Pattern of Distal Radius Fracture in Malaysian Children

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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. Healing occurs promptly, non-union is uncommon, and some degree of displacement can usually be accepted due to good remodelling potential. Overall outcome of non-operative treatment is usually good. Recommendation to use less rigid splinting for incomplete distal radius fractures is gaining popularity.

On the other hand, long term problems related to incomplete remodelling in older children has also been reported. 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. 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. 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. 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...
Table I: Distribution of place of injury with age and sex

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

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

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

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

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

Table III: Distribution of fracture type, age and gender

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

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

Table IV: Fracture displacements based on anteroposterior and lateral radiographs

<table>
<thead>
<tr>
<th>Type of Fracture</th>
<th>No.</th>
<th>Percentage</th>
<th>Mean angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antero-posterior Radiograph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radial tilt</td>
<td>47</td>
<td>37.3%</td>
<td>8.5</td>
</tr>
<tr>
<td>Ulnar tilt</td>
<td>16</td>
<td>12.6%</td>
<td>6.4</td>
</tr>
<tr>
<td>Lateral Radiography</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dorsal tilt</td>
<td>85</td>
<td>67.4%</td>
<td>12.6</td>
</tr>
<tr>
<td>Volar tilt</td>
<td>15</td>
<td>11.9%</td>
<td>11.1</td>
</tr>
<tr>
<td>Translation more than 50%</td>
<td>42</td>
<td>33.3%</td>
<td>NA</td>
</tr>
</tbody>
</table>

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
The non dominant limb is more commonly used to
upper limb.

**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, 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. 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.
The non dominant limb is more commonly used to
upper limb.

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. 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. 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.

Fall from a low height is the most common mechanism of
injury as reported by other studies (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, but relatively lower than another
study from urban India by Tandon et al (25.0%). 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. 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. 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%, and type 2 Salter Harris
fractures predominate. 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. We have more fractures with volar tilt (11.9%) compared to the 5.0%
reported by Brudvik et al (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. 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. 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, installation 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