Benha Journal of Applied Sciences (BJAS) **print: ISSN 2356–9751**
Vol. (7) Issue (8) (2022), (17-26) **online: ISSN 2356–976x**
http://bjas.journals.ekb.eg

Comparison Between Uniplanar External Fixation VS Dynamic External Fixation "Suzuki Frame" In Treatment Of Phalangeal Fractures

M.A.Elbehiry, H.A.Bassioni and W.A.kandel
Orthopedic Surgery, Dept., Faculty of Medicine, Benha Univ., Benha, Egypt
E-mail: kandel212@yahoo.com

Abstract

Background: In the skeletal system, phalangeal fractures are among the most frequent and most often treated conservatively as a minor injury. An open incision, dissection, and the use of K-wire for internal fixation are often necessary because the smaller bone pieces or less fastness in fixation tugged by local ligament make early mobilisation difficult. The purpose of this research was to compare the results of uniplanar external fixation vs external dynamic fixation of phalangeal fractures of the hand. During this investigation, 20 patients with phalangeal fractures of the hand were treated with either uniplanar external fixation or external dynamic fixation. For this research, all of the patients included were cared for at Benha University Hospital or Kafr-Elshiekh General Hospital between January of 2019 and March of 2019. According on the kind of fixation, the twenty patients were split into two groups. Uniplanar External Fixation: 10 patients in Group 1. Patients in Group 2 who had Dynamic External Fixation "Suzuki Frame" were included. The patients in this study were between the ages of 19 and 62. There were 15 men and 5 women in all. A total of six patients had a problem with their dominant hand, whereas 14 patients had a problem with their nondominant hand. A total of 20.0 percent of patients in group 1 had excellent results, 40 percent had good results, ten percent had fair results, and 30 percent had poor results, while in group 2, three patients had excellent results, 40 percent had good results, 30 percent had fair results, and none had poor results. Complications included stiffness in 20% of patients in group 1, 10% in group 2, 10% in group 3, and 10% in group 2; in group 1, 10% had non-union of fracture; in group 2, 20% had stiffness and 20% had loosening of fixator; and in group 2, 0% had non-union of fracture or pin-tract infection. Phalangeal fractures may be treated with the mini external fixator. Reduced soft tissue dissection, a high rate of union (95 percent), and the ability to move nearby joints are also advantages. The use of a small external fixator in open fractures enables for wound examination and treatment without the need of additional hardware at the fracture site. Using an external dynamic fixator may save you time and money over open surgery. As a result of this, it may be re-adjusted in the outpatient clinic, which provides solid support and stability. It prevents stiffness by allowing early mobilisation of the proximal interphalangeal joint.

Key words: Uniplanar External Fixation, Dynamic External Fixation, Suzuki Frame, Phalangeal Fractures.

1. Introduction

There are an annual incidence of 67.9 per 100,000 people with finger fractures and 11.2 per 1000 people with finger dislocations.

a substantial angular moment and a longitudinal force vector are transmitted through the joint to cause PIP fractures.

[1] The articular congruency and soft tissue supports offer stability to the proximal interphalangeal joint (PIPJ), which is a basic hinge joint.

Collateral ligaments, volar plate, joint capsule, dorsal expansion, extensor tendon, and flexor tendons offer soft tissue support.

In many cases, PIP joint fractures are misdiagnosed as "sprains" or "jams," resulting in a delay in the proper treatment.

The symptoms of early arthritis might include stiffness, discomfort, swelling, angulation, and radiographic abnormalities if an injury is not promptly recognised and treated.

Any therapy for PIPJ should aim to provide a painless, stable, and mobile PIP joint.

Many treatment options have been reported to attain these aims, such as extension block splinting, closed reduction and percutaneous fixation, open reduction and internal fixation, and dynamic external fixation.

Internal or external fixation devices are used to stabilise the fracture and restore articular congruity.

The primary therapy for these fractures is anatomical reduction and stable fixation, followed by early mobilisation.

Chronic pain, stiffness, deformity and early degenerative arthritis might result from improper therapy.

Five.) Comminuted and intra-articular fracture in the knee

The use of Kirschner′s wire for open reduction and internal fixation is typically not suitable when there is a danger of infection from open wounds and when additional soft tissue injury is to be avoided owing to the smaller bone fragments or less fastness in fixing tugged by local ligaments.

If the fracture is well aligned, permitting early joint mobility, and the congruent joint surface is maintained, this treatment approach would seem to be the most desirable.

Dynamic external fixation of PIPJ fractures might do this by providing indirect fracture reduction, maintaining fracture alignment and permitting early mobility, resulting in an acceptable functional result.

[3] A number of external fixators are available for the treatment of these complex fractures, and external fixation is a viable therapy option.

Distraction mobilisation of the affected joint is used by the fixators to preserve articular integrity by taxising the ligaments.

An investigation was carried out to determine if unipalanar external fixation or dynamic external fixation resulted in better functional outcomes for patients with phalangeal fractures (Suzuki frame)

2. Patients and Methods

For the purpose of this research, 20 patients with phalangeal fractures of the hand were randomised to receive either uniplanar external fixation or external dynamic fixation.

Benha University's ethics committee authorised the study.

For this research, all of the patients included were cared for at Benha University Hospital or Kafr-Elshiekh General Hospital between January of 2019 and March of 2019.

A minimum of 12 weeks of follow-up was required for all patients, and a maximum of 36 weeks of follow-up was used, with an average of 24 weeks.

Prior to beginning any treatment, all patients completed a written permission form. **2.Patient selection:**

2.1Inclusion criteria:

1. Age: Skeletally mature patients.
2. Sex: Both males and females.
3. Fractures involving more than 40 % of the articular surface of the phalanx.
4. Comminuted, complex phalanx shaft/base fractures.

2.2Exclusion criteria:

1. Chronic injury.
2. Segmental digital injuries compromising the phalangeal head.
3. Significant preexisting arthritis.
4. Simultaneous need for reconstructive soft-tissue coverage
5. Skeletally immature patient.

2.3Patient data

Age

Age of the patients has been divided into 3 age groups.

The age in group 1 ranged from 25 to 59 years with mean ±SD was 38.60± 11.14 years while the in group 2 the age ranged from 19 to 62 years with mean ±SD was 33.70± 14.28 years.

The 18-<40 age group was the most affected group

Sex

In both studied groups the majority of patients were males (80%) and (70%) respectively.

Hand affected:

The Dominant hand was affected in 4 fractures (40 %) in group 1, while in group 2 the dominant hand was affected in 2 fractures (20%) only.

Occupation

Construction workers and manual workers constituted for the majority of patients.

Smoking

Out of the 20 patients in this study, 4 patients (40%) in Group 1and 3 patients (30 %) in group 2 were cigarette smokers who have been smoking at least a pack of cigarettes per day for the last 10 years and thus been denoted as heavy smokers.

Fracture type

In (group 1) 5 (50%) fractures were closed fractures and 5 (50%)were open fractures, while in (group 2) 6 fractures (60%) were closed fractures and 4 (40%)were open fracture .

Fracture classification

6 fractures (60%) were Extra articular fractures in group 1 ,while in group 2 were 7 extra articular fractures (70%) .

Distribution of fractures

40% patients had fracture in ring finger in group 1 while in group 2, 40% of fracture were in middle finger.

2.4METHODS

All patients were initially assessed in the emergency department.

2.5The Examination included:

History taking:

- Personal history: Name, Age, Sex, Occupation, Address, Hand dominance and Special habits of medical importance (smoking, drug abuse).
- Previous medical and surgical history: including tetanus immunization status.
- History of the trauma: date, time and mechanism of trauma.

Examination

A. General examination:

Examination included head, neck, chest, abdomen, upper and lower limbs for detection of other injuries.

B. Local examination:

Examination was done for assessment of the injured hand:

- Evaluation of vascularity.
- Evaluation of nerve injury.
- Evaluation of open injuries.
- Evaluation of tendon integrity.

Radiological evaluation

Routine Anteroposterior and oblique and lateral views were obtained.

Primary care for open fractures

- Dressing.
- Splintage.
- Parenteral injection of prophylaxis antibiotic (cefotaxime 1gm) every 12 hours.
- Injection of anti-tetanic serum and also anti-rabies serum in animal bites.

Then fractures were assessed for the suitability of internal fixation or not.

Operative treatment

Time lapse between injury and operation:

All cases involved in this study were informed about the surgical procedure, a written consent was obtained.

The lag until operation in group 1 ranged from immediate to 4 days, 7 cases were managed within 24 hours from injury (70%), 2 cases (20%) after two days and one case (10%) after four days, while in group 2 the lag ranged from 0 to 2 days .5 cases (50%) on the same day 4 cases (40%) on the next day and one case (10%) after two days.

Technique:

Position:

All patients were operated upon while lying in a supine position.

Anesthesia:

All patients were regionally anaesthetized.

Antibiotic:

One gram of a broad-spectrum antibiotic were given prior to the surgery.

Intraoperative fluoroscopy:

Intraoperative imaging was a prerequisite and was used for all cases throughout the procedure.

Operative steps:

The twenty patients were divided into two groups according to type of fixation

- **Group ١**: ١0 patients with Uniplanar External Fixation.
- **Group 2**: 10 patients with Dynamic External Fixation "Suzuki Frame".

C) Methods of evaluation:

Clinical evaluation:

Objective measurements of the active range of motion (AROM) of PIPJ and DIPJ of the affected finger were measured using a standard goniometer **(Figure.1).** The grip strength was also assessed and was compared with the uninjured side.

Fig. (1) Goniometer.

The patients were asked to record their current level of pain according to a numerical scale (0 equals no pain, 10 equals worst pain ever).

Radiological evaluation:

Follow up x-rays were done at 1, 3, 6, 12 weeks follow-up visits after the procedure that were evaluated for PIP congruency, reduction, arthritis and fracture healing. A joint was considered arthritic if there was more than 1 mm of intraarticular depression, significant joint space narrowing, or osteophytes formation present. Any other problem or complication was recorded.

Evaluation of the results:

Although total active range of motion (TAM) evaluation was originally designed for evaluation of the results of tendon surgery in the hand, it was rapidly adopted to evaluate the results of treatment of hand fractures because of its numerous advantages.

In the medial four fingers TAM is the sum of the angles formed by metacarpophalangeal (MP), proximal interphalangeal (PIP) and distal interphalangeal (DIP) joints in the maximum flexion in the fist position. Minus the total extension deficit of these joints. (Hyperextension of these joints is disregarded) Recovery is calculated as percent-regained motion compared to normal range of digital motion (260°)

In the thumb it is the sum of angles formed by metacarpophalangeal (MP) and distal interphalangeal (DIP) joints in the maximum flexion in the first position minus the total extension deficit of these joints (210°)

Method of measurement:

Using a goniometer the active flexion of the interphalangeal and metacarpophalangeal joints are calculated and added. If there is any flexion deformity or extension lag, it is measured in degrees and subtracted from the total amount of joint flexion to produce the total active range of motion (TAM).

2.6. Statistical analysis

Data was collected, coded then entered as a spread sheet using Microsoft Excel 2016 for Windows, of the Microsoft Office bundle; 2016 of Microsoft Corporation, United States. Data was analyzed using IBM Statistical Package for Social Sciences software (SPSS), 21st edition, IBM, United States. The Kolmogorov-Smirnov test was used to verify the normality of distribution. Continuous data was expressed as mean ± standard deviation, median & IQR while categorical data as numbers and percentage. Data was presented as tables and graphs. Results was considered statistically significant at a p-value of less than or equal 0.05 and highly statistically significant at a p-value of less than or equal 0.001. The used tests were: Chi-square test, Fisher's Exact or Monte Carlo correction, Student T-test and Mann Whitney test.

3. Results

Table (1) Demographic characteristics among the two studied groups.

		Group 1 (Uniplanar External Fixation) (n = 10)		Group 2 (Suzuki Frame) (n = 10)		Test value	P-value	Sig.
		N	%	N	%			
Age (years)	**Mean± SD**	38.60± 11.14		33.70± 14.28		T= 0.856	0.414	NS
	Median (IQR)	37.0 (30.0 -47.0)		30.0 (22.0- 36.0)				
	Range	25.0- 59.0		19.0 –62.0				
Gender	**Male**	8	80.0%	7	70.0%	X^2= 0.267	^{FET} 0.500	NS
	Female	2	20.0%	3	30.0%			
Occupation	**Construction worker**	3	30.0%	1	10.0%	X^2= 2.476	0.649	NS
	Driver	2	20.0%	1	10.0%			
	Farmer	1	10.0%	1	10.0%			
	Housewife	1	10.0%	3	30.0%			
	Manual worker	3	30.0%	4	40.0%			

p≤0.05 is considered statistically significant, p≤0.01 is considered high statistically significant,

SD= standard deviation, -comparison between groups done by T:Independent Samples Student T test, X2: Chi-Square Test, FET= Fischer Exact Test.

Table (1) illustrates demographic characteristics among the two studied groups. The age in group 1 ranged from 25 to 59 years with mean ±SD was 38.60± 11.14 years while the in group 2 the age ranged from 19 to 62 years with mean ±SD was 33.70± 14.28 years with no statistical significant difference between the two groups (p=0.414). There was no statistical significant difference between the two groups as regards gender and occupation (p=0.500 & 0.649 respectively).

Table (2) Comparison between the studied groups regarding fracture characteristics.

		Group 1 (Uniplanar External Fixation) (n = 10)		Group 2 (Suzuki Frame) (n = 10)		Test value	P-value	Sig.
		N	%	N	%			
Fracture type	**Closed**	5	50.0%	6	60.0%	X^2= 0.202	^{FET} 1.00	NS
	Open	5	50.0%	4	40.0%			
Fracture classification	**Extra articular**	6	60.0%	7	70.0%	X^2= 0.220	^{FET} 1.00	NS
	Intra articular	4	40.0%	3	30.0%			
Distribution	**Little**	1	10.0%	1	10.0%	X^2= 3.33	0.343	NS
	Middle	1	10.0%	4	40.0%			
	Ring finger	4	40.0%	2	20.0%			
	Thumb	3	30.0%	0	0.0%			
	Index	1	10.0%	3	30.0%			
Lag until operation (days)	**Mean± SD**	1.10± 1.29		0.60± 0.70		$^{Z}_{MWU}$= 0.813	0.416	NS
	Median (IQR)	1.0 (0.0 -2.0)		0.50 (0.0- 1.0)				
	Range	0.0- 4.0		0.0 –2.0				

p≤0.05 is considered statistically significant, p≤0.01 is considered high statistically significant,

SD= standard deviation, -comparison between groups done by ZMWU: Mann-Whitney U T test, X2: Chi-Square Test, FET= Fischer Exact Test.

Table (2) illustrates fracture characteristics among the two studied groups. In group 1, there were 5 (50.0%) patients with open fractures and 5 (50.0%) patients with extra articular fractures, while in group 2, 4 (40%) patient with open fractures and 6 (60.0%) patients with extra articular fractures with no statistically significant difference between the two studied groups as regards fracture type and classification (p>0.05). 40% patients had fracture in ring finger in group 1 while in group 2, 40% of fracture were in middle finger with no statistically significant difference between the two studied groups as regards fracture type and classification (p>0.05).

The lag until operation in group 1 ranged from immediate to 4 days with mean ±SD was 1.10± 1.29 days while in group 2 the lag ranged from 0 to 2 days with mean ±SD was 0.60± 0.70 days with no statistical significant difference between the two groups (p>0.05).

Table (3) Comparison between the studied groups regarding operative and post-operative data.

		Group 1 (Uniplanar External Fixation) (n = 10)		Group 2 (Suzuki Frame) (n = 10)		Test value	P-value	Sig.
		N	%	N	%			
Start of movement	immediate	-	-	6	60.0%	-	-	-
	3rd day	-	-	2	20.0%			
	7th day	-	-	2	20.0%			
Union time (weeks)	Mean± SD	5.33± 1.12		4.60± 1.43		T= 1.235	0.234	NS
	Median (IQR)	6.0 (4.0 -6.0)		4.50 (4.0- 5.0)				
	Range	4.0- 7.0		3.0 –8.0				
Time of removal (days)	Mean± SD	28.0± 15.0		26.0± 5.85		Z_{MWU}= 0.485	0.628	NS
	Median (IQR)	23.0 (21.0 -26.0)		24.0 (21.0 -30.0)				
	Range	21.0- 70.0		21.0- 35.0				
Time of removal	3 weeks	5	50.0%	4	40.0%	X^2= 1.254	0.534	NS
	4 weeks	4	40.0%	3	30.0%			
	>4 weeks	1	10.0%	3	30.0%			

p≤0.05 is considered statistically significant, p≤0.01 is considered high statistically significant,

SD= standard deviation, -comparison between groups done by ZMWU: Mann-Whitney U T test, T: Student T test, X2: Chi-Square Test, FET= Fischer Exact Test.

Table (3) illustrates operative and post-operative data among the two studied groups. Most patients (60.0%) in group 1 retained the finger movement immediately after operation. The mean union time in group 1 & 2 was 5.33± 1.12 weeks and 4.60± 1.43 weeks respectively with no statistically significant difference between the two studied groups (p>0.05). The mean time of removal in group 1 & 2 was 28.0± 15.0 days and 26.0± 5.85 days respectively with no statistically significant difference between the two studied groups (p>0.05).

Table (4) Comparison between the studied groups regarding results.

		Group 1 (Uniplanar External Fixation) (n = 10)		Group 2 (Suzuki Frame) (n = 10)		Test value	P-value	Sig.
		N	%	N	%			
Results	Excellent	2	20.0%	3	30.0%	X^2= 4.20	0.241	NS
	Good	4	40.0%	4	40.0%			
	Fair	1	10.0%	3	30.0%			
	Poor	3	30.0%	0	0.0%			

p≤0.05 is considered statistically significant, p≤0.01 is considered high statistically significant,

SD= standard deviation, -comparison between groups done by X2: Chi-Square Test,

Table (4) illustrates results of surgery among the two studied groups. Two patients (20.0%) in group 1 had good results, 40% patients had good results, 10% patients had fair results and 30% patients had poor results while in group 2, three patients (30.0%) had good results, 40% patients had good results, 30% patients had fair results and none of patients had poor results. There was no statistically significant difference between the two studied groups (p>0.05).

Table (5) Comparison between the two groups regarding results.

	Group (1)		Group(2)	
	number	percentage	number	percentage
Satisfactory	6	60%	7	70%
Unsatisfactory	4	40%	3	30%
total	10	100%	10	100%

Accordingly, excellent and good results were considered as satisfactory results, and were encountered in 6 patients (60%) in group(1) and 7 patients (70%) in group(2), while unsatisfactory results (fair and poor results) were encountered in 4 patients (40%) and 3 patient(30%) in group(1) and group(2) respectively. **(Table.5)**

Table (6) Comparison between the studied groups regarding complications.

		Group 1 (Uniplanar External Fixation) (n = 10)		Group 2 (Suzuki Frame) (n = 10)		Test value	P-value	Sig.
		N	%	N	%			
Complications	No	5	50.0%	6	60.0%	X^2= 2.127	0.712	NS
	Stiffness	2	20.0%	2	20.0%			
	Loosening of fixator	1	10.0%	2	20.0%			
	Non-union	1	10.0%	0	0.0%			
	Pin-tract infection	1	10.0%	0	0.0%			

p≤0.05 is considered statistically significant, p≤0.01 is considered high statistically significant,
SD= standard deviation, -comparison between groups done by X2: Chi-Square Test,

Table (6) illustrates complication among the two studied groups. Two patients (20.0%) in group 1 had stiffness, 10% patients showed loosening of fixator, 10% patients had non-union of fracture and 10% patients had pin-tract infection while in group 2, 20% had stiffness and 20% patients showed loosening of fixator and none of patients had non-union of fracture or pin-tract infection. There was no statistically significant difference between the two studied groups (p>0.05).

4.Case presentation

Case 1

A 39 years old female housewife sustained a closed fracture of the right ring finger.

Fixation of fracture was done using dynamic external fixator

Fig. (1) application of Suzuki frame.

Removal Of Suzuki Frame After 4 Weeks Removal Of Suzuki Frame After 4 Weeks **(Figure 2)**

Fig. (2) xray of fracture after removal of frame.

Case 2

A 25 years old male construction worker sustained direct trauma with heavy object leading to open fracture of right index finger.

Fixation of fracture was done using dynamic external fixator (figure 3)

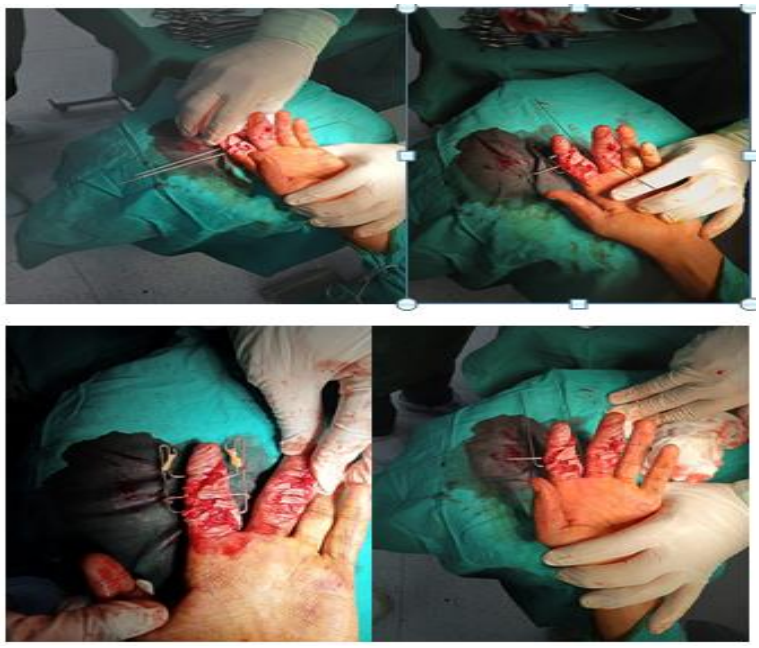

Fig. (3) application of Suzuki frame

Fig. (4) immediate post-operative x ray.

Frame was removed 5 weeks later, 7 weeks follow up x rays showed complete union. (Figure 5)

Fig. (5) x ray showing fracture union.

5. Discussion

The union rate in the Drenth trial was 100% (33 patients); [6].

More over two-thirds of the patients in Ma X's research (33 cases) were reunited [7].

It took an average of 5 weeks (with a range of 3–12 weeks) for all 25 patients included in the Lenehan research to heal and return to work.

Mean time of union in the Dailiana trial (59 patients) was 6 weeks (range: 5-12 weeks).

In the LI Wen-jun study (26 patients), the average time to union was 7 weeks (range 5–12 weeks).

One non-united with open comminuted intra-articular fracture was found in group (1), whereas in group 2, the mean time of union was 4.60 (range 3-8) weeks, with union occurring in 19 of the 20 fractures (95 percent).

Splinting, internal fixation, and external dynamic fixation were compared in Stern et al's comparative study.

Traction using an external dynamic fixator had the greatest outcomes after a year of follow-up.

There was a 75% success rate in the internal fixation group, however 25% of these patients needed PIPJ arthrodesis owing to problems, such as infection and loss of reduction, in this group.

In all instances, splinting with extension blocking splintage was ineffective, with all patients reporting some degree of discomfort and a high prevalence of degenerative arthritis and limited joint mobility.

The distal interphalangeal joint's ultimate range of motion was decreased regardless of treatment method.

However, external fixation had the least impact on this.

Tension across the joint and soft tissues may minimise fracture fragments, according to Ellis et al in their study of the dynamic external fixator.

It's also important to get the joints moving as soon as possible since this promotes cartilage remodelling while also ensuring that the fragile blood supply to the fracture pieces remains unharmed.

It may also help heal damaged cartilage and prevent joint fibrosis, both of which may limit mobility.

This procedure eliminates the need for open surgery, which may cause adhesion and stiffness and, in certain cases, may not achieve the aim of stable reduction of fracture pieces, particularly if there is a lot of comminution.

[11] In investigations by Lenehan, Dailiana, and Ma X, the mean duration between injury and operation was 3.25 days (ranging from 1–20), 5 days (ranging from 0 to 54), and 3.7 hours (ranging from 2-8) respectively.

Eighth and Ninth [7].

According to our findings from this investigation

Group 1 had a lag time of up to 4 days, whereas Group 2 had a lag time of 0 to 2 days, with an average of 0.60 days.

A total of 59.5 percent were rated as excellent, 33.3 percent as fair, and 7.4 percent as bad by Schuind.

41.7 percent of Drenth's evaluations were outstanding, 27.8 percent were good, 8.3 percent were fair, and 22.2 percent were bad.

Among the 28 patients who had fracture healing, Ma X found exceptional outcomes in seven instances, good in 12 cases, and fair in five others. In four cases, the results were bad. (12) and (6) (7).

A total of 20.0 percent of patients in group 1 had excellent results, 40 percent had good results, ten percent had fair results, and 30 percent had poor results, while in group 2, three patients had excellent results, 40 percent had good results, 30 percent had fair results, and none had poor results.

The majority of patients in this research, 70% of whom were between the ages of 18 and 40, were medically free and had appropriate bone quality, which might be attributed to a multifactorial effect.

In most instances, they went to the ER quickly and the procedure lag did not exceed three days.

The majority of patients (80%) were urged to begin early postoperative range of motion.

It was equivalent in terms of the demographic distribution of the patients, which was 35 years old on average, to Wegge et al [13] (range 18-60 years).

According to Drenth, Lenehan, Dailiana, and Ma X's research, the average age ranged from 15 to 69 years, 34 to 62 years, and 36 to 74 years, respectively [6].

Among the 25-59-year-olds in Group 1, the mean age was 38.60; among the 19-62-year-olds in Group 2, the mean age was 33.70.

In our research, the male to female ratio was 3:1, but in the work of Wegge et al. [13], the ratio was 5:1.

A correlation between gender and age was found to be negligible in this investigation.

One possible explanation for the preponderance of men is that they were mostly manual labourers with a high propensity for hand trauma.

Patients with open fractures and serious soft-tissue injuries accounted for 81.9 percent of the patients in the Drenth study.B

Only 9 (36 percent) of Dailiana's patients had open fractures, while Lenehan had 23 (38.9 percent).

In the Ma X investigation, all patients had open fractures.

the numbers six through nine (7)

Five patients in group 1 had open fractures, whereas four patients in group 2 had open fractures.

LI

There were 26 patients with solely intra-articular fractures, and Wen-outcomes jun's were 8 outstanding, 13 good, 3 acceptable, and 2 bad.

In addition, 80.8 percent of the total active joint motion functioned at an excellent or good level.

(5)\sIn present research there were only three instances (30 percent) with intra-articular fractures in group (1) whereas in group (2) there were 4 (40 percent) with intra-articular fractures

There was a mean of 5.8 (range 3 - 11) weeks following a phalangeal or metacarpal fracture in the Drenth, Lenehan, Dailiana studies that the device had

been removed, 3.7 (range 2.7 - 6), and 6 (range 5 – 12) weeks respectively.

There are (six) (8)

Group 1 had the device there for an average of four weeks, whereas Group 2 had it there for an average of two and a half weeks.

A total of 27.8% of the patients in Drenth's mixed trial had a complication rate in which one of the pins got loose, two patients had soft tissue interference from the device, one patient had the device inhibit mobility of the neighbouring finger, and one patient had the fracture become displaced.

Loosening only caused fracture displacement in one case, necessitating a surgical repositioning.

There were no infections in the Lenehan research, however two patients complained occasional minor soreness.

Because of the loosening of one patient's fixator, he or she had to be treated in the outpatient department.

Radiographic results of phalangeal shortening or rotation, joint incongruity, and narrowed joint space were found to be abnormal in eight patients in the LI Wen-jun research.

Two patients had pin tract infections despite the external fixator having no loose or broken pins.

Hynes and Giddins reported that two individuals developed sepsis at the proximal wire/bone junction.

Pin track sepsis has also been documented by other researchers, which may lead to major consequences.

For Syed et al, there may be three reasons why pin site infection rates are high.

If you use straight K-wires, you're going to get the same effect as using a straight screw, but you're going to get loosening and sepsis if you do any kind of movement, whether it's active or passive.

Allison (16) showed this using a dynamic fixator consisting of stainless-steel spring wire wound around two K-wires.

There were no pin site infections in any of their patients.

This might be because the spring was able to move independently of the proximal and distal wire–bone contacts during finger mobility.

The cancellous bone of the proximal phalangeal metaphysis may not be strong enough to withstand the torque created at the bone–wire contact in the preceding series.

Wire loosening and infection are the result of this.

(17) The fixator was kept for up to 6 weeks in other trials, which may have increased the risk of infection at the pin site. This may explain why infection rates were so high in those studies.

The fixation period was reduced as a result of these considerations.

In the case of Syed et al., the primary issue was fixator assembly uncoupling owing to insufficient wire bending for hooks.

Group 1 contained two patients with 20% stiffness, 10% loosening of the fixator, 10% non-union of the fracture, and 10% pin-tract infection, while in Group 2, 20% had stiffness and 20% loosening and 20% non-union of the fracture, and none of the patients had pin-tract infection.

Schuind had a 2.2% infection rate in his mixed sample and a 2.6% infection rate in his open fracture research.

In the Lenehan trial, there were no infections.

Two patients in the Dailiana research had superficial pin track infections, which were successfully treated with oral antibiotics and intensive wound washing for two weeks.

Both had pin tract infections, as well (8; 9).

In the LI Wen-jun. and Ma X investigations, no pinhole infection was observed, but wound infection occurred in three instances and resulted in nonunion in all three cases.(2) (4)

Schuind's mixed research had a non-union rate of 2.2 percent, while his open fracture study had a non-union rate of 10.5.

A 9 percent rate of un-united fractures was reported by Ashmead and colleagues, whereas a 0% rate was seen in the Drenth research.

There were five occurrences of nonunion in Ma X's research, two of which were caused by wound infection and two of which were caused by simple extra articular fracture.(6), 71, 74, 75

Sixty-eight (7)

For example, in group 1, one open comminuted and intra-articular fracture (5%) required bone grafting after four months and fixing with two crossing K. wires, which resulted in unsatisfactory union after two months.

Mcculley (19) employed a plastic sheath of an IV cannula or hypodermic needle as the crossbar for external fixation, and Kwires were introduced through the plastic and into the bone as the pins for external fixation of metacarpal and phalangeal fractures of the hand.

For complicated finger injuries, Thomas K. recommends the same straightforward procedure.

Although Schuind et al. proposed the general use of external fixators, even in straightforward hand fractures, most series keep the mini-external fixation for open or comminuted fractures, serious soft tissue injury and heavily-contaminated fractures with significant bone loss.

Using external fixation, 28 (85%) of 33 patients were happy with their outcomes, according to Dernth's study.

All participants in the Lenehan trial were satisfied with both the ultimate treatment outcome and the technique of therapy. [6, 8].

A Mini External Fixator is an acceptable treatment for phalangeal fractures, as can be shown in the results.

Reduced soft tissue dissection, a high rate of union (95 percent), and the ability to move nearby joints are also advantages.

The use of a small external fixator in open fractures enables for wound examination and treatment without the need of additional hardware at the fracture site.

6. Conclusion

Using an external dynamic fixator may save you time and money over open surgery.

As a result of this, it may be re-adjusted in the outpatient clinic, which provides solid support and stability.

It prevents stiffness by allowing early mobilisation of the proximal interphalangeal joint.

References

[1] D Ootes, KT Lambers DC Ring. The epidemiology of upper extremity injuries presenting to the emergency department in the United States. Hand,vol.7,pp.18–22,2012.

[2] FE Liss, SM Green. Capsular injuries of the proximal interphalangeal joint. Hand Clin,vol.8,pp.755–68,1992.

[3] A Fouad, G Hegazy, M Seddik, H Safwat, M Negm, I El- sebaey. Treatment of Proximal Interphalangeal (PIP) Joint Fracture by Dynamic Kirschner Wire Fixator. Ortho Rheum Open Access J,vol.2(2),pp.2–7,2016.

[4] RK Thomas, RS Gaheer, RD Ferdinand. A simple external fixator for complex finger fractures. Acta Orthop Belg,vol.74(1),pp.109-13,2008

[5] WJ Li, W Tian, GL Tian, SL Chen, CQ Zhang, YH Xue, Management of intra-articular fracture of the fingers via mini external fixator combined with limited internal fixation. Chin Med J (Engl),vol. 122(21),pp.2616-9,2009.

[6] DJ Drenth, HJ Klasen. External fixation for phalangeal and metacarpal fractures. J Bone Joint Surg Br,vol.80(2),pp.227-30,1998.

[7] X1Ma, L Sun, J Dai, Y Chai, C Zhang. Mini external fixation device for comminuted open fractures of metacarpal and phalange Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi,vol.27(1),pp.17-20,2013.

[8] Lenehan B, Fleming P, L,aing A, O'Sullivan M. Treatment of phalangeal fractures in the hand with the mini-Hoffman external fixator. Eur J Orthop Surg Traumatol,vol.13,pp.142–4,2003.

[9] Z Dailiana, D Agorastakis, S Varitimidis, K Bargiotas, N Roidis, KN Malizos. Use of a Mini-External Fixator for the Treatment of Hand Fractures. J Hand Surg,vol. 34(A),pp.630–636,2009.

[10] PJ Stern, RJ Roman, TR Kiefhaber, JJ McDonough. Pilon fractures of the proximal interphalangeal joint. J Hand Surg Am. American Society for Surgery of the Hand,vol.16,pp.844–50,1991.

[11] SJ Ellis, R Cheng, P Prokopis, A Chetboun, SW Wolfe, EA Athanasian, Treatment of proximal interphalangeal dorsal fracture-dislocation injuries with Dynamic external fixation : A Pins and Rubber Band System. Hand Surg,vol.32,pp.1242–50,2007.

[12] F Shuind, W Cooney, F Burny, N Ank. Small external fixator devices for the hand and wrist. Clin Ortho,vol.293,pp.77- 82,1993.

[13] J.Wegge, , C. Roth, B.Neubach, K. H.Schmidt, & R.Kanfer, (). Age and gender diversity as determinants of performance and health in a public organization: The role of task complexity and group size. *Journal of Applied Psychology*, *vol.93*(6), pp.1301–1313 , 2008.

[14] AA Syed, M Agarwal, R Boome. Dynamic external fixator for pilon fractures of the proximal interphalangeal joints: A simple fixator for a complex fracture. J Hand Surg Am,vol.28 B(2),pp.137–41,2003.

[15] MC Hynes, GEB Giddins. Dynamic external fixation for pilon fractures of the interphalangeal joints. J Hand Surg Am,vol.26,pp.122–4,2001.

[16] DM Allison. Fractures of the base of the middle phalanx treated by a dynamic external fixation device. J Hand Surg Am,vol.21,pp.305–10,1996.

[17] R Thomas. M Kiefhaber, PJ Stern. Fracture Dislocations of the Proximal Interphalangeal Ioint Thomas. J Hand Surg Am,vol.23A(3),pp.368–80,1998.

[18] DI Ashmead, K D Roth, RL Walton, JB Jubiter. Treatment of hand injuries by external fixation. J Hand Surg,vol. 17A,pp.956- 641,992.

[19] SJ McCulley, C Hasting. External fixator for the hand: a quick, cheap and effective method. J R Coll Surg Edinb,vol. 44(2),pp.99-102,1999