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Distal end radius fractures managed with ligamentotaxis

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Abstract
Distal radius is the site where the narrower diaphyseal part gradually broadens and thins out and thick cortical bone gradually replaced by spongy cancellous bone. In our study it extended from 0-18mm from distal articular surface proximally. Dorsal part of DER has lot of tendons, so there is always compression in the ventral and tension in the dorsal surface. Because of the tension, compression and distinct curvature fractures is very common at this region. Mostly common occurs around 12-18mm in elderly and 0-9mm in young from the articular surface. Union is early, but malunions are common Although distal radial fractures occur uniformly across all age group, a bimodal pattern was observed with one peak among young and one among elderly age-groups. Males suffered more fracture in the younger age group while female patient predominate in the elderly group due to higher incidence of osteoporosis. The most common fracture observed was AO type B, followed by Type A and C respectively caused mainly by accidental falls, although there is significant contribution by RTA in younger males. The surgical definition of distal radius has to be understood and emphasis must be paid in understanding and outlining the watershed line, the anatomy of ulnar and radial columns, the anatomy of lister's tubercle and the cortico-cancellous junction. While plating distal portion of the plate must not exceed the watershed line and be perfectly at the line of the pronator quadrates. Further prospective randomized studies with longer duration of follow up periods will be required to compare outcomes of different treatment modalities in different fracture types accurately to be able to come up with a regional standard protocol for managing these fractures based on the race, age, sex, demands, life expectancy, level of activity and availability of resources and type of health care services available locally.

Keywords: External fixation, extra-articular fracture, intra-articular fracture, radius fracture

Introduction
Distal radius fractures are one of the most common types of fractures, with over 640,000 cases reported during 2001 in the US alone [1]. Such data in the Asian region is lacking but is expected to be similar. For reasons not fully understood, and likely multi-factorial, the incidence of this fracture appears to be on the rise in the US and abroad [2]. The lifetime risk is 15% in women [3] and is one of the most common fracture in the postmenopausal period [4], which portends a high risk for future fragility fractures.

When analyzing the incidence of distal radius fractures, there are three major populations to consider: children and adolescents, young adults, and the elderly. The young and elderly populations are both considered at high risk for this injury. A significantly growing elderly population with a markedly increasing life expectancy is expected to increase the fracture incidence by a further 50 % by the year 2030 [6].

The distal radius usually refers to the lower end of the radius within one and half inch from the wrist joint line. It has a quadrilateral cross-section and includes the metaphyseal and epiphyseal regions. Anatomic features of the distal radius include the styloid process, the dorsal tubercle, and four surfaces: anterior, lateral, posterior, and medial. The scaphoid fossa, lunate fossa, and sigmoid notch are three concave articular surfaces. The scaphoid fossa and the lunate fossa are separated by a dorsal-volar ridge which defines the scaphoid and lunate facets. Studies of this iconic, yet still misunderstood area are few and far between. Works by Herzberg *et al.* [7] and Windisch *et al.* [8] have helped us understand distal limit, watershed line, dorsal tubercle, and wrist columns.

It has been demonstrated that volar cortex is thicker than dorsal hence fewer comminution and less likely to fracture. They also demonstrated the attachment of joint capsule and Pronator Quadrates attachment and its importance during internal fixation.

So a study was undertaken to find out answers to few important questions which remained unanswered in long run including defining the distal radius, whether locked plates offer any definite advantage over the traditional methods in terms of the long-term outcome, does, does the cost of the surgery and the implant balance any earlier return to normal function and is there a place for fixing simple, even un displaced fractures in elderly patients to allow a more rapid return to full function. The treatment of distal end radius fractures continues to evolve, and many such questions are expected to be answered by our institutional study.

Materials and Methods

This is a prospective randomized controlled observe study with sample size of 118 patients. Data has been collected from the patients who have attended orthopaedics OPD or those admitted to the orthopaedic wards of IMS & SUM HOSPITAL from November 2016 to June 2018. Data about both conservative (plaster technique) and surgical management (percutaneous pinning, platting, ex fix) of the fracture has been recorded.

All surgical procedures was done in the operation theatre under strict aseptic precautions and under suitable anaesthesia. Minimum follow up after the treatment up to 6 months were ensured for all patients included in the study. They were followed up and assessed at every 6 weeks, 3 months, 6 months and 1 year, for fracture union, status of implant, finger and wrist movements and if any complications. Final assessment of the functional outcome was done at 6 months.

On arrival of the patient in the casualty/opd, primary assessment of the haemodynamic status and vital parameters were done. Thorough history was taken with emphasis on mode of injury and any co morbidity like diabetes mellitus and hypertension, chronic obstructive pulmonary disease. History of smoking, previous fractures and osteoporosis was noted. Local examination was done to assess skin condition and swelling and to rule out any neurovascular compromise. Other associated injuries were examined and appropriately treated. X ray of injured limb were done in Anterior-posterior view and lateral view. Fractures were classified on x-ray using AO Classification for distal end of radius. Patient were chosen for conservative or surgical management based on patient demands and radiological and clinical assessment. Those selected for conservative management were taken to plaster room for the plaster to be done. And those who were chosen surgical management in them temporary immobilization of fracture was done with slab. Those patient who were admitted for surgical management were shifted to ward and given limb elevation. All the patients both undergoing conservative and surgical management were encouraged finger movements. Suitable analgesics were given to all the patient. For patient undergoing surgery preoperative blood investigation and pre anaesthetic check-up was done. X rays were discussed with senior faculties. Patient and relatives were explained treatment options and asked if they were willing to be a part of the study. Informed written consents were taken. Patient and relatives explained in details the procedure selected and its potential benefits and complications. Once surgical fitness was gained patient were posted for suitable surgical procedure. Type of anaesthesia was usually brachial plexus block or general anaesthesia wherever indicated.

Results

The age of the patients who attended OPD with distal radius fracture included in our study ranged from 20 to 85 years; average was 58 years. More than 56% of the patients belong to sixth decade and above. Osteoporosis being more prevalent at increasing age groups could predispose to increased frequency of fracture at advanced age group.

Table 1: Age distribution of cases

Age group (in years)	No of cases	
`20-30	12	43.4% (<5th decade)
31-40	22	
41-50	19	
51-60	21	56.6% (>6th decade)
61-70	22	
71-80	16	
>80	10	
Total	122	

The number of males and females in our study were 51 & 67 respectively. Our study shows significant increased incidence of fractures in females compared to males with increased age (>50y).

Table 2: Gender distribution of cases

Age	Male	female	Ratio
<50 y	33	18	2:1
>50 y	16	49	1:3
total	51	67	1:1

In our study, fractures were more common on right side. One possible cause could be due to right hand dominance in general population. 65 cases were right and 49 left sided, which showed predominance of dominant hand injury which is right side. 4cases of bilateral hand fractures were seen which was relatively rare.

Table 3: Side distribution of fracture among cases

Side	Right	Left	Bi-lateral
	65	49	4
%	55.1%	41.5%	3.5%

Fracture Distribution

In our study majority of the fractures were partially articular B (46.7%) type followed by Extra articular A type (32%) and completely articular C types (21.3%) respectively. While extra articular A type fracture were more common in the elderly, Partially articular B type were more common in the young. Since A1 fractures involved only the ulna, they were not included in our study.

Table 4: Distribution of patterns of fracture

Age(yrs)	A1	A2	A3	Tot	B1	B2	B3	Tot	C1	C2	C3	Tot
20-30	-	1	1	2	1	3	5	9	1	1	0	2
31-40	-	1	1	2	4	5	9	18	1	1	0	2
41-50	-	4	0	4	2	4	5	11	2	2	1	5
51-60	-	4	0	4	2	5	3	10	2	4	0	6
61-70	-	11	2	13	0	2	2	4	1	2	2	5
71-80	-	7	2	9	0	2	1	3	2	1	1	4
>80	-	5	0	5	1	1	0	2	0	1	1	2
Total	-	33	6	39(32%)	10	22	25	57(46.7%)	9	12	5	26(21.3%)

Mode of Injury

Majority of the fractures were due to accidental fall over an outstretched hand (42.62%). These fractures were found mostly in the elderly. Road traffic accident constituted the second most common cause with 35.24% mostly seen in young.

Table 6: Mode of injury

Mode of injury	No of cases	%
RTA	43	35.24%
Fall on outstretched Hand	52	42.62%
Industrial Trauma	11	9.01%
Sports trauma & closed contact sports	16	13.11%

Example of a patient

56 y female, Mode: Accidental fall at home on outstretched hand Type: AO 23 A2 Management: Closed reduction with pop cast

Final follow up

Day 1 (on the day of fracture)

Follow up 4 weeks

Follow up 24 weeks old

Final follow up

Dorsi Flexion

Palmar Flexion

Supination

Pronation

Discussion

Distal radius fractures are one of the most common types of fractures, with over distal radius fractures are one of the most common types of fractures, accounting for around 25% of fractures in the pediatric population and up to 18% of all fractures in the elderly age group. There were 640,000 cases reported during 2001 in the US alone [26]. Although the pediatric and elderly populations are at the greatest risk for this injury, distal radius fractures still have a significant impact on the health and well-being of young adults. Data from the past 40 years has documented a trend towards an overall increase in the prevalence of this injury. For the pediatric population, this increase can likely be attributed to a surge in sports related activities.

The incidence of fracture in young group was observed between 0-9mm from the distal articular region, while in elderly fractures were more common in two zones. First being 2-9mm from articular surface and second zone between 12-18 mm from distal radius. The probable reason is difference in bone mineral density and thickness of cortical bone in both group. In young the cortical bone mass being significantly more is more resistance to axial transmission of weight in comparison to the cancellous region of the distal most region. Together in combination with associated higher percentage of RTA, sports and industrial injuries involving higher forces exceeding 3000 N, leads to more common articular fracture in this group. In the elderly group, the cancellous group continues to be weaker, while the cortico-cancellous junction around 12-18mm from the articular surface forms another weak zone due to transition of cancellous to cortical bone. The cortical thickness of volar cortex being more than dorsal, leads to more dorsal fracture than volar. The thickness of medial and lateral cortices seem to remain constant with age and not affect fracture incidence or outcomes.

Ryan *et al.* [32] Demonstrated a statistically significant difference between the incidence rates of boys and girls, with 64% of all fractures occurring in boys. Other studies by Landin LA *et al* and Hangio H *et al* showed similar results. Baron *et al.* [30] reported that in the age group of 19–49, men and women had almost identical incidence rates however the incidence among women increased to approximately 4.88 times than men in the elderly age group. Brogren *et al.* [28] also documented comparable differences between elderly men and women, finding women had a higher overall incidence, with almost 5 times more fractures in women than in men.[33] They noted that the incidence for women increased rapidly from 50 years of age and older, almost doubling every 10 years until 90 years of age. Flinkkila *et al*. [34] took a closer look at this trend, breaking the age groups into 5 year increments, and found a similar trend. Our study also showed similar statistics with no of males being twice as females below age group of 50 years with ratio of 2:1, which reversed to 1:3 in the above 50 years age group with females being nearly thrice as those of males.

Leung *et al.* [35] reported a side distribution pattern which had 38.88% and 61.11% of left and right hand, respectively., while Mannur *et al*. [36] had reported 45% and 55% of left and right hand, respectively. Koji Fujii *et al.* [37] further reported 45.45% of dominant hand involvement and 54.54% of non-dominant hand involvement in study group. In our study 55.1% cases were right handed while 41.5% were left sided which was consistent with above studies.

Most of the fractures of the lower end of radius are usually the result of fall on outstretched hand as well as result of road traffic accident. In our study, we observed that of 46.62% (52 cases) of fractures occurred as a result of fall on outstretched hand, while 35.24% (43 cases) were due to Road traffic accidents. Similar study conducted by Yamamoto *et al.* [46] Aggarwal *et al.* [47] and Rahul R Bhagul *et al*. [48] had 23.86%, 38% and 50% of patients having injury due to fall on outstretched hand, and 20.45%, 30%, and 46.6% of patients had RTA, respectively. Which was consistent with our study showing increased incidence of fractures due to fall on outstretched hand.

Despite the euphoria of the good and very good clinical results in majority of distal radius fractures with use of ORIF in comparison to an external fixation technique, surgeons must keep in mind that the use of implants may cause serious complications. Knight D *et al.* [72] reported that tendon irritation to rupture is a major problem with a rate of 0 to 38 %. Flexor tendon irritation to rupture is due to very distal plate positioning, whereas extensor problems are the consequence of a screw too long in length. Beson *et al.* [73] reported screw penetration into the third dorsal compartment and fracture-related bony spurs or gapping at the fracture side as potential causes of the extensor pollicis longus tendon (EPL). Rahul R Bhagul *et al.* [48] reported wrist stiffness as the main complication. In the cases managed by closed reduction and cast the incidence of wrist pain was more. In our study group also we observed wrist stiffness as the most common complication. There were 17 cases of wrist stiffness involving type C out of 26 cases suggesting high incidence among C type fracture. Type A & Type B cases had 10 & 12 cases of wrist stiffness receptively. Wrist pain was the second most common complication with 8 cases involving Type C fractures. Carpel tunnel syndrome

was seen in 4 cases. 12 cases of malunion were noted radio logically in type A fractured mostly managed by closed reduction, suggesting importance of operative management in managing distal radius fractures. EPL rupture was seen in 2 cases on type A fracture managed conservatively, suggesting attrition of EPL tendon following malunion while 1 case of traumatic EPL rupture was seen in type C fracture which was managed with primary repair. Pin track infection was rare seen only in 3 cases which healed after removal of the pins.

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