2 mm with separation remaining <2 mm with flexion of the elbow to 90 degrees or with extension against gravity. Patients with these fractures are able to actively extend the elbow against gravity. Type I fractures may be further subdivided into type IA, non

comminuted fractures, and type IB, comminuted fractures. Since these fractures are non displaced by definition, the degree of comminution is not practically significant, and types IA and IB may essentially be regarded as and treated as the same lesion.

Mayo Type II

Mayo type II fractures are the most common type. These fractures, which are stable fractures with >3 mm of displacement, may be non comminuted (type IIA)or comminuted (type IIB). Because the collateral ligaments are intact, the forearm is stable relative to the humerus.

Mayo Type III

Mayo type III fractures are unstable, displaced fractures and represent fracture-dislocations. Like types I and II, type III fractures may be sub classified into non comminuted (IIIA) or comminuted (IIIB) types.

3) Schatzker classification of olecranon fractures: (45)

These fractures were classified by Schatzker based on fracture pattern and mechanical considerations as to the type of internal fixation required for repair**(Springer Verlag Berlin., 1996)** (Fig. 6).

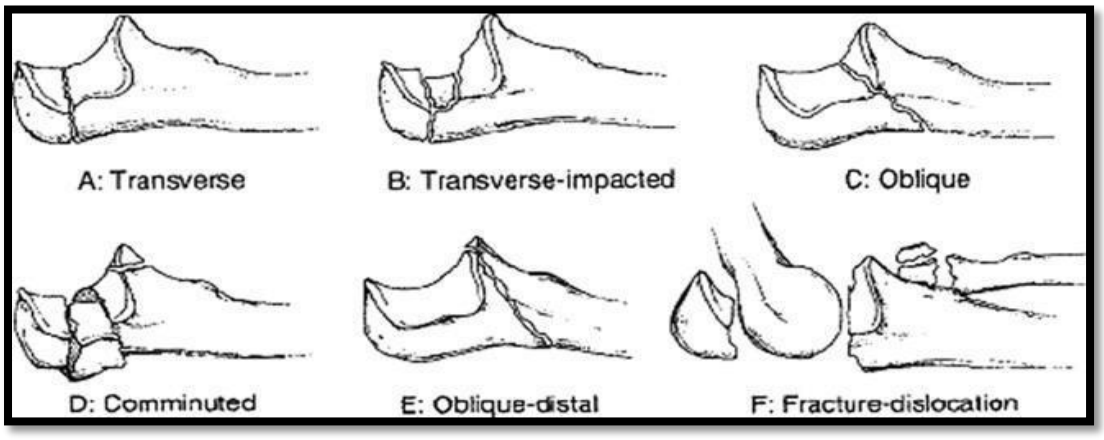


Fig.: 9 A diagram Showing Schatzker's classification of Olecranon fractures (BucholzRWet.al 2005)

1- Transverse pattern : This occurs at the apex of the sigmoid notch and represents an avulsion fracture from a sudden violent pull of both triceps and brachialis, and uncommonly from direct trauma.

2- Transverse impacted pattern : A direct force leads to comminution and depression of the articular surface

3- Oblique pattern : This occurs as a result of hyperextension injury, it begins at begins at midpoint of the sigmoid notch and runs distally.

4- Comminuted pattern : Fractures with associated injuries these results from direct high energy trauma, fractures from the coronoid process may lead to instability

5- Oblique distal pattern: Fractures extend distal to the coronoid and compromise elbow stability

6- Fracture dislocation: It is usually associated with severe trauma.

MATERIAL & METHOD

The present study includes consecutive 20 cases of proximal ulna fracture in adults admitted and treated at Dhiraj General Hospital attached to S.B.K.SHAH Medical College, Piparia, Baroda between April 2015 to September 2017.

Method of collection of Data :

Collection of data for patients presenting with fracture of proximal ulna was done as follows :-

- History by Verbal communication
- Clinical examination, both local and systemic.
- Radiological examination routine and other imaging modalities.
- Investigation baseline and others.
- Fracture anatomy assessed with X-rays (Xray elbow with forearm Antero Posterior and Lateral).
- Diagnosis - Clinical and Radiological.
- Informed written consent taken for surgical procedure.
- Surgery - Open reduction and Internal fixation with various implant depending upon fracture pattern and surgeon preference.
- Post Operative treatment :
    - Routine antibiotic and analgesic .
    - Evaluation by X- rays – ELBOW = AP & LATERAL VIEW
- Complications management if any:
- Follow up : Assessment at 4 weeks , 3 months , 6 months and final folllowup
- Assessment of any complications.

- Assessment of function using Mayo ELBOW performance score.

Inclusion Criteria:

1. Patient aged 18 years and above.
2. All patients with PROXIMAL ULNA FRACTURE
3. Patients willing to take part in study.

Exclusion Criteria:

- Patients not willing for surgery
- Associated fracture of the other bone of ipsilateral upper limb
- Pathological fracture
- Patient unfit for surgery.

In general condition of the patient, the vital signs were recorded .Methodical examination was done to rule out fracture at other sites. Local examination of injured elbow revealed swelling, deformity and loss of function .Radiographic study was done taking AP and Lateral x-ray of the involved elbow.

- The patient was taken for surgery after routine investigations and after obtaining fitness toward surgery. The investigations were as follow: CBC, Urine routine micro, FBS, Blood urea , Serum creatinine, SGPT, SGOT ,HIV ,HBSAG, HCV and ECG .
- All patients were treated surgically with open reduction and internal fixation.
- All the patients were placed in lateral position with arm supported and forearm hanging. In all patients a posterior approach was used to give better exposure of the fracture.
- Depending upon the fracture pattern an appropriate fixation device was used after anatomical reduction under IITV.
- Closure was done in layers and post operatively posterior slab was given .

POST OPERATIVE MANAGEMENT:

- Immediate check x-ray to see reduction and joint congruity, implant placement and size.
- Antibiotic drugs till the sutures are removed.
- Analgesics and supportive drugs.
- Active mobilization of elbow within one to three weeks with or without crepe bandage.
- Post operatively active range of motions exercises were carried out by patient under supervision of trained physiotherapist at 6-7th postoperative day. When there was doubt regarding stability of fixation cast bracing or broken slab can be used to allow early active mobilization.

The patients were discharged after suture removal and were called for regular followup at 1 month, 3 month, 6 months and final followup at usually 9 months to 1 year duration. At each followup radiological assessment was done with elbow AP and Lateral radiographs and functional assessment was done as per the proforma.

Implants for tension band wiring

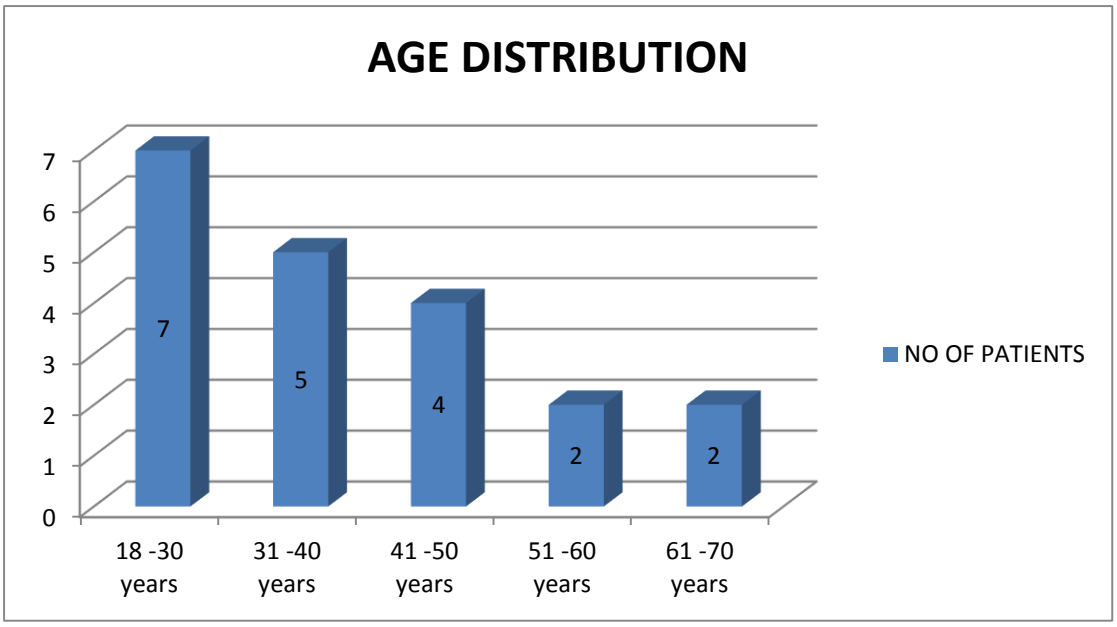
OBSERVATION AND RESULTS

At Dhiraj General hospital S.B.K.S Medical institute & Research centre, Pipariya, Vadodara, 20 patients fulfiling the inclusion criteria and willing for the study were included in analysis those were operated for TBW with either K wire or cannulated cancellous screw or Rush Pins from April 2015 to September 2017. Basic clinical history was elicited. Careful examination of skeletal system and soft tissue injuries was done and recorded. Radiographs of the affected extremity and trauma series were done. We classified all the cases according to Mayo`s classification. They were regularly follow up at 1 month, 3 months, 6 months post operatively. Assessment of functional outcome was done during each follow –up.

AGE DISTRIBUTION

TABLE :1

AGE GROUP IN YEARS	NO. OF PATIENTS	PERCENTAGE (%)
18-30	07	35
31-40	05	25
41 -50	04	20
51-60	02	10
61 -70	02	10
TOTAL	20	100

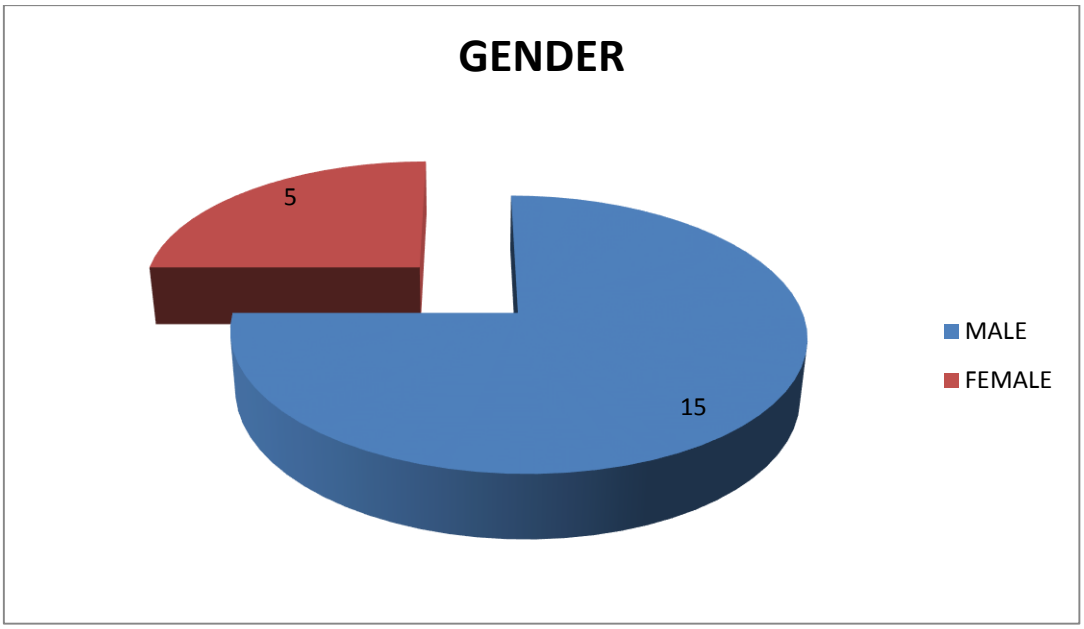


In our study the average age of patients was 39.95 years. 7 Patients were in the age group of 18-30 years, 5 patients were in the age group of 31-40 years, 4 patients were in the age group of 41-50 years , 2 Patients were in the age group of 51-60, and 2 patients were in the the age group of 61-70. 80% of the patients were in the age group of 18 to 50 years suggesting young active population who suffered this injury.

GENDER

TABLE: 2

SEX	NO. OF PATIENTS	PERCENTAGE
MALE	15	75 %
FEMALE	05	25 %
total	20	100 %

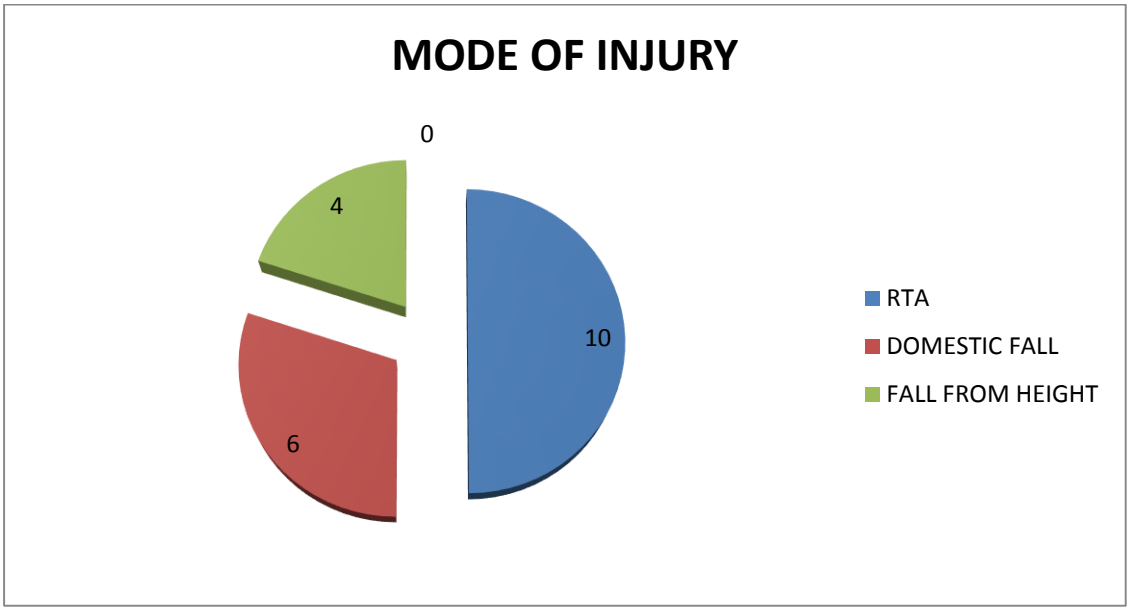


In the present study, 15 (75 %) patients were male while 5 (25%) patients were females. This is because males are the bread earners of the family & do more labourer work.

MODE OF INJURY

TABLE : 3

MODE OF INJURY	NO OF THE PATIENT	PERCENTAGE OF PATIENTS (%)
ROAD TRAFFIC ACCIDENT	10	50
DOMESTIC FALL	06	30
FALL FROM HEIGHT	04	20
TOTAL	20	100

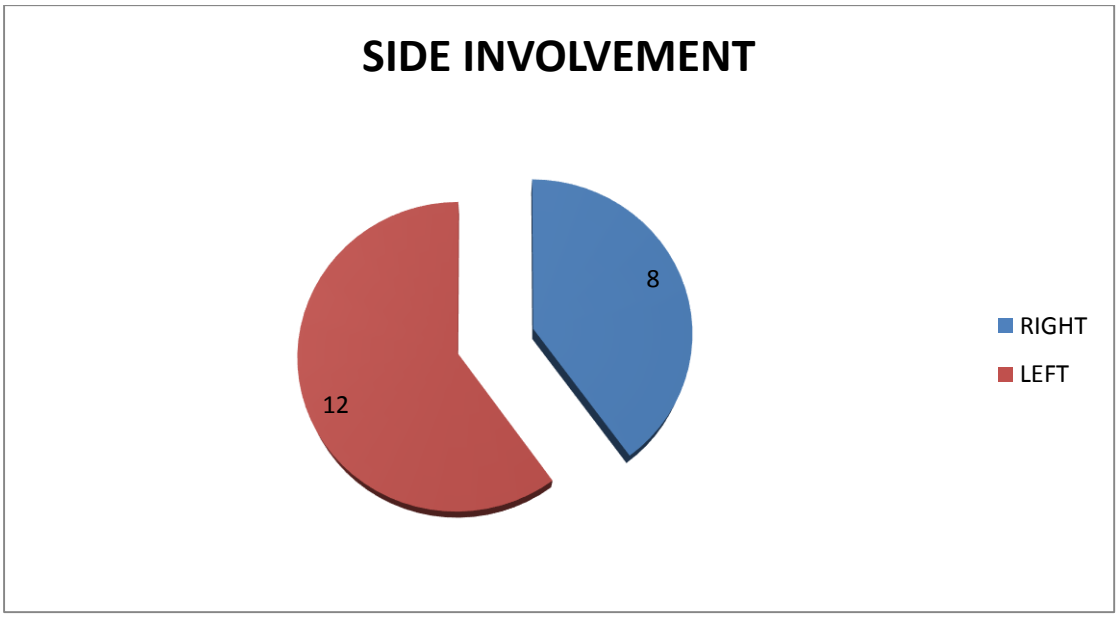


Out of 20 patients 10 (50%) patients got injured in a road traffic accident (RTA), while 6 (30%) patients got injured due to domestic fall and 4(20%) patients got injured due to fall from height.

AFFECTED SIDE

TABLE :4

SIDE	NO. OF PATIENTS	PERCENTAGE (%)
RIGHT	08	40 %
LEFT	12	60 %
TOTAL	20	100 %

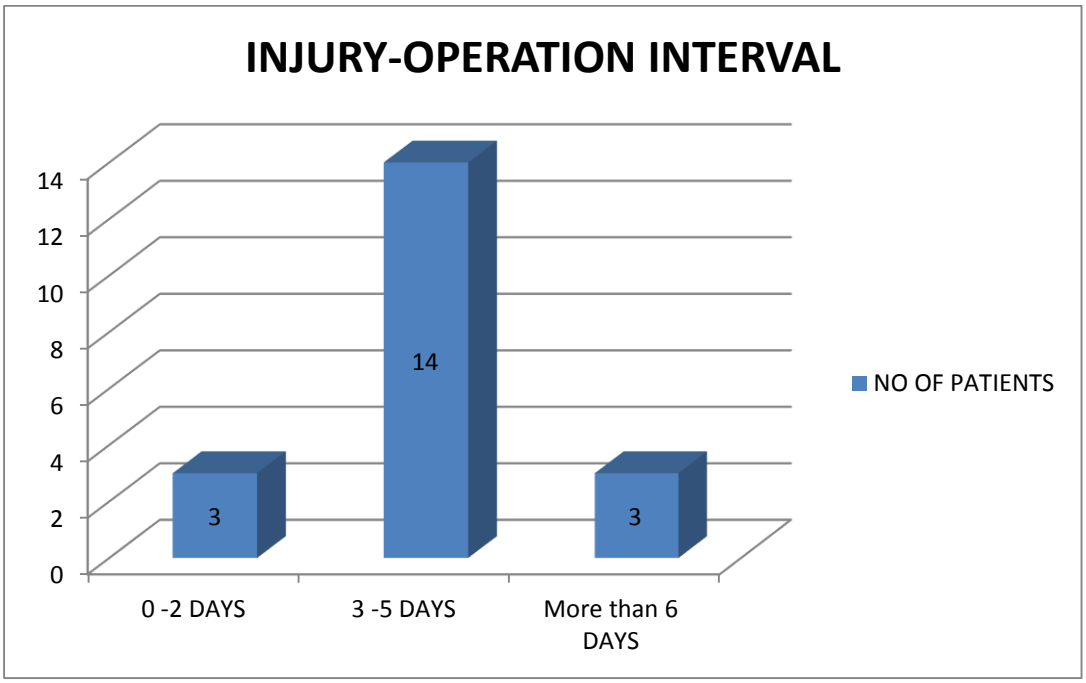


In the present study, 8 (40%) patients had right proximal ulna fracture, while 12 (60 %) patients had injured left side injury.

INJURY OPERATION INTERVAL

TABLE: 5

In Days	NO. OF PATIENTS	PERCENTAGE (%)
0-2	03	15 %
3-5	14	70 %
More than 6	03	15 %
TOTAL	20	100 %



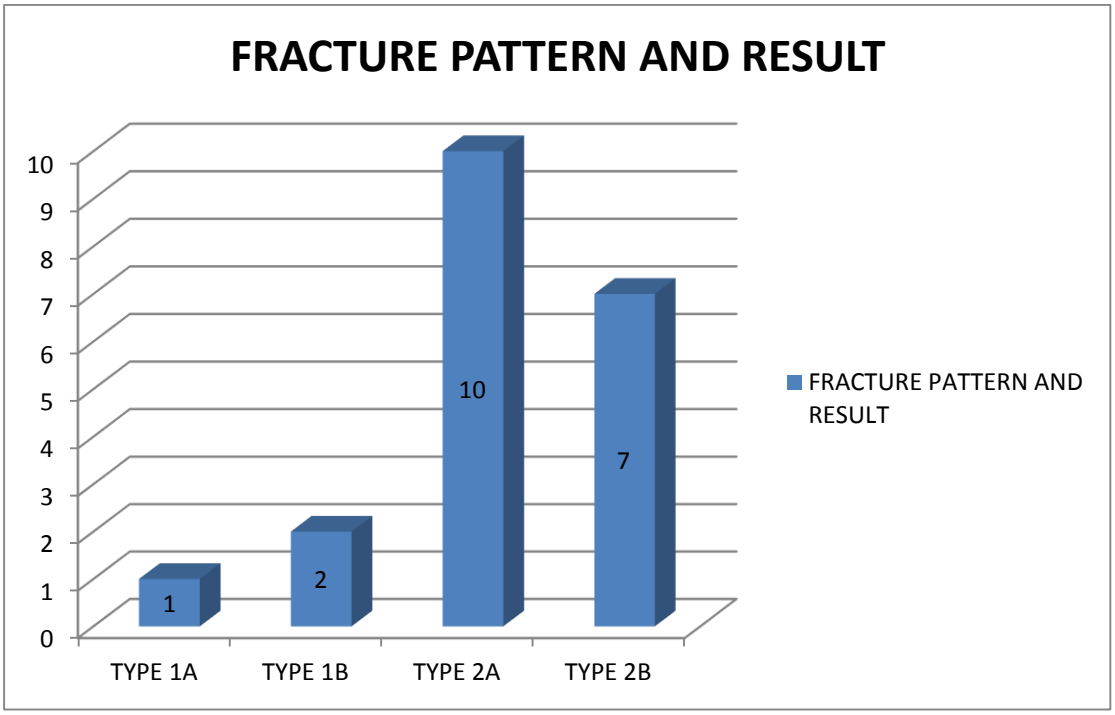
In our study, 70% (14) patients were treated within 3 to 5 days of injury.

FRACTURE PATTERN AND RESULT

TABLE :6

FRACTURE TYPE	NO OF PATIENT	AVERAGE FINAL SCORE
TYPE 1A	1	100
TYPE 1B	2	95
TYPE 2A	10	90.5
TYPE 2B	7	88.57
TOTAL	20	93.51

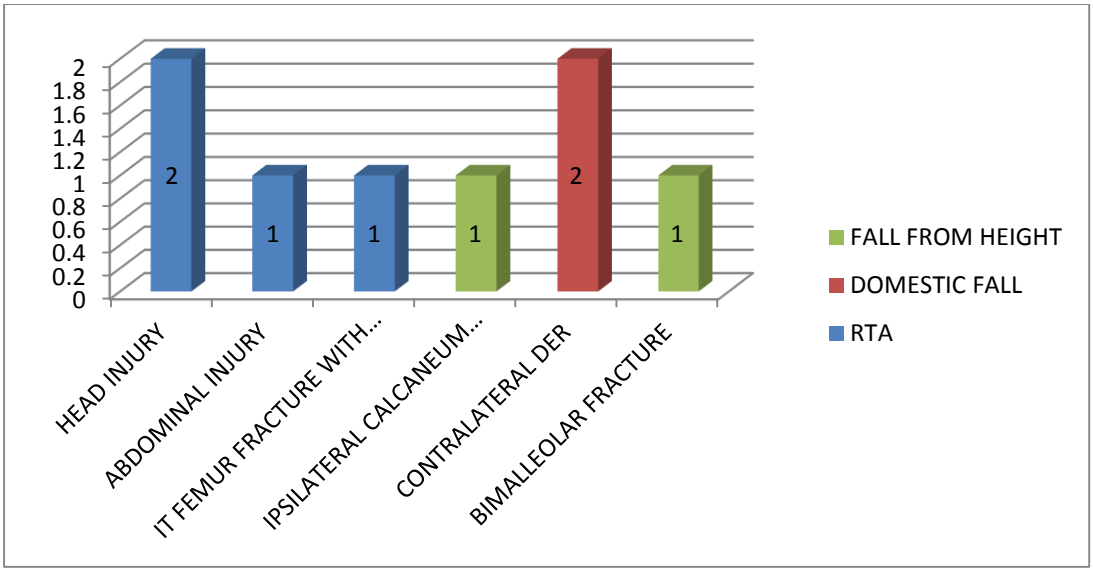
In our study Average final score in type 1A was 100, in type 1B was 95, in type 2A was 90.5 and in type 2B was 88.57.



ASSOCIATED INJURIES

TABLE : 7

ASSOCIATED INJURY	NO OF PATIENTS	MODE OF TRAUMA		
		RTA	DOMESTIC FALL	FALL FROM HEIGHT
HEAD INJURY	02	02	00	00
ABDOMINAL INJURY	01	01	00	00
IT FEMUR FRACTURE WITH PATELLA FRACTURE	01	01	00	00
IPSILATERAL CALCANEUM FRACTURE	1	-	-	1
CONTRA-LATERAL DISTAL END RADIUS	2	-	2	
BIMELLEOLAR FRACTURE	1	-	-	1

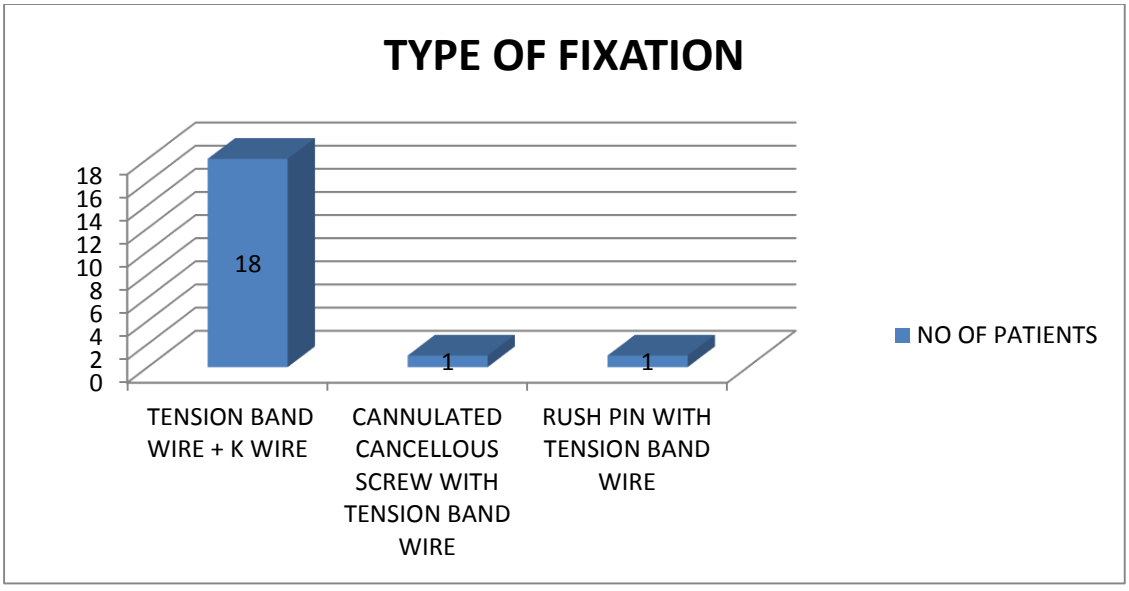


In our study 2 patients had Head injury, 1 patient had abdominal injury, 1 patient had IT Femur fracture , 2 patients had contralateral distal end radius fracture, 1 patient had bimalleolar fracture and 1 patient had ipsilateralcalcaneum fracture .

TYPE OF FIXATION :

TABLE : 8

TYPE	NO OF PATIENT	PERCENTAGE (%)
TENSION BAND WIRE +K WIRE	18	90
TENSION BAND WIRE +CANNULATEDCANCELLOUS SCREW	01	5
TENSION BAND WIRE + RUSH PIN	01	5
TOTAL	20	100

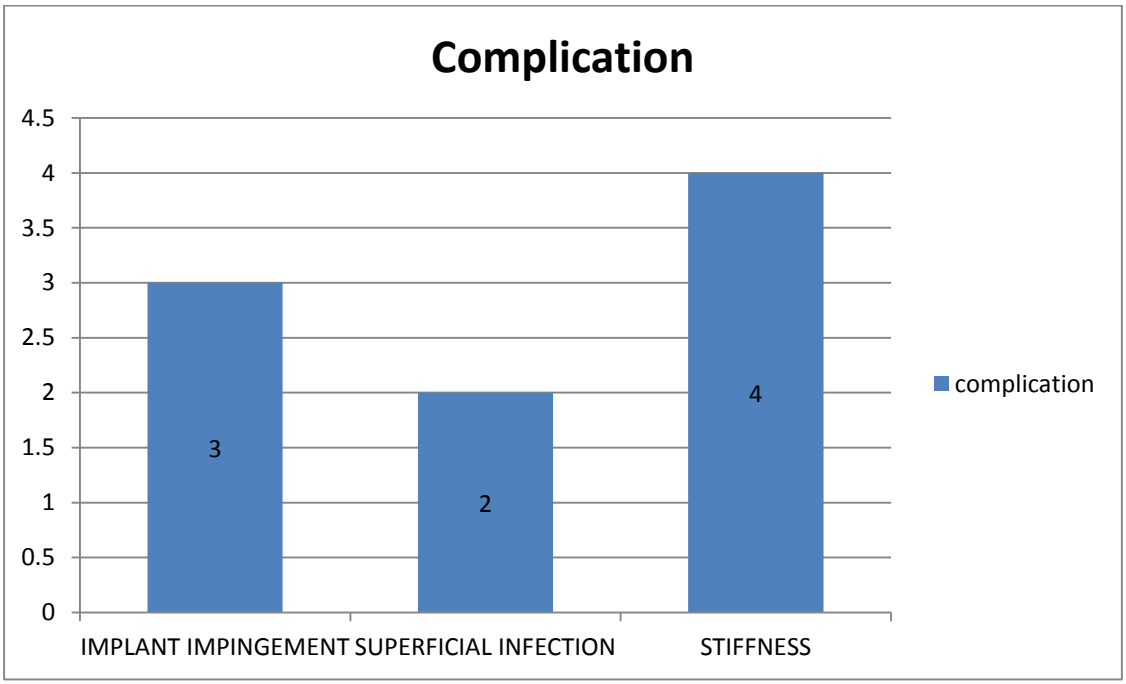


In our study all patients were treated with TENSION BAND WIRE method ,out of which 18 Patients were treated with additional k-wire, 1 patient treated with cannulatedcancellous screw and 1 patient treated with intramedullary Rush pin.

COMPLICATIONS

TABLE : 9

COMPLICATION	No. Of patients	PERCENTAGE
IMPLANT IMPINGEMENT	3	15
SUPERFICIAL INFECTION	02	10
STIFFNESS	04	20
TOTAL	9	45

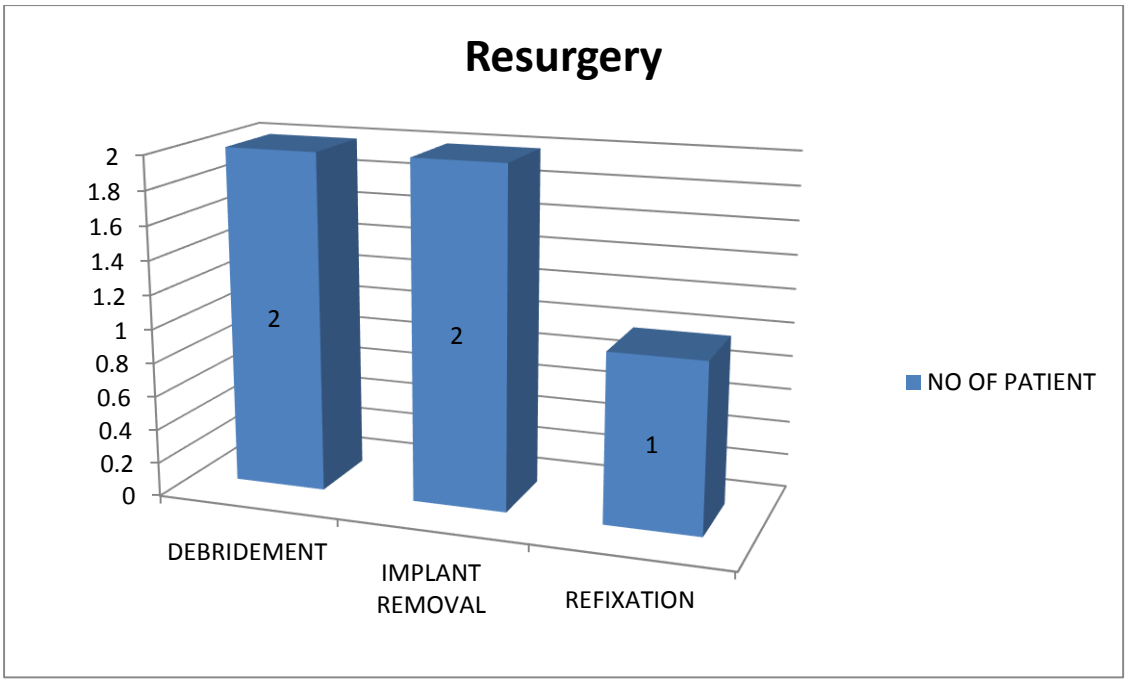


In our Patients, 2 had superficial infection, 3 had implant impingement and 4 had stiffness of elbow joint accounting for 20 % of total patients .

RE-SURGERY REQUIRED

TABLE : 10

RE-SURGERY	NO. OF PATIENTS
DEBRIDEMENT	02
IMPLANT REMOVAL	02
RE-FIXATION	01

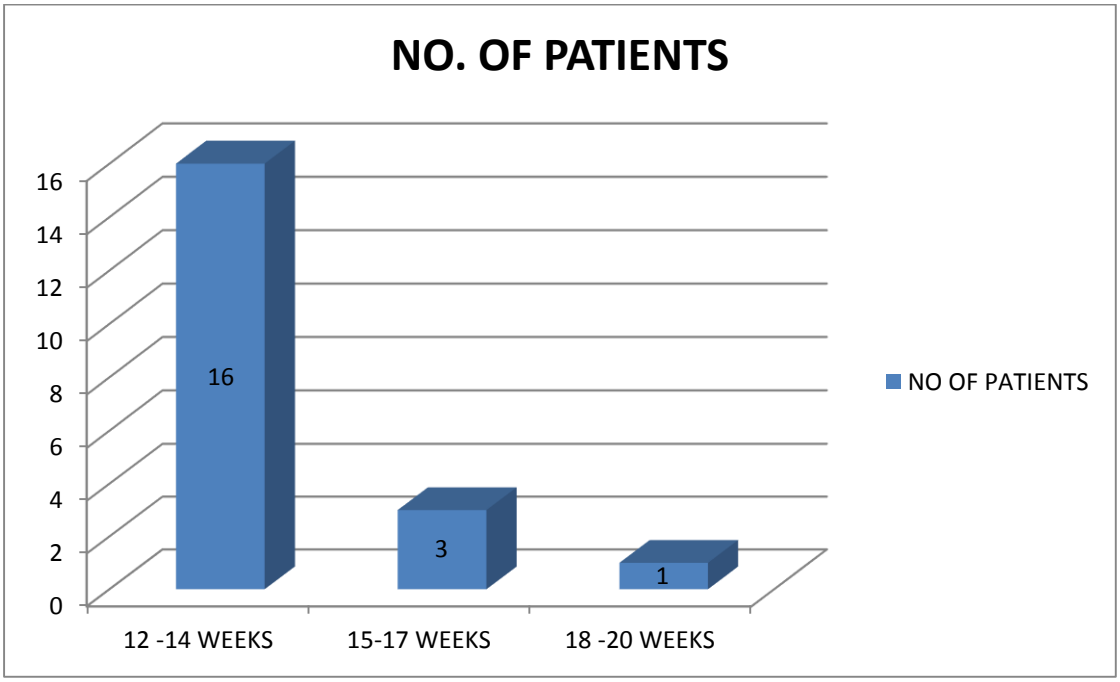


In our study debridement for superficial infection was done in 2 patients , while 2 patient with implant impingement had undergone for implant removal and 1 patient for re-fixation of implant .

RADIOLOGICAL UNION

TABLE: 11

RADIOLOGICAL UNION IN WEEKS	NO OF PATIENTS	PERCENTAGE OF PATIENTS (%)
12 -14	16	80
15-17	3	15
18 – 20	1	5
TOTAL	20	100



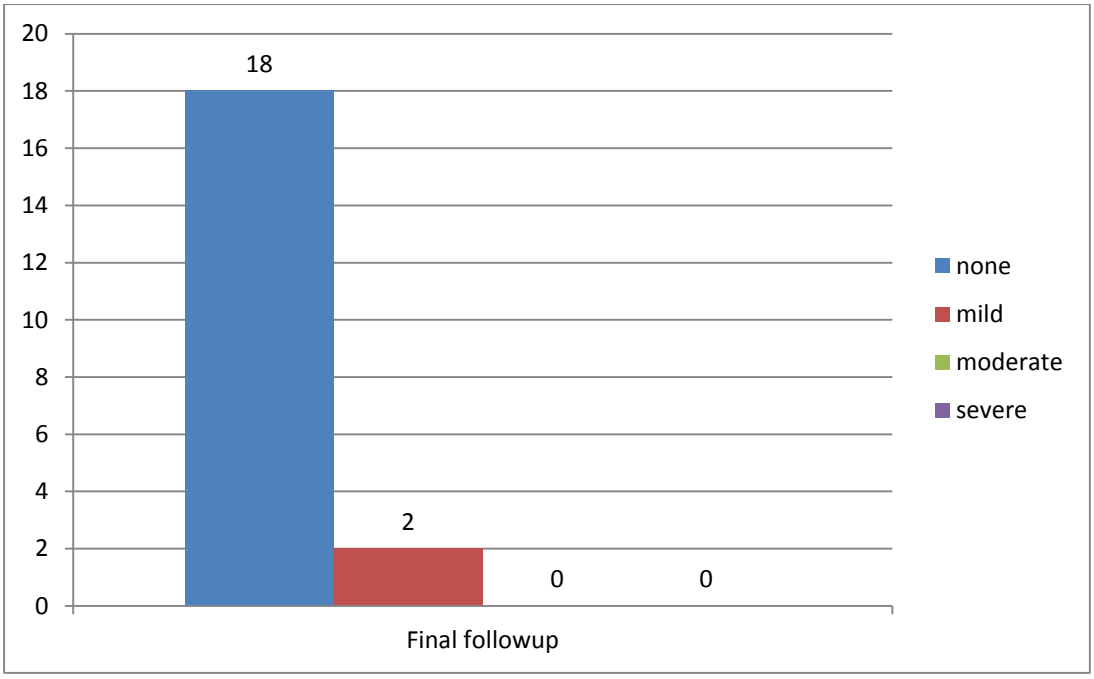
In Our study maximum number of patients (80%) had radiological union between 12 to 14 weeks.

Result Assessment

1. PAIN

TABLE: 12

PAIN	FINAL FOLLOWUP
NONE	18
MILD	2
MODERATE	0
SEVERE	0

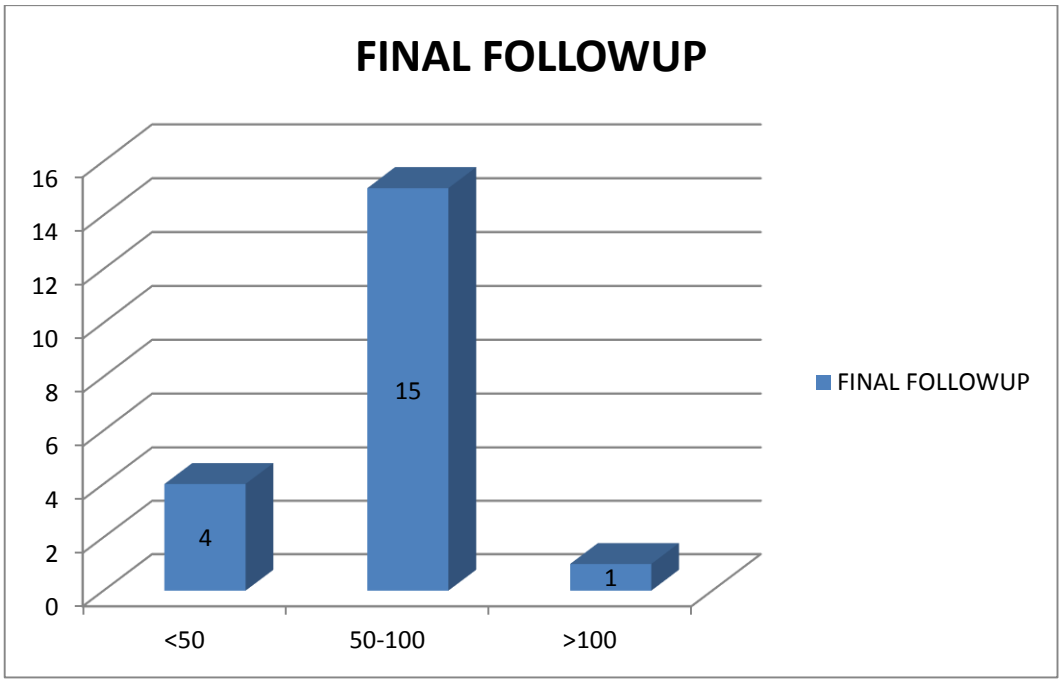


In our study at final followup maximum no . of patiets(18) had no pain ,while rest 2 patients had mild pain .

MOTION :

TABLE : 13

MOTION	FINAL FOLLOWUP
>100	15
50-100	4
<50	1

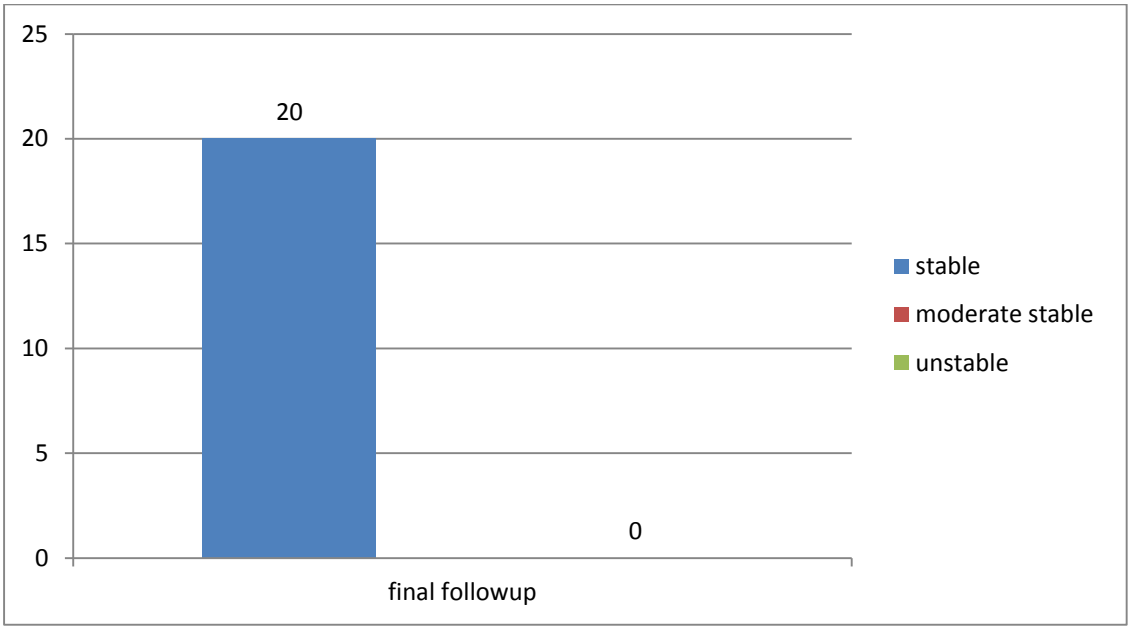


In Our study at final follow-up 15 patients had elbow range of movement between >100 degree .4 patients had movement of 50-100 degree, while 1 patient had > 50 degree range of movement at final follow-up.

STABILITY

TABLE : 14

STABILITY	FINAL FOLLOWUPS
Stable	20
Moderate Instability	0
Gross Instability	0

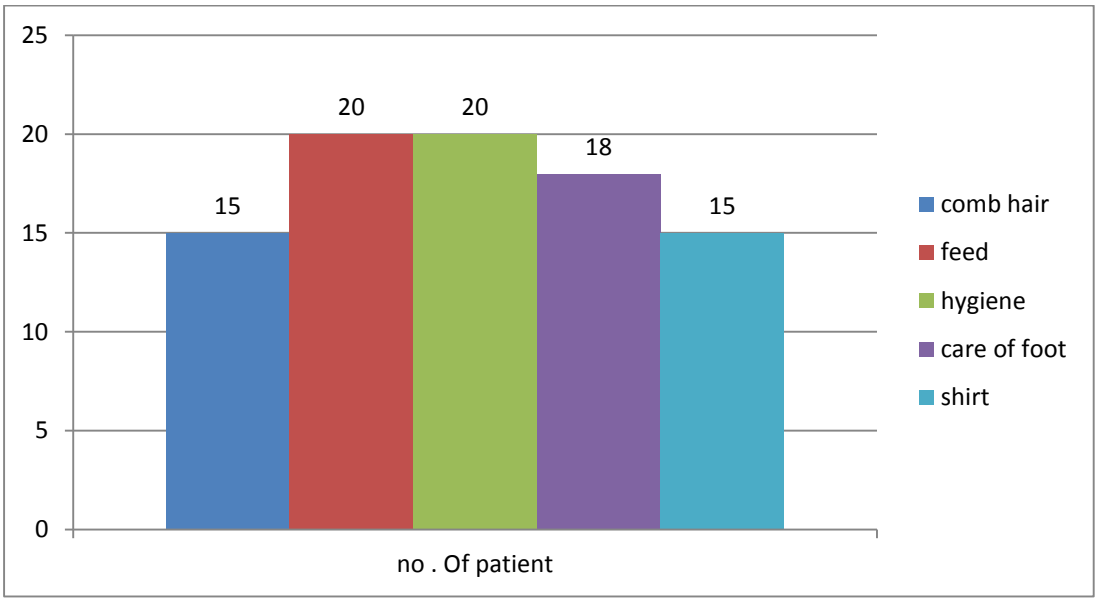


In our study all patients had stable elbow at final follow-up .

FUNCTIONS:

TABLE: 15

ACTIVITY	NO OF PATIENTS WITH BELOW MENTIONED FUNCTION AT FINAL FOLLOWUP
COMB HAIR	15
FEED	20
HYGIENE	20
SHIRT	15
CARE OF FOOT	18

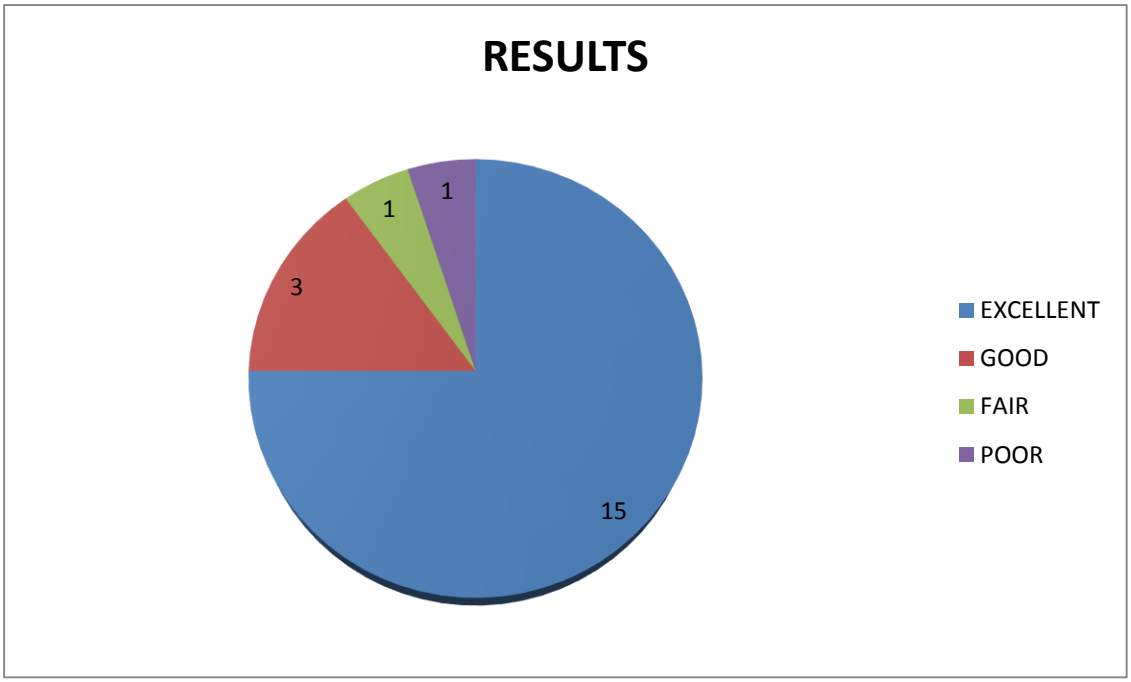


In our study 15 patient were able to comb hair and wear a shirt, 20 patients were able to feed themselves and maintain hygiene, 18 patients were able to take care of their foot.

RESULTS at Final follow-up

TABLE: 16

RESULT		NO. OF CASES	PERCENTAGE
EXCELLENT		15	75 %
GOOD		3	15 %
FAIR		1	5 %
POOR		1	5%
TOTAL	20	100	

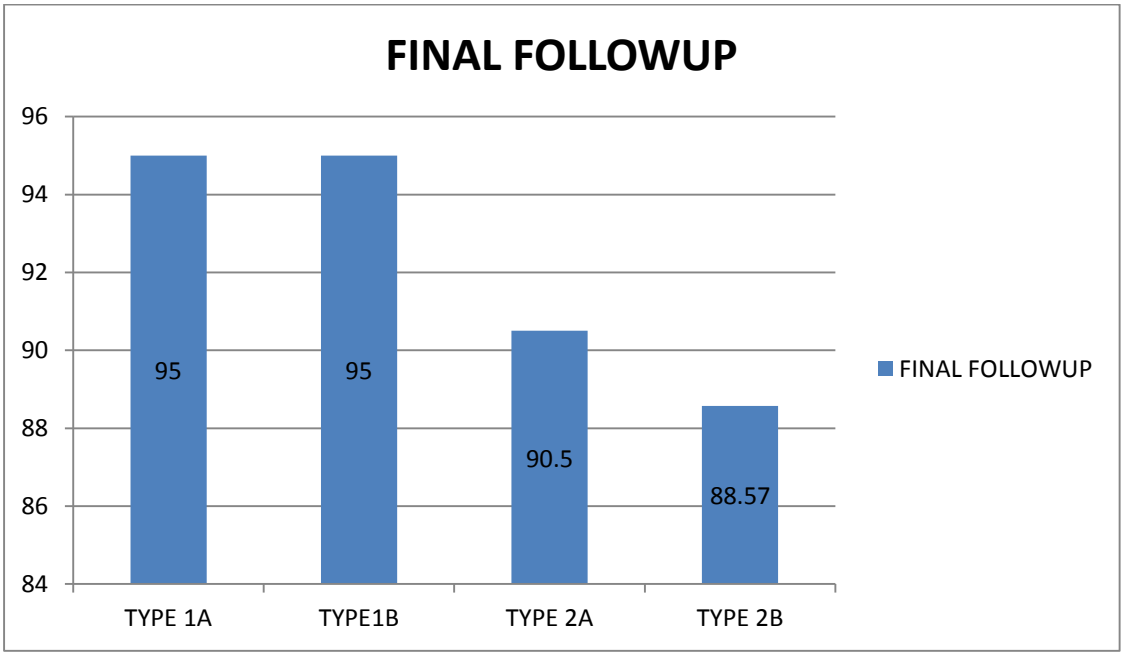


In our study at final follow-up 15(75%) patients had excellent result, 3(15%) patients had good result , 1(5%) patient and 1 (5%) patient had poor result .

FUNCTIONAL OUTCOME ACCORDING TO FRACTURE TYPE

TABLE : 17

TYPE OF FRACTURE (ACCORDING TO MAYO CLASSIFICATION)	FINAL FOLLOWUP (AVERAGE)
TYPE 1A	100
TYPE1B	95
TYPE 2A	90.5
TYPE 2B	88.57



In our study Olecranon fractures were classified according to Mayo classification .Their functional outcome as average of patients with same fracture pattern were as follows .

Average Mayo score in Patients with Type 1A had 100 and 1B fracture had 95 at final followup .

Patients with Type 2A fracture had average Mayo Score 90.5 at final follow-up. Patients with Type 2B fracture had average Mayo Score 88.57 at final follow-up.

DISCUSSION

Proximal ulna fractures may be caused by direct injury to the posterior part of the elbow joint or indirectly by the forces generated within the triceps muscle during a fall on a partially flexed elbow [47]. The clinical picture is obvious and conventional radiographs of elbow are usually sufficient to depict the lesion and the potentially associated injuries.

Olecranon fractures are common injuries of the proximal ulna which constitute about 10% of all upper extremity fractures [48]. The fractures are usually isolated but associated lesions can occur in complex injuries and polytrauma cases [49, 50].

Open reduction and rigid internal fixation has become the accepted method of treatment for displaced fractures of the proximal ulna (olecranon) in order to allow early mobilisation, and the prevention of contracture of the elbow. The goals of fixation are realignment of the longitudinal axis of the proximal ulna (olecranon), the provision of sufficient stability to allow early mobilisation, preservation of the coronoid process, and anatomical restoration of the articular surface of the trochlear notch.(51) The final outcome may be affected by infection, stiffness and loss of joint motion, or hardware impingement.(52,53,54)

Where there is marked comminution with bone loss, tension-band wiring may lead to collapse of the fragments with shortening of the articular surface of the proximal ulna (olecranon), discongruity of the joint, impingement, loss of movement and degenerative osteoarthritis.(55)In some circumstances, the proximal bone fragment may be small and thin, making fixation with a plate difficult. The goals of proximal ulna (olecranon) fracture management are to restore and maintain joint stability, articular congruity, strength, and a pain-free arc of functional elbow motion.

We have excluded Monteggia fracture dislocations in paediatric patients and we didn't have any patient above 18 years with Monteggia fracture dislocation. So the study is for fracture olecranon.

According to Byron E Chalidis, tension band wiring is the gold standard for the treatment of olecranon fractures which leads to good elbow function and minimal loss of physical capacity.

The present study on proximal ulna fractures treated with various modalities was conducted in the department of Orthopaedics, Dhiraj Hospital, Pipariya. We have included 20 patients with olecranon fractures who were treated surgically and followed up for a minimum of 6 months.

AGE INCIDENCE: In our study the most common age group was 18-30 years which included 7 (35% patients) as they are the most active young population and most commonly involved in road traffic accidents.

The average age of patients in our study was 39.95 years which is comparable to the study done by Chalidis et al in which it was 48.6yrs.(56)

SEX INCIDENCE: By and large all trauma series have male preponderance, similarly we also had male preponderance of 75% (15 patients). This is comparable to the study done by Chalidis et al which quotes male preponderance of 53.2%.(56) Males are the major earning population in our country and thus they travel more which increases the risk of road traffic accidents.

SIDE INVOLVEMENT: In our study left side was most commomly injured in 60% of patients which is comparable to the study done by Chalidis et al in which left side was injured in 56.4% of patients.(56)

MODE OF INJURY: In our study the most common mode of injury was road traffic accidents in 50% of patients. In other studies the most common mode of injury is direct fall on elbow. This is because of increase in the incidence of road traffic accidents with increase in population and speedy vehicles in our country. In the study done by HS Mann et al it was 36.7%.(57) This is because in foreign countries domestic fall is the most common cause of trauma while in developing countries like ours road traffic accidents are more common.

ASSOCIATED INJURY: In our study 45% of patients had associated injuries ranging from distal end radius fracture to trochanteric fractures. Out of 9 associated injuries 1 patients had ipsilateral trochanteric fractures. This suggests high velocity injury in all patients with road traffic accidents.

TYPE OF FRACTURE: In our study the most common type of fracture according to Mayo classification was type 2A (displaced without comminution) in 50% of patients which is comparable to the study done by HS Mann et al (50%).(57) The second most common type was 2B (displaced with communition) in 35% of patients.

INJURY-OPERATION INTERVAL: In our study the average interval between injury and operation was 3.9 days. This is because most of our patients are from Madhya Pradesh which is 300 kilometers far from our hospital. None of the patient reported late than 3 days.

IMPLANT USED: The choice of implant was decided according to the fracture geometry, bone quality and surgeon's fade. The most common procedure done was tension band wiring with 2 kirschner wires in 18 (90%) patients. In one patient (Case No. 13) tension band wiring with one cannulated canncellous screw was done as per surgeon's choice in Mayo type 2A fracture and in other patient (Case No. 14) tension band wire with 2 rush pins was done in a long oblique Mayo type 2B olecranon fracture.

FRACTURE UNION: In our study the average union time was 14.3 weeks which is comparable the study done Fan et al which had average union time of 14 weeks and HS Mann et al which had union rate of 13.6 weeks.(57) Olecranon fracture is an avulsion type of injury in a cancellous bone. Union is as such not a problem if the patient has been operated. However, with infection the union can be delayed.

In 2(10%) patients in whom we had superficial infection with diabetes mellitus, the union occurred around 16-18 weeks.

EARLY COMPLICATIONS: In our study 2 (10%) patients had superficial infection which was treated by debridement and higher intravenous antibiotics (Case No. 5 and Case No. 8). Both the patients were having diabetes mellitus since 2 years. In a study done by HS Mann et al, the rate of superficial infection was 10%. (57)

LATE COMPLICATIONS: Late complications like K- wire impingement, delayed union, joint stiffness and heterotrophic ossification may occur in patients of olecranon fractures treated with tension band wiring. K-Wire impingement or back out is one of the commonest complications following tension band wiring in olecranon fractures.

We had 3 (15%) patients with K-wire impingement which were painful (Case No. 2, 14, 18). This problem was resolved by K-wire removal on long term follow up but all these 3 patients had elbow stiffness. In a study done by HS Mann et al, K wire impingement was reported in 23.3% of patients.(57)

DELAYED UNION: As this injuries are the avulsion fractures of cancellous bone, the usual union time is 13-14 weeks after fixation of fractures. We had delayed union in 2 (10%) patients who had infection following surgery and required wound debridement. Both of them were past middle age with diabetes mellitus. Union in both of the patients occurred by 16-18 weeks.

ELBOW STIFFNESS: As the olecranon fracture is intra articular fracture, post fixation physiotherapy plays a major role. Also if a fracture is grossly comminuted and intra-articular alignment could not be achieved due to unforeseen circumstances, patient can have restriction of movements in elbow. The commonly observed stiffness and lack of full extension may occur due to protruding K-wires or lack of exercises. We had 3 patients with restriction of elbow range of movements. In a study done by HS Mann et al elbow stiffness was reported 23.3% of patients.(57)

HETEROTROPHIC OSSIFICATION: Heterotrophic ossification around the elbow is not a uncommon occurrence, especially with fractures of lower end of humerus and proximal ulna. We have observed 1 (5%) patient (Case No. 18) with heterotrophic ossification and joint stiffness. This patient also gave history of massage around elbow. It was treated conservatively with Indomethacin 75 milligrams at bed time. Excision of mass and low grade radiation were advised but patient refused. Ajay Pal Singh et al reported the rate of heterotrophic ossification as 1.9%. (58)

RESULT ASSESSMENT: We had taken Mayo's score to assess the final outcomes in our patients. The basic factors considered are pain, motion, stability and activities of daily living (function). Based on this criteria, total score was calculated and graded. Mayo's score is been already enlisted in materials and methods.

PAIN: 90% (18 patients out of 20 patients) had no complaints of pain at the final follow up. Only 10% (2 patients) complained of mild pain on excertion at the time of final follow up.

STABILITY: None of the patients following olecranon fractures showed elbow joint instability.

MOTION: There are 3 grades of motion to be considered. The arc is divided into less than 50 degrees, 50-100 degrees and more than 100 degrees. 15 (75%) patients had motion arc between 50 to 100 degrees, 2 (10%) patients had more than 100 degrees of arc and 3 (15%) patients had less than 50 degrees of motion arc.

FUNCTION: In function, we assess for activities of daily living like feeding, combing hair, hygiene, buttoning of shirt and care of feet. In our study, 13 (65%) patients could do all these activities easily without any assistance. 3 patients had difficulty in combing hairs, 2 patients had difficulty in care of feet, one patient had difficulty in feeding and maintaining hygiene and the last one patient had difficulty in feeding and buttoning of shirt.

RESULTS: The final outcome was graded according to Mayo's scoring criteria as excellent, good, fair and poor. We had excellent results in 75% (15) patients and good in 15% (3) patients. These were termed as satisfactory results comprising 90% of patients. We had fair result in 5% (1) patient and poor result in 5% (1) patient. These were termed as unsatisfactory results comprising of 10% of patients. The final results were satisfactory in 100% of young population of 18-42 years of age group. In older age group above 50 years of age 33.3% (2 out of 6 patients) had unsatisfactory results. All the patients with Mayo type 1 fracture had satisfactory outcomes which is justifiable as the fracture is un-displaced. However, we had 2 (10%) unsatisfactory outcomes. Unfortunately, both the patients were past the middle age and had Mayo type 2A and 2B fracture each. The first patient was 60 year female with Mayo type 2A fracture, was treated with tension band wiring with 2 k-wires. Postoperatively she was non compliant for physiotherapy and had unsatisfactory result. The second patient was 50 year male with Mayo type 2B fracture was treated with tension band wiring with 2 rush pins. Postoperatively he had late implant impingement which needed re surgery after 3 weeks.

Overall we have observed that our results are in concurrence with the study published by Mann et al and Chalidis et al. We had 90% satisfactory results whereas Chalidis et al had 85.5% and Mann et al had 90% satisfactory results.

We had 10% unsatisfactory results whereas Mann et al had 14.5% and Chalidi et al had 10% unsatisfactory results.

STUDY	EXCELLENT	GOOD	FAIR	POOR
HS Mann et al(57)	66.7%	23.3%	10%	--
Chalidi et al (56)	56.5%	29%	9.7%	4.8%
Our Study	75%	15%	5%	5%

All the patients with olecranon fractures when treated with tension band wiring in a proper manner gives excellent outcomes or we can say, for fracture olecranon tension band wiring is the gold standard of treatment.

SUMMARY AND CONCLUSION

The present study was conducted in the Department of Orthopaedics, Dhiraj Hospital, SBKS Medical Institute & Research Centre, Pipariya between April 2015 to September 2017. In our study, we included 20 patients of proximal ulna fracture treated with open reduction and internal fixation using various modalities. The follow up results were analyzed and discussed on the basis of Mayo's score.

The most common age group was between 18 to 30 years of age comprising 35% of patients.

Males were most commonly injured (70% of patients) in this study.

The most common mode of injury was road traffic accident in 50% of patients who were young active patients followed by domestic fall in 30% of patients who were past middle age.

45% of patients had associated injuries ranging from distal end radius fracture to trochanteric fractures.

The most common fracture pattern observed according to Mayo classification was type 2A in 10 (50%) patients that is displaced fracture without comminution. It was followed by type 2B in 7 (35%) patients.

All the patients were operated with tension band wiring which was achieved with 2 K-wires in 90% of patients, with rush pin in 5% of patients and with cannulated canncellous screw in 5% of patients.

The average union time after tension band wiring was 14.3 weeks in our series. We had no case of non union

There were 2 (10%) patients who had superficial infection which needed debridement. There was no infection following debridement and higher intravenous antibiotics. These both patients had delayed union, in which fracture united between 16-18 weeks.

There were 5 (25%) patients who had late complications. 3 of them had implant impingement which required implant removal on long term follow up. 4 patients had

joint stiffness whose movement arc was either less than 50 degrees or between 50 to 100 degrees. One patient had heterotrophic ossification who had done massage following at home.

All the joints were stable at the time of final follow up with mild pain only in 2 (10%) patients. Rest 18 patients had no complaints of pain on final follow up.

Only 3 (15%) patients had movement arc of less than 50 degrees suggesting stiffness. Probably with a long term physiotherapy, the arc of movement in 2 patients would increase.

Based on Mayo's criteria, we had 75% excellent, 15% good, 5% fair and 5% poor outcomes.

3 patients (15% of total) with Mayo type 1 fractures had excellent outcomes.

Both the patients with unsatisfactory outcomes were past middle age and had type Mayo 2A and type 2B fractures respectively.

From this study we had derived the following conclusions:

As this injury is an avulsion fracture, it should be treated surgically.

Being the intra-articular fracture, articular congruity with stable fixation should be achieved.

K-wires should be buried deep so that the problems of impingement could be avoided.

Tendon of triceps should be protected.

As per Tension band wire principle postoperatively mobilisation must be initiated to avoid joint stiffness as well as gain compression at fracture site.

Massage should be avoided to prevent heterotrophic ossification.

We conclude that for olecranon fractures tension band wiring is the gold standard treatment.

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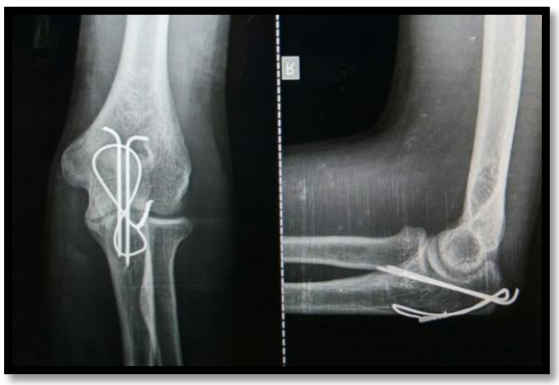
CASES

CASE – 1

21 years old male patient with history of RTA had closed right olecranon fracture, (Mayo type 2A) , He was Treated with tension-band wiring with k-wire. At final followup he had full range of movement & Excellent result as per Mayo`s score.

PREOP

POSTOP



FOLLOWUP

CLINICAL IMAGES :

(OPERATIVE SCAR MARK)

(EXTENSION)

(FLEXION)

CASE - 2

A 42 years old,male patient with history of RTA had closed right olecranon fracture(Mayo type2A) . He was treated by Tension –Band wiring with k- wire. Reduction was not satisfactory & later patient developed heterotropic ossification at operative site. At final followup though he had fixed flexion deformity of 20 degree, further flexion was full & painless & had excellent result as per mayo`s score.

PREOP :

POSTOP :

FINAL FOLLOWUP :

CLINICAL IMAGES:

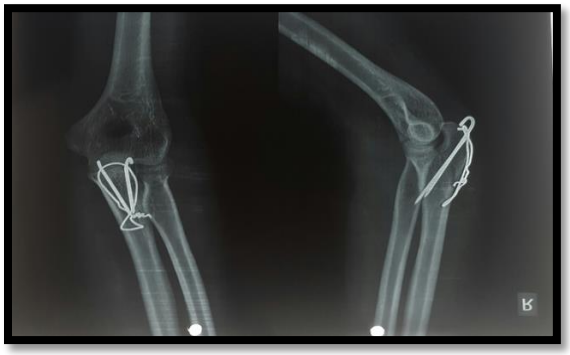
(EXTENSION)

(FLEXION)

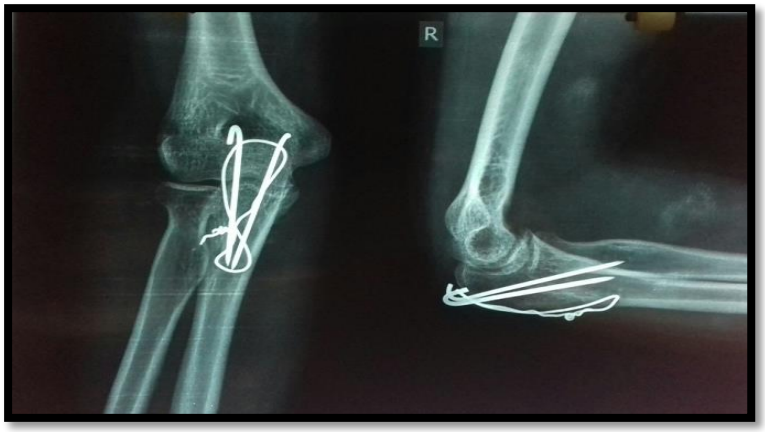
CASE - 3

28 yrs old Male patient with history of RTA had closed right olecranon (Mayo type 2A) He was treated with Tension –Band wiring with k-wire. At final followup he had full range of movement and graded as excellent as per mayo score .

PREOP :



POSTOP :



FINAL FOLLOWUP :

CLINICAL IMAGES :

(OPERATIVE SCAR)

(EXTENSION)

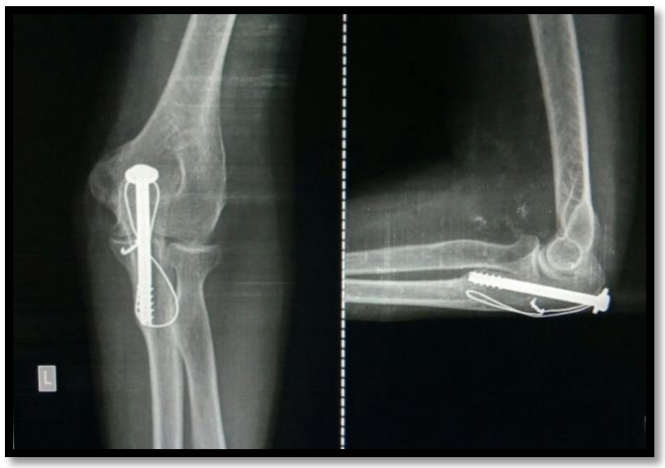
(FLEXION)

CASE - 4

A 41 years old Female patient with history of domestic fall had closed left olecranon, (Mayo type 2A) .She was treated with Tension band wiring with cannulated-cancellous screw. At final followup she had full range of movement & excellent result as per mayo score.

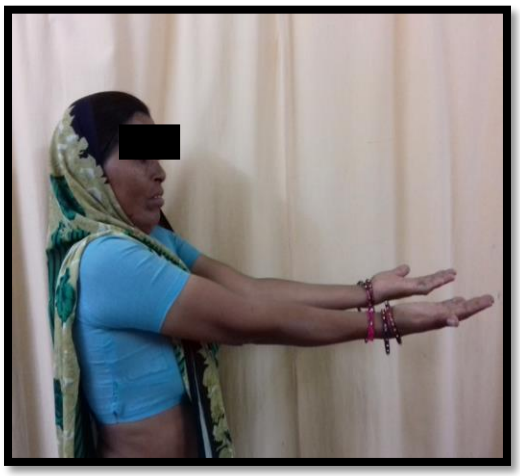
PREOP:

POSTOP:



FINAL FOLLOWUP :

CLINICAL IMAGES :



(EXTENSION)

(FLEXION)

(OPERATIVE SCAR)

ANNEXURE-I

"STUDY OF PROXIMAL ULNA FRACTURE TREATED BY VARIOUS MODALITIES"

PROFORMA

- Name
- Age/ sex
- Address/ Phone no
- Occupation
- DOI
- DOA
- DOS
- DOD
- INDOOR NO.
- GENERAL
  - Mode of injury
  - Interval b/w Injury and operation
  - Interval b/w Admission and Surgery
  - Associated injury
  - Neuro-vascular involvement
- CLINICAL FINDINGS
  - Swelling
  - Dislocation
  - Ecchymosis
  - Blisters
  - Nerve palsy

- DIAGNOSIS
  - Fracture side: Rt/ Lt
  - Type of ULNA fracture(AO/OTA Classification):
  - Associated Radial head fracture and Dislocation: present (at the same level/proximal)
  - Fracture classification :
- OPERATIVE DETAILS
  - Anaesthesia / Position of Patient:
  - Implant used :
  - Radiological findings:
    a) Reduction: anatomical / acceptable / non anatomical
    b) Quality of fixation:
- POST OPERATIVE DETAILS
  - Immobilization period :
  - Antibiotics used:
  - Duration of antibiotics:
  - Early post-operative Complications: Local -
    Systemic -
  - Secondary procedures needed: Debridement
    Refixation
    Any Other procedure
- Follow up findings:

  Post op period (1 month / 2 month/ 3 month / 6 month/Final followup)

Clinical examination:

- Pain at fracture site:
- Local skin condition :
- Range of movement (if feasible) : ELBOW

WRIST

- Local complication: redness/ discharge/ wound gapping
- Radiological findings:
  a) Fracture callous: present/ present but not adequate/ absent):
  b) Fracture alignment: same as post op/ altered
  c) Implant stability:
- Need for second operative intervention
  - Change of implant
  - Bone grafting
- Date of Implant removal (if required)
- Return to occupation

➢ <u>At Final Follow Up:</u>

Clinical examination:

- Pain at fracture site
- Range of movement: ELBOW

  WRIST
  - Presence of sudeck's osteodystrophy / VIC
  - Limb length discrepancy:
  - Radiological analysis:
  - Union: anatomical/ acceptable/ not acceptable / varus / valgus
  - Any other significant finding
  - Restoration of pre injury occupation
  - Patient satisfaction
  - Surgeon's comment

Result assessment with Mayo Elbow Score (46)

Criteria	**1 month**	**3 month**	**6 month**	**Final Followup**
Pain None (45) Mild (30) Moderate (15) Severe (0)				
Motion Arc > 100 (20) Arc > 50-100 (15) Arc < 50 (5)				
Stability Stable (10) Moderate Instability (5) Gross Instability (0)				
Function Comb Hair(5) Feed (5) Hygiene (5) Shirt (5) Care of foot (5)				
Total				

Results grading :

Excellent : >90

Good : 76-90

Fair : 60-75

ANNEXURE-II

PARTICIPANT INFORMATION SHEET

Study title: - "STUDY OF PROXIMAL ULNA FRACTURE TREATED BY VARIOUS MODALITIES"

You are being cordially invited to participate in the above titled study. The proposed study is a scientific endeavor to generate data on Proximal ulna fracture treated by various modalities in our hospital.

1. Purpose & nature of the study: -

   To evaluate the outcome of Proximal ulna fracture treated by various modalities in patients admitted to Orthopaedic wards of Dhiraj Hospital.

2. Voluntary nature of participation: -

   Your participation in this study is voluntary and at your free will. You can refuse to participate in the study. More over you are also free to withdraw at any time without having to give a reason. Despite this, you will continue to receive your standard medical care and treatment.

3. Study methods: -

   The study is interventional and the investigator will not intervene in any part of the treatment. The treatment will be decided by the treating doctor, and only the treatment and the investigations will be observed and noted by the investigator.

   The investigator may ask questions relevant to your history, your disease, drug treatment and may enter the information in the Case Record Form (CRF) prepared for the purpose.

4. Participant's responsibility: -

   You will share information regarding the health problem with the investigator as required.
   You will co-operate with the investigator with regard to follow-up visits.

5. Expected adverse events, risks and solution: -

This is an interventional study only. Treatment of your disease will be decided by senior consultant only and not by the investigator. There is no question of adverse effects or risk to you on account of the study.

6. Benefits of participation: -

Your disease will be diagnosed easily and fast, there will be better chances of accurate diagnosis and treatment.
So the treatment will be started as early as possible.
Your treatment will become more appropriate and effective.

7. Confidentiality: -

Your information will remain strictly confidential and will not be revealed to any third party and will not be published anywhere without your prior permission.

8. Investigator's Contact Information: -

This interventional study, no additional problem will expect to arise. However if you need to share any information or seek advice with regard to the study, you can contact –

Dr. NILESH R. CHAREL

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Mob: - 9725769560

પરિશિષ્ટ-3
પક્ષકાર માહિતી શીટ

અભ્યાસ શીર્ષક: - સ્ટડી ઓફ પ્રોક્ઝીમલ અલના ફેક્ચર ટ્રીટેડ બાય વેરીયસ મોડાલીટી

ઉપરોક્ત શિર્ષક અભ્યાસમાં ભાગ લેવા માટે તમે સદ્ભાગ્યે આમંત્રિત છો. પ્રસ્તાવિત અભ્યાસે આપણા હોસ્પિટલમાં વિવિધ પદ્ધતિઓ દ્વારા પ્રોક્ઝીમલના અલના ફેક્ચરની સારવાર કરવામાં આવેલ છે.

1. અભ્યાસનો હેતુ અને સ્વભાવ: -

ધીરજ હોસ્પિટલના ઓર્થોપેડિક વાલીઓમાં દાખલ કરાયેલા દર્દીઓમાં વિવિધ પદ્ધતિઓ દ્વારા પ્રોક્ઝીમલના અલના ફેક્ચરની સારવાર કરવી.

2. સહભાગીની સ્વૈચ્છિક પ્રકૃતિ: -

આ અભ્યાસમાં તમારી સહભાગી સ્વૈચ્છિક છે અને તમારી સ્વતંત્ર ઇચ્છા પર તમે અભ્યાસમાં ભાગ લેવાનો ઇન્કાર કરી શકો છો. કોઈ પણ કારણ આપ્યા વગર તમે કોઈપણ સમયે પાછી ખેંચી શકો છો. આમ છતાં, તમે તમારી પ્રમાણભૂત તબીબી સંભાળ અને સારવાર મેળવશો.

અભ્યાસ પદ્ધતિ: -

આ અભ્યાસ આંતરવૈયક્તિક છે અને તપાસ કરનાર કોઇ પણ સારવારમાં દરમિયાનગીરી કરશે નહીં. આ સારવારનો નિર્ણય ડૉક્ટર દ્વારા લેવામાં આવશે, અને માત્ર સારવાર અને તપાસ જ તપાસકર્તા દ્વારા અવલોકન અને નોંધવામાં આવશે.

તપાસકર્તા તમારા ઇતિહાસ, તમારી રોગ, ડ્રગ સારવાર સંબંધિત પ્રશ્નો પૂછી શકે છે અને આ હેતુ માટે તૈયાર કરેલા કેસ રેકોર્ડ ફોર્મ (સીઆરએફ) માં માહિતી દાખલ કરી શકે છે.

4. સહભાગીની જવાબદારી: -

આવશ્યકતા મુજબ તપાસકર્તા સાથે સ્વાસ્થ્ય સમસ્યા અંગેની માહિતી તમે વહેંચશો. અનુવર્તી મુલાકાતોના સંદર્ભમાં તમે તપાસકર્તા સાથે સહકાર કરશો.

5. અપેક્ષિત પ્રતિકૂળ ઘટનાઓ, જોખમો અને ઉકેલ: -

આ માત્ર એક હસ્તક્ષેપ અભ્યાસ છે તમારી બિમારીની સારવાર માત્ર વરિષ્ઠ સલાહકાર દ્વારા નક્કી કરવામાં આવશે, તપાસકર્તા દ્વારા નહીં. અભ્યાસના લીધે તમને કોઈ પ્રતિકૂળ અસરો અથવા જોખમ વિશે કોઈ પ્રશ્ન નથી.

6. ભાગીદારીના લાભ: -

તમારી બિમારીને સરળતાથી અને ઝડપી નિદાન કરવામાં આવશે, સચોટ નિદાન અને સારવારની સારી તકો હશે. તેથી સારવાર શક્ય તેટલી વહેલી શરૂ થશે. તમારી સારવાર વધુ યોગ્ય અને અસરકારક બની જશે.

7. ગુપ્તતા: -

તમારી માહિતી સખત ગોપનીય રહેશે અને કોઈપણ તૃતીય પક્ષને જાહેર કરવામાં આવશે નહીં અને તમારી પૂર્વ પરવાનગી વગર પણ તે પ્રકાશિત થશે નહીં.

8. તપાસ કરનારની સંપર્ક માહિતી: -

આ આંતરિક અભ્યાસ, કોઈ વધારાની સમસ્યા ઊભી થવાની અપેક્ષા રાખવામાં આવશે નહીં. જો તમને કોઈપણ માહિતી શેર કરવાની અથવા અભ્યાસના સંદર્ભમાં સલાહ લેવાની જરૂર હોય, તો તમે સંપર્ક કરી શકો છો -

ડૉ. નિલેશ આર. ચારેલ
રેસિડેન્ટ ઓર્થોપેડિક્સ,
ઓર્થોપેડિક વિભાગ,
એસબીકેએસ એમઆઇ અને આરસી, પીપારીયા
તાલ વાઘોડિયા, જિ. વડોદરા
મોબ: - 9725769560

ANNEXURE-IV

INFORM CONSENT

Study Title- "STUDY OF PROXIMAL ULNA FRACTURE TREATED BY VARIOUS MODALITIES"

Study Number:

Subject's Initials: Subject's Name:

Date of Birth / Age:

Address of subject:

Qualification:

Occupation: student/self employed/service/house wife/others:
(please tick as appropriate)

Annual income of the subject:

Details of Nominee (s):
Name of Nominee:

Address of Nominee:

Relation to Subject:

		Please initial box (Subject)
(i)	I confirm that I have read and understood the information sheet dated ……....….for the above study and have had the opportunity to ask questions.	☐
(ii)	I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.	☐
(iii)	I understand that the Sponsor of the clinical trial, others working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it,	☐

even if I withdraw from the trial. I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published. ☐

(iv) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s) ☐

(v) I agree to take part in the above study. ☐

Signature (or left thumb impression) of the participant

Legally acceptable representative _____

Signatory's Name _____ Date _____

Signature of the investigator _____ Date _____

Study Investigator's Name _____

Signature of the impartial witness _____ Date _____

Name of the witness _____

Copy of the Patient Information Sheet and duly filled Informed Consent Form shall be handed over to the subject or his/her attendant.

સંમતિ જાણ

અભ્યાસ શીર્ષક: - સ્ટડી ઓફ પ્રોક્ઝીમલ અલના ફ્રેક્ચર ટ્રીટેડ બાય વેરીયસ મોડાલીટી

અભ્યાસ નંબર:

વિષયનો પ્રારંભ: વિષયનું નામ:
જન્મ તારીખ / ઉંમર:

વિષયનું સરનામું:

લાયકાત:

વ્યવસાય: વિદ્યાર્થી / સ્વ રોજગારી / સેવા / ઘરની પત્ની / અન્ય :(કૃપા કરીને યોગ્ય તરીકે નિશાની કરો)

આ વિષયની વાર્ષિક આવક:

નોમિની (ઓ) ની વિગતો:
નોમિની નામ:

નોમીનીનું સરનામું:

વિષય સાથે સંબંધ:

કૃપા કરી પ્રારંભિક બોક્સ (વિષય)

(i) હું પુષ્ટિ કરું છું કે મેં માહિતીપત્રની તારીખ વાંચી અને સમજી લીધી .... ઉપરના અભ્યાસ માટે અને પ્રશ્નો પૂછવાની તક મળી છે. ☐

(ii) હું સમજી શકું છું કે અભ્યાસમાં મારો સહભાગિંહ સ્વૈચ્છિક છે અને તે કોઈપણ તબીબી કાળજી અથવા કાયદાકીય અધિકારોને પ્રભાવિત કર્યા વિના, કોઈપણ કારણ વગર, કોઈપણ સમયે હું પાછી ખેંચી શકું છું. ☐

(iii) હું સમજું છું કે ક્લિનિકલ ટ્રાયલના પ્રાયોજક, અન્યો ☐

પ્રાયોજકની વતી કાર્યરત, એથિક્સ કમિટી અને નિયમનકારી સત્તાવાળાઓએ વર્તમાન અભ્યાસના સંદર્ભમાં અને અન્ય કોઈ સંશોધનમાં તેનો સંદર્ભ આપવા માટે મારી સ્વાસ્થ્યના વિક્રમોને જોવાની મારી પરવાનગીની જરૂર નથી,

જો હું ટ્રાયલમાંથી પાછો ખેંચી લો તો પણ હું આ ઍક્સેસ માટે સંમત છું, પણ હું સમજું છું કે તૃતીય પક્ષો દ્વારા પ્રકાશિત અથવા પ્રકાશિત થયેલા કોઈપણ માહિતીમાં મારી ઓળખ જાહેર કરવામાં આવશે નહીં.

(iv) હું કોઈપણ અન્ય માહિતી અથવા પરિણામોના ઉપયોગને પ્રતિબંધિત કરવા માટે સંમત થતો નથી. ☐

(v) હું ઉપરના અભ્યાસમાં ભાગ લેવા માટે સંમત છું. ☐

વિષય / LAR ની હસ્તાક્ષર (અથવા અંગૂઠા છાપ):

તારીખ: / /

હસ્તાક્ષરનું નામ:

તપાસકર્તાના હસ્તાક્ષર:

તારીખ: / /

અભ્યાસ તપાસ કરનારનું નામ:

સાક્ષીની હસ્તાક્ષર

તારીખ: / _ /

સાક્ષીનું નામ:

પેશન્ટ ઈન્ફર્મેશન શીટની નકલ અને ભરવામાં આવશે ઈન્ફોર્મ્ડ કોન્સન્ટ ફોર્મ વિષય અથવા તેના / તેણીના પરિચરને આપવામાં આવશે.

MASTER CHART

SR NO.	AGE (YEARS)	SEX	OCCUPATION	SIDE OF INJURY	MECHANISM OF INJURY	INJURY ADMISSION INTERVAL (DAYS)	INJURY OPERATION INTERVAL (DAYS)	ASSOCIATED INJURY	ASSOCIATED COMORBIDITIES	TYPE OF FRACTURE (ACCORDING TO MAYO CLASSIFICATION)	TYPE OF SURGERY	RADIOLOGICAL UNION (IN WEEKS)	FOLLOW UP IN MONTHS	MAYO SCORE AT FINAL FOLLOWUP					COMPLICATIONS	RESURGERY	RESULTS
														PAIN	MOTION	STABILITY	FUNCTION	TOTAL			
1	19	MALE	STUDENT	RIGHT	RTA	3	3	-	-	1A	TBW +K Wire	12	21	45	15	10	25	95	-	-	**EXCELLENT**
2	28	MALE	DRIVER	LEFT	RTA	1	0	-	-	2B	TBW +K Wire	12	20	45	15	10	15	95	IMPLANT IMPINGEMENT	RE FIXATION	**EXCELLENT**
3	28	FEMALE	HOUSE WIFE	RIGHT	FALL FROM HEIGHT	2	5	IPSILATERAL CALCANEUM FRACTURE	-	2B	TBW +K Wire	14	11	45	15	10	20	90	-	-	**GOOD**
4	55	FEMALE	HOUSE WIFE	RIGHT	DOMESTIC FALL	1	4	IPSILATERAL CLAVICLE FRACTURE	HTN	1B	TBW +K Wire	14	13	45	15	10	20	90	STIFFNESS	-	**GOOD**
5	68	FEMALE	HOUSE WIFE	LEFT	DOMESTIC FALL	3	6	CONTALATERAL DISTAL END RADIUS FRACTURE	DM, COPD	1B	TBW +K Wire	18	10	45	20	10	25	100	SUPERFICIAL INFECTION	DEBRIDEMENT	**EXCELLENT**
6	67	MALE	FARMER	LEFT	DOMESTIC FALL	2	5	-	HTN	2A	TBW +K Wire	14	20	45	15	10	25	95	-	-	**EXCELLENT**
7	42	MALE	DRIVER	LEFT	RTA	0	5	-	-	2A	TBW +K Wire	12	14	45	15	10	25	95	-	-	**EXCELLENT**
8	40	MALE	LABOURER	LEFT	RTA	1	6	-	-	2A	TBW +K Wire	16	6	45	5	10	20	80	SUPERFICIAL INFECTION	DEBRIDEMENT	**GOOD**
9	38	MALE	FARMER	RIGHT	RTA	1	5	HEAD INJURY	-	2A	TBW +K Wire	14	12	45	15	10	25	95	-	-	**EXCELLENT**
10	23	MALE	WORKER	RIGHT	RTA	0	2	-		2B	TBW +K Wire	14	12	45	15	10	20	95	-	-	**EXCELLENT**
11	50	MALE	FARMER	LEFT	DOMESTIC FALL	1	3	CONTRALATERAL DISTAL END RADIUS FRACTURE	DM	2A	TBW +K Wire	14	8	45	15	10	25	95	-	-	**EXCELLENT**
12	35	MALE	LABOURER	LEFT	FALL FROM HEIGHT	1	4	-	-	2B	TBW +K Wire	13	18	45	15	10	25	95	-	-	**EXCELLENT**
13	40	FEMALE	HOUSE WIFE	LEFT	RTA	2	6	HEAD INJURY	-	2A	CC SCREW+TBW	13	18	45	20	10	25	100		-	**EXCELLENT**
14	50	MALE	FARMER	LEFT	DOMESTIC FALL	0	4	-	HTN	2B	TBW+ RUSH PIN	15	9	30	5	10	10	55	IMPLANT IMPINGEMENT, STIFFNESS	IMPLANT REMOVAL	**POOR**
15	38	MALE	LABOURER	LEFT	FALL FROM HEIGHT	1	3	CONTALATERAL BIMALLEOLAR FRACTURE	-	2B	TBW +K Wire	14	17	45	15	10	25	95	-	-	**EXCELLENT**
16	21	MALE	DRIVER	RIGHT	FALL frOM HEIGHT	2	4	-	-	2A	TBW +K Wire	14	11	45	15	10	25	95	-	-	**EXCELLENT**
17	27	MALE	WORKER	RIGHT	RTA	1	3	ABDOMINAL INJURY	-	2A	TBW +K Wire	14	6	45	15	10	25	95	-	-	**EXCELLENT**
18	42	MALE	FARMER	RIGHT	RTA	1	4	IPSILATERAL IT FEMUR FRACTURE	-	2B	TBW +K Wire	12	15	45	15	10	25	95	IMPLANT IMPINGEMENT, STIFFNESS	K WIRE REMOVAL	**EXCELLENT**
19	60	FEMALE	HOUSE WIFE	LEFT	DOMESTIC FALL	2	5	-	HTN, DM	2A	TBW +K Wire	14	21	30	5	10	20	65	STIFFNESS	-	**FAIR**
20	28	MALE	FARMER	LEFT	RTA	0	2	-	-	2A	TBW +K Wire	12	6	45	15	10	25	95	-	-	**EXCELLENT**