A RETROSPECTIVE STUDY ON PATTERN AND OUTCOME OF METACARPAL AND PHALANGEAL FRACTURES OF THE HAND AS SEEN IN K.N.H FROM JAN.1999 TO DEC 1999

INVESTIGATOR: DR. JOSEPH MUCHIRI S. WANJOHI
M B ch.B (NBI)

SUPERVISOR: Mr. GEORGE K. MUSEVE
M B ch. B (NBI)
M. Med. Surgery (NBI)
Lecturer- UON

Declaration

I certify that this dissertation is my original work and has not been presented for a degree in another University.

Sign ----------

JOSEPH MUCHIRI S WANJOHI
(M.B.Ch.B)

Supervisor:

This dissertation has been submitted for examination with my approval as a University Supervisor.

Sign ----------

MR. GEORGE K. MUSEVE
(M.B.Ch.B, M.Med (Surg)
Lecturer U o N
Orthopaedic Surgeon.

This book is dedicated to

Mum and Dad

They taught me how to read and write.

Acknowledgements

I wish to thank my supervisor Mr. Museve for his assistance and guidance throughout for the

inception to the eventual production of this book.

I extend my gratitude to the staff in the records department, orthopaedic clinics, orthopaedic

wards, and plaster rooms for making it feel like it was in essence a team. I could not have

gone through it without my teachers and colleagues who helped me achieve my goals. Dr.

Muriithi of community health University of Nairobi provided variable advice.

Special thanks goes to Ms. Wanjiku Karugu of Appropriate Development Consultancy Ltd. and Mr. Njoroge of Obs/gyne Dept.-.Nairobi University and all their friends who gave their time and materials in preparing this manuscript.

Table of Contents

	Page
Title	..i
Declaration	..ii
Dedication	..iii
Acknowledgment	..iv
Table of contents	..v
Abbreviations	..vi
Summary/ Abstract	..vii
Introduction	..1
Literature review	..2
Incidence/Prevalence.	..2
Background Information	.. 4
Causes	..5
Hand Skeleton	..6
Classification	..7
Approach to the patient with hand injury	..8
Management	
-Overview	..10
-Initial Management	..13
-Definitive Management	..14
Complications	..26
Study Justification	..29
Aim	..29
Specific Objectives	..29
Methodology	..30
Results	33
Discussion and Conclusions	..59
Recommendations	..67
References	..68
Appendices	..75

Abbreviations used in this desertation

MC	**Metacarpal**
PP	**Proximal phalanx**
MP	**Middle Phalanx**
DP	**Distal Phalanx**
CM	**Carpometacarpal Joint**
MCP	**Metacarpophalangeal Joint**
PIP	**Proximal Interphalangeal Joint**
DIP	**Distal Interphalangeal Joint**
ORIF	**Open reduction and internal fixation**
EF	**External fixation**
R.T.A	**Road traffic accidents.**

Summary/ Abstract

This is a retrospective study {descriptive} on metacarpal and phalangeal fractures of the hand on patients who presented to Kenyatta National Hospital over a one-year period from 1st Jan. 1999 to 31st Dec. 1999. Epidemiological aspects of these patients as recorded from case files from the records department and X-ray films from the radiology department, provided information about the fractures. A letter of recall of these patients was sent out using the addresses in the files for an appointment in the orthopaedic clinic where the outcome of the management offered was assessed. A time period of six weeks was allowed for the patients to avail themselves for inclusion into the study from the time the letters were dispatched.

The information included prevalence, sex, age, causes, sites of injuries, and type of fracture of the hand skeleton. The mode of management offered and both the degree of functional recovery attained then and possible complications were also assessed. A total number of 203 case files were retrieved with adequate data to be included into the study. Age range was 4 years to 59 years. Seventy two percent were males and the rest were females.

The right hand was involved 61.6% of the time. The most frequent cause was assault, 37.4%, followed by work related injuries, 29%. Fifty percent were open fractures. Most of the hands had a single fracture, 63%. Metacarpals had 51% of the fractures followed by the proximal phalanx, 32%. The middle phalanx was the least fractured. The 5th metacarpal was the most vulnerable of the metacarpals with the 4th Mc the least fractured. The 4th proximal phalanx was the most fractured, 33% of the proximal phalanges; the 2nd middle phalanx 55% of the middle phalanges, while the third distal phalanx sustained 47.6% of the distal phalangeal fractures.

Most fractures occurred in the diaphyseal region of the bones, 44.9%; the distal joints were involved more frequently compared to the proximal joints. Fifty seven percent had transverse fractures. Out of 203 patients, only 74 patients (36.5%) were recruited into study on outcome. The mean range of duration since injury was 54 weeks. Ninety percent

had been managed conservatively but only 54% had gone through some form of rehabilitative programme. Thirty five percent of the patients were unhappy with the outcome. Fifty nine percent had some degree of stiffness with only 28%-38% able to perform some acceptable degree of fine movement and activities. Sixty nine percent were unable to achieve their full power grip. Sixty six percent had various degrees of malunion

Introduction

The hand is easily injured as it reaches out to touch, hold or provide support. The resultant crisis lead to a great loss in man-hours for it renders the hand suddenly useless.

In the industrialized world, work related injuries to the hand are the most common. These countries have realized the impact these injuries impart on the individual and the society at large, and have developed specialized units that deal with hand injuries and have advocated for improved industrial safety standards.

As this country becomes technologically advanced, and with current laxity and inadequate enforcement of labour laws, injuries to the hand and thus the hand skeleton are bound to increase.

This is a descriptive study , and from a basic point of view will attempt to summarize and document data on prevalence, common methods of management applied, and outcome from which further studies in details can be advanced in areas of specific concern or initiation of programmes to increase public awareness in hand injuries or establishment of a hand injury unit at Kenyatta National Hospital.

Literature Review

Incidence and Prevalence

According to Murphy et al, hand injuries account for 10-20% of an accident and emergency department workload [3]. A study done by Okeke et al in Nigeria found that the male-female ratio was 3:1 [4]. Burridge in New Zealand found that for work related injuries of the hand, males were eight times more common than female's [5]. Zahrani in Saudi Arabia found that all industrial hand injuries occurred in males reflecting the labour pattern of that Islamic country [6].

Okeke found an age range from 5-60 years, with a mean of 25.1 ± 15.1 years, with a peak incidence in the 3rd decade [4]. Burridge at el found the highest rate in the young and rates decreased with increased age [5]. While Zahrani at el found an age range of 20 to 50 years with a mean of 28 years. About 50% of these patient belonged to the age 20-30 years age group [6].

In Okeke's study machines were the commonest cause of hand injuries associated with multiple injuries [4]. Burridge found that 75% of the injuries were caused by cutting instruments and machines with meat workers at highest risk [5]. Zahrani found that overwork and tiredness were predisposing factors with 81% of workers not following safety measures at the time of the injury. That accident process, recklessness and ignorance play a major part in causation [6].

In Zahrani's study, the right hand was involved in 57% of the patient with traumatic amputation and fracture dislocations accounting for 65% of the hand injuries [5]. With the distal phalanx being involved in 46% of the cases [5]. Okeke found that right hand injuries were 51.7% while both hands were involved in 6.8% of the patients, with most of the injuries being multiple. The little and ring fingers being the most commonly involved of fingers [4].

At Kenyatta National hospital on average going through the outpatient and inpatient case records approximately 20 patient monthly are seen with fractures of the metacarpal and phalanges. This excludes those patients with soft tissue injuries only such as tendons, nerves muscles, skin injuries or in various combinations who may be more.

Background Information

Historical Background

By the end of World War I, very little was written on injuries of the hand. It is after the emergence of explosives that the hand which had hitherto provided a small target, that injuries to the hand received serious attention. Bunnel, S. in 1931 described the physiological reconstruction of a thumb after total loss. Kanavel in 1939 published a monograph describing infection of the hand in an article in the magazine 'Infection of the Hand'. He taught extensively on how to care for infections of the hand[1,2]

With the subsequent advent of antibiotics, these above two gentlemen heralded the era of modern hand surgery. They built a solid foundation upon which the present and future care of hand injuries now rests. We have learnt from them that serious infection and injuries of the hand maybe managed adequately achieving significant functional and clinical recovery

Causes of Metacarpal and Phalangeal Fractures

The most common causes of patient presenting with hand injuries have been found to be:

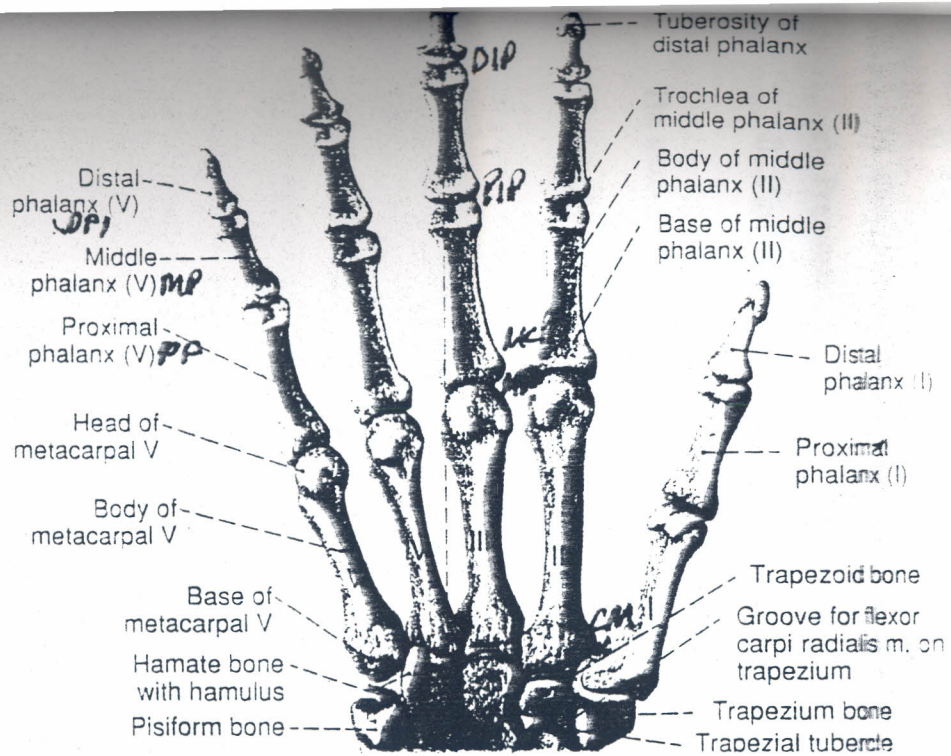
1. Industrial Accidents - with increasing industrialization and high labour cost for trained workers, there has been the tendency to employ casual workers with poor job training who are made to handle machines with conveyor belts or moving parts which tend to trap hands causing wringer injuries [4,5,6].

2. Road traffic accidents cause various degrees of injuries to the hand. There has been an increase in the automobile population and hence accidents [4].

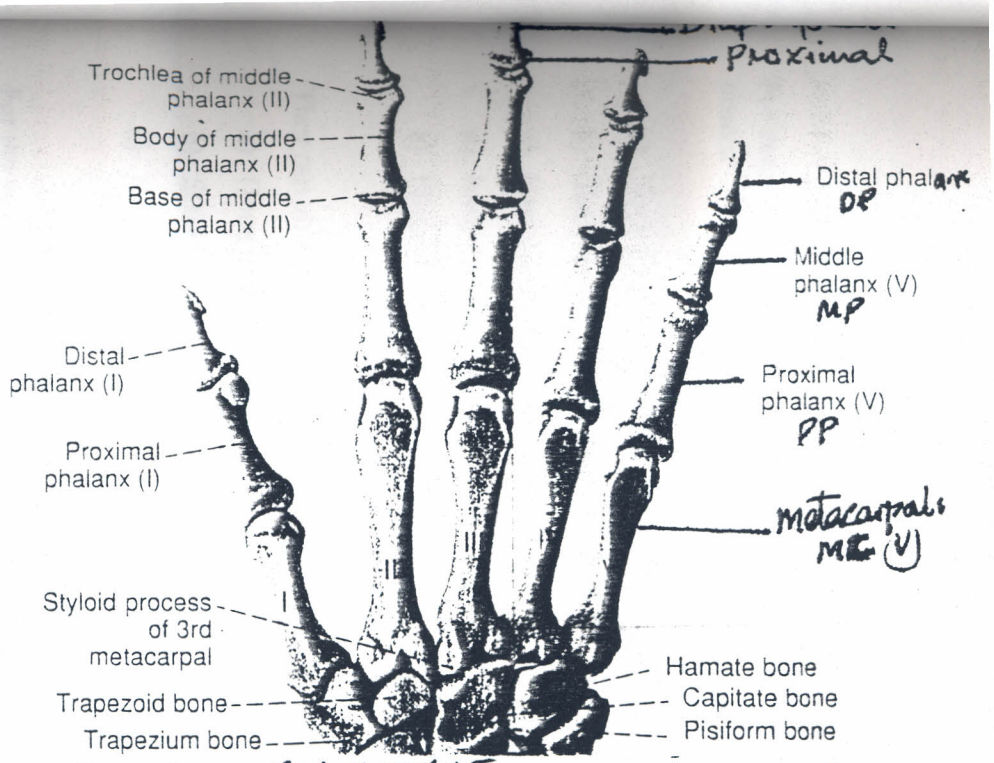
3. In domestic activities, accidents do occur during which fingers are trapped in closing doors or being hammered or crushed by heavy objects [4,5].

4. Sports such as basketball, volleyball and boxing having their share of injuries [7].

5. Missiles such as gunshot or explosives are common causes of injuries especially in ethnic conflicts



PALMAR SURFACE



DORSAL SURFACE

NB: DP – Distal Phalanx
MP – Middle phalanx
PP – Proximal phalanx

DIP – Distal Interphalangeal joint
PIP – Proximal Interphalangeal joint
MCP – Metacarpophalangeal joint
CM – Carpometacarpal joint

Classification of Metarcarpal and Phalangeal Fractures

For ease of diagnosis and management these fractures can be classified in the following manner [8,9]

a) Neck fractures (Distal)
b) Shaft fractures (Diaphyseal)
c) Base fractures (Proximal)
d) Intra-articular fractures
e) Physeal and epiphyseal fractures

They can also be characterized as:

a) Open or closed
b) Stable or unstable
c) Displaced or undisplaced

For the study and data presentation, the following classification will suffice:

a) Distal
b) Diaphyseal
c) Proximal
d) Open and closed

The intra-articular, physeal and epiphyseal fractures will be characterized separately as a sub-set of the above classification.

Approach to a patient with a hand injury

a) *Initial Assessment*

This should be aimed initially to determine the condition of the patient as a whole. when the injured hand is not of higher priority due to another life threatening injury to the patient, it is appropriate to apply temporary dressings and immobilize the extremity while sorting them. A detailed history is then taken in an attempt to answer the questions, where, what, when and how. The precise mechanism of the injury must be noted. Detailed records must be kept especially so for work-related injuries for medical-legal purposes. A record of the age, handedness, vocation, level of education, number of dependants and personality are essential. These may help in determining the need for any major reconstructive surgery [8,9]. A medical and social history should include as much details as possible.

b) **Physical examination**

It is preferable that this is done in a controlled environment.

A test of sensibility to light touch and two-point discrimination of individual digits maybe done before any form of anesthesia is given. Pain intensity maybe subjective. Inspect the hand fully. Make, if possible a recognizable sketch of the hand locating the extent and location of the injury under some form of anaesthesia or sedation. Palpate the hand. Note the state of the soft tissues, crepitation or bony instability, joint movements and muscle bellies, the vascular state of the hand, any incipient compartment syndrome [9,10].

c) **Other diagnostic tests**

(i) X-rays - Anteroposterior, true lateral and oblique views [9,10,11]

(ii) CT-Scan/ MRI - Foreign bodies not visible on routine soft tissue X-rays maybe seen [12].

(iii) Occasionally an angiogram maybe called for if there is suspected vascular insufficiency after an injury to show the vascular pattern before a re-constructive procedure is embarked on. [13]

Note that a further detailed examination would have to wait until during any form of surgical intervention especially so for severe injuries with extensive soft tissue damage.

Management of Metacarpal and Phalangeal Fractures-Overview

The initial management of these fractures will depend on whether they are open or closed and any complications that have already ensued at the time of diagnosis. Correct decisions will have the greatest effect upon ultimate functional recovery or long term disability. Open wounds and mutilating injuries to the hand present a tremendous challenge to the surgeon and a good knowledge of the basic hand anatomy is imperative and is criminal to leave the management of these injuries to a pretender or moonlighting residents[14]

Open fractures:

a) Tidy versus Untidy.

This classification coined by Rank and Wakefield still hold true today. A tidy injury is inflicted by a sharp object, clean, minimal soft-tissue injury and contamination. There is minimal swelling and bacterial colonization, less than 10^5 bacteria/gram of tissue and a delay of less than 12-24 hrs before proper adequate surgical debridement is done. An Untidy injury involves wounds with extensive soft tissue injuries by avulsion or crushing forces associated thermal or electrical burns, mangled by machinery or high velocity explosives or missiles. A wound over 24hrs before any debridement and lavage is done. A bacterial count of over 10^5 bacteria per gram of tissue or less if the bacteria are highly virulent[14,15].

b) Tetanus prophylaxis is mandatory

c) Antibiotic Prophylaxis should never in any way be a substitute for a timely thorough surgical debridement and lavage. Aerobic and anaerobic culture and special biopsies or swabs for unusual infection should be obtained, and knowledge of bacterial flora likely to contaminate the wound would be helpful in deciding what antibiotics to use initially[14,16].

d) Elevation of the injured hand is a priority.
This reduces bleeding and further decreases the development of edema and pain.

e) Tourniquet use allows for a clear operating field.

In a conscious patient a tourniquet may be used for a short period, about 30 minutes, but under Regional block or general anesthesia, it may be applied for 2hrs at time with periods of release lasting 15 minutes or so. However, their use is dangerous with risk of severe hyperperfusion injuries or, actual nerve crushing may occur.

f) Options for wound closure are: -

(i) Primary closure - tidy wounds with minimal tissue loss can be closed primarily. Attempts must be resisted to close a wound when in doubt; it should then be left open.

(ii) For large open wounds and all contaminated wounds other surgical options must be employed.

- Secondary closure - A delay of 5-6 days post-injury before closure if the wound is clean.
- Use of free flaps especially due to the development of miscrovascular technique has enabled aggressive surgeons to complete many operative procedure and reconstruction in the early hospitalization period. The probable aim is to restore length and function. These include skin grafts, local and distant flaps and free tissue transfers. Graft loss and donor site morbidity must be carefully evaluated before embarking on it and realistic expectation must be put into consideration[17,18]
-
- Amputations may have to be considered after massive injuries especially in the face of irreversible ischaemia. It is also less gratifying and definitely a disservice to the patient if after reconstruction, the hand is insensate, painful, immobile and non-functional. A single graft may decrease significantly the function of normal adjacent digits and thus the whole hand, but, its imperative that the decision to amputate or not is undertaken by the most experienced surgeon.
- Use of external fixators in the immobilization of these fractures has become more advanced and sophisticated in the last 20 years and should be used more frequently.

- Bone grafting, either autograft, more commonly, or allografts and xenografts rarely may be used to bridge segments of bone loss [19]

Closed Injuries.

-Their management will be dealt with in later sections.

Metacarpal and Phalangeal Fractures - Initial Management

The initial management of these injuries rest in the alleviating of pain, decrease or minimizing the swelling, detection of complications that may arise. Depending on the state of the hand, definitive management of the injury can be formulated. Measure to counteract complications can be initiated. Swelling is decreased by elevation of the extremity, fasciotomy for compartment syndrome in the hand and fingers.

Pain:

Having in mind that pain is a multidimensional phenomenon one has to take several factors in mind when dealing with these patients.

- The affective - motivational component, which covers more highly, differentiated affective states such as anxiety and depression
- Cognitive component, which includes such dimensions as attention-distraction, the significance and interpretation of the situation with, references to past personal and observed experience
- The behavioral component which maybe exhibited either physiologically, verbally or motor inactivity

Taking into consideration that pain is a subjective phenomenon, then the physician must accept that in the end, the patient is the only 'expert' as regards the pain he or she is experiencing. However, this concept may not accurately reflect the gravity of pain on its own, but based on empathy, it may form the basis of a good relationship with the patient

Also, it's worth noting that pain control is a prerequisite to early motion. Its accomplished with a combination of drugs given around the clock, rather than on as needed basis[20,21]

Definite Management of Metacarpal and Phalangeal Fractures

I: **Splints**

This usually revolves around splinting of these fractures to allow for rest, protect the broken bones, promote healing, skeletal substitution and preserve joint motion. Splints can either be external or internal splints and static or dynamic splints, and functional appliances [22]

a) External Splints

This provides immobilization of the fractures by providing their inherent rigidity outside the body parallel to the fractured bone. The materials used must be light, sufficiently strong, durable and malleable enough. Such materials include plaster of Paris, aluminum, stainless steel, wood, cramer wire and plastics. The other type of external splints involves insertion of pins and wires into the fragments resulting from the fracture and providing rigidity externally via an apparatus providing alignment and immobility of the fracture. Examples of these include the day frame and orthofix. What is suitable for a fracture depends on the site and stability of the fracture before and after reduction or whether it is an open or closed fracture. However, as a precaution, several factors need to be observed.

- Immobilize in the position of function
- Immobilize the least number of joints
- Immobilize for the shortest period of time
- If possible, allow for slight movement

Pulp and skin traction may also be used for fractures on metacarpals and phalanges after reduction. This avoids rotation at the fracture site and prevents finger overlap on fisting [22]

b) **Internal Splinting - Internal Fixation (IF)**

This is now a very advanced science, which involves application of metallic and biodegradable materials across the fracture site to provide for rigidity. These so-

called internal fixators include kirschner wires, miniplating and macroplating systems non-absorbable and absorbable intramedullary implants. [23,24]

c) Splints can also be designed to be either static or dynamic, or serve as functional appliances. [25]

Static splints immobilize joints in a fixed position and maintain that alignment throughout the period of application. They have the disadvantage of allowing joints to stiffen and become fixed. Dynamic splints allow for movement in the joints of the bone fractures. They encourage normal muscles to maintain power and tone while encouraging weak muscles to strengthen.

Functional appliances are designed to add stability to joints in order to enable other joints function maximally. [26]

Individual bones.

II. Metacarpal Fractures

For ease of management, these fractures can be classified anatomically on the location of the fracture; Distal, Diaphyseal, Proximal and Intra-articular fracture

a) Distal (Neck) Fractures

Usually this is a transverse fracture with volar angulation. The first and medial two Mc, part of the mobile units of the hand can allow for angulation up to 20° but rotation must be fully corrected. the Mcs - 2 & 3, angular deformity should always be reduced (they form part of the fixed units of the hand). A plaster cast is usually used to hold and maintain the reduction, which is allowed for 10-14 days. If the fracture has the tendency to redisplace, use of internal fixation is recommended Kirshner Wires and miniplates are increasingly being used. 4th and 5th Mc neck fractures may heal without any splinting or fixation [27,28]

b) **Diaphyseal (Shaft) Fractures**

These are generally of three types, transverse, oblique or spiral pattern. Accurate alignment is very essential. With more than 4mm shortening, malrotational often occurs. Transverse fractures if undisplaced maybe adequately treated by casts. If initially significantly displaced or displace easily, then open reduction/IF is advocated. For oblique and spiral fractures, the tendency to rotational displacement is more significant, and if angulation is more than 10° with significant rotational misalignment, then open reduction and internal fixation is advised. Long spiral or oblique fractures are best internally fixed. Highly comminuted or unstable compound fractures are externally fixed in order to maintain length and stability.

c) **Metacarpal base Fractures**

These are usually either oblique or transverse and stable except fractures of the base of thumb metacarpal. Marked displacement is rare. After correcting rotational deformity splinting with a simple cast is adequate. When there are multiple fractures, use of pin fixation is advocated. Displaced fractures not easily reduced should be internally fixed. External fixation has also been advocated if there are open fractures or involving the joints[29,30,31]

d) **Fracture dislocations and Intra-articular fractures**

These are important especially around the base of the 1st metarcapal (Bennett's fracture dislocation) and fifth metacarpal base (reverse Bennett's fracture)

- Bennett's fracture dislocation is commonly due to a direct punching force, usually oblique extending into the carpometarcapal joint. Usually unstable. It is advocated that perfect reduction is necessary and internal fixation method of choice by use of screws or Kirshner wires. Use of casts is still practiced for these fracture dislocations, but continued reduction must be demonstrated in which case the cast is worn for 4 weeks. However there is a poor long-term outcome [29,30,31]

- Reverse Bennett's fracture is also common as a result of direct trauma. It is preferred to reduce the fracture by traction and maintain with a percutaneous pin fixation or open reduction and internal fixation.

- Other carpometacarpal (CM) and metacarpophalangeal (MP) fractures involving the joints do occur. Usually through cancellous bone and are frequently impacted and stable. If it is due to a bony avulsion, and reduction is difficult, in order to restore articular surface contour, then internal fixation is recommended. Occasionally it maybe necessary to excise fragments that maybe in the way to effect reduction or remove free intraarticular loose bodies. Otherwise closed manipultion and casting is useful for a period of 3-6 weeks.[33,34]

III. **Phalangeal Fractures**

Using a similar simple classification as for metacarpal fractures

a) **Proximal Phalanx**

The bones have predominantly cancellous bones in the proximal, distal and epiphyseal regions, thus they heal rapidly compared to the diaphysis which is made of cortical bone.

Fractures in these bones have a high risk of tendon adhesions and tendency for the flexor apparatus and extensor mechanism being involved in the initial injury and subsequent circatrization process is high.

{I}. **Diaphyseal fractures**

These can be either transverse, oblique or spiral. Commonly the transverse fracture is encountered. Usually proximal fragment angulates forwards due to the action of

the interossei muscles and the distal fragment in extension due to the extensor mechanism. There maybe some degree of rotation.

Therefore in managing these fracture the displacement of the fragment and rotational deformity must be corrected. 'Functional splintage' is effective. A simple external splint or 'buddy' strapping for 2-3 weeks is adequate.

Internal fixation is indicated if

- The patient is unreliable
- Markedly comminuted fractures

Kirshner wires, miniscrews and miniature plates are increasingly being advocated. [36,37]

(II). **Proximal fractures of the Proximal Phalanx**

Manipulative reduction can sometimes be difficult because of the three dimensional tendency to deformity, dorsal and lateral angulation and hyperpronation involving the proximal fragment. By reversing the deformities in maximum flexion of MP joint, then reduction can be achieved in most cases followed by buddy system splinting for 3 weeks.

For other fractures that are difficult to reduce this can be achieved by internal fixation especially so if there is interposition of soft tissues Periarticular fractures usually require ORIF, using wires and microplates[36,37]

b) Middle Phalangeal Fractures

The pattern and anatomical location of the fracture is significant in the management of these fractures. Most are treated like those of the proximal phalanx above.

For fractures involving the Distal Interphalangeal joints (DIP joints). Their management revolves around the proper management of the soft tissues around these, fractures [38,39]

- Fractures involving the insertion of the terminal extensor tendon and oblique articular ligaments, are, reduced by hyperextension thereby reducing the avulsed fragment to the distal phalanx. A simple splint is used to maintain that position for 4 weeks. If reduction is difficult to achieve, then open reduction and internal fixation especially where large fragments are involved. [38,39]
- Flexor tendon avulsion fractures should be treated by open reduction and fixation. Where fragments are small advancement of profundus to its insertion maybe necessary or use of pin fixation methods [40,41]

- Palmar plate avulsion injuries are easily reduced by flexion 30°-40° and can then be maintained by cast or splint for 3 weeks. Osseous chips grade 3 and 4 of Hintringer require surgical intervention [42]

- For comminuted fractures involving DIP joint, reduction can be achieved by gentle compression and traction, brief cast or splint support and early motion to mould the articular surface.[43]
- Tuberosity fractures and avulsion fractures of the collateral ligament origins may require open reduction and internal fixation. Supracondylar fracture can be a problem because the articular fragment may swing from side to side. If closed reduction fails then open reduction and internal fixation maybe the best option. [41]

Shaft fractures of the middle phalanx

These are relatively uncommon, usually as a result of direct crushing forces. They have a high tendency to heal with tendon adherence. Because of the insertion of the central slip of extensor mechanism and flexor superficial is muscle, an unstable fracture may tend to zigzag in position. However, if a dynamic balance can be achieved, closed reduction and manual correction of angulatory and rotatory deformity is usually adequate followed by splinting or digital casts immobilizing the distal and proximal middle phalanx joints. Where reduction cannot be achieved or the patient prefers open reduction, and where there is adequate facilities and experience use of miniature plates and miniscrews is becoming more fashionable. Pin fixation is however simpler. ([36,37])

c) Distal Phalangeal Fractures

For ease of description these fractures are divided into Tuft (head) shaft (Diaphyseal) and physeal (base) fractures and, intraarticular fractures and dislocations
These fractures are usually as a result of crushing forces, they maybe closed or open.

i) Tuft fracture

An intact pulp or nail usually acts as a stabilizing factor in these fractures. Usually in closed fractures, reduction can be achieved and then the fracture disregarded otherwise one may apply a protective metal or plastic splint until the pain subsides. ([44])

In open injuries, if the nail bed is damaged then its treatment is as important for a functional as well as cosmetic recovery. Thorough debridement after removal of the nail and repair of soft tissue is attempted as best as possible (The nail bed must be repaired adequately). Usually this plus splinting is adequate. If the soft tissue repair does not provide adequate stability or where the pulp or nail have been disrupted, the fragments maybe displaced and unstable. Suturing the wound after adequate surgical toilet may provide the

stability. Additionally, a K wire fixation to the fragments maybe necessary. [37]

ii) Shaft fractures

Most closed injuries are non-displaced requiring only protective splinting. Radiographic union may take longer than 10 weeks. A third may still be un-united six months later. [44] Open fractures are thoroughly debrided and repaired. A protective splint may be adequate otherwise pin or wire fixation may be necessary.

iii) Basal Fractures of the Distal Phalanx

These are usually unstable fractures; however, closed reduction of closed fractures can be accomplished, maintained in extension of the distal phalanx and DIP joint for 6 weeks. Check X rays at 2 weekly intervals helps in confirming the position of the fracture to avoid over correction deformity.

In open fractures, thorough debridement is done. Angular and rotational deformities are then corrected. Soft tissues are repaired. Protective splinting or cast is applied. In children angular deformity of up to 30° maybe accepted in the AP axis. Elevation and warmth, and antibiotics in open injuries are necessary after surgical toileting.

Fractures due to avulsion of a fragment from the base have been alluded to previously and an example is the mallet finger. The fragment attached to the extensor tendon may vary in size, and if reduction is not achieved accurately by hyperextension, then the fragment should be fixed back by use of Kirschner wires or miniscrews. [38,41,44]

iv) **Childhood Physeal Injuries**

Both metacarpal and phalangeal physeal and epiphyseal injuries present special problems frequently overlooked. However, the principles of their management are basically as those applied for epiphyseal injuries elsewhere in children. Knowledge of the mechanism of injury and potential effects on the growth potential of the digits are very important. [45,46]

The epiphysis of the proximal phalanges of the fingers and the 1st metacarpal are the most frequently injured. [47]

Salter types I and II fracture frequently demonstrate remarkable remodeling potential although they are in essence easier to reduce. Intraarticular salter type III and IV fractures often require surgical repair and are more associated with growth disturbances and posttraumatic osteoarthritis. Type V though rare; frequently result in growth arrest. [45,46,47]

Displaced fractures, which are difficult to reduce and maintain, often enough require open reduction and internal fixation. One may use Kirschner wires and biodegradable pins Kirschner wires serve as buttressing internal fixators, biodegradable pins where used have fewer numbers of additional operative procedures than kirschner wires. [48,49]

Use of miniplating and microplating systems are not favorable to a growing bone and are associated with more extensive soft tissue injuries due to the multiple operation required. They are more likely to result in growth disturbances.

These fractures when discovered, maybe the only evidence of child abuse. The morphologic features are usually consistent with forced hyperextension injuries. Thus, the hands should be included as part of skeletal surveys in child abuse suspicious cases.[50]

v. Associated Injuries

Whenever a fracture occurs, other structures are also injured, and the effect of that injury may last long after the fracture(s) has healed, the so-called fracture diseases. The skin maybe damaged by the deforming force or its associated energies e.g. heat or radiation, primarily resulting in an open fracture, or subsequent edema resulting in a compartment syndrome and/or blistering. [51] Vessels maybe compromised resulting in intravascular thrombosis. Ischaemic necrosis of the distal fragment may occur. Thus the vascular integrity of the fracture and distal structures must be assessed initially and subsequently, Fasciotomy, Urokinase injections or Microvascular surgery maybe necessary. [52,53] Digital nerves, though rarely, maybe severed or trapped by bony fragments leading to lack of sensation distally. The cut ends may form neuromas which maybe a source of chronic pain. Chronic paresthesias and sympathetic dystrophy may follow crush injuries. [54] Nail and nail bend injuries especially in crushing injuries of the distal phalanx do occur. Nail bed regenerates well in the presence of the nail matrix and poorly in its absence. Where a nail bed has been avulsed, a full thickness skin graft allows the remaining nailbed to advance distally. [55] The sesamoid bones of the thumb maybe fractured and be a source of pain and restriction of motion of the 1st metacarpal joint of the thumb.[56] Ligamentous injuries of the small joint occur sometimes associated with joint surface contussions. Most readily respond to a short course of protective splinting. However, where articular surfaces avulse with either incomplete or complete tear of the ligaments,

reduction of the fracture maybe difficult, thus requiring ORIF and/or repair of these complex joint injuries.[57] Torn muscles may heal with significant scaring and tethering to have considerable functional limitation even after the bones have healed. Tendons maybe injured directly by the crushing forces or the resultant fragment may trap or tether them interfering with their smooth gliding functions. The healing process may also form cicatrization adhesions between the mobile structures. Tendons have occasionally ruptured long after fractures have healed. [58,59]

vi. Rehabilitation

Advances in surgical techniques that have enabled greater functional restoration of anatomy of the injured hand has necessitated development of better rehabilitative programmes for the hand. Fractures involving the metacarpals and phalanges affect the soft tissues, tendons and joints to various degrees as alluded above. Thus, as the fracture starts to heal the eventual functional outcome of the other tissues and structures must be taken into account. Understanding of the psychological impact injuries to the hand entail may assist in the rehabilitative programmes. [60,61]

These programmes can be divided into:

(i) Acute phase programmes

(ii) Later phase programmes which include return to work programmes

a) Acute Phase Rehabilitation

These are designed essentially to the prevention or decrease of complications that occur early after injury or postoperative period. The early motion programmes establish easier tendon and joint cartilage gliding, decrease development of unwanted adhesions, edema subsides faster and also enhance the healing process and return to normal function.

Early controlled motion programmes can be derived from a combination of Kleinerts controlled active extension with rubber-band passive flexion, Duraus controlled passive techniques, and the modification of the Kleinert orthosis that uses a palmar pulley system [62,63,64]

b) Later Phase Rehabilitation

These programmes are designed to improve the functional outcome and decrease the consequences of complications that are in the process or have already set in Joint stiffness secondary to immobilization requires vigorous and sustained hand therapy in order to increase their range of motion. Maximization of motion after healing is the primary goal in posttraumatic stiffness and other fracture diseases. Team effort is mandatory since reconstructive microsurgical techniques maybe needed due to severe joint contractures, tendons adhesions and neurovascular defects. This may enhance greatly the progress of remobilization process. Otherwise without these principles in mind, the best surgical intervention produces sub-optimal results and the desire to return the patient to his or her previous vocation may not be achieved [62,64]

Complications of Metacarpal Phalangeal and Phalangeal Fractures

1. **Stiffness**

This results as a limited range of motion in the normally mobile joints. It occurs due to peritendinous or paraarticular adhesions and is due to lack of motion or soft tissue injuries. This can be minimized by avoiding sustained periods of immobilization of fingers. Use of ORIF and External Fixators allows for early mobilization of the joints. [65]

2. **Malunion**

Because the fractures have a three dimensional configuration, then the risk of healing out of alignment or angulated or rotated is high. This can easily lead to crossfinger malfunction.

3. **Ankylosis**

Injuries especially involving joint surfaces the anatomical structures change in relation to one another due to cicatrization processes.

4. **Non union**

This also occurs, and may lead to pseudoarthrosis. Infection, bone loss and distraction, either operative or interposition of soft tissues may lead to this. Therapy resistant pain during function and loading may occur in the long-term.

5. **Traumatic Wound Contracture**

Open fractures with associated loss of soft tissues if left alone heals by second intention with severe scar formation and contracture which eventually affects the function of the hand. The early use of fasciocultaneous and musculocuteous flaps for early wound coverage is gaining increasing importance. With intervention in the acute phase being advocated [17,18,66,67]

6. **Epiphyseal injuries**

May result in disturbances of growth of the fingers. This eventually disturbs the structural integrity of the hand skeleton. Thus aggressive management with aim of restoring anatomy and assure healing which maximize future functional recovery is important in the young. (45,46,47,48,49)

7. **Cold intolerance**

This may occur in the injured hand and is usually persistent. It is associated with a high incidence of early postoperative pain, and high quality postoperative pain relief appears to decrease the incidence. (68,69)

8. **Persistent mechanical allodynia**

This occurs rarely after injury (severe) to the hand. The pain is felt at any attempt to move the hand and the symptoms are slightly relieved by stressing nerve roots C5, 6, 7 upto the distal extent of the median nerve in the neural self Mobilization Programme advocated by Sweeney and Harms. (70)

9. **Infection**

Infection of bone and soft tissues may occur especially involving open fractures and can be very stubborn in its eradication. Infection of implant can be bothersome and protracted. (71,72)

10. **Osteoarthritis**

Fractures that involve joints are also in the longterm liable to result in osteoarthritis especially if the configuration of the articular surface is deformed.

1. Due to **post-traumatic adhesions**, complete fusion of tendons can result e.g. Flexor pollicis longus and the flexor digitorum profundus indicis. (73)

12. Damage to nerves and tendons have been associated with development of **Beau's lines** on finger nails, thus affecting nail cosmesis. [74]

13. **Reflex sympathetic dystrophy**

- often caused by inappropriate or inadequate hand Therapy. [75]

14. **Recurrent compartment syndrome**

- markedly elevated hand compartment pressures can occur weeks after undergoing successful de-compressive fasciotomies for acute compartment syndrome [76]

Study Justification:

By understanding the epidemiological aspects of fractures of the hand and management outcome, one is then in a position to campaign for the establishment of hand injury unit or public programmes on hand fractures awareness. This would also provide a data for which a further comprehensive prospective study can be based on.

Aim:

Determine the epidemiological aspects of fractures of metacarpal and phalangeal bones and mode of management and outcome of the fractures of the hand as seen in KNH.

Specific Objective:

(i) Determine the prevalence of the metacarpal and phalangeal fractures of the hand.

(ii) Determine the pattern of metacarpal and phalangeal fractures of the hand.

(iii) Determine the mode of management offered to those patients.

(iv) Determine the outcome of these fractures injuries.

(v) Compare the findings with other studies done elsewhere in other countries.

(vi) Make recommendations based on my findings on how to improve on management.

Methodology

a) Location: **Kenyatta National Hospital situated in Nairobi, Kenya.**

b) **Subjects:**

All patients seen in both outpatient departments and inpatients from 1st Jan 1999 to 31st Dec 1999, provided data on epidemiology aspects to be studied. The sample size was determined by the period of study. For the outcome the patients who availed themselves for re-examination, those recruited from data in the occupational therapy department records which were found to be adequate, unlike those in the orthopaedic clinics. Also those scheduled for review in the clinics and casualty departments were included.

METHOD

1.-Data collection.

Retrieval of patient's files documented to have had hand injuries with metacarpal and phalangeal fractures. X-rays of the hands plus X-ray request forms for any available data. Further information was available from patients who responded to the recall letters, occupational therapy department and casualty reviews.

Data available from-

(a) Files where recorded –variables sort were-bone involved, sites and pattern of fractures, treatment protocols and outcome.

(b) Clinical assessment of functional recovery-

i) presence of complications e.g. pains stiffness, malunion or non-union.

ii) Ability to perform simple task-Pick- up marbles, pick-up matches or pins / *perform simple fine and gross activities as recorded in the files.*

iii) Grip strength test- degree of difficulty in extracting 1 or 2 fingers from the patient's grip and/or ability to blanch the finger tips and palm when making a fist

(c) Patients own subjective feeling of outcome-

(i) Excellent—Complete recovery

(ii) Good—Residual pain or deformity but functional

(iii) Poor—disabled

2. (a) Inclusion criteria

- Metacarpal and Phalangeal fracture seen in 1999.
- Respondent to recall letters
- files with adequate data –epidemiological and on outcome.

(b) Exclusion criteria

- Digital amputations
- Inadequate data on file records or unavailability of X-ray films where necessary.

3. Data Presentation

Being a descriptive study the variables were tabulated into frequency of occurrence or distribution and compared to findings from other investigators.

4. **Possible study limitations**

(i) Some records were not adequate especially from the orthopaedic clinics and thus some patients had to be excluded

(ii) Recording of outcome by inference from the files may not correctly reflect the actual status.

(iii) Only a third of the patients were included on the study on outcome.

Ethical Considerations

a) The patients case files were safeguarded and only reviewed by the researcher during the period of study and after.

b) For purpose of confidentiality, patients were identified by a serial number only, but not by name

c) Reasonable handling of the files and X-rays films was executed at all times e.g. avoidance of mixing them or damage.

d) A written permission was sought from the Research and Ethical Committee of Kenyatta National Hospital.

e) No unnecessary costs were incurred by the patients

f) Patients requiring further management were referred to the relevant specialist.

I. RESULTS (Findings)

II. INCIDENCE - PREVALENCE

Of the 4470 new patients seen in the year 1999,252 patients with hand fractures represented a prevalence of 56.4per 1000 of orthopaedic caseload. Forty nine patients were excluded because the case files received had incomplete documentation/data or the X-ray films were unavailable e.g. privately acquired films or had complete traumatic amputation of the digits involved.

Seventy patients (34.5%) were admitted and 133 patients (65.5%) were treated on outpatient basis. A total of 203 patients were included in the study as in table I below.

TABLE I: Study Subjects

Study subjects	Numbers
New orthopaedic patients	4470
Patients with hand fractures	252
Patients included in the study	203
Inpatients	70
Outpatients	133

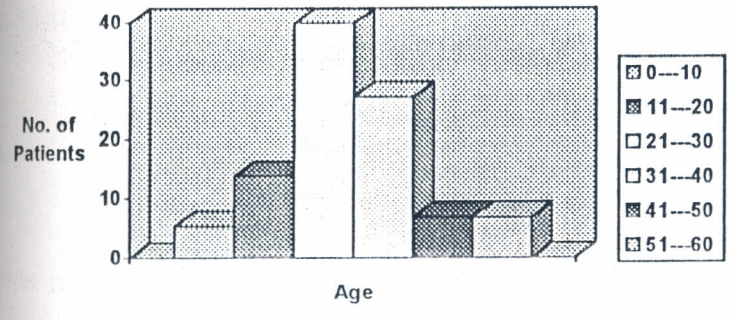
Age.

The age ranged from 4 years to 59 years, with a mean age of 29years. Most of the patients were between 20 to 40 years (66.99%) no patient was below one year. See table II and figure 1 below.

Table II: Age Distribution

Age groups	Number	Percentage
0---10	11	5.42
11---20	28	13.79
21---30	81	39.9
31---40	55	27.09
41---50	14	6.9
51---60	14	6.9
Total	**203**	**100**

Figure 1: Age distribution



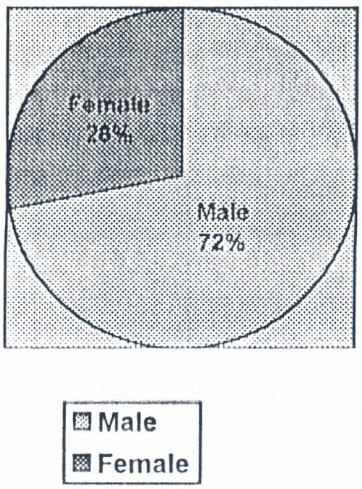
Sex

There were 146 (71.92%) male patients and 57 (28.08%) female patients, giving a ratio of 2.6:1.See table III and figure 2 below.

Table III: Sex Distribution

Sex	Number	Percentage
Male	146	71.92
Female	57	28.08
Total	**203**	**100**

Figure 2 : Sex Distribution



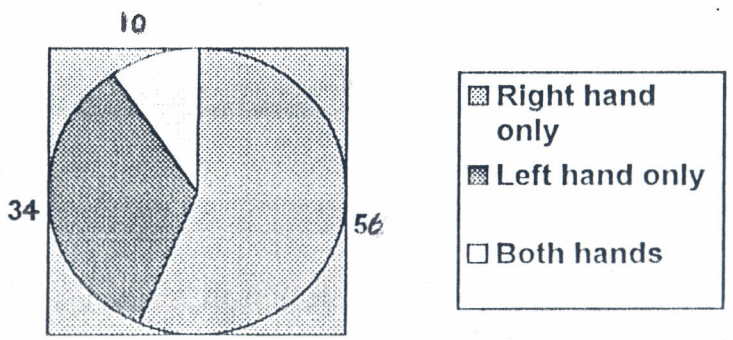
Injured hands.

The most frequently injured hand is the right hand accounting for 135 of the injuries (60.5j%), and both hands 9.85% as shown in table 1V and figure 3 below.

Table IV: Distribution of Patients by Injured Hand(s)

Hands	Number	Percentage
Right Hand only	115	56.65
Left Hand only	68	33.50
Both Hands	20	9.85
Total	**203**	**100**

Figure 3:Distribution of patients by injured hands in percentages.



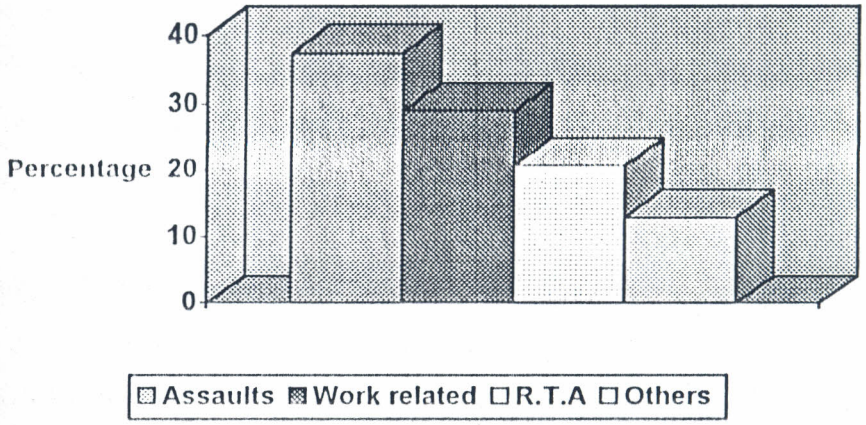
Causes

Seventy six (37.43%) sustained their injuries after an assault with various objects, including 5 who had gun shot wounds to the hand. While 59 patients (29.06%) had work related injuries. Forty-two patients (20.7%) were involved in road traffic accidents. Twenty-six patients (12.81%) sustained their injuries at their homes environment e.g. closing doors, using hammers or pangas or falling objects. There were various major causes of hand fractures as seen in table V and figure 4 below.

Table V: Distribution of Causes

Causes	Numbers	Percentages
Assaults	76	37.43
Work related	59	29.06
R.T.A	42	20.70
Others	26	12.81
Total	**203**	**100**

Figure 4: Distribution of causes



Characteristics of the Fractures

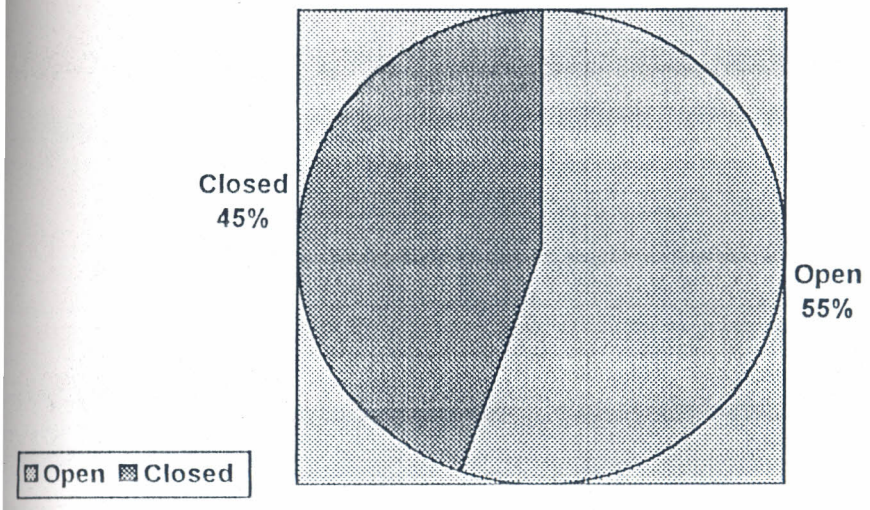
Open or closed fractures

Total number of fractures was 354 of which 198 (55.9%) were open and 156 (45.1%) were closed as seen in table VI and figure 5. Note that all the 70patients who had open fractures were admitted (see table I)

Table VI: Skin Status

Skin Status	Numbers	Percentages
Open	198	55.9
Closed	156	45.1
Total	**354**	**100**

Figure 5: Skin Status



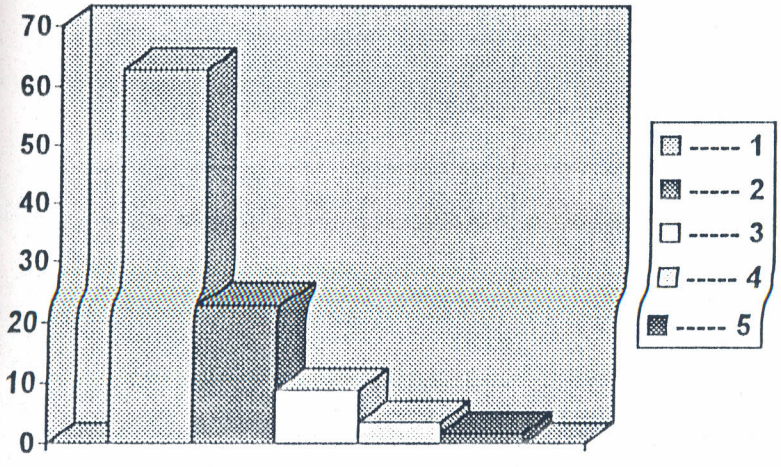
Fractures per hand

From the table VII and figure 6 below, most of hand injuries sustained one fracture, 140 hands (62.78%) followed by 2 fractures per hand 51 hands (22.87%). Eighty-three hands (37.22%) sustained multiple fractures accounting for 214 (60.5%) of the total number of fractures.

Table VII: Distribution of Fractures According to the Hand(s)

Number of fractures	Hands	
	Number	Percentage
1	140	62.78
2	51	22.87
3	20	8.97
4	8	3.59
5	4	1.79
TOTAL	223	100

Figure 6 : Distribution of Fractures According to the Hand(s)



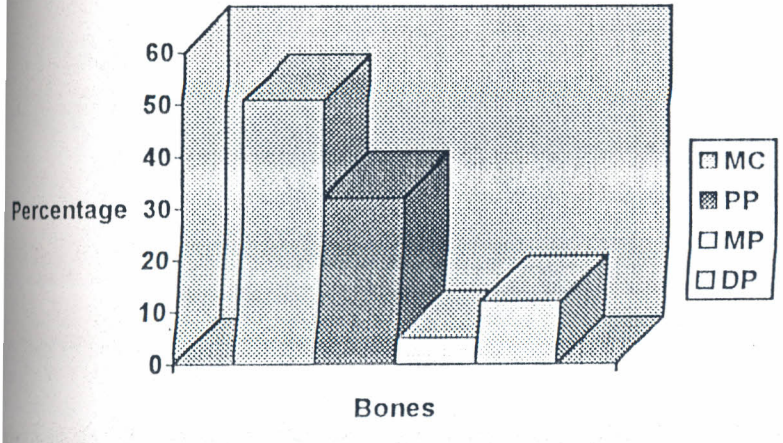
Distribution of Fractures According to Bones Involved

Of the 354 fractures observed,180(50.85%)involved metaacarpals,while114 (32.2%)involved proximal phalanges .The middle phalanx was least involved with 18(5.09%) of the fractures. This distribution is shown in table V111 and figure7 below.

Table VIII: Distribution of Fractures According to Bones Involved (n = 354)

Bones	Number	Percentage
MC	180	50.85
PP	114	32.20
MP	18	5.09
DP	42	11.86
Total	**354**	**100**

Figure 7 : Distribution of Fractures According to Bones Involved (n = 354)



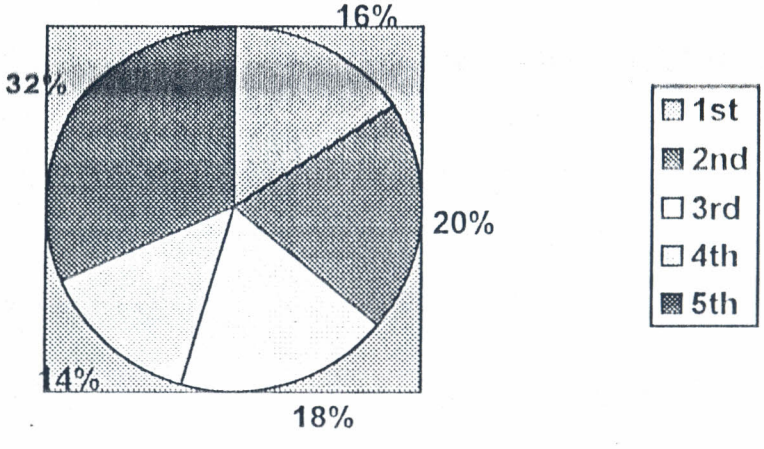
The Metacarpal fractures.

The fifth metacarpal was the most fractured in hand injuries, 57 fractures (31.67%) followed by the index metacarpal with 36 fractures (20%). The fourth metacarpal was the least fractured among the metacarpals. Table IX and figure 8.

Table IX: Distribution of Metacarpal Fractures According to Digits (n = 180)

MC (n= 180)	Number	Percentage
1st	29	16.11
2nd	36	20.00
3rd	33	18.33
4th	25	13.89
5th	57	31.47
Total	**180**	**100.00**

Figure 8: Metacarpals.



Phalangeal fractures

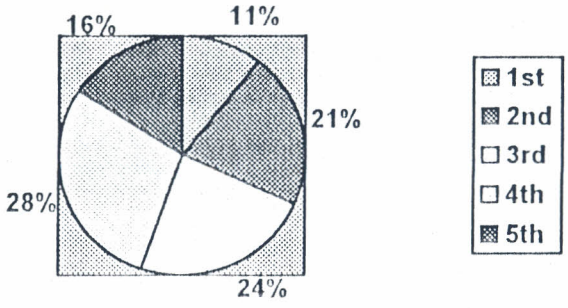
a) Proximal phalanges (PP)

A total of 114 proximal phalangeal fractures were recorded. The fourth proximal phalanx were 33 (28.95%) and the first proximal phalanx 12 (10.53%) the least fractured.See table X and figure 9a.

Table X: Distribution of Phalangeal Fracture According to Digits

PP (n= 114)	Number	Percentage
1st	12	10.53
2nd	24	21.05
3rd	27	23.68
4th	33	28.95
5th	18	15.79
Total	**114**	**100**

Figure 9a:PP.



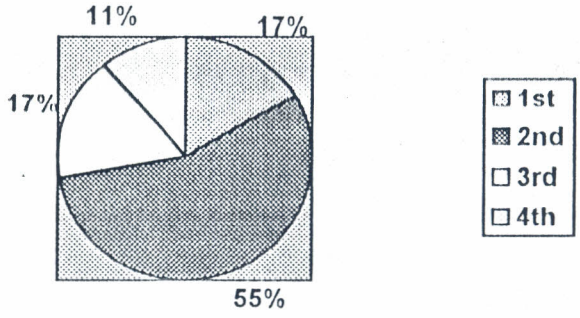
b) **Middle phalanges (M P)**

Eighteen middle phalanges were involved with the index fingers having 10 fractures (55.56%). fourth middle phalanx sustained 2 fractures out of 18 (11.11%). See table Xb and figure 9b below.

Table X (b): Middle phalanges (MP)

M P (n= 18)	Number	Percentage
1st	3	16.67
2nd	10	55.56
3rd	3	16.67
4th	2	11.11
Total	**18**	**100**

Figure 9 (b) :MP



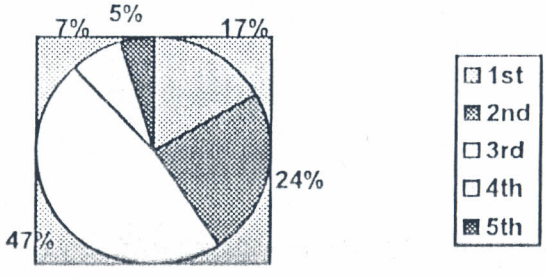
c) **Distal phalanges (DP)**

Out of 42 distal phalangeal fractures, 20 (47.62%) occurred in the third finger, with the fifth finger sustaining 2 (4.76%) fractures. When one considers all the phalangeal fractures, 174, the fourth proximal phalanx was the most injured 33 (18.96%)See table Xc and figure 9c below.

Table X (c) : Distal phalanges.

DP (n= 42)	Number	Percentage
1st	7	16.67
2nd	10	23.81
3rd	20	47.62
4th	3	7.14
5th	2	4.76
Total	**42**	**100**

Figure 9 (c) :DP



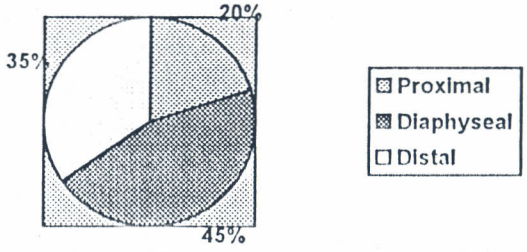
Sites of fractures

Most of the fractures occurred in the diaphyseal region 159 (44.9%), followed by distal fractures 122 (34.5%).See table XI and figure 10a below.

Table XI (a): Distribution of Sites of Fractures According to the Bones Involved

Bones	Proximal	Diaphyseal	Distal	Total
M C	31	94	55	180
PP	27	50	37	114
M P	7	7	4	18
DP	5	8	28	42
Total	**70**	**159**	**122**	**354**
Percentage	**19.8**	**44.9**	**34.5**	**100**

Figure 10a: Sites of fractures.



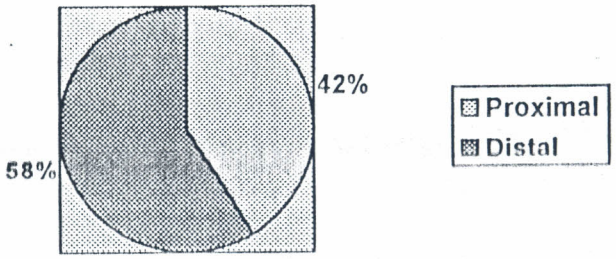
Intra-articular Sites.

Most of the intra-articular fractures involve the distal aspect of the bones, 33(58.5%) as compared to the proximal joint surfaces as seen in table XI (b)and Figure 10 b below.

Table XI (b): Distribution of Intra-Articular Fractures Sites

Bones	Proximal	Distal	Total
M C	8	20	28
PP	10	9	19
M P	2	4	6
DP	2	0	2
Total	**22**	**33**	**55**
Percentage	**41.5**	**58.5**	**100**

Figure 10b:Intra-articular sites.



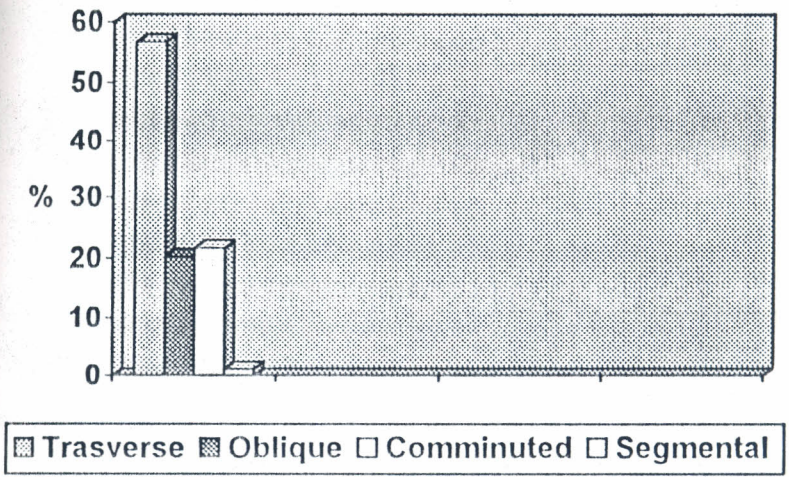
Pattern{Configuration} of fractures

Most of the fractures were transverse in shape, 201 (56.78%). There were only 4 segmental fractures, which occurred in 2 metacarpals (1.13%). Oblique and comminuted fractures occurred almost equally (Table XII and Figure 11 below.)

Table XII: Pattern of Fractures According to the Bones of the Hand (n = 354)

Bones	Transverse	Oblique	Comminuted	Segmental
M C	117	38	21	4
PP	59	26	29	0
MP	12	0	6	0
DP	13	8	21	0
Total	**201**	**72**	**77**	**4**
Percentage	**56.78**	**20.34**	**21.75**	**1.13**

Figure 11: Pattern of Fractures According to the Bones of the Hand (n = 354)in percentages.



Outcome

A total of 74 patients (36.45%) were recruited/included in the data for analysis on outcome as follows

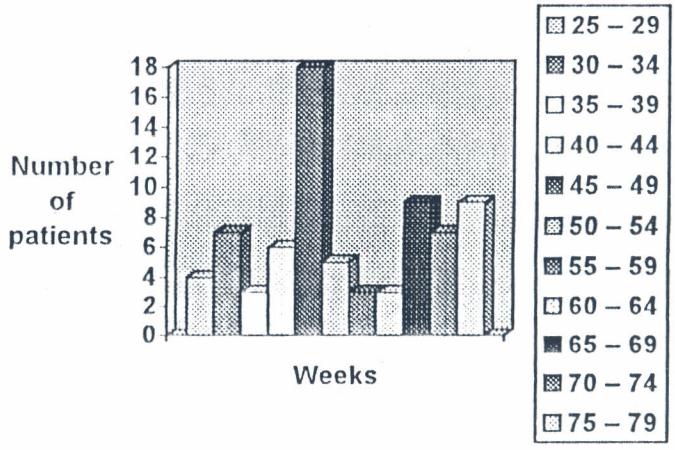
- Occupational therapy records - 40pts.
- Recall letters respondents - 21pts
- Scheduled orthopaedic reviews - 7pts
- Casualty depart - 6pts

This is likely to be biased since only the patients with a problem are likely to be reviewed if at all. The period since their injury ranged from 26 to 78 weeks. The mode was in the range of 45--49 weeks, with a mean of 54 weeks .Adequate callous is usually evident by the third week and healing is well advanced by the sixth week. It is worth to note that any deformity lasting for this long is likely be troublesome.

Table XIII: Duration Since Injury

Weeks	Number
25 – 29	4
30 – 34	7
35 – 39	3
40 – 44	6
45 – 49	18
50 – 54	5
55 – 59	3
60 – 64	3
65 – 69	9
70 – 74	7
75 – 79	9
Total	**74**

Figure 12: Duration since injury



Management protocols

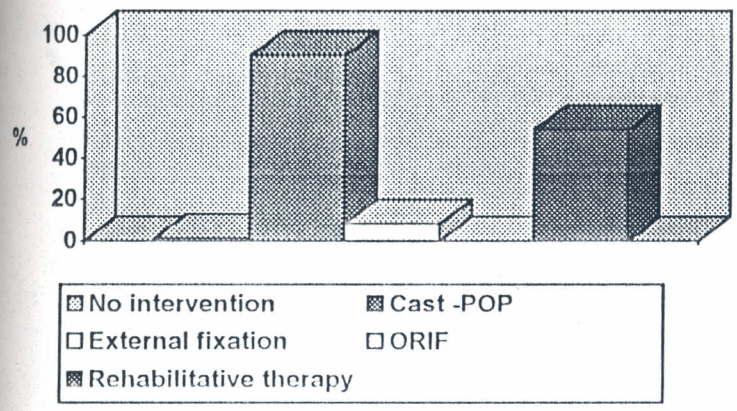
Most patients had plaster of paris cast applied (90.54%). The six patients who underwent external fixation had compound fractures, which had necessitated their admission and subsequent surgical toilet. Only forty patients (54%) had pursued a rehabilitative programme. For the others this programme was either not prescribed or its importance was not emphasized. Of the patients reviewed none underwent open reduction and internal fixation (ORIF) either as an emergency or as an elective procedure. See table XIVa and figure 13 below.

Table XIV(a) :Methods Used in Management of Patients

Method	Number	Percentage
No intervention	1	1.35
Cast -POP	67	90.54
External fixation	6	8.11
O.R.I.F	0	0.00
Rehabilitative therapy	40	54.00

NB: External fixation was done with wires only.

Figure 13:Management protocols



Immobilisation.

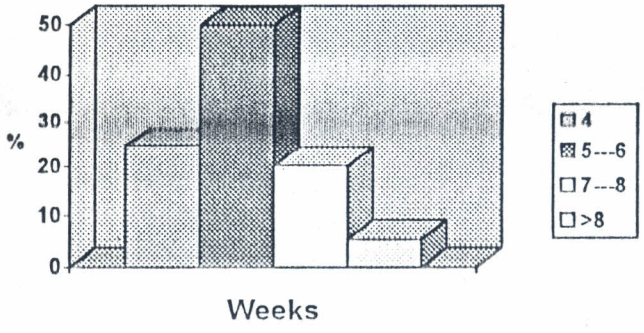
Only eighteen (24.32%) of the patients were immobilised for four weeks or less. The rest of the patients had their casts for a longer period than generally accepted.

See table and figure below.

Table X1V(b): Duration of Immobilization

Weeks	Number	Percentage
4	18	24.32
5--6	37	50.00
7--8	15	20.27
>8	4	5.41
Total	74	100.00

Figure14: Duration of Immobilization



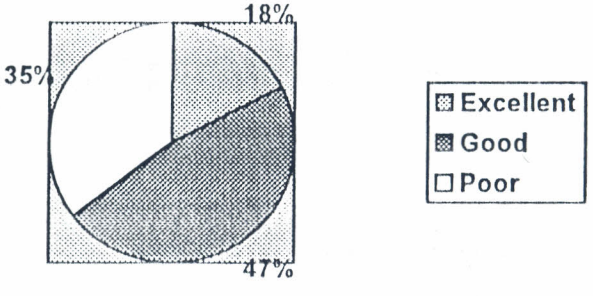
'atient's subjective opinion

'wenty-six patients {35.14%} were not happy about the management sequele. This was also judged 'om the patients complains.

'able XV : Patient's Own View of the Outcome {Subjective opinion}

Patient's view	Number	Percentage
Excellent	13	17.57
Good	35	47.29
Poor	26	35.14
Total	**74**	**100**

Figure15: Subjective opinion



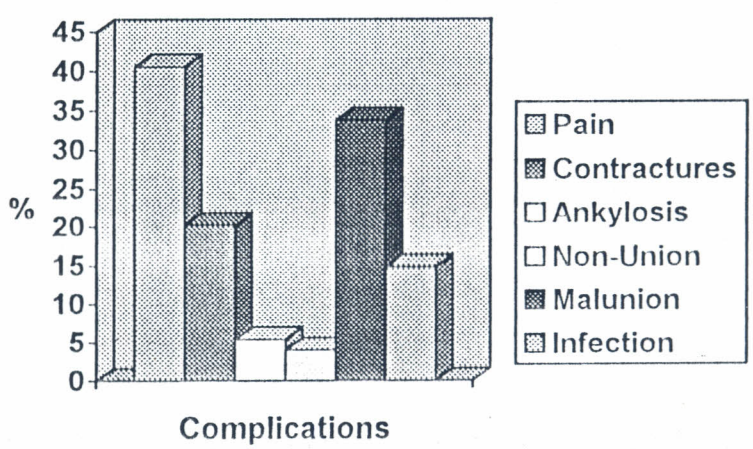
Complications

The most common major complication was the presence of residue pain in 40.54% of the patients followed by various degrees of mal-union in 33.78%. In 14.8% of the patients had persistent infection following compound fractures.See table XVI Aand Figure 16 below.

Table XV1and figure 16): Clinical Examination for Complications (n=74)

Complications (major)	Number	Percentage
Pain	30	40.54
Contractures	15	20.27
Ankylosis	4	5.41
Non-union	3	4.05
Malunion	25	33.78
Infection	11	14.86

Figure 16:Complications



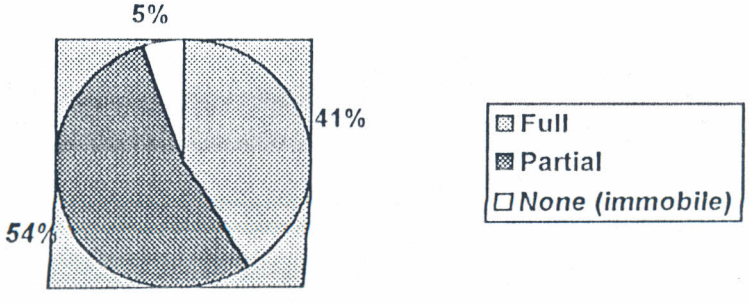
Range of motion

Both extension and flexion of all the fingers were observed or records indicated. Only 30 patients (40.54%) could achieve full range of movements. The others had various degrees of mobility including ankylosis. See the table XVII and figure 17 below.

Table XV11: Joints Range of motion

Range	Number	Percentage
Full	30	40.54
Partial	40	54.05
None (immobile)	4	5.41

Figure 17:Range of motion.



Data on function

a) Dexterity

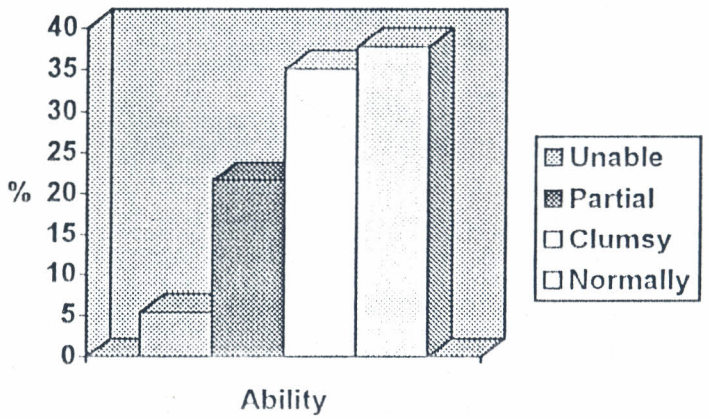
(i) Gross activities e.g. pick up five marbles/pens

Of the patients tested, only 28 (37.84%) were able to pick and hold five marbles pens {Gross pick up} in their injured hand normally. The patients in the clumsy group were able to perform the activity requested e.g. pick up the marbles but after several attempts, they accounted for 35.14%. Sixteen patients (21.62%) could not hold all the five marbles or pens in their hand(s). See table XVIII(a) and figure 18 below.

Table XV111(a): Gross activities.

Ability	Number	Percentage
Unable	4	5.41
Partial	16	21.62
Clumsy	26	35.14
Normally	28	37.84
Total	**74**	**100.00**

Figure 18:Gross functions.



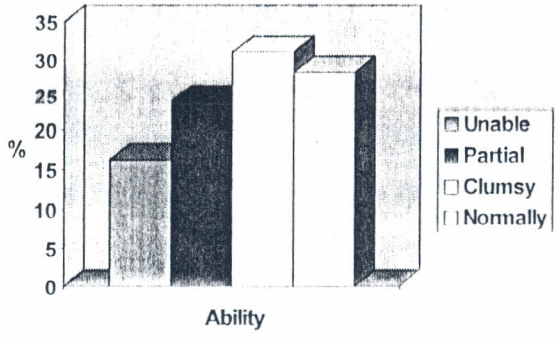
Pinch grip/fine activities e .g . Pick up matches/pins from a flat surface

Twelve patients (16.22%) were completely unable to pick small objects e.g.pins/matches. Only 21 patients (28%) had no problems picking up the matches and hold them in injured hand. Fifty five point four percent had various degrees of difficulty as shown in table XVIII(b) and Figure 19 below.

Table XV111(b) : Fine activities.

Ability	Number	Percentage
Unable	12	16.22
Partial	18	24.32
Clumsy	23	31.08
Normally	21	28.38
Total	**74**	**100.00**

Figure: 19.Pinch function.



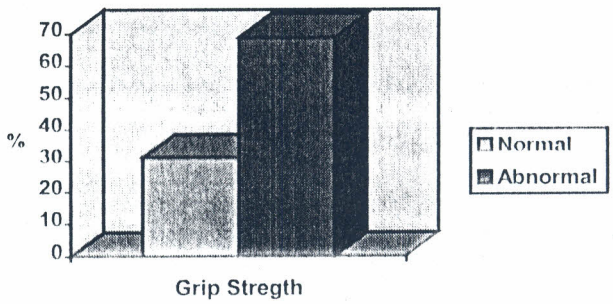
b) Grip strength test

This was tested by the ability of the patient to resist withdrawal of one or two fingers from the grip or brunch the finger tips after a tight fist. Well over half the patients could not develop adequate grip power to resist easy withdrawal of the fingers or brunch their fingertips. This is shown in table XVIII(c) and figure 20 below.

Table XV111(c): Grip strength

Grip strength	Number	Percentage
Normal	23	31.08
Abnormal	51	68.92
Total	74	100.00

Figure 20:Grip Strength.



Radiological reviews

Review of x-rays ordered for the patients who had significant symptoms e.g. pain, infection or severe stiffness. Out of forty-one patients reviewed with x-rays 61% had various degrees of mal-union and 7.98% had persistent infection of bone; four in the distal phalanges, two in the proximal phalanges and one in a metacarpal bone. See table XIX below.

Table XIX:Radiological complications. (n=41)

Features	Number	Percentage
Union	13	31.7
Non-union	3	7.3
Mal-union	25	61.0
Osteomyelitis	7	17.98

DISCUSSION and CONCLUSIONS

EPIDEMIOLOGY- Occurrence

Hand injuries are common as can be alluded from a prevalence of 56.3 per1000 for hand fractures of all new orthopaedic caseload. Two thirds of these patients are managed on an outpatient basis and thus rarely ever meet a specialist in their management. Murphy N.M had found 10-20% of accident and emergency department workload to be due to hand injuries.[3] The patients attending Kenyatta National Hospital, are pre-selected by their ability to pay for medical attention{cheaper at K.N.H.}.

Age

The study showed that all the age groups sustained hand fractures but the majority were in the 3rd and 4th decade of life, with a mean age of 29 years. These groups comprise the most productive work force of any country. These findings correlated well with Okeke et al and Burridge et al findings that the 3rd decade of life is most affected [4,5]. Fifty percent in the study done by Zahrani et al were between 20 and 30 years in Saudi Arabia(6){TableII and figure 1}.

Sex

Males sustained these injuries more often than females, with a male: female ratio of 2.6:1. This may be explained by the fact that men comprise the majority of the work force and are also involved in more violent confrontations,{Table III and figure 2}. This is similar to OKeKe et al findings in Nigeria of a male: female ratio of 3:1 for hands injuries in general [4]. Burridge and Marshall in New Zealand found that men were eight times more prone to hand injuries than women [5]. It is worth to point out that most of the previous investigators quoted in this study looked at hand injuries in general and not just fractures as in this study and thus some of their findings can only be deduced when comparing.

Hand involvement

The right hand is involved more in these injuries because in the majority of people it is the dominant hand with 60.5% of the fractures. It tends to be used more often in warding off attacks, operating machinery and providing support in falls. Okeke et al found 51.7% involvement of the right hand and 6.8% for both hands in hand injuries[4].In this study bilateral fractures occurred in 9.95% as seen in table IV and figure 3.

Causes

The commonest cause of hand fractures seen at Kenyatta National Hospital was found to be due to assault, 37.43%. Work related injuries and road traffic accidents constituted 29.06% and 20.70% respectively. This can be explained as a reflection of the increased crime rate in the catchment area of this hospital especially with the slums surrounding Nairobi city.. Okeke et al found that machine (work related) caused 55.2% of the hand injuries, followed by heavy objects and RTA having 22.4% and 15.5% respectively [4]

Fractures characteristics

Open and closed fractures

There were more open fractures, 55.9% compared to closed fractures, 45.1%. This can be explained by the fact that the bones are relatively subcutaneous and any force that causes a fracture is likely to break the skin cover{Table VI and figure 5}.Okeke et al found the skin to be involved in 98.3% of the cases with hand injuries in general, although over 50% of his patients got those injuries from machines [4]. Burridge and Marshall in their study of work related injuries found 70% open wounds since his commonest cause of work related injuries were cutting or piercing instruments [5].

Distribution of fractures

In this study most of the hands sustained a single fracture, 140 hands (62.73%) followed by double fractures, 22.87% and other multiple fractures in declining frequency {Table VII and figure 6}. This can be explained by the fact that most of the fractures were sustained in assault cases usually in an attempt to ward off an attacker and work related injuries involved machines and home implements that provided small areas of contact with the hand.

Most hands had a single fracture, 140 (39.5%) of the 354 fractures while 51(22.87%) hands had double fractures (Table VII and figure 7). This shows that most injuries involved small forces.

The metacarpal bones sustained 50.85% of the fractures in this study followed by proximal phalanx, 32.20%{Table VIII and figure7}. These bones provide a larger area of contact in an attempt to block an attack or in a road traffic accident. Okeke et al found that the distal phalanx was the most commonly fractured bone, occurring in 40% of hand injuries, followed by the middle phalanx, 27% and, metacarpals the least likely with 22.4%[4]. This is probably due to the difference in the causes of hand fractures in our environment, and exclusion of soft tissue injuries only in this study. Zahrani et al found that the distal phalanx was the most vulnerable in sustaining an industrial hand injury [6].

The fifth metacarpal bone is the most likely to sustain fracture, 31.67% with the fourth metacarpal being the least likely 13.89%{Table IX and figure 8}. Okeke et al found the fifth finger the most likely to be injured in his study, 54.4% of the hand injuries [4], while Zahrani et al found that the index finger was the most likely to get injured, 26% of hand injuries [6]. The difference is probably due to the different groups of causes and levels of injuries studied.

There were 114 proximal phalangeal fractures out of 174 phalangeal fractures. The fourth proximal phalanx was the most likely to be fractured, 28.95% followed by the third and the second with 23.68% and 21.05% respectively. These bones are larger than the 1st and 5th proximal phalanx and are relatively immobile at the metacarpo-phalangeal joints compared to the latter and would thus be more vulnerable to injury {Table. Xa and figure 9a}.

The middle phalanges are the least likely to get injured,they accounted for 10.3% of the phalangeal fractures {Table Xb and figure 9b}. This however, is lower than in Okeke's study where he found a 27.2% involvement in hand injuries although he did not mention how many of these sustained fractures [1].

The distal phalanges provide the most vulnerable targets because of their extreme anatomical position. They account for 24% of phalangeal fractures. The 3rd distal phalanx was the most vulnerable accounting for 47.62% of the distal phalangeal fractures. It is the largest finger with the longest reach, followed by the distal phalanx of the index finger, 23.81%. The other distal phalanges were vulnerable but with less than 30% distal phalangeal fractures between them{Table Xc and figure 9c}. Okeke at al found that the distal phalanges were involved in over 40% of hand injuries although he did not investigate how many of these sustained fractures [4].

Sites of fractures

Most of these fractures occurred in the diaphyseal region, 44.9% followed by distal aspects of the bones, 34.5%. This implies that most of the forces applied to the bones was applied from the distal aspect and may have had a bending component to it resulting to the trend noted. This is also seen when intra-articular involvement is considered with 58.5% involving the distal joint for each bone. (Table XI (a) and XI (b), and figure 10a and 10b).

Pattern of fractures

Most of the metacarpal and phalageal fractures occurred transversely 56.73% as noted in this study. Oblique and comminuted fractures occurred in almost equal frequency. Segmental fractures were 1.13%{Table XII and figure 11}. Thus most of the forces applied had a bending component resulting in transverse fracture, while oblique fracture had an added twisting force to the bending forces. Comminuted fractures are likely to be due to crushing forces associated with heavy or blunt objects or even gunshots.

Duration of immobilisation

From the tableXIV b,fifty percent of the patients were immobilised in a cast for 5-6weeks duration. Four 0f the patients who sustained damage to tendons and had longstanding wounds were immobilised for more than eight weeks. This is a prolonged period of immobilisation bound to result in severe stiffness [16]

Outcome:

Only about a third (36.45%) responded to the recall letters. It is likely that many who didn't respond may have heard excellent results or the letters never got to them in time. The mean period since injury was 54 weeks. Any outcome after a period of six weeks is likely to be permanent.

Management

Most of the patients had plaster of paris cast applied without consideration to the pattern of fracture. Only six patients (8.11%) had reduction and external fixation. None of those who responded recall

letters had open reduction and internal fixation (ORIF). Okeke et al had a ten percent rate of ORIF. [4].Rehabilitation, an integral part of hand injury management was used in 54% of the patients. (Table XIVa). Chemens et al recommends a more aggressive approach. [60].

Patients subjective view

No matter what the clinician's views are, the patients own subjective assessment of the usefulness of their hand in relation to their work and day to day activities. No one knows better than the patients themselves, the order of his acquired handicap. Thus when 35patients(47.29%) are unhappy with their results it calls for a review of management protocols. Compared to Okeke's study, this is slightly worse than their finding of 39.7% poor results. [4].

Complications

Pain on activities was commonly a persistent symptom signifying all was not well. Forty point five four percent of the patients suffered some form of pain. Because of prolonged periods of immobilisation, stiffness affected 37 patients (49%) to various degrees in the patients reviewed. (table XVII)

Mal-union occurred in 25 patients of the 41 patients (61%) of the patients reviewed with x-rays. (Table. XVI, & XIX). The method of immobilisation in the management of these patients (cast-POP) does not assure further non-displacement subsequently before healing occurs. Eleven patients (14.86%) had persistent infection of which seven were chronic osteomyelitis (table XIX) as a sequel

Functional recovery.

Recovery of dexterity of the hand to normal was observed in 28 patients for gross pick-up lost (37.84%) and 21 patients (28.38%) for pinch grip using the injured fingers. Pinch grip function was most affected with 12 patients (16.22%) unable to pick up a matchstick from a flat surface (table XVIIIa&b). Generally the degree of stiffness of the fingers influenced the ability to achieve fine movements of the fingers This results are relatively poorer than Okeke's study[4]. Fifty-one (68.92%) of the patients could not develop a normal grip power for the age, sex and body characteristics (table XVIIIc)

X-Ray reviewed

Radiological characteristics in patients with significant symptoms showed 38 patients (92.68%) achieved union of the fractures although as mentioned previously due to the mode of management 60.98% of them had some degree of malunion (table xix). Only 3 of the patients reviewed had nonunion. These results are likely to be high as a result of bias introduced by patients selection characteristics e.g. only those with a problem are likely to avail themselves for the study.

Proposed outcome classification

Excellent -mild degree of complications

- Normal functional recovery
- Patients satisfaction with outcome

Good -mild to moderate degree of complications

- Mild limitation of function not bothering the patient
- Patients acceptance of the results as good, and acceptable to him or her.

Poor -severe degree of complications

- Moderate to severe limitation of function bothering the patient
- patient unhappy with the result

The high rate of complications e.g. residual pain, malunion and less than 40% normal functional recovery both clinically and radiologically, and the fact that 47% of the patients reviewed were unhappy about their outcome points to the conclusion that our results are no better than in Okeke's study in Nigeria [4]

Conclusions:

Hand injuries occur with significant frequency as can be alluded from the prevalence of hand injuries. Males are affected more frequently than females. Usually in the age 20yrs to 40yrs,

Which is the most productive age group of our workforce resulting significantly in loss of man-hours. Thus its imperative that hand injuries be accorded the necessary attention that they deserve. The right hand is the most frequently involved. Assault plays a major contribution although work related injuries and R.T.A. are equally important. Most hands sustain a single fracture usually involving the metacarpals or proximal phalangeal bones. The distal joints are more susceptible than proximal joints due to their extreme position.

Most fractures occur in a transverse pattern. More than 90% are managed by cast immobilisation for duration longer than four weeks. About two thirds thought their outcome good to excellent although the frequency of complications e.g.. Pain, stiffness and malunion are still very high for referral hospital.

There were limitations in data collection especially in some case files, which contained inadequate basic information. This should not however have been the case. For medical legal reason, more thorough initial recording of the extent of the injuries should have been implemented especially for some of the patients in this study had to be excluded.

There was low admission rate for these patients especially so for patients with closed fractures, even when there were multiple fractures. Probably this was as a result of the low operative intervention normally practice in this institution. Thus establishment of a hand unit would allow for more operative management criteria and thus reflect on the admission rate. The overall outcome of management of fractures of the hand is not satisfactory. Too much reliance is placed on conservative mode of management unlike in more developed countries. It is also clear there is no adequate protocol in place for management of hand injured patients. Also a lot of faith is placed on moonlighting non-surgical residents in the management of these patients

Recommendations:

1. Establish a hand surgery unit at Kenyatta National Hospital or any other hospital.

2. Teach the primary care doctors at Accidents and Emergency unit about the significance of hand injuries and their whole background of causation and management

3. Establish public awareness programmes about hand injuries and governing labour laws that ensure companies establish safety measures in these work places and that workers employed have appropriate knowledge of their working environment by proper training.

4. Establish a prospective study on the management aspects of hand injuries over a longer period of time to see what eventually becomes of these patients.

5. Encourage operative methods of management of these patients by use of plates, screws and other microplating systems.

6. Insisting that every patient receives adequate rehabilitative therapy to enable him / her return to his / her vocation. Occupational hand therapists must receive adequate training on hand therapy and be more innovative especially in the third world.

7. Develop hand assessment charts relevant to our community that are universally used by all hospitals looking after these patients to encourage both proper record keeping and for medical legal aspects of these injuries. Also develop a protocol of management applicable to the existing hierarchy in the medical profession.

References

1 Bunnel, S.
Physiological Reconstruction of a Thumb after Total Loss
Surg. Gynaecology, 52: 245, 1931

2 Kanavel, A. B
Infection of the hand, ed. 7
Philadelphis, Lea and Febiger, 1939

3 Murphy N.M
Applied Hand Anatomy: Its importance in accident and emergency
Archives of Emergency Medicine 9(1): 14-8

4 Okeke L.I, Dogo D., Ladipo J.K
Crush injuries of the hand
African Journal of Medicine and Medical Sciences
22(3):69-72, 1993 September

5 Burridge and Marshall
Work related hand and lower arm injuries in New Zealand, 1979 to 1988
Aust. N.Z Journal of Public Health 1997 Aug.

6 Al Zahrani and Ikran
Predisposing factors to industrial hand injuries in Saudi Arabia
Journal of Hand Surgery (Br) Feb 1997

7. Siegel D B
The boxer's fracture: angulated metacarpal neck fractures of the little finger
Journal of the Southern Orthopaedic Association.
4(1): 32-7, 1995

8. Overton DT, Uchara D T
Evaluation of the injured hand
Emergency Medicine Clinic of North America
11(3): 585-600, 1993 August.

9. Sach R
The Injured Hand
Australian Family Physician. 21(7): 920-4, 927-30, July 1992

10. Martin L I, Gupta A
Hand assessment
Plastic Surgical Nursing 12(3: 89-94, 1992

11. Campbell D A , Kay S.P
The Hand Injury Severity Scoring System
Journal of Hand Surgery – Br. Vol. 21(3): 295-8, 1996 June

12. Neumann K, Langer R
Radiologic skeletal diagnosis: Traumatology of the distal forearm, the wrists and hand German
Aktuelle Radiologie 6(4): 171-5, 1996 July

13. Peter F , Hoffmann R Weidemann H
Traumatic thrombosis of the ulnar artery - German
Unfallchirurg 98(3): 151-3, 1995 March

14. Cziffer E, FarkasJ
Management of Potentially Infected Complex Hand Injuries
Journal of Hand Surgery – Am. Vol 16(5): 832-4, 1991 September

15. Evans R.B
An update on wound management – Review
Hand Clinics 7(3): 409-32, 1991 August

16. Drew P J, Titley OG
Use of antibiotics after complex open hand Injury.

17. Chen S H, Wei F C, Cheu H C
Emergency free flap transfer for reconstruction of acute complex extremity wounds
Plastic and Reconstructive Surgery 89(5): 882-8; Discussion 889-90, 1992 May

18. Lee W. P, May J W Jr.
Neurosensory free flaps to the hand: Indications and donor selection
Hand Clinics 8(3): 465-77, 1992 August

19. Rinaldi E
Autografts in the treatment of osseous defects in the forearm and hand
Journal of Hand Surgery - Am. vol. 12(2): 282-6, 1987 March

20. Miller DS
Medical management of pain for early motion in hand and wrist surgery
Hand Clinics 12(1): 139-47, 1996 February

21. Melzack R
The Tragedy of Needles Pain

22. Duncan R M
Basic Principles of Splinting the Hand
Physical therapy 69(12): 1104-16, 1989 December

23. Leibovic S J
Internal fixation sets for use in the hand. A comparison of available instrumentation (review)
Hand Clinics 13(4): 531-40, 1997 November

24. Kumta S M , Spinner R, Loung Pc
Absorbable Intramedullary Implants for Hand Fractures
Journal of Bone and Joint Surgery Br. Vol - 74(4): 563-6, 1992 July

25. Wang S M
Use of the hand splint
Chinese Journal of Nursing, 22(7): 307, 1987 July

26. Sorensen J S, Freund K G, Kejla G
Functional fracture bracing in metacarpal fractures
Journal of Hand Therapy 6 (4): 263-5, 1993 October -December

27. Ford D J
Fractures of the 5th Metacarrpal Neck
Journal of Hand Surgery - Br. vol. 14(2): 165-7, 1989 May

28. Broddam M, Hansen T B
Subcapital fractures of the 4th and 5th metacarpals treated without splinting and reposition
Scandinavian Journal of Plastic and Reconstructive Surgery and Hand Surgery
29(3): 269-70, 1995 September

29. Vichard P, Tropet Y, Nicolet f
Longitudinal pinning of fractures of the base of the 1st metacarpal
Ann Chiv Main 1982

30. Nonnenmacher J
Osteosynthesis of fractures of the base of the 1st MC by an external fixator
Ann Chir Main 1983

31. Livesley P J
The Conservative Management of Bennett's Fracture- dislocations; a 26 year follow-up
Journal of Hand Surgery - Br Vol. 15(3); 291-4, 1990 August

32. Frere G, Hoel G, Moutet F
Fractures of the 5th Metacarpal Neck
Ann Chir Maui 1982

33. Carroll R E, Carlson E
Diagnosis and treatment of injury to the 2nd and 3rd carpometacarpal joints
Journal of Hand Surgery - Am Vol 14 (1): 102-7, 1989

34. Korr H D
Hamate - Metacarpal fracture dislocation
Journal of Emergency Medicine
10(5): 565-8, 1992 September-October

35. Widgerow A D, Edinburg M. Biddulph S L
An analysis of proximal phalangeal fractures
Journal of hand Surgery - Am vol 12(1): 134-9, 1987 January

36. Pun W K, Chow S P, So YC, Luk KD
Unstable phalangeal fractures
Journal of Hand Surgery - Am. vol 16(1): 113-7, 1991

37. Baratz M E, Divelbiss B
Fixation of phalangeal fractures
Hand Clinics. Review Article 1997 November

38. Wolfe S W
Articular fractures of the hand: Guidelines for Management
Orthopaedic Review. 20 (2) 123-8 1991 February

39. Buchler U Fischer T
Use of a minicondylar plate for metacarpal and phalangeal periarticular injuries
Clinical Orthopaedics and Related Research
(214): 53-8, 1987

40. Schnebel B E, Flesher D, Garcia-Moral C A
Isolated traumatic avulsion of the flexor digitorum sublimis
American Journal of Sports Medicine 17(5): 692-4, 1989

41. Bischoff R, Buechlor U, De Roche R
Clinical results of tension band fixation of avulsion fractures of the hand
Journal of Hand Surgery - Am vol 19(6): 1019-26, 1994 November

42. Schaller P, Geldmacher J
Rupture of the palmar plate - Conservative or surgical therapy (German)
Handchimirgie, Microchirurgie, Plastische Chirurgie
21 (6): 322-7, 1989, November

43. Fahmy N R
The stockport serpentine spring system for the treatment of displaced communited intra-articular phalangeal fractures.
Journal of Hand Surgery - Br vol 15(3): 303-11, 1990

44. Dacruz D J, Slade R J, Malone W
Fracture of the distal phalanges
Journal of Hand Surgery - Br vol 13(3): 350-2, 1988 August

45. Torne B A
Epiphyseal injuries in the small joints of the hand
Hand Clinics 4(1): 113-21, 1988 February

46. ACS G, Molnar L, Zaborszky Z
Hand fractures and epiphyseal injuries in childhood (Hungarian)
Orvosi Hetilap 133(27): 1705-9, 1992 July 5

47. Light T R, Ogden J A
Metarcarpal Ephiphyseal fractures
Journal of Hand Surgery - Am vol 12(3): 460-4, 1987

48. Banerjee A
Irreducible distal phalangeal epiphyseal injuries
Journal of Hand Surgery
Br Vol. 17(3) 337-8, 1992

49. Waters P M, Benson L S
Dislocation of the distal phalanx epiphysis in toddlers
Journal of Hand Surgery - Am Vol 18(4): 581-5, 1993 July

50. Nimkin K, Spevak M R, Kleinman P K
Fractures of the hands and foot in child abuse:
Imaging and Pathologic Features
Radiology 203(1): 233-6, 1997 April

51. Sagi A, Amir A, Fliss D M, Ozi s
Combined thermal and crush injury to the hand and fingers
Burns 23(2): 176-81, 1997 March

52. Condamine J L
The role of vascular microsurgery in trauma of the hand
Phlebologie 42 (2): 245-9, 1989 April-June

53. Wheatley M J, Swift R
Successful hand revascularization with Urokinase following a crush injury
Annals of Plastic Surgery 39(1): 94-6, 1997 July

54. Sloan E P
Nerve injuries in the hand - Review
Emergency Medicine Clinics of North America
11(3): 651-70, 1993 August

55. Ogo K
Does the nailbed really Regenerate?
Plastic and Reconstructive Surgery 80(3): 445-7, 1987

56. Gibeautt J D, Saba P, Hoenecke H
The Sesamoids of the MC joint of the thumb ; an Anatomical and clinical study
Journal of Hand Surgery - Br vol 14(2): 244-7, 1989

57. Kjaer - Petersen K, Andersen K
Combined basal metacarpal fracture and ligament injury of the metacarpophalangeal joint of the thumb
Journal of Bone and Joint Surgery -

Br Vol 73(1): 176-7, 1991 January

58. Harryman DT. 2d, Jordan TF 3d
Physeal phalangeal fracture with flexor tendon entrapment. CASE report and Review of Literature
Clinical Orthopaedics and Related Research
(250): 194-6, 1990 January

59. Naani N H
Intratendinous rupture of the flexor digitorum profundus tendons in zones II and III
Journal of Hand Surgery - Am, vol 20 (3): 478-83, 1995

60. Johnson R K
The role of psychological evaluation in occupational hand injuries - Review
Occupational Medicine 4(3): 405-18, 1989

61. Didierjean A, Foucher G
Psychoanalysis in hand surgery. Psychological impact of accidents - French
Soins - chirurgie (123): 39-40, 1991

62. Chemens S, Foss- Campbell B
Rehabilitation following traumatic hand injury: hand therapists Perspective. Part I: Acute phase of hand rehabilitation, and Part II: later phase of hand rehabilitation.
Plastic Surgical Nursing 13(3): 129-39, 1993

63. Crosby C A, Wehbe M A
Early motion protocols in hand and wrist rehabilitation
Hand Clinics 12(1): 31-41, 1996

64. Dovelle S, Heeter P K
The Washington Regimen; Rehabilitation of the hand following flexor tendon injuries - Review
Physical Therapy. 69(12): 1034-40, 1989 December

65. Putman M D
Posttraumatic stiffness in the hand - Review
Clinical Orthopaedics and Related Research (327): 182-90, 1996

66. Adam R, Castagnetti C, Landi A
Degloving Injuries of the Hand and Fingers
Clinical Orthopaedics and Related Research
314: 19-25, 1995 May

67. Brenner P
Timing of free microsurgical tissue transfer for the acute phase of hand injuries
Scandinavian Journal of Plastic Surgery. 31(2) 165-70, 1997 June

68. Naucarrons J D, Rai S S, Sterne G D
The natural history of cold intolerance of the hand.
Injury 27(9): 607-11, 1996 November

69. Campbell D A, Kay S P
What is cold intolerance
Journal of Hand surgery – Br Vol. 23 (1) 3-5 1998

70. Sweeney J, Harnes A
Resistant mechanical allodynia following injury of the hand: Treatment through mobilization of the nervous system
Journal of Hand Therapy 9(4); 328-38, 1996

71. Mcclinton M A, Helgemo S L Jr.
Infection in the presence of skeletal fixation in the upper extremity (Review)
Hand Clinics 13(4): 745-60, 1997 November

72. Tsukayama D T
Pathophysiology of Posttraumatic esteomyelitis (Review)
Clinical orthopedics and Related Research. (360) 22-9 1999

73. Anonymous
Flexor digitorum profundus common to thumb and index finger, associated with a post-traumatic distal adherence of both tendons
Journal of Hand Surgery- Br Vol. 13(1): 72-4, 1988

74. Ward D J, Hudson I, Jeffs J V
Beau's lines following hand trauma.
Journal of Hand Surgery -Br. Vol 13(4): 411-4, 1988

75. Muramatsu K, Kawai S, Akino T
Treatment of chronic regional pain syndrome using manipulation therapy and regional anaesthesia
Journal of Trauma 44 (1): 189-92, 1998

76. Chokshi B V, Lees, Wolfe S W
Recurrent compartment syndrome of the hand: A case report
Journal of Hand Surgery – Am. Vol. 23(1): 66-9 1998 January

QUESTIONNAIRE

Proforma Questionnaire-Data from files and X-ray records

1. Code..... Date by month.....

2. Sex
   1. Male
   2. Female ☐

3. Age in years ☐☐

4. Hand(s) injured

   1. R+ ☐

2. L+

3. Both

5. Cause:

   1. RTA ☐

2. Assault

3. Work related

4. Others

6. Open or closed Fracture
   1. Open
   2. Closed ☐

7 **X-Ray Films**

Bones	Sites	Pattern	Joints involved

PATIENT REVIEW QUESTIONNAIRE

Review code

[ ]

1. Time since injury in weeks [ ][ ]

2(a). Mode of management accorded [ ]
   1. None
   2. Cast-PoP
   3. Open reduction and internal fixation
   4. Rehabilitation-Physiotherapy

(b) Duration of immobilisation (weeks) [ ][ ]

3. Patients view of outcome [ ]
   1. Excellent
   2. Good
   3. Poor

4. Clinical assessment-Complications [ ]
   1. Pain
   2. Stiffness
   3. Scarring/Contracture
   4. Ankylosis
   5. Non-union
   6. Malunion
   7. Infection (osteomyelitis)
   8. Others (specify)_____

5. Joint range of motion-Finger(s) injured [ ]
   1. Full range (normal)
   2. Partial
   3. Immobile

6. Investigators assessment of function-use grading below

a).Gross pick-up e.g. 5 marbles/pens

0. Unable to perform task
1. Complete task partially
2. Complete task but clumsy
3. Perform task normally

☐

b).Fine pick-up e.g.5 matches/pins

0. Unable to perform task
1. Complete task partially
2 Complete task but clumsy
3. Perform task normally

☐

c) Grip strength

1. Normal
2. Abnormal

☐

7. X-ray review

1. Union
3. Malunion
4. Osteomylities

☐

Dr. J.M. Wanjohi
Orthopaedic Clinic
Kenyatta National Hospital

Date: _____

Mr./Mrs./Miss._____

RE: EVALUATION OF OUTCOME/ CONSENT

As part of my thesis, I'm carrying a study on the outcome of fractures of the hand that were seen and managed at Kenyatta National Hospital from January 1999 to December 1999.

I would appreciate if you could avail yourself at clinic No.5 on _____ for your inclusion into this study. Please bring this letter with you having signed below as consent to be included in the study.

Your response will be highly appreciated.

Client's signature _____

DR. WANJOHI