Evaluation of Treatment of Unstable Distal Radial Fractures by External Fixator

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Conflict of Interest: None
Received: 12.07.2020
Accepted: 16.03.2021
www.banglajol.info/index.php/JSSMC

Abstract:

Background: *Distal radial fractures are very common in Orthopaedic practice but still there is no unanimity about its treatment.*

Objective: *To evaluate the external fixator for the treatment of unstable distal radius fractures.*

Methods: *This prospective observational study was carried out from January 2018 to December 2019 over a period of two years. Twenty-five consecutive patients of both sexes between the ages of 18 to 60 years with closed or open unstable distal radius fractures with or without intra-articular extension admitted in the Department of Orthopaedic Surgery, 250 Bedded General Hospital, Tangail & several private hospitals in Tangail & Dhaka city were selected. Patients with diabetes mellitus or chronic renal or hepatic disorder or extra-articular fractures or volar & dorsal shear injuries (Barton fractures) were excluded from this study. All the patients were evaluated thoroughly including distal neurovascular status and any associated injuries ruled out. Patients were operated as early as possible. But 4 cases were lost to follow up. Remaining 21 patients were followed up for at least 6 months and a maximum period of 12 months.*

Results: *In this series mean age of the patient was 35.71±11.65 years and males (66.7%) were predominant than females (33.3%). In this series right side was involved in 13 patients (61.9%) and left side in 8 patients (38.1%). The mechanism of injury included road traffic accident 13 (61.9%), fall on slippery ground 7 (33.3%) and occupational accident 1 (4.8%). Six patients of this study (28.6%) had associated injury other than the local soft tissue injury. Most of the patients (66.7%) were operated on the day of admission, 2 patients (9.5%) were operated within 3 days and 5 patients (23.8%) were operated within 7 days. As per AO classification, majority (38.1%) injury was type C_3 fracture followed by C_1 (33.3%), C_2 (14.3%), B_1 (9.5%) and A_3 (4.8%). According to functional outcome, satisfactory was 76.2% and according to anatomical outcome, satisfactory was 85.7%.*

Conclusion: *According to this study finding satisfactory outcome was 76.2% (functional) and 85.7% (anatomical).*

Key Words:
Unstable Distal Radial Fractures, External Fixator

[J Shaheed Suhrawardy Med Coll 2021; 13(1): 20-25]
DOI: https://doi.org/10.3329/jssmc.v13i1.60926

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Introduction

Patients with distal radial fractures are frequently observed in Orthopaedic Emergency and Outpatient Department. It has been estimated to account for one-sixth of all fractures that are seen and treated in emergency rooms.[1] Despite the fact, still there is no unanimity about its treatment specially regarding the technique of immobilization. Results obtained with different techniques at different hospitals are also variable.[2]

Distal radius fracture (DRF) is a common injury with bimodal distribution including the high-energy injuries in young population and a second rise in incidence in older population with osteoporosis.[3]

The principal goal of fracture treatment in DRF is not only to achieve bony union but also to have a pain-free and well-functioning limb.[4] This can be accomplished with

different surgical approaches, some being more invasive than others. In general, it is preferred and cost-effective if the optimal function is achieved without an invasive surgery.[5]

This fracture type has a variety of treatment alternatives, including nonoperative closed reduction and casting of stable fractures, open reduction and internal fixation (ORIF) with dorsal or volar locking plates, and external fixation.

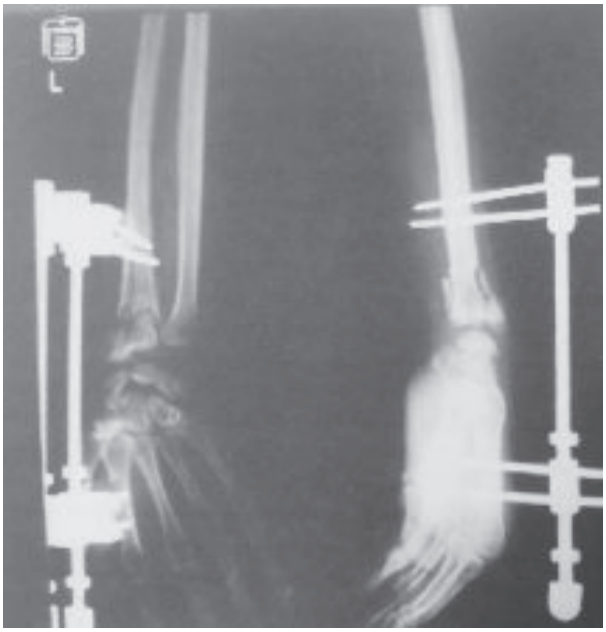
Optimal surgical management of unstable DRFs remains controversial.[6] Closed reduction with percutaneous pinning or external fixation has become less common with a trend toward using volar locking plates for internal fixation.[7] External fixation of DRFs traditionally has involved either spanning or simple nonspanning devices. Spanning fixation is particularly useful in open or highly comminuted fractures with an unstable soft-tissue envelope. In the past, non spanning external fixation typically was reserved for fractures with a noncomminuted extra articular distal fragment to which several large pins or Kirschner wires (K-wires) could be secured. The Non-Bridging External Fixator (NBX; Nutek Orthopaedics) may be used in cases that traditionally might be treated with locked plating or fragment-specific fixation. Specifically, this device is indicated for comminuted intra-articular DRFs in which bone quality may be less than ideal. The NBX, also suitable in open fractures with a stable soft-tissue envelope, can restore and maintain articular alignment by providing subchondral support and stability with fragment-specific fixation. A key advantage of this type of external fixation is that it involves percutaneous fixation and allows for early postoperative range of motion (ROM). Numerous studies have found excellent outcomes of treating unstable DRFs with ORIF with volar locking plates.[8-10] However, few studies have compared the clinical and radiographic outcomes of ORIF with those of nonspanning external fixation in the treatment of unstable comminuted intraarticular DRFs. Windolf and colleagues[11] found that, in cadaveric unstable intra-articular DRFs, nonspanning external fixation with multiplanar K-wires had biomechanical characteristics comparable to those of volar locking plates. Other suitable DRF treatment options have been found: an alternative nonbridging external fixator with multiplanar K-wires (Gradl and colleagues[12]) and the Cross-Pin Fixation system (A.M. Surgical) (Mirza and colleagues.[13] We conducted a study to find out functional outcome of unstable DRFs treated with external fixator.

Methods:

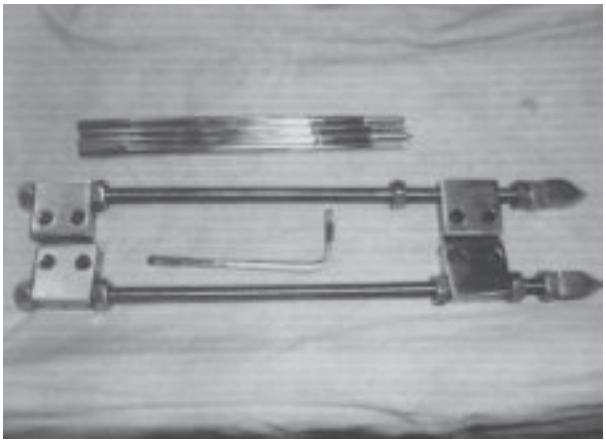
This prospective observational study was carried out from January 2018 to December 2019 over a period of two years. Twenty-five consecutive patients of both sexes between the ages of 18 to 60 years with closed or open unstable distal radius fractures with or without intra-articular extension admitted in the Department of Orthopaedic Surgery, 250 Bedded General Hospital, Tangail & several private hospitals in Tangail & Dhaka city were selected. Patients with diabetes mellitus or chronic renal or hepatic disorder or extra-articular fractures or volar & dorsal shear injuries (Barton fractures) were excluded from this study. All the patients were evaluated thoroughly including distal neurovascular status and any associated injuries ruled out. Patients were operated as early as possible. But 4 cases were lost to follow up. Remaining 21 patients were followed up for at least 6 months and a maximum period of 12 months.

In the operating room, patient was positioned supine on the table with the injured limb placed on a side trolley of suitable height and anaesthesia was given. After draping and painting, two holes were made by means of a hand drill fitted with a drill bit of 2.5mm size for a schanz screw of 3.5mm diameter on the dorsal aspect of radius at right angle. Self-tapping schanz screw of 3.5mm size was then inserted either by means of a hand drill or manually. In the similar manner second pair of shcanz screw of 2.5mm diameter at 5mm apart was inserted on the dorsal aspect of 2nd metacarpal at right angle by using a drill. Then the fracture was reduced by traction, counter traction and manipulation. While the limb in traction, connecting bars and clamps were fitted to the schanz screws. With the help of suitable arrangement at the distal end of connecting bars the existing distraction (ligamentotaxis) was increased or decreased.

Preoperative X-RAY



Postoperative Photograph



Basic elements of the external fixator.

Post-operative radiographs were assessed for fracture reduction, maintenance of radial length and inclination, lateral tilt and articular step, placement of fixator pins and K wires. Active and passive finger motion, elbow motion were started from the first postoperative day. The external fixator and pins were usually removed at 6 weeks after bridging trabeculae across the fracture site. A below elbow cast was applied for another 2 weeks followed by wrist mobilization exercises. Patients were followed monthly till 6 months and then 3 monthly till final follow up to 12 months.

The results were designated as excellent, good, fair and poor considering the anatomical and functional aspects of the wrist separately. Anatomical evaluation was based on the criteria outlined by Lidstrom (modified by Sarmiento and Latta).[14] And functional evaluation was based on the criteria outlined by Gartland and Werley (modified by Sarmiento).[15]

Results

Table-I

Distribution of patients in Different age groups (n=21)

	Frequency (n)	Percentage (%)
Age group (years)		
18-25	5	23.8
26-34	5	23.8
35-43	7	33.4
44-52	2	9.5
≥53	2	9.5

Mean age of the patients was 35.71±11.65 years varied from 18 to 60 years. Maximum number of patients belonged to the age group of 35 - 43 years.

Table-II

Distribution of patients according to six (n=21)

	Frequency (n)	Percentage (%)
Gender		
Male	14	66.7
Female	7	33.3

In the present series 14 (66.7%) patients were male and 7 (33.3%) were female.

Table-III

Distribution of the study subjects according to side of involvement (n=21)

Side of involvement	Frequency (n)	Percentage (%)
Right	13	61.9
Left	8	38.1

In this series right side involvement was 13 (61.9%) and left side involvement was 8 (38.1%).

Table-IV

Distribution of the study subjects according to type of injury, fracture and associated injury (n=21).

	Frequency (n)	Percentage (%)
Cause of injury		
RTA	13	61.9
Fall on slippery ground	7	33.3
Occupational accident	1	4.7
Type of fracture		
Closed fracture	18	85.7
Open fracture	1	4.8
Technically open fracture	2	9.5
Associated injury		
Trochanter fracture	2	9.5
Shoulder dislocation	1	4.8
Fracture distal end of ulna	3	14.3

The most common cause of unstable distal radial fractures was road traffic accident (61.9%) followed by fall on slippery ground (33.3%) and occupational accident (4.7%). Most common type of fracture was closed type fracture (85.7%) followed by technically open fracture (9.5%) and open fracture (4.8%). Out of 21 patients only 6 (28.6%) patients had associated major injuries. Among them, patients presented more with distal ulnar fracture (14.3%).

Table-V

Distribution patients according to AO/ASIF type of the fractures (n=21)

AO/ASIF type	Frequency (n)	Percentage (%)
A_3	1	4.8
C_1	7	33.3
C_2	3	14.3
C_3	8	38.1
B_1	2	9.5

Table shows that the majority (38.1%) injury was AO/ASIF type C_3 fracture followed by C_1 (33.3%), C_2 (14.3%), B_1 (9.5%) and A_3 (4.8%).

Table VI

Distribution of the study subjects according to time interval between injury and fixation (n=21).

Time interval between injury and fixation (days)	Frequency (n)	Percentage (%)
0 - 1	14	66.7
2 - 3	2	9.5
3 - 7	5	23.8

Majority cases were operated on the day of injury (66.7%). No cases were delayed more than 7 days.

Table VII

Distribution of the patients according to duration of hospital stay (n=21).

Hospital stay (days)	Frequency (n)	Percentage (%)
0 - 3	16	76.19
2 - 7	3	14.29
>7	2	9.52

In most the cases hospital stay was less than one week. 16 patients (76.19%) were discharged by 3 days and the remaining but 2 were discharged by one week.

Table-VIII

Distribution of the study subjects according to duration of immobilization by external fixator (n=21).

Duration of Immobilization (weeks)	Frequency (n)	Percentage (%)
6	13	61.9
7	5	23.8
8	3	14.3

In majority cases (61.9%) external fixator were kept for 6 weeks. Only in 8 (38.1%) cases more than 6 weeks were required but no cases got more than 8 weeks of immobilization.

Table IX

Complications of external fixator (n=21).

Complications	Frequency (n)	Percentage (%)
Pin tract infection	5	23.8
Soft tissue infection	3	14.3
Pin loosening	2	9.5

Pin tract infection was the most common complication (23.8%) followed by soft tissue infection (14.3%) and pin loosening (9.5%).

Table-X

Anatomical and functional outcome of the study subjects (n=21)

Results	Anatomical outcome	Functional outcome
Satisfactory	18 (85.7)	16 (76.2)
Excellent	4 (19.0)	4 (19.0)
Good	14 (66.7)	12 (57.2)
Unsatisfactory	3 (14.3)	5 (23.8)
Fair	1(4.8)	3 (14.3)
Poor	2(9.5)	2 (9.5)

In this series 21 patients were available finally for functional evaluation. It shows satisfactory (excellent+good) results in 76.2% (19.0%+57.2%) cases and unsatisfactory (fair+poor) results in 23.8% (14.3%+9.5%) cases. According to anatomical outcome, satisfactory (excellent+good) result was 85.7% (19.0%+66.7%) and unsatisfactory (fair+poor) result was 14.3% (4.8%+9.5%) cases.

Discussion

In this series mean age of the patient was 35.71±11.65 years and the maximum number of the patients belonged to the age group of 35 - 43 years. Distal radius fracture was observed among the patients with higher age comparing this study.[16-18] In this study 14 (66.7%) patients were male and 7 (33.3%) were female. Male predominance was observed in the study of Tahir et al.[16]

In this series right side was involved in 13 patients (61.9%) and left side in 8 patients (38.1%). Left side involvement was found more in other studies.[16,19] The mechanism of injury included road traffic accident 13 (61.9%), fall on slippery ground 7 (33.3%) and occupational accident 1 (4.8%). In the study of Tahir et al.[16], motor vehicle accident (n=19, 38.8%), fall from height (n=17, 34.7%) and fall from standing height (n=13, 26.5%). In this series most of the cases were closed injury. Six patients of this study (28.6%) had associated injury other than the local soft tissue injury. Of the 2 patients (9.5%) had trochanter fracture 1 patient (4.8%) had shoulder dislocation and other 3 patients (14.29%) had distal ul nar fracture.

Most of the patients (66.7%) were operated on the day of admission, 2 patients (9.5%) were operated within 3 days and 5 patients (23.8%) were operated within 7 days. The mean time from injury to presentation in the orthopaedic trauma unit was 3.8 days.[17] The mean interval from admission to surgery was 1.2 days with a range of zero to seven days. Most of the patients were operated on the same day of admission in emergency theatre (n=26, 53.1%).[16]

As per AO classification, majority (38.1%) injury was type C_3 fracture followed by C_1 (33.3%), C_2 (14.3%), B_1 (9.5%) and A_3 (4.8%) in this study. Most of fractures were C_2 (n=18, 36.7%), followed by C_1 (n=11, 22.4%), and B_1 (n=9, 18.5%).[16]

In this study, according to functional outcome, satisfactory (excellent + good) result was 76.2% (19.0%+57.2%) and unsatisfactory (fair + poor) result was 23.8% (14.3%+9.5%). According to anatomical outcome, satisfactory (excellent + good) result was 85.7% (19.0%+66.7%) and unsatisfactory (fair + poor) result was 14.3% (4.8%+9.5%) cases.

It is found that satisfactory results of anatomical and functional evaluation were 83.3% and 77.8% in a study conducted at NITOR by Ahsan.[20] Tahir et al.[16] revealed satisfactory result in 81.6% cases and unsatisfactory result in 18.4% cases. Jakim et al.[21] reported 83% good to excellent results and only a few complications.

In this study, pin tract infection was the most common complication (23.8%) followed by soft tissue infection (14.3%) and pin loosening (9.5%). The most common complication was superficial pin tract infection in 14.3% patients. Features of Median nerve compression (4.1%) and superficial radial nerve symptoms (6.1%) (Tahir).[16]

Conclusion:

This study showed satisfactory result in 76.2% cases and unsatisfactory result in 23.8% cases as functional outcome. According to anatomical outcome, satisfactory result was 85.7% and unsatisfactory result was 14.3%.

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