Pattern of Distal Radius Fracture in Malaysian Children

Asim Abdelmoneim Mohamed, MD Ortho, Noor Fadzilah Razali, MSc, DSc, Rukmanikanthan Shanmugam, Msc Ortho (UM), A Saw, FRCS (Ed)

Department of Orthopaedic Surgery, University Malaya Medical Centre, 59100 Kuala Lumpur, Malaysia

SUMMARY

Introduction: The distal radius is the most common fracture site in children, but local information on the fracture pattern, mechanism of injury and socio-demographic characteristics of the fracture is lacking.

Material methods: We interviewed 126 children and their family members who were under follow up for this fracture in a single institution over a period of 2 years. Radiological images were reviewed to ensure that only those with fracture in the distal one third of the forearm were included.

Results: The overall incidence of this fracture increased with age, and male dominance was noted starting from schooling age. Most fractures occurred at home (38.8%), and 52.3% of all fractures were due to low energy falls. Sports injuries were mainly due to playing football, and road accidents due to riding bicycles. There were 49 (38.8%) children with incomplete fractures, and 19 (15.0%) with physeal plate fractures.

Conclusion: Male dominance for distal radius fracture occurred at a comparatively younger age in our population. Preventive measures should focus on home environment since this is the most common place for fracture to occur. Special attention should be paid to boys after the school going age.

KEY WORDS:
Epidemiology, distal forearm, gender, socio-cultural, Asia

INTRODUCTION

The distal radius is one of the most common fracture sites in children, contributing between 20% to 35% of paediatric fractures and about 80% of all forearm fractures in children [1,2,3,4]. Healing occurs promptly, non-union is uncommon, and some degree of displacement can usually be accepted due to good remodelling potential [3]. Overall outcome of non operative treatment is usually good [1,2,5,6]. Recommendation to use less rigid splinting for incomplete distal radius fractures is gaining popularity [7,8].

On the other hand, long term problems related to incomplete remodelling in older children has also been reported [5,6]. Information on various configurations of this fracture, mechanisms of injury and demographic pattern of the injured children may help us to estimate the fracture load and plan strategies to prevent the condition. Currently, most of the information on the this fracture is based on Western population [3,4,9]. Information derived from developing countries where children contribute a higher proportion of the total population is lacking. We conducted this study to look into the fracture patterns and socio-demographic factors associated with distal radius fractures in this country.

MATERIALS AND METHODS

All children below the age of 12 years who presented to our hospital with a diagnosis of distal forearm fracture between January 2008 and December 2009 (24 months) were enrolled for this cross sectional study. Approval from the ethical committee of the institution was obtained. We identified the relevant children from the paediatric outpatient clinic and conducted an interview with the child and parents or caretakers in the clinic. We also reviewed medical records and retrieved radiographic images of all these children to validate the clinical information and fracture site / configuration. Only fractures involving the distal one third of the forearm length (measured from tip of olecranon to radial styloid) were included. Patients with pathological fractures were excluded. Data collected included race, age, gender, date of injury, place and mechanism of injury, site and type of fracture and method of treatment. Physeal plate fractures were classified according to the Salter Harris classification, while metaphyseal fractures were classified as complete and incomplete fractures. We classified the mechanism of injury into seven types as described by Rennie et al [4]. We then compared rates of fractures between male and female gender using proportionate test (Ratio test) and a p-value of less than 5% would be considered significant.

RESULTS

A total of 126 children presented with distal radius fracture during the study period. There were 93 boys (73.8%) and 33 girls (26.2%) giving a male to female ratio of 2.8:1. Incidents of injury increased markedly especially in boys of school going age, and boys outnumbered girls more than 3 times after 8 years old. (Figure 1) The mean age for all the children at the time of injury in our study group was 8.9 years (range 1.5 – 12 yr). The mean age for boys was 9.1 years and for girls 8.4 years. Fractures involved the right upper limb in 59 children (46.8%) and the left side in 67 children (53.2%). The racial distribution was 62 Malays (64.2%), 27 Indians (27.7%) and 10 Chinese (7.9%).

The fractures were sustained at home in 49 children (38.8%), at playground or park in 27 children (21.4%), at sports tracts

This article was accepted: 15 June 2012
Corresponding Author: Asim A Mohamed, Department of Orthopaedic Surgery, University Malaya Medical Centre, 59100 Kuala Lumpur, Malaysia
Email: asimamm2006@yahoo.com

Table I : Distribution of place of injury with age and sex

Place of Injury	No.	Percentage	Mean age (years)	Male: Female Ratio	p-value
Home	49	38.8%	8.2	1.8 : 1	0.025*
Park playground	27	21.4%	8.2	1.7 : 1	0.203
School	17	13.4%	9.6	3.2 : 1	0.039*
Sports / track	22	17.4%	10.2	21 : 1	0.002**
Road	10	7.9%	10.3	9 : 1	0.009**
uncertain	1	0.8%	11.4	NA	NA

**: 1% level of significance and *: 5% level of significance.
NA Not applicable

Table II: Distribution of mechanism of injury with age and gender

Mechanism of Injury	No.	Percentage	Mean age (years)	Male: Female Ratio	p-value
Fall (below bed height)	66	52.3%	8.9	1.6 : 1	0.031*
Fall (above bed height)	22	17.4%	7.7	3.4 : 1	0.019*
Fall during contact sports	22	17.4%	10.7	21 : 1	0.0001**
Fall down stairs/slobs	2	1.5%	11.7	2 : 0	NA
Fall from building	1	0.8%	11.2	NA	NA
Blunt trauma	2	1.5%	7.5	1 : 1	0.8908
Road traffic accident	10	7.9%	10.7	9 : 1	0.0061**
Uncertain	1	0.8%	11.4	1 : 0	NA

**: 1% level of significance and *: 5% level of significance.
NA Not applicable

Table III: Distribution of fracture type, age and gender

Type of Fracture	No.	Percentage	Mean Age (years)	Male: Female Ratio	p-value
Metaphyseal Fractures					
Complete fractures	58	46.0%	8.8	3.4 : 1	0.004**
Torus	26	20.6%	8.8	2.2 : 1	0.042*
Greenstick	23	18.2%	8.5	3.6 : 1	0.014*
Physeal Fractures					
Salter 1	1	0.7%	8.6	NA	NA
Salter 2	18	14.2%	9.8	1.5 : 1	0.188
Total	126	100.0%	8.9	2.8 : 1	0.0001**

**: 1% level of significance and *: 5% level of significance.
NA Not applicable

Table IV: Fracture displacements based on anteroposterior and lateral radiographs

	No.	Percentage	Mean angle (degrees)
Antero-posterior Radiograph			
Radial tilt	47	37.3%	8.5
Ulnar tilt	16	12.6%	6.4
Lateral Radiography			
Dorsal tilt	85	67.4%	12.6
Volar tilt	15	11.9%	11.1
Translation more than 50%	42	33.3%	NA

NA Not applicable

in 22 children (17.4%) and at school in 17 children (13.4%). Only 10 children (7.9%) sustained their fractures on the road (Table I). When we analyze the mechanisms of injury, we noted that about half (52.3%) of the fractures were due to low energy falls (from a level below bed height). In 22 children (17.4%), the fractures were due to sports and tracts activities, and more than half of them (63.6%) were due to playing football. Male dominance was most significant in fractures occurring on the road (p=0.009) and in the sporting fields / tracts (p=0.002).

Twenty-two children (17.4%) sustained fractures following fall from level above bed height; nine of them (40.9%) fell from monkey bar in the playground and one child fell from balcony at the first floor of a building (also sustained skull fracture). Of the 10 children who sustained fractures on the road, 7 of them (70%) fell from bicycles. One of them presented with Gustilo grade 1 open fracture. Male dominance is significant in nearly all the mechanisms of injuries except for those with very low incidence due to lack of statistical power. The dominance is most significant in contact sports ($p<0.001$) and road traffic accidents ($p=0.006$)(Table II)

Fifty-eight children (46 %) had complete metaphyseal fractures (Table III). It is interesting to note that the mean age of children with Salter Harris type 2 fractures were slightly older than the rest but the number is too small for statistical analysis. In addition, the difference in male to female ratio for this group was not statistically significant. Distal radius

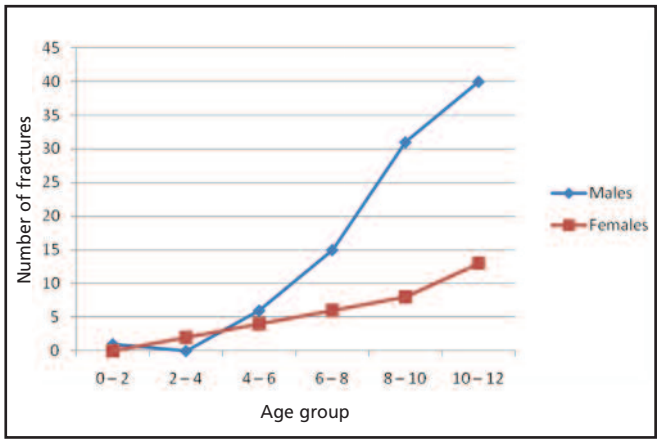

Fig. 1 : Number of fractures by age in years.

fracture segments showed radial tilt (mean of 8.5o) in the presenting radiographs in 37.3% of the fractures and ulnar tilt (mean of 6.4o) in 12.6% of fractures. Dorsal tilt (mean of 12.6o) occurred in 67.4% of the fractures while volar tilt (mean of 11.1o) in 11.9% (Table IV). Translation of more than half of the bone width was noted in 33.3% of fractures on presentation. Most of our children with displaced fractures were managed by closed manipulation followed by plaster casting under general anesthesia or sedation. Two children had percutaneous K-wire fixations of their distal radius fractures.

DISCUSSION

Our study showed that boys outnumbered girls by about 3 times in overall number of distal radius fracture below the age of 12 years old. From the age they started to attend school, male dominance was already obvious (Figure 1). Most studies reported male predominance in older children and attribute this to physiological influence of hormones at puberty [3, 4, 9], where boys would be more adventurous and would be more likely to participate in risky physical activities. This is supported by their findings where higher rate of distal radius fracture over the girls only become obvious during the adolescence [1,3,10]. In the Asian community, cultural and social values may have exerted its influence at a younger age, and girls are expected to display more feminine behaviour as early as lower primary schools. In our study, the increasing incidence of distal radius fracture with age was very obvious in boys, but we were not able to demonstrate a peak due to upper limit of our study group (Figure 1). Many hospitals in developing countries adopt a lower age limit for paediatric patients due to limitation in paediatric expertise and bigger patient load.

The fracture involved the left side in only 53.2% of our cases. The left to right ratio of 1.13:1 is much lower than those reported for this fracture in other studies which is about 2.3:1 [1, 3, 11]. The non dominant limb is more commonly used to break a fall, and we would expect more fractures of the left upper limb [1].

Home was the place of injury for about one third (38.8%) of our distal radius fractures (Table I). This is in contrast with figures reported by Landin where only 5% of all fractures were related to home environment [3]. Public facilities like playgrounds and parks are not commonly available in many developing countries, and most children spend their non schooling time at home. This is supported by a study from India that reported about 47.0% of all fractures in children occurred at home [11]. Measures to improve safety awareness at home environment should be carried out to reduce the risk of fractures as a whole. The second and third common places of injury were playground (21.4%) and sports tracts or fields (17.4%), similar to other published studies [1,11,12].

Fall from a low height is the most common mechanism of injury as reported by other studies [13,14] (Table II). The percentage of fractures on the road (7.9%) was comparable with the rate of 7.0% reported for general fractures in children by Rennie *et al* [4], but relatively lower than another study from urban India by Tandon et al (25.0%) [11]. Falling from bicycle is the most common cause (70%) in this group since children under 12 years old do not have license to operate motorized vehicles. This high rate of cyclist injuries was also reported by Landin [15]. Most of the protective devices for contact sports and road traffic users are designed to prevent injuries to the head, ankle and knee injuries. In children, these injuries were relatively less common as compare to forearm fractures. Further study on the design for protective gears for children should be conducted in order to ensure that they are able to effectively reduce the risk of injuries or fractures in the paediatric age group.

Our rate of incomplete fractures of distal radius is lower than other reports in the literature 9,16. For physeal plate fractures, our rate was about 15 % and mostly contributed by type 2 Salter Harris fractures. Reported rates of physeal plate fracture varied from 8% to 27% [1,9,16], and type 2 Salter Harris fractures predominate [17]. Although we were not able to analyse the age and gender distribution of this fracture subgroup due to age limitation and small number of patients, we noted slightly higher mean age (9.8 years) and lack of male dominance (male to female ratio 1.5 : 1, not statistically significant) in these children (Table III). Girls generally attain growth spurt earlier than boys and higher risk of fracture may be due to weaker physeal plate in this stage of growth.

Dorsal and radial tilt of the distal fragment was the most common displacement for distal radius fracture, corresponding to other reports in the literature [9,16]. We have more fractures with volar tilt (11.9%) compared to the 5.0% reported by Brudvik *et al* [16] (Table IV). In our study, 38.8% were incomplete fractures. The more recent literature favours managing incomplete fractures with minimal or soft splinting, and good results have been reported [7,8]. On the other extreme, about one third (33.3%) of our fractures had more than 50% translation based on presenting radiographs, suggesting a higher force of injury and lower inherent stability. Wrist pain and limitation in forearm motion have been reported after long term follow up, and they usually affect children who sustain fractures at age older than 10 years old [5,6]. Older children have shorter time for remodelling before they reach skeletal maturity.

Prevention and proper management of distal radius fracture is important especially in older children because of high incidence and potential long term morbidity of the condition in this group. Measures to reduce the incidence of fall from tripping or running at home, installtion of safer playground facilities and better supervision at school may help to reduce the incidence of distal radius fracture in children. The main limitation of this study is the age limit of 12 years old that excludes older children before skeletal maturity. The sample population is limited to admissions and referrals to a single institution.

CONCLUSION

Incidents of distal radius fracture increase with age, and male dominance occurred at a comparatively younger age in our population. Fractures occurred most commonly at home, followed by playground and school, and fall from low height contributed about half of all the fractures. Preventive measures should focus on the home environment since this is the most common place for fractures to occur, and special attention should be given to boys of school going age.

REFERENCES

1. Wilkins K E: The incidence of fractures in children. In: Rockwood C A, Wilkins K E, and Beaty J H . Fractures in Children. Philadelphia, Lippincott-Raven; Ed. 4. 1996. 3-17.
2. Stutz C, Mencio G A. Fractures of the Distal Radius and Ulna: Metaphyseal and Physeal Injuries. J Pediatr Orthop 2010; 30: S85-S89.
3. Landin LA. Fracture patterns in children: Analysis of 8,682 fractures with special reference to incidence, etiology and secular changes in a Swedish urban population 1950-1979. Acta Orthop Scand Suppl 1983; 202: 1-109.
4. Rennie L, Court-Brown C M, Mok J Y, Beattie T F. The epidemiology of fractures in children. Injury 2007; 38: 913-22.
5. Zimmermann R, Gschwentner M, Kralinger F, Arora R, Gabl M., Pechlaner S. Long-term results following pediatric distal forearm fractures. Arch Orthop Trauma Surg, 2004: (124): 179-86.
6. Friberg K S I. Remodelling after distal forearm fractures in children. III: Correction of residual angulation in fractures of the radius. Acta Orthop Scand l979; 50: 741-9.
7. Davidson J S, Brown D J, Barnes S N, Bruce C E. Simple treatment for torus fractures of the distal radius. J Bone Joint Surg Br, 2001; (83): 1173-5
8. West S, Andrews J, Bebbington A, Ennis O, Alderman P. Buckle fractures of the distal radius are safely treated in a soft bandage: a randomized prospective trial of bandage versus plaster cast. J Pediatr Orthop, 2005: (25): 322-5
9. KramhØft M, BØdtker S: Epidemiology of distal forearm in Danish children. Acta Orthop Scand 1988; 59(5): 557-9.
10. Hedström E M, Svensson O, Bergström U, Michno P. Epidemiology of fractures in children and adolescents. Acta Orthop 2010; 81: 148-53.
11. Tandon T, Shaik M, Modi N. Paediatric trauma epidemiology in an urban scenario in India. J Orthop Surg 2007; 15(1): 41-5.
12. Cheng J C, Ng B K, Ying S Y, Lam P K W. A 10-year study of the changes in the pattern and treatment of 6,493 fractures. J Pediatr Orthop 1999; 19: 344.
13. Fiissel D, Pattison G, Howard A. Severity of playground fractures: play equipment versus standing height falls. Injury Prevention 2005;11:337–339. doi: 10.1136/ip.2005.009167
14. Mahadev A, Soon M Y H, Lam K S. Monkey Bars are for Monkeys: A Study on Playground Equipment Related Extremity Fractures in Singapore. Singapore Med J 2004; 45(1): 9-13.
15. Landin L A. Epidemiology of Children's Fractures. Journal of Pediatric Orthopaedics B. 1997; 6: 79-83.
16. Brudvik C, Hove L M. Childhood fractures in Bergen, Norway: identifying high-risk groups and activities. J Pediatr 2003; 23: 629-34.
17. Houshian S, Holst A, Larsen M, Torfing T. Remodeling of Salter-Harris Type II Epiphyseal Plate Injury of the Distal Radius. J Pediatr Orthop 2004; 24: 472-6.