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A Retrospective Analysis from A Single Center Perspective On Complications After Fixing Distal Radius Fracture In Pediatric Population

Ammar K. Alomran[1]. Abdulaziz M. Alhawas[1], Ahmed I .Almulhim[1], Mohammad S. Alfehaid[2], Arwa K. Alumran[3], Abdullah F. Alkharashi[1], Noof M. Alabdulwahab[4], Reem E. Alalwan[5]

[1]Department of Orthopedic, College of Medicine, Imam Abdulrahman bin Faisal University, Dammam, Saudi Arabia

[2]Orthopaedic Department, Al Omran General Hospital, Al Omran City, Saudi Arabia

[3]Public Health Departement, Imam Abdulrahman Bin Faisal University, Khubar, Saudi Arabia

[4]Orthopaedic Department, Dammam Medical Complex, Dammam, Saudi Arabia

[5]Orthopaedic Department, King Hamad University Hospital, Bahrain

Corresponding author: Ahmed I. Almulhim.Department of Orthopedic, College of Medicine, Imam Abdulrahman bin Faisal University, Dammam, Saudi Arabia E-mail: ahmadimulhim1993@hotmail.com. ORCID ID: http//www.orcid.org/0000-0002-9080-5456.

ABSTRACT

Background: The Distal radius fractures in the pediatric age group have similar complications to any other fracture. One interpretation of the high fracture incidence in the distal third of the radius is the relative weakness of the metaphyseal part. **Objective:** The aim of this study is to provide an evaluation of Surgical complications of distal radius through satisfactory reduction and proper fixation by K-wires through bone growth plates. **Methods:** A retrospective single-center study in a tertiary hospital in Eastern Saudi Arabia from 2000 to 2021, using the hospital's electronic records system. The Inclusion criteria of this study involve all distal radius fracture cases who underwent surgical fixation by k-wire or plating system and are up to 14 years old. The exclusion criteria include loss of follow-up, incomplete data, and age of more than 14 years. **Results:** the study included 103 patients. The side of injury was almost equally distributed between the left and right sides. The odds of having at least one complication increase by 2.5 folds if the site of fracture is at the diaphysis. Further, if the distance of the fracture line to the epiphysis is more than 20 mm, the odds of reporting at least one complication post-procedure is 4.4 times higher than if it was at the level of the epiphysis. The majority of diaphyseal fractures required less than 6 weeks for radiological healing, which is significantly different from other sites which were evaluated. **Conclusion:** Complications of distal radius fracture due to Surgical intervention could be confounded by the complexity of the fracture itself. In our study, we found the distance of the fracture from the physis was inversely proportional to the likelihood of complications. For a comprehensive appreciation of physeal plate, we recommend extended follow-up for those who present with signs of severe distal radius fracture, especially in case of associated ulnar fracture.

Keywords: Paediatric Orthopaedics, Physeal injury, Distal radius fracture, Salter Harris Classification, K wire fixation.

1. BACKGROUND

The most frequent injury in children is a fractured distal radius. According to studies, the lifetime risk of distal radius fracture is 27% in girls and 42% in boys (1). Interestingly, a study in Sweden found an increase in the incidence of distal radius fractures among children in the summertime and a decline during the winter months (2). The most commonly reported mechanism is a fall on an outstretched hand.

To describe fractures with the involvement of the physeal plate, the Salter-Harris classification is the most widely used categorization scheme. It was developed by two Canadian orthopedic surgeons in 1963 with the aim to classify and predict the prognosis of fractures with physeal involvement in children (3) It classifies the growth plate fractures into 5 types (Figure 1). Type I is a fracture through the growth plate, characterized by widening of the growth plate. Type II involves fracture through physis with extension to the metaphyseal segment. Type III is a fracture of the physis extending to the epiphysis. Type IV describes a fracture that results in a small fragment comprised of the epiphysis, physis, and metaphysis. Type V results when crushing of the physis occurs. Although Salter-Harris classification is widely used by orthopedic surgeons worldwide, it was not validated by many studies. Nonetheless, available studies show high inter- and intra-observer reliability (4).

Management is determined by the type of fracture and the degree of displacement. Open fractures will almost certainly necessitate a surgical fixation. Closed fractures with acceptable alignment according to Noonan and Price criteria (5) can be treated conservatively with casting and followed in the outpatient setting. Treatment with soft cast immobilization is usually sufficient for torus (or buckle) fractures. The possibility of treatment at home is also possible for this fracture (6). On the other hand, closed fractures with unacceptable alignment, require more complicated management. Closed reduction in the emergency department followed by casting can result in acceptable alignment. However, due to the risk of re-displacement, particularly in the first two weeks, patients usually require close follow-up. Fractures with unacceptable alignment even after reduction or fractures with inherently unstable patterns will require surgical fixation.

Options for fixation include K-wire, plate, and screws in older children, Flexible nails, and a novel method of bioresorbable implants (7).

The most common method of fixation is the Kirschner wire technique, since it is readily available, relatively easy, and minimally invasive. K-wires can be placed outside the skin and hence can be removed in an outpatient setting, without the need for a second procedure. However, fixation with K-wires carries the risk of pin-track infection and requires casting for the relative weakness of the wires (7,8). Plate and screws can be a valid option in overweight adolescents where fixation with K-wires is not anticipated to adequately fix the fracture. Advantages include the achievement of stable anatomical reduction. Disadvantages include the risk of infection and prominent or painful hardware that results in secondary procedures for removal in the future. Flexible Nails are elastic rods most commonly used in both bone forearm fractures. The use of flexible nails is growing due to its inherently minimal invasive nature with effective fracture stabilization. It is recommended more for fractures of the shaft or fractures with a distance greater than 3.5 cm from the physis (9). Disadvantages include a secondary procedure to remove the rods 4-6 months after initial surgery. Bioresorbable implants were introduced to help overcome the need for secondary procedures. It is a convenient option to overcome additional procedures, their related costs and complications (7).

Fractures of the distal radius can put the patient and their families under stress. Children may also stop attending school or participating in sports and social activities for a lengthy time. Emergency department visits, closed reduction trials, surgical procedures, and follow-up appointments can result in significant financial burdens. In addition, the possibility of re-displacement, which usually requires re-manipulation or surgical fixation is possible, theoretically throughout the first 4 weeks after fracture (10).

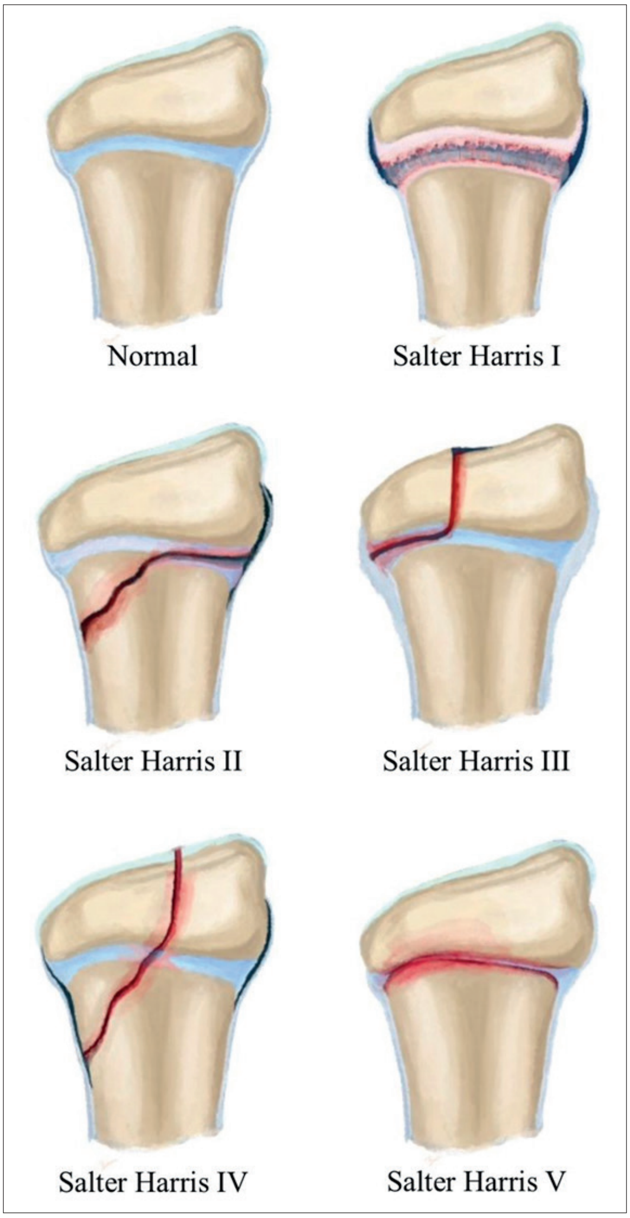

Figure 1: The Salter Harris classification.

In addition, iatrogenic complications are not uncommon. Casting restricts the movement of the forearm and hand and can result in bothersome itchiness and skin irritation. Stiffness requiring physical therapy is possible with prolonged immobilization. Infection can result in devastating sequelae, from requiring simple antibiotics to complete revision or malunion. Prominent hardware and the necessity for removal at later times is something to be aware of as well (10).

As professionals in the healthcare industry, we acknowledge the impact of stress on patients, their loved ones, and ourselves. It is imperative that we analyze our previous experiences in order to enhance our management skills and ensure optimal results.

2. OBJECTIVE

The aim of this study is to provide an evaluation of Surgical complications of distal radius through satisfactory reduction and proper fixation by K-wires through bone growth plates.

3. MATERIAL AND METHODS

Study design

This is a retrospective single-center study, using medical records from 2000 to 2021.

Settings

King Fahd Hospital of University (KFHU), Al Khobar, Saudi Arabia. KFHU is a tertiary teaching hospital with 400 beds.

Participants

The Inclusion criteria of this study involve all distal radius fracture cases who underwent surgical fixation by k-wire or plating system, and up to 14 years old, between the period 2000 to 2021. The exclusion criteria include loss of follow-up, incomplete data, and age of more than 14 years.

Variables

The variables assessed in the study include patients' demographic data, clinical history, physical findings, radiological impression, method of fixation, follow up, and complications aiming to address the outcome of distal radius injury in pediatric age group using the electronic hospital records.

Data sources/ measurement: Records of demographic data, clinical history, physical findings, radiological impression, method of fixation, follow-up, and complications were collected from the electronic system.

Study size

We retrospectively reviewed 103 patients (age 3-14 years) with distal radius fractures, who underwent surgical fixation with K-wire or plating system.

Statistical methods

Frequencies and percentages are calculated for summarizing the study variables. Chi-square test is used to assess the bivariate association of the study variables and whether the participant has at least one complication. In addition, crude odds ratios and their designated 95% confidence intervals were computed. significant value is set at 0.05, and all analysis was calculated using the Statistical Package for Social Sciences (SPSS) software version 27 (IBM Corp, 2017).

4. RESULTS

In total, 103 out of 121 patients were included in this study. Those are the patients who get admitted to the hospital. Most patients were males (n = 90, 86.5%) compared to females (n = 14, 13.5%). Regarding the side of injury, more than half were on the Left side (n = 59, 56.7%) and (n = 45, 43.3%) on the Right side. (n = 19, 18.3%) of the patients had fractures that can be classified as Salter-Harris fractures (Type 1, 2, 3, or 4). Most patient fractures were displaced (n = 94, 90.4%), compared to only (n=10, 9.6%) being non-displaced. Approximately half of the patients (n = 56, 53.8%) had Early (<24h) operative management, were (n = 48, 46.2%) had late operative management (>24h). In relation to the fracture site to the hand dominancy, (n=4, 43.3%) were unknown; moreover, (n=30, 28.8%) of the patient fractures were on the dominant side, and (n = 29, 27.9%) on the non-dominant side. Fall was the most commonly reported mechanism of injury by (n=83, 79.8%) of the

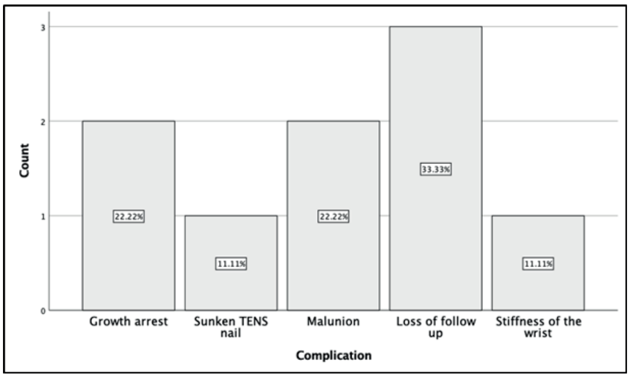

Figure 2. Complications in the study sample.

patients; second was Road Traffic or Motorcycle accidents by (n = 16, 15.4%), and for (n = 5, 4.8%) of the patients, the mechanism of injury was unknown. Figure 2 summarizes the complications.

Complications-demographic analysis

Of the 103 patients, 9 had at least one complication. Of those complicated cases, the majority were male (n = 8, 88.9%), with only one Female case (n = 1, 11.1%). More than two-thirds of the complicated cases were on the Left side (n = 7, 77.8%), compared to (n = 2, 22.2%) on the right side. Among the cases that had fractures that were classified as Salter-Harris, only one patient had complications (n = 1, 11.1%); in contrast, (n = 8, 88.9%) of the cases that were not classified as Salter-Harris were complicated. Most (n = 8, 88.9%) of the complicated fractures were displaced, and only one (n = 1, 11.1%) was non-displaced. As for the time interval between injury and operative management, approximately more than half (n = 5, 55.6%) were early (<24h), and (n = 4, 44.4%) were late (>24h). Concerning the side dominancy of the complicated cases, none were on the dominant side, and (n=4, 44.4%) were on the non-dominant side, and lastly, more than half were an unknown side of the injury (n = 5, 55.6%).

Fracture Site and Complications

Most injuries among included cases were more than 20 mm from the epiphysis (n= 37, 36%), followed by 11 to 20 mm away from the epiphysis (n= 34, 33%). Although none of the variables was significantly related to complication (Table 1), the odds of having at least one complication increased by 2.5 folds if the fracture site was at the diaphysis.

In addition, if the distance of the fracture line to the epiphysis is more than 20 mm, the odds of reporting at least one complication post-procedure is 4.4 times higher than if it was at the level of the epiphysis. Several variables appear to be significantly related to the fracture site, as shown in (Table 2).

Only 19 of the 103 cases in the study could be classified by the Salter-Harris classification; most of them were type 2 (n= 11, 57.8%) of the 19 Salter-Harris classified fractures. No significant relation was founded between Salter-Harris types fractures and complications.

Fixation Methods and Complications

Most of the cases in the study were treated by two crossing wires configurations (n= 66, 64%), while 14% had Titanium Elastic Nail System (TENS), and only 4%

Variables		Frequency (%)	Complication		Test (P-Value)	OR (P-value)	95% CI
			None ***n*= 95 (%)**	**At least 1** ***n*= 9(%)**			
Gender	Male	90 (86.5)	82 (86.3)	8 (88.9)	x^2= .05 (.83)	1	-
	Female	14 (13.5)	13 (13.7)	1 (11.1)		.79 (.83)	.09, 6.83
Side of Injury	Left	59 (56.7)	52 (54.7)	7 (77.8)	x^2= 1.78 (.18)	1	-
	Right	45 (43.3)	43 (45.3)	2 (22.2)		.35 (.20)	.07, 1.75
Salter Harris classification	Type 1, 2, 3, or 4	19 (18.3)	18 (18.9)	1 (11.1)	x^2= .34 (.56)	1	-
	None[†]	85 (81.7)	77 (81.1)	8 (88.9)		1.87 (.57)	.22, 15.02
Displacement	Displaced	94 (90.4)	86 (90.5)	8 (88.9)	x^2= .03 (.87)	1	-
	Nondisplaced	10 (9.6)	9 (9.5)	1 (11.1)		1.19 (.87)	.13, 10.67
Time between injury and OR	Early < 24 h	56 (53.8)	51 (54.3)	5 (55.6)	x^2= .01 (.94)	1	-
	Late >24 h	48 (46.2)	43 (45.7)	4 (44.4)		.93 (.91)	.23, 3.67
Dominancy	Dominant	30 (28.8)	30 (31.6)	0 (0)	x^2= 5.16 (.13)	0 (1.0)	0, 0
	Non dominant	29 (27.9)	25 (26.3)	4 (44.4)		1.28 (.73)	.31, 5.23
	Unknown	45 (43.3)	40 (42.1)	5 (55.6)		1	-
Mechanism of Injury	Fall (Unspecified)	83 (79.8)	76 (80.0)	7 (77.8)	x^2= .78 (.68)	1	-
	Road Traffic or Motorcycle accident	16 (15.4)	14 (14.7)	2 (22.2)		1.55 (.61)	.29, 8.25
	Unknown	5 (4.8)	5 (5.3)	0 (0)		0 (1.0)	0, 0
Site of Fracture	Epiphysis	19 (18.3)	18 (19.0)	1 (11.1)	x^2= 5.80 (.83)	1	-
	Metaphysis	28 (26.9)	27 (28.4)	1 (11.1)		.67 (.78)	.04, 11,36
	Diaphysis	57 (54.8)	50 (52.6)	7 (77.8)		2.52 (.40)	.29, 21,93
The distance of fracture line to the epiphysis	0 mm	24 (18.3)	23 (24.2)	1 (11.1)	x^2= 4.47 (.22)	1	-
	1-10 mm	9 (8.7)	9 (9.5)	0 (0)		0 (1.0)	0, 0
	11-20 mm	34 (32.7)	32 (33.7)	2 (22.2)		1.44 (.78)	.12, 16.82
	>20 mm	37 (35.6)	31 (32.6)	6 (66.7)		4.45 (.18)	.50, 39,56
Wire Configuration	1 wire	8 (7.8)	7 (7.4)	1 (11.1)	x^2= 2.93 (.57)	1	-
	2 wire crossing and/or Lag screw	66 (64.1)	61 (64.9)	5 (55.6)		.57 (.63)	.06, 5.64
	2 wires parallel	6 (5.8)	6 (6.4)	0 (0)		0 (1.0)	0, 0
	TENS	14 (13.6)	13 (13.8)	1 (11.1)		.54 (.68)	.03, 9.99
	Plate and screws or 3 k-wires crossing	9 (8.7)	7 (7.4)	2 (22.2)		2.0 (.60)	.15, 27.45
Clinical Healing	Less than 6 weeks	51 (49.0)	48 (50.5)	3 (33.3)	x^2= 1.52 (.47)	1	-
	More than 6 weeks	33 (31.7)	30 (31.6)	3 (33.3)		1.60 (.58)	.30, 8.45
	Loss of follow up	20 (19.2)	17 (17.9)	3 (33.3)		2.82 (.23)	.52, 15.35
Variables		Frequency (%)	Complication		Test (P-Value)	OR (P-value)	95% CI
			None ***n*= 95 (%)**	At least 1 ***n*= 9(%)**			
Radiological Healing	Less than 6 weeks	90 (86.5)	82 (86.3)	8 (88.9)	x^2= 0.41 (0.82)	.88 (.91)	.10, 7.84
	More than 6 weeks	4 (3.8)	4 (4.2)	0 (0)		0 (1.0)	0, 0
	Loss of follow up	10 (9.6)	9 (9.5)	1 (11.1)		1	-
Associated injury	No injury	36 (34.6)	33 (35.1)	2 (22.2)	x^2= 0.94 (0.62)	1.77 (.50)	.34, 9.27
	Distal ulnar fractures	62 (59.6)	56 (59.6)	6 (66.7)		3.30 (.36)	.25, 43.47
	Others*	6 (1.0)	5 (5.3)	1 (11.1)		1	-
Duration of follow up after reduction in months.	Median (IQR)	3 (4)	3 (5)	3 (3)	*Mann-Whitney U-test*= 409.500 (0.833)	1.002 (.952)	.94, 1.06

* Other associated injuries include Humeral fracture, Pelvis fracture, Scalp injury, Distal ulnar, Trochanteric avulsion, Bilateral tibia, Fibula fracture, Abdominal fracture.
[†] Not involving growth plate.

Table 1 – The variables that influence having at least one complication.

were fixated by plates and screws. As seen in the table.2, most of the three k-wire crossing configuration was done for diaphysis fractures. In addition, two wire-crossing configurations were mostly performed for the metaphysis and diaphysis fractures, while only 20% of the two wire-crossing were performed for epiphysis fractures; this difference was statistically significant (x2= 22.93, P= .028). The rest of the variables assessed in the study were not significantly associated with the fracture site (Table 2).

Most of the three k-wire crossing configuration was done for diaphysis fractures. In addition, two wire-crossing configurations were mainly performed for the metaphysis and diaphysis fractures, while only 20% of the two wire-crossing were performed for epiphysis fractures; this difference was statistically significant (x2=

Variables		Site of Fracture			Test (P-value)
		Epiphysis n= 19 (%)	Metaphysis n= 28 (%)	Diaphysis n= 57 (%)	
Gender	Male Female	15 (78.9) 4 (21.1)	27 (96.4) 1 (3.6)	48 (84.2) 9 (15.8)	x^2= 3.56 (.17)
Side of Injury	Left Right	15 (78.9) 4 (21.1)	16 (57.1) 12 (42.9)	28 (49.1) 29 (50.9)	x^2= 5.17 (.076)
Salter Harris classification	Type 1, 2, 3, or 4 None (not involving growth plate)	19 (0) 0 (0)	0 (0) 28 (100)	0 (0) 57 (100)	x^2= 104.00 (<.001)
Displacement	Displaced Nondisplaced	18 (94.7) 1 (5.3)	26 (92.9) 2 (7.1)	50 (87.7) 7 (12.3)	x^2= 1.08 (.584)
Time between injury and OR	Early < 24 h Late >24 h	9 (47.4) 10 (52.6)	16 (57.1) 12 (42.9)	31 (54.4) 26 (45.6)	x^2= .45 (.799)
Dominancy	Dominant Non dominant Unknown	3 (15.8) 7 (36.8) 9 (47.4)	9 (32.1) 7 (25.0) 12 (42.9)	18 (31.6) 15 (26.3) 24 (42.1)	x^2= 2.15 (.708)
Mechanism of Injury	Fall (Unspecified) Road Traffic or Motorcycle accident Unknown	15 (78.9) 3 (15.8) 1 (5.3)	22 (78.6) 5 (17.9) 1 (3.6)	46 (80.7) 8 (14.0) 3 (5.3)	x^2= .32 (.989)
The distance of fracture line to the epiphysis	0 mm 1-10 mm 11-20 mm >20 mm	17 (89.5) 1 (5.3) 1 (5.3) 0 (0)	6 (21.4) 7 (25.0) 14 (50.0) 1 (3.6)	1 (1.8) 1 (1.8) 19 (33.3) 36 (63.2)	x^2= 93.545 (<.001)
Wire Configuration	1 wire 2 wire crossing 2 wires parallel TENS Plate and screws 3 k-wires crossing Plate and screws and 3 k-wires crossing	2 (10.5) 13 (68.4) 2 (10.5) 0 (0) 0 (0) 1 (5.3) 1 (5.3)	2 (7.1) 24 (85.7) 1 (3.6) 1 (3.6) 0 (0) 0 (0) 0 (0)	4 (7.0) 29 (50.9) 3 (5.3) 13 (22.8) 4 (7.0) 4 (7.0) 0(0)	x^2= 22.93 (.028)†
Clinical Healing	Less than 6 weeks More than 6 weeks Loss of follow up	23 (63.2) 3 (15.8) 4 (21.1)	18 (64.3) 6 (21.4) 4 (14.3)	21 (36.8) 24 (42.1) 12 (21.1)	x^2= 8.71 (.069)
Radiological Healing	Less than 6 weeks More than 6 weeks Loss of follow up	18 (94.7) 0 (0) 1 (5.3)	24 (85.7) 2 (7.1) 2 (7.1)	48 (84.2) 2 (3.5) 7 (12.3)	x^2= 2.70 (.610)
Variables		Site of Fracture			Test (P-value)
		Epiphysis n= 19 (%)	Metaphysis n= 28 (%)	Diaphysis n= 57 (%)	
Associated injury	No injury Distal ulnar fractures Others*	7 (87.5) 0 (0) 1 (12.5)	11 (33.3) 19 (570.6) 3 (9.1	16 (26.2) 43 (70.5) 2 (3.3)	x^2= 15.71 (<.003)
Duration of follow up after reduction in months.	Median (IQR)	2 (5)	3 (4)	3 (7)	Kruskal-Wallis H test= 1.390 (.499)

*Other associated injuries include Humeral fracture, Pelvis fracture, Scalp injury, Distal ulnar, Trochanteric avulsion, Bilateral tibia, Fibula fracture, Abdominal fracture.
Bold text indicates significant associations.
†17 cells (81%) have expected count less than 5.

Table 2 – The site of fracture and the variables associated with it.

22.93, P= .028). The rest of the variables assessed in the study were not significantly associated with the fracture site (Table 2).

Operation time and complications

More than half of the cases analyzed in the study underwent surgery within 24 hours of the injury (N=5; 55.6%) in order to attain optimal alignment. Delaying the surgery did not result in any significant increase in complications.

Union rate

Most cases were clinically and radiologically healed within six weeks of the injury (50%, and 87%, respectively). Most diaphyseal fractures require less than six weeks for radiological healing, significantly different from other fracture sites (x2= 2.70, P= .610). All fractures were united during three months Except (N=20; 19.2%) who lost their follow-up.

Associated injury and complications

More than 55% of cases in the study had distal ulnar fractures as an associated injury. In addition, most of the fractures in the diaphysis presented with distal ulnar fractures as an associated injury, which appeared to be statistically significant (x2= 15.71, P= <.003). As seen in the Table 2, The rest had no other injuries, and no associations were found.

5. DISCUSSION

The fixation method for distal radius fractures in skeletally immature patients is a topic of debate. Our study found that the further the fracture is from the physis, the more likely complications are to occur. To fully understand the complications of distal radius fractures in pediatric patients, we suggest conducting extended follow-up, utilizing a larger sample size, and involving multiple centers. Unfortunately, these limitations were present in our study.

Complications demographic analysis

The incidence of distal radius fracture complications was higher in males (88.9%) within our population. This is similar to the finding of. Azad et al. who conducted the largest epidemiological study of distal

radius fractures in the united states, and concluded that the pediatric age group has male predominance in the aspect of distal radius fracture (11). However, Wasiak et al. reported no significant correlation between complication rate and gender.12 Almost half of the complications were on the non-dominant side, and more than two-thirds of complicated cases were on the left side among our population which showed no significance. Similarly, Knopp et al. found no high-risk association between complication rate with the side of the fracture (13).

Fracture location and complications

This study demonstrates that fractures of the diaphyseal part have a 2.5-fold increased risk of complications compared to more distal fractures. Truntzer et al reported a 10-degree per year remodeling potential of the distal physis of the radius. However, this effect is limited to the distal radius. Additionally, the distal radial physis can also contribute to the remodeling of diaphyseal fractures in pediatrics less than 10 years of age (14).

Variables that are found to be significantly associated with fracture site include Salter-Harris classification I through IV and the distance of the fracture line to the epiphysis. Knopp et al reported lower complication rates in distal radius fractures when compared to proximal forearm fractures (13). Again, this may be explained by the contribution of the distal physis to remodeling (14).

Fixation methods and complications

The usual treatment of choice for displaced distal radius fractures remains to be K-wire fixation (15). In our study, the most utilized treatment method was a fixation with 2 crossing wires, which was mainly used for metaphyseal and diaphyseal fractures. Three-wire configuration was also used for diaphyseal fractures. In contrast, Ramoutar et al favored the utilization of 1 K-wire and an immobilizing cast as sufficient fixation methods. In addition, their study examined the number of K-wires used and their effect on the eventual dorsal angulation. Their study concluded that increasing the number of K-wires is not associated with improvement in dorsal angulation (16). Tang et al described a method using a 2mm stainless-steel wire for the fixation of fractures at the meta-diaphyseal junction. They proposed that using 1 K-wire that goes approximately 10cm proximal to the fracture resulted in excellent outcomes and had more efficient costs compared to flexible nails (17).

Approximately 14% of distal radius fracture was fixed by the TENS method. Most frequently, it is used with both bone diaphyseal forearm fractures. Ahmed et al advised practicing caution in using flexible nails for distal forearm fractures as it is associated with high re-operation rates due to loss of reduction (9). Somisetty and Kapila also reported excellent outcomes in the vast majority of cases treated with TENS fixation (18,19).

The least number was fixed with plates and screws, accounting for only 4% of our study. This is in line with general practice as plates are considered to be of a more invasive nature and generally not the preferred method of fixation in the pediatric age group. Greig et al stated that plating can be used in an adolescent approaching skeletal maturity, with unstable fractures and intra-articular involvement (20).

Operation time and complications

More than half of the cases analyzed in the study underwent surgery within 24 hours of the injury (N=5; 55.6%) in order to attain optimal alignment. Delaying the surgery did not result in any significant increase in complications. However, in the operation period which is not included in our study, Van der Reis et al. study which compared intramedullary nail (IMN) fixation vs. plate and screws for forearm fracture in the pediatric age group reported that IMN fixation took shorter average operation time compared to plate and screws. However, there was no statistically significant difference in the rate of complications between the two procedures (21).

Union rate

Most cases were clinically and radiologically healed within six weeks of the injury (50%, and 87%, respectively). Most diaphyseal fractures require less than six weeks for radiological healing, significantly different from other fracture sites (x2= 2.70, P= .610). A study done by Kapila et al, showed the meantime for the radiological union was 9.2 weeks ranging from 6-13 weeks which involved all fracture sites (22). Compared to Ali AM study which was done only on diaphyseal fractures, reported that the mean time was 10 weeks ranging from 7-12 weeks (23). All fractures in our study were united during three months Except (N=20; 19.2%) who lost their follow-up.

Associated injury and complications

More than 55% of cases in the study had distal ulnar fractures as an associated injury. In addition, most of the fractures in the diaphysis presented with distal ulnar fractures as an associated injury, which appeared to be statistically significant (x2= 15.71, P= <.003). As reported by Juha-Jaakko. S, most forearm shaft fractures involve both bones and it is rare to have isolated radius shaft fracture (24). Similarly, Roy. D agrees that it is uncommon to have isolated displaced distal radius fracture with no associated ulnar fracture (25).

Shown in Table 2, The rest of the cases in our study had no other injuries, and no associations were found.

6. CONCLUSION

Distal radius fracture is a controversial condition when it comes to method of fixation in skeletally immature patient. In our study, out of the 103 patients, 9 experienced complications, which included follow-up loss. If the fracture site was at the diaphysis, there was a 2.5-fold increase in the likelihood of complications. Additionally, if the distance of the fracture line to the epiphysis was more than 20 mm, the odds of reporting at least one complication after the procedure were 4.4 times higher than if it was at the level of the epiphysis. K wires and elastic nail fixation did not have a higher complication rate compared to each other. However, Plate fixation, as reviewed in the literature, showed a high complication rate. Delaying surgical intervention did not result in any significant increase in complications. Within six weeks of the injury, union rates were clinically (50%) and radiologically (87%) achieved. More than 55% of cases in the study had distal ulnar fractures as an associated injury, which did not increase the rate of complications.

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