Original Research Paper

Volume - 11 | Issue - 08 | August - 2021 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Orthopaedics

"FRACTURES OF METACARPALS & PHALANGES IN HAND, MANAGEMENT WITH UMEX (Universal Mini External Fixator) IN DEPARTMENT OF ORTHOPEDICS AT PSIMS & RF"

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ABSTRACT Fractures of metacarpals and phalanges are the most common fractures of upper extremity and account for about 10% of total such cases. The outer rays of the hand are most commonly injured. The incidence of metacarpal and phalangeal fractures is most common in males and peaks at the age of 10-40 years.

Objectives:

1. To study the effectiveness of fixator.
2. To study the functional outcome of injuries after management by Universal mini external fixator.
3. To study the complications associated with their management.

Methodology: From March 2018 to December 2019, a total of 30 patients with 38 fractures of metacarpal and phalanges of hand were treated with Universal mini external fixator, followed up and evaluated based on fracture healing with follow up X- rays, Range of movements, and Soft tissue healing in case of open fractures.

Results: Most of the cases (60%) were followed up for 6 months. The mean follow up period was 34.2 weeks (SD=7.50).The Mean fracture healing is 13.04 weeks (SD=3.57).The Mean soft tissue healing is 15.8 days (SD=6.23).Functional outcome Was Excellent in 31.58%,Good in 42.11%,Fair in 21.05%.Poor in 5.26%.

Conclusion: UMEX method is not an alternative to established methods of management of small bone fracture but is an additional and useful tool in management of small bone fractures of hand.

KEYWORDS : Hand fractures, UMEX-universal mini external fixator, metacarpals, phalanges

MATERIAL AND METHODS:

Source Of Data:

The study will be conducted on all patients of fractures of hand fulfilling the inclusion criteria in the both in-patients and outpatient, in The Department of Orthopedics, Pinnamaneni Institute of Medical Sciences and Research foundation, Gannavaram, Krishna(D), Chinna Avutapalli, Andhra Pradesh, India, 521286, From March 2018 to December 2019.

Sample size – 30.

Type Of Study: Cohort study.

Inclusion Criteria:

1. Patients in the Age group of 10 years to 60 years.
2. Unstable fractures of hand.
3. Intra articular fractures and Juxtra-articular fractures.
4. Open fractures.
5. Multiple fractures.
6. Patients who have given their written informed consent for the procedure.

Exclusion Criteria:

1. Severely crushed hand injuries.
2. Fractures associated with Tendon injuries.
3. Fractures with associated Neurovascular injuries.

Statistical Analysis:

The data is analysed with Proportion, Mean, Standard deviation.

Method And Collection Of Data:

Method :

Since most of the fractures of hand are caused by road traffic accidents, makes it imperative to assess both the fracture and the patient as whole. In our study a treatment protocol with the priority list was followed.

Priority I:

A patient sustaining a fracture of hand is likely to have multiple fractures involving major long bones resulting in shock either, hypovolemic or neurogenic which takes the "first priority. Shock was combated with fresh blood transfusion, intravenous plasma expanders and intravenous fluids. Once the cardiopulmonary status was stable, the next step in the treatment protocol was carried out.

Priority II:

Assessment of injury/Chemo-immuno prophylaxis. Assessment of the injury was done by grading the open injuries of hand into two grades as per **Swanson et al**[1].

Type I:

Clean wound without significant contamination or delay in treatment.

No significant systemic illness.

Type II:

(Any one or more of the following) Contamination with gross dirt/debris Delay in treatment longer than 24 hrs. Significant systemic illness.

Both open and closed injuries were examined meticulously for injury to adjacent tendons, nerves and blood vessels. Peripheral circulation was assessed by noting colour, temperature, capillary filling and patency of collateral circulation by Allen's test.

Radiography were taken in two views as antero-posterior(AP) and Oblique(OBL) and if necessary Lateral(LAT)views. The level and pattern of fracture, amount of displacement and angulation were noted. Radiography of other parts were taken when indicated for associated injury.

Pain was alleviated by analgesics. Broad spectrum antibiotics and Anti tetanus prophylaxis were started in case of open injuries.

Priority III - UMEX application:

Once the patients general condition was stable, patient was taken for UMEX fixator application. A thorough debridement of the wound was

done in open injuries. The desired pin placement and frame configuration was decided first depending on the fracture pattern. Pin placement was chosen as per the safe zones and also to facilitate subsequent dressing changes in open injuries.

Pins were inserted directly using a hand drill or power drill with slow speed. Skin and fascia were incised prior to pin insertion. The clamps and side rods were applied. The distractor / compression device was applied and compression or distraction at the fracture site which ever is necessary was done and the fracture reduced. The frame was then tightened.

In case of intra-articular fracture, we follow the principle of ligamentotaxis.

Check x-rays of hand AP& Oblique views were taken to study the reduction.Post operatively the limb was elevated to reduce oedema. In case of open injuries, the wound was dressed daily. Pin sites were cleaned daily with spirit and betadine solution. Sterile gauge pieces soaked in betadine solution were placed around pin sites. Active and passive movements of the joints proximal and distal to the fixator were carried out.

Priority IV : Rehabilitation :
Active and passive movements of the joints proximal and distal to the fracture were continued. After about 3 weeks, a radiological examination followed by removal of critical connecting rods and clinically testing for union. If there is no abnormal mobility or undue pain the frame was removed. If there is excruciating pain and abnormal motion at the fracture site, the frame is re-applied. The test is repeated next week and the frame is removed depending upon presence of pain and abnormal mobility.

Associated injuries were treated simultaneously and the patient was followed regularly for a further period of about 1 year.

Priority V: Recording of results:
The maximum follow-up in this study was about 54 weeks and minimum was 17 weeks. The majority of cases were followed upto 6 months. The complications such as pintract infection, pin loosening, joint stiffness, malunion, osteomyelitis were looked for and noted.

Functional assessment was done based on total active range of movements in degrees of each injured finger separately according to **Duncan et al[2].** This adds the active flexion of metacarpophalangeal, Proximal interphalangeal and distal interphalangeal joints, then subtracting the sum of extension deficits of these three joints.

Functional assessment based on total active range of movements in degrees of each injured finger separately according to Duncan et al[2].

Fingers	Thumb	Result
220-260	120-140	Excellent
180-220	100-120	Good
130-180	70-100	Fair
<130	<70	Poor

ANALYSIS OF DATA
Table 1: Demographic Data

Parameter	n	mean	Std Dev	Min	Max
Age	30	32.97	10.41	14	58

Table 2: Distribution Based On The Age Group

Parameter	Number	Percentage
1-10	0	0
11-20	2	6.67
21-30	11	36.67
31-40	10	33.33
41-50	6	20
51-60	1	3.33
Grand total	30	100

- Most of the patients (69%) were in the age group between 21-40 yrs. The youngest was 14 years old whereas the oldest one was 58 years old. The average age of the patient was 32.97±10.41years. Good outcome is significantly associated with younger age group with P=0.046.
- In our study, 90% cases were males and 10% cases were females. Inference: Good outcome is associated with male group with P=0.038. Most of the patients were worker by occupation - 40%. Most of the cases came with RTA (40%) followed by Industrial accidents (30%) and Agricultural accidents (16.67%).
- 26.67 % of the patients had associated injuries involving the other systems or other bones

Table 3: Distribution Based On The Incidence In Dominant / non Dominant Hand.

Parameter	Number	Percentage
Dominant (Right)	20	66.67
Non-Dominant (Left)	10	33.33
Grand Total	30	100

Most of the fractures occurred in the Dominant hand (66.67%).

55.26% of cases had proximal phalanx fractures, metacarpal (34.21%), middle phalanx (10.55%), were seen.

Out of the 38 fractures, 21 of them were involving shaft of the small bone, 10 fractures were Juxta articular and another 7 were involving in the intraarticular joint surface.

Most of the fractures are comminuted around 51.53%.
Inference:
Good outcome was strongly associated with shaft and juxta-articular fractures with P=0.033.

Most of the open fracture were Type II comprising 60%.

86.67% of the cases were operated within 1st 3days, 13.33% were operated between 4 to 7 days after injury. Inference: Good outcome is strongly associated with cases operated with in 3 days with P=0.022.

Out of the 10 open fractures soft tissue healing occurred in first two weeks in 50% cases. In most of the fractures radiological union occurred within 12 weeks (52.63%).

Most of the cases were followed up for a minimum of 6 months. The mean follow-up period was of 34.2 ± 7.50 weeks.

Duration of UMEX fixator in situ was 5-6 weeks in 63.33% of the cases, 3-4 weeks in 33.33% cases whereas in one patient it was found 6-8 weeks. Mean duration of UMEX application was 4.42 ± 0.70 weeks.

Complications:
5 cases had minor pin tract infection and 3 among them pin loosening. 10 cases had partial stiffness. One patient of epiphysis develops osteomyelitis. One case which was compound comminuted proximal phalanx right thumb with bone loss went for nonunion.

Inference:
Good outcome is strongly associated with Closed fractures compared with Open fractures with P=0.038.

RESULTS
Table 4: Final Results

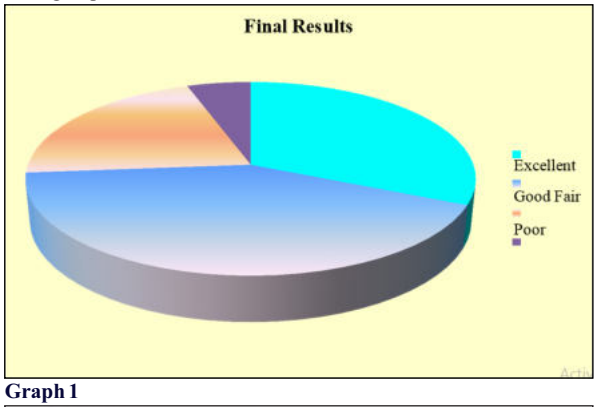
Parameter	Number	Percentage
Excellent	12	31.58
Good	16	42.11
Fair	8	21.05
Poor	2	5.26
Grand Total	38	100

The results were found to be excellent in 31.58 %. Good in 42.11 % cases, Fair in 21.05 %, whereas poor results were seen in 5.26 % of fractures.

Statistical Methods:
Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance.

The following assumptions on data is made, **Assumptions: 1.** Dependent variables should be normally distributed, 2. Samples drawn from the population should be random, Cases of the samples should be independent.

Student "t" test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale within each group. Chi-square/Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.



Graph 1

Picture 1. Instrumentation Of Umexclinical Photographs Of Cases In This Study

CLINICAL PHOTOGRAPHS OF CASES IN THIS STUDY
Case -1. Comminuted fracture of 5th metacarpal

Pre op x-rays AP VIEW **OBLIQUE VIEW**

Post –op x-ray showing **Post-op reduction of fracture fragments**

At 4 weeks, extension **flexion**

Implant removed after 1 month **After 6 months**

Case-2 : Open Comminuted Fracture Of Proximal Phalanx Of Index Finger
Pre-op

Pre-op x-rays


Post-op Post-op x-ray


Implant removed at 4 weeks After 4 weeks

Case-3: Comminuted Fracture Base Of Proximal Phalanx Of 5th And Fracture Base Of 5th Metacarpal.


PRE-OP PRE-OP X-RAY


POST-OP POST-OP X-RAY


AT 4 WEEKS IMPLANT REMOVED AFTER 4 WEEKS

Case-4 Comminuted Fracture Of Proximal Phalanx Of Rt Hand Middle Finger.


Pre-op AP VIEW Pre-op OBLIQUE VIEW


POST –OP X-RAYS

AFTER 4 WEEKS X-RAY SHOWING Of Callus Formation Around Fracture

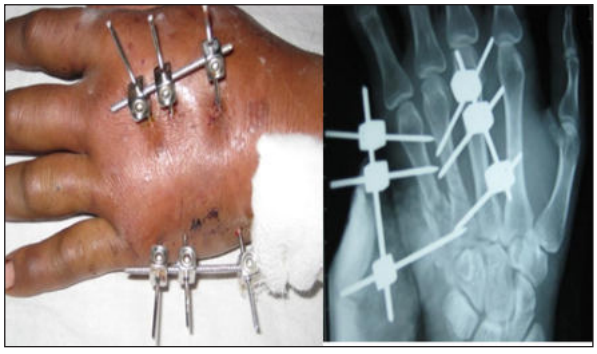



After Implant Removal

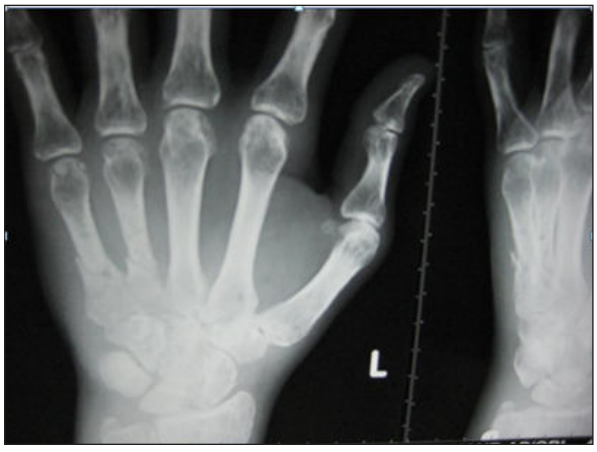
After Implant Removal, Extension And Flexion Of Fingers


Case5: Comminuted Juxta-articular Fracture Of Lt 4th And 5th Metacarpal Base.

Pre-op x-ray



Immediate post-op **Post-op x-Ray**



After Implant Removal At 4weeks 8days.

DISCUSSION

It must be emphasized that this study is only short term follow-up of maximum of about 54 weeks and the mean follow up of 34.2 weeks and therefore, the discussion that follows is essentially a preliminary assessment.

The aim of this study is to evaluate the results of UMEX fixator in fractures of phalangeal and metacarpals in hand particularly open fractures, intra-articular fractures unstable fractures and multiple fractures.

Most phalangeal and metacarpal fractures are treated conservatively. Patients with unstable fractures require operative reduction and stabilisation to obtain the optimal position for bone healing and to allow early movement. In all our cases, the fractures were either open or involving the joint surface or multiple fractures which were difficult to manage conservatively. So we have used UMEX fixation technique to tackle the above fractures as well as to avoid any additional injury to the bone and soft tissues.

From March 2018 to December 2019, we treated 30 patients with 25 phalangeal and 13 metacarpal fractures by external mini fixation using UMEX fixator and includes patients ranging from 10 yrs to 60 yrs. The maximum incidence of fractures was between 21 - 40 yrs. and mean age was 32.97 yrs.

Drenth and **Klasen**[3] studied 33 patients with 29 phalangeal and seven metacarpal fractures by external fixation using a mini-Hoffman device. Their mean age was 35 yrs. (15-69).

Pritsch &Engel[4] studied 36 metacarpal fractures with a method of external fixation

Using Kirschner wires bonded with acrylic resin. Most of the patient were young men between 20 -30 yrs old, the youngest patient was 12 years and oldest is 52 years.

The incidence of fractures in our study were more common in males (90%) and this rightly corresponds to the risk of ambulant life led by males.

In **Drenth** and **Klasen** series of 33 patients, 27 were men and 6 were women.

In 66.67% of the cases, the dominant hand was involved in our study as compared to **Drenth & Klasen** study only 30% involved the dominant hand.

The mode of injury out of 30 patients, 12 patients had sustained injury due to road traffic accident amounting to 40% followed by Industrial accident like fall of machinery leading to crushing of hands in 9 patients (30%), injuries in agricultural fields in 5 patients (16.67%), assault in 2 patients (6.67%).

In, **Drenth** and **Klasen** studies most had blunt injury; 9 were caused by RTA (27%). 9 were by machinery (27%), 10 were falling or cutting objects (30%).

In our study associated injuries were seen in 8 patients (26.66%). 4 patients had long bone fractures and other patients had injuries involving other systems like chest injuries (II &III Rib fracture) and one head injury. In all this patients most of the fractures of the phalanges and metacarpals were seen in the dominant hand.

Associated injuries are considered because their coincidence delays the timing of surgery. In case of head injury the surgical procedure was delayed till the patient recovered from head injury.

The open fractures were classified according to **Swanson et al. Gustillo's** classification of open fractures and its subsequent modifications has been widely accepted by orthopedic surgeons. After reviewing a large series of patients having hand fractures, **Swanson** and **Coworkers** concluded that Gustillo's classifications is not readily applicable to open fractures in the hand. Because their study indicated that key factors influencing an increased likelihood of infection were wound contamination, delay in treatment longer than 24 hrs and systemic illness, they offered a separate classification for open fractures.

Swanson et al[1] Classification for open fractures of hand:

Type I - Clean wound without significant contamination or delay in treatment. No significant systemic illness.

Type II - Contamination with gross dirt/debris Delay in treatment longer than 24 hours Significant systemic illness including diabetes.

In our study, by following **Swanson et al** Classification there were 4 cases of Type I (13.33%) and 6 cases of Type II (20%). No injury with vascular impairment was noted.

In **Drenth and Klasen** study, there were 27 open fractures , 25 of them were with severe soft tissue injuries in out of 36 fractures, and in 12 cases partial or completely divided tendon injury was noted.

In our study, out of the 10 open fractures most of them involved proximal phalanx.

Two cases had severe soft tissue injury and one among them had bone loss. Most of the fractures involved proximal phalanx-21out of 38 fractures (55.26%) followed by 13 metacarpal fractures(34.21%)and middle phalanx of 4(10.55%). We have not treated any distal phalanx fractures.

In **Drenth & Klasen** studies constituted 21 proximal fractures, 8 middle phalanx fractures and 7 metacarpal fractures. No cases of distal phalanx were managed by them.

The pattern of fractures was studied with X-ray's in both Antero-posterior and Oblique views. In some cases, oblique view was specially asked for better study of fracture pattern.

The site of fractures in our study, mainly involved shaft of the bone in 55.26% of the cases, 18.42% of intra articular and another 26.32% of juxta articular fractures.

In 21 fractures involving the shaft, most of them were comminuted and short oblique fractures (63.45%) and another 12.55% were intra-articular fractures and 24% were juxta-articular and transverse type fractures.

Out of the 5 juxta articular fractures one were epiphyseal injury and out of 5 intra articular fractures 50% of them were unicondylar.

In **Drenth & Klasen** studies, 25 fractures were Comminuted, 6 were transverse 3 were oblique and 2 intra articular fracture.

In our institution, we planned UMEX fixation as an emergency procedure and it was done in most of the cases on the day the patient was seen. Most of the cases were operated within first 3 days (86.67%), 13.33% of cases in 4 - 7 days following trauma.

The delay in treatment in last group is because of late reporting or associated injuries which delayed the treatment plan.

Those cases which have operated after 5 days especially open injuries had developed complications like delay in soft tissue healing, Pintract infection, decreased range of movements ultimately resulting in poor results.

In most of the cases smooth K-wires were used. Trocar tipped K-wires (four angled facets) were preferred over the diamond tipped wire (two angled facets) because better holding power of trocar tipped wires.

Usually 2 wires were placed in each fragment in most of the fractures which had enough space for passing 2 wires. Most of the juxta articular and intra articular only one pin in each fragment was used and enough stability was obtained. In joint spanning frames, 2 pins were used in each fragment more often.

K-wires drilling has a propensity to cause thermal necrosis, therefore they were best inserted at slow drilling speeds using power or hand drill.

Dr.B.B.Joshi and associates[5] used sharp, trocar tipped K-wires in their study and they have showed the usefulness of drilling trocar tipped K-wires in tough cortical bone and preferred two pins in each fragment.

Drenth & Klasen have used threaded pins for his mini-Hoffman frames which were pre-bent to 40 - 60° to prevent interference of the other finger movements.

Jacquet has used threaded pins for his external mini fixator, so also **Gary M Lonne and Robert E Lins,** who have used Jacquet external mini fixator for static external fixation in the hand and carpus.

To protect the soft tissues, wires should be placed dorsal to the mid lateral line to avoid damage to the neurovascular bundles and flexor sheaths. Some authors have objected to the use of external fixation because of the dorsal fixation of the extensor hood which hinders active movement and predisposes to permanent adhesions. Some advocates of external fixation have also acknowledged that there is limitation of movement whereas others claim that extensor tethering is not a problem.

Halliwell[5] has shown that a dorsal placement of pin caused less mean reduction in the amount of flexion of proximal interphalangeal joints than the lateral (10 'O' clock position).

In our study we have followed the safe zones advised by **Dr. B.B.Joshi & associates** [4] and our soft tissue complications due to pin placement were negligible. We have used dorsolateral K-wires at proximal and middle phalanges which may impale the lateral band or oblique retinacular ligament, but this structure recover their function after removal of the frame and transverse wires were used for border figures in which neurovascular bundles lie anterolaterally. In metacarpals we used dorsal or dorsolateral pins by taking care to avoid superficial veins which are easily moved away with the lax overlying skin. Extensor tendons must be identified and the wires passed on one or the other side of the tendon without transfixing them.

In our study the bulk of the cases involved the proximal phalanx and the proximal interphalangeal joint confirming the experience of other studies. In these we have used dorso oblique frames. In fractures of middle phalanx unilateral or coplanar frames were used.

In juxta articular and intraarticular fractures, we utilized Vidal's principle of ligamentotaxis to provide reduction and this has been reported to provide good results by many authors. In one case of compound proximal phalanx fracture left thumb with bone loss, we have used biplanar frame.

Reinforcement of the assembly was achieved in most of the cases by adding another connecting rod parallel to the first

Most of the soft tissue injuries healed in the first 2 weeks (50.33%), 43.33% of the cases healed in 3-4 weeks and 6.33% after 4 weeks. The average soft tissue healing was 2.32 weeks. Soft tissue healing was delayed in cases where there was delay in treatment, multiple fractures and open fracture associated with severe soft tissue injury.

The fractures were considered clinically united when there was no pain or motion at the fracture site when stress was applied. In most of the cases UMEX fixator was removed once clinical union was achieved. UMEX fixator was removed in minor O.T. or dressing room without any anesthesia except in children and apprehensive patients in whom the fixator was removed under sedation (midazolam).

In our study fixator was removed in 63.33% of the cases during 5-6 weeks, 33.33% in 3-4 weeks and 3.33% in 6-8 weeks. The mean duration of UMEX fixation in situ was 4.42 weeks.

The fixator was removed early in transverse fractures as compared to comminuted fractures and intra-articular fracture because to avoid the chances of collapse of fragments.

When correlation co-efficient test was applied between age of the patient and UMEX in situ in 10% of the cases, it was found that there is partial positive correlation between age and UMEX in situ.

In **Drenth & Klasen** studies, the fixator device had been removed at a mean 5.8 weeks after a phalangeal fracture (3-11Wks) and 6.1 weeks after a metacarpal fracture (2-12) weeks.

Most the fractures were followed up for a minimum of 6 months (56%). The longest follow up was for a case compound fracture proximal phalanx of Lt thumb with juxta-articular extension with bone loss was 54 weeks, which went for non union. The mean follow up period was 34.2 weeks. Around 13% of the patients were followed up <24 weeks because of loss of follow up of patients.

In **Drenth & Klasen**[3] studies, mean period of treatment of phalangeal fractures was 7 months and metacarpal fractures was five months. The mean follow up was 4.4 yrs.

Fracture healing occurred in most of the cases with in 12 weeks totaling to 52.63%. Healing took more than 20 weeks in case which had multiple fractures delay in surgery timing and in old patient. The mean fracture healing in our study was 13.0467 weeks. Reviewing the literature, the average radiological healing of phalanges and metacarpals is 4-5 months which ranges from 1-17 months. The fracture healing time in our study compares favorably with those reported in the literature.

The pattern of hospital stay in our study revealed that 65% of the cases were in patients who were discharge on the first or second post operative day. At the same time we have managed 35% of the cases on out patient basis without any complications.

There were 2 major complications and few general complications in our UMEX fixator study. The most common complication was joint stiffness which was either partial or total stiffness. A joint was considered partially stiff when the range of motion in that particular finger was < 180° in case of fingers and <100° in case of thumb. And those cases range of motion <130° in case of fingers and <70° in case of thumb was considered total joint stiffness.

In our study 11 cases (10 partial and 1 total) developed joint stiffness. Most of the cases which went for stiffness were open injuries, cases reported late, multiple fractures or intra-articular comminuted fractures. One case which had fracture proximal phalanx Lt thumb developed sundeck's osteodystrophy ultimately leading to stiffness of thumb.

Reviewing the ***Drenth & Klasen***[3] studies, 11 fractures out of 36 had developed partial or total stiffness.

The other most common complication was pin tract infection in about 5 fractures. In our series most of the fractures were superficial infections. The pin tract infections healed promptly by antibiotics.

Pin tract infection were reduced by following methods.
1. By adequate skin stab for pin placement.
2. Inserting the pin by hand drill which eliminates the heat necrosis of soft tissues and bone.
3. Effective pin and frame care.

No case went for osteomyelitis at pin site. One case developed osteomyelitis of fracture site and he is not on follow-up regularly.

Malunion was a problem in 2 cases due to lack of accurate reduction or post reduction collapse. In case of comminuted fractures and multiple fractures, because of lack of accurate reduction, it resulted either in axial or rotational malunion. None of the malunited fractures caused significant disability in our studies.

We had 3 fractures which developed pin loosening which did not effect the healing of the fractures. All the cases which had been pin loosening, had infection of pin site prior to loosening and all the cases of pin loosening have occurred after 3 weeks.

One case which had compound fracture proximal phalanx left thumb with intra articular extension with bone loss developed nonunion . The procedure of bone grafting which was a necessity in this case was not performed because patient was not willing for second surgery.

Results were declared as per criteria described earlier into excellent/ good / fair and poor. Out of the 21 fractures involving proximal phalanx, 8 were excellent,8 good and rest of the cases were 3fair and 2 poor. Among 4 middle phalanx, 1 excellent, 2 were good, 1 fair. Among 13 metacarpal fractures, 3 had excellent results, 6 were good, and 4fair. Among 13 cases operated in 1-30 years age group 10 had excellent / good result where as 17 cases operated in the age group 31 to 60 years, 2 had excellent and 8 had good and 5 are fair.

Among 10 open fractures, 4 out of 3 type I open fracture were excellent / good result, where as out of 6 type II, 5 cases were good or fair and 1 case were poor.

Part of finger	Excellent / good	Fair / poor
Proximal phalanx	16	5
Middle phalanx	3	1
Metacarpal	9	4
Total	28	10

Comparison Chart:

		Drenth & Klasen[3]	Our study
No. of patients		33	30
No. of fractures		36	38
Sex	Male	27	27
	Female	6	3
Mean age incidence		35 yrs	32.97 yrs
Dominant hand		44%	66.67%
Road traffic accident		9	12
Agricultural and Industrial accident		19	14
Open fractures		27	10
Phalangeal fractures	Proximal Phalanx.	21	21
	Middle Phalanx	08	04
	Distal Phalanx	-	-
Metacarpal fractures.		07	13
Intra articular fractures		2	5
Epiphyseal fractures		-	1
Fracture pattern	Transverse fractures	6	2
	Comminuted fracture	25	19
	Short oblique	3	7
	Juxta-articular	-	4
Fixator used		Mini-Hoffman	UMEX
Pins in each fragment		1	1 or 2
Follow up		4.4 yrs	34.2weeks
Fixator in Situ		5.95 weeks	4.42 weeks
Complications	Pin tract infection	-	5
	Joint stiffness	11	11
	Pin loosening	6	3
	Malunion	-	2
	Non union	-	1
	Osteomyelitis	-	1
Result	Excellent / Good	25	28
	Fair / poor	11	10

Range of movement is inversely proportional to the age of the patient. When correlation test was applied to 10% of the cases, it was found that there is a partial negative correlation between age of the patient and range of movement in this study group (r = -0.4725).

As we have compared most of our parameters with ***Drenth*** and ***Klasen*** studies, I would like to compare and put in a table form.

CONCLUSION

- Hand fractures are a common entity because they are peripherally placed. Most of the patients were males because of the ambulant life they lead.
- Most phalangeal and metacarpal fractures can be treated conservatively.Patients with multiple fractures, open fractures, intra articular require operative reduction and stabilisation to obtain the optimal position for bone healing and to allow early movement.
- UMEX is an adequate treatment modality for unstable phalangeal and metacarpal fractures which are open, intra-articular and multiple.
- UMEX is simple to operate, has less complication rate and can be used by an average surgeon in an average operating environment. The learning curve is comparatively small.
- UMEX simplifies the post-operative management of both injured finger and limb. It allows early mobilisation which prevents joint stiffness.
- Pintract infection and pin loosening are the main disadvantages of UMEX fixation.
- Understanding the biochemical principles and correct application methodology is essential for optimal use of available equipment.
- UMEX fixation provides an adequate basis for bone healing, but does not guarantee good functional outcomes. This seem to depend on the severity of accompanying injuries as shown by our fair and poor results in both phalangeal injuries
- UMEX method is not an alternative to established methods of management of small bone fracture but is an additional and useful tool in management of small bone fractures of hand.

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