

# Monkey Bars are for Monkeys: A Study on Playground Equipment Related Extremity Fractures in Singapore

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## ABSTRACT

**Studies in Caucasian populations have shown that a significant percentage of childhood extremity fractures occur at the playground. There are no comparable studies in Asian populations. Thus this study sets out to determine the pattern of playground related extremity fractures in Asian populations and to suggest modifications to prevent or reduce these injuries.**

**This study involved a retrospective review of 390 patients with these fractures who visited our Department from May 1997 to December 1998. This accounted for 19.5% of all fractures seen in the same period. The largest age group affected were the five through 12-year-old patients with a male to female ratio of 2:1. Monkey bars or upper body devices were the most common cause (66%). The most common fracture was supracondylar fractures (43%).**

**Further studies to determine the actual dimensions of playground equipment will be carried to ascertain with greater certainty the safety of these equipment in our playgrounds.**

**Keywords: extremity fractures, monkey bars, paediatric fractures, playground, supracondylar**

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## INTRODUCTION

The need to play is extremely important in the physical as well as mental development of children. With increasing population density and scarcity of land it is no wonder that many children in Singapore play at public playgrounds, which are designed and built, based on specifications laid out by the National Parks Board and spelt out in the "Specification for Playground equipment for public use"<sup>(1)</sup>.

Playgrounds were originally developed during the 19<sup>th</sup> century to offer children play opportunities in an increasingly industrialised society<sup>(2)</sup>. With it

came the need to ensure the safety of the playground and thus guidelines like the one quoted above. However a worrying trend of injuries occurring at these playgrounds in developed countries despite compliance to these specifications had sparked several studies in several countries which have questioned the safety of these guidelines and the need for modifications. Amongst these countries are the United States of America (USA)<sup>(3-6)</sup>, United Kingdom (UK)<sup>(7,8)</sup> and New Zealand<sup>(9)</sup>. What was glaring in all these studies, which will be discussed in detail later, is the increased incidence of upper extremity injuries occurring from a fall from "hanging" equipment which is known by different terms such as "monkey bars", "jungle gym" or "upper body equipment" as used in the National Parks Board in Singapore<sup>(1)</sup>.

Although well studied in the Caucasian community, as noted above, there has been no study so far which described the pattern of these injuries in the fast developing region of South East Asia. Thus this study was carried out at the KK Women's and Children's Hospital which saw a majority of paediatric patients and as such provided a good guide to the pattern of injuries of children in Singapore.

The purpose of this study is to firstly determine the pattern of extremity fractures sustained as a result of using playground equipment and secondly to make educated recommendations, based on our findings, on the modifications that might reduce the incidence of these injuries.

## METHODS

A retrospective review of case notes and radiographs was performed on all outpatients and inpatients with extremity fractures seen by the Department of Orthopaedic Surgery, KK Women's and Children's Hospital between May 1997 and December 1998. Basic demographic information as well as mode, site and nature of the extremity fracture was obtained. Only fractures relating to playgrounds were included. Out of these, only those

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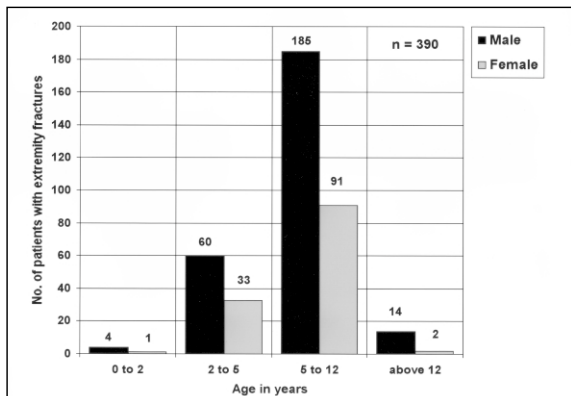


Fig. 1 Bar chart shows the age-sex distribution of patients with extremity fractures related to playground equipment.

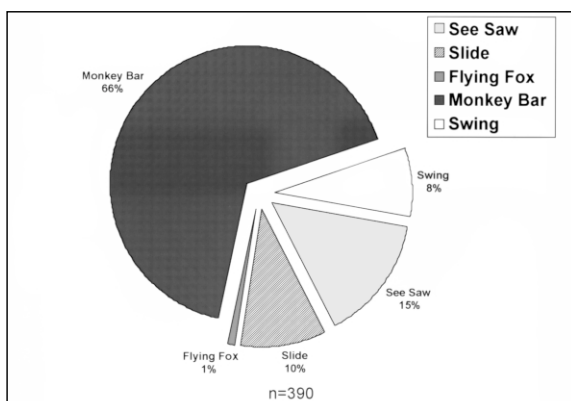


Fig. 2 Pie chart shows the contribution of different playground equipment to extremity fractures.

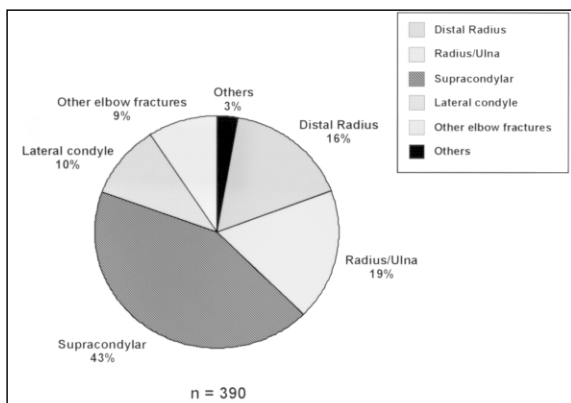


Fig. 3 Pie chart shows the nature of extremity fractures related to playground equipment.

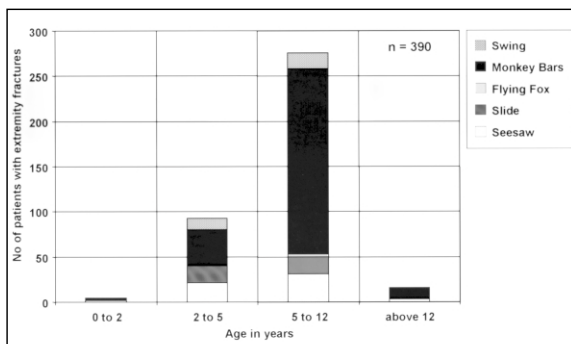


Fig. 4 Bar chart shows the mode of playground equipment related extremity fracture in different age groups.

related to playground equipment were studied. Injuries such as falling while running at the playground were excluded as they were not unique to playgrounds.

The patients were further stratified into four age groups; those from birth through two years old, those from two through five years old, those from five through 12 years old and those above 12 years old. This age stratification was based on that used by the National Parks Board when making specification for its “upper body equipment” of which monkey bars are included<sup>(1)</sup>. This allows for more meaningful interpretation of data relating to age. Since this study is largely descriptive in nature, no statistical methods were used for the purpose of statistical hypothesis testing.

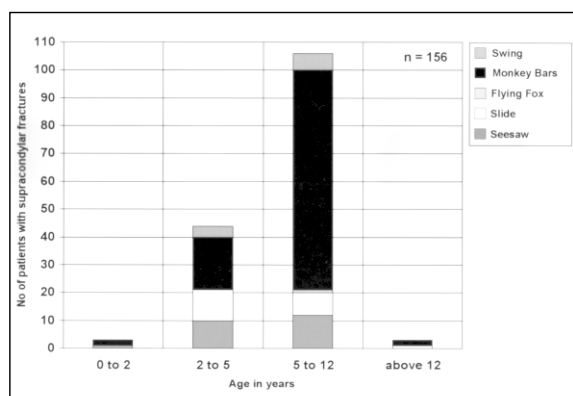
**RESULTS**

There were a total of 2,001 extremity fractures treated by the Department of Orthopaedic Surgery, KK Women’s and Children’s Hospital between May 1997 to December 1998. Out of these, there were 390 (19.5%) extremity fractures that were related to the use of equipment at playgrounds. It was these 390 patients that were studied.

The male to female ratio was approximately 2:1. Two hundred and sixty-six (68%) were Chinese, 66 (17%) were Malay, 44 (11%) were Indian and the rest were categorised under “Others” (4%). The age ranged from two to 15 years old with the average age being seven years old and the median age being seven as well. There were 5 (1.3%) patients less than two years old, 93 (23.8%) were between two through five years old, 276 (70.7%) were between five through 12 years old and 16 (4.2%) were above 12 years old. The sex ratio within each group was approximately 2:1 (Fig. 1).

With regard to mode of injury, the majority of injuries were caused by monkey bars (66%) with the contribution of other playground equipment as shown in Fig. 2. With regard to site of fracture, 362 (92.8%) occurred in the upper extremity and 28 ( 7.2% ) occurred in the lower extremity. Two hundred and five of the 362 upper extremity fractures were on the left side (56.6%) with the rest on the right. Of the upper extremity fracture, supracondylar fractures were most common (43%) with other fractures contributing a lesser proportion (Fig. 3). When mode of injury was stratified according to age, monkey bars produced the largest number of fractures in the five through twelve years age group (Fig. 4).

Supracondylar fractures sustained from playground equipment was then studied, as this was



**Fig. 5** Bar chart shows the mode of playground equipment related supracondylar fractures in different age groups.

the most common fracture treated in our hospital as well as the most likely fracture to require hospitalisation. Of the 2,001 fractures seen, 472 (23.6%) were supracondylar fractures. Out of these, 156 (33.0%) were related to playground equipment. And out of the 156, 102 (65.3%) were related to monkey bars. The male to female ratio was about 2:1. Ninety-five (60.9%) occurred on the left elbow with the rest occurring on the right side. The age of patients ranged from two to 14 years with average being seven years old. When stratified for age and mode of injury, the five through 12 years age group showed the highest numbers of supracondylar fracture with the largest proportion being related to monkey bars (Fig. 5).

## DISCUSSION

Playgrounds have been defined as “designated areas where stationary or manipulative equipment is located to facilitate a child’s physical, emotional, social and intellectual development”<sup>(10)</sup>. As such it is implied that playgrounds are an essential part of a growing child. Therefore it is of paramount importance that these places have adequate safety measures so that the development of a growing child is not compromised with playground related injuries.

To this end, most developed countries have strict guidelines to the design and use of these playgrounds. In Singapore, the design and use of playground equipment is regulated by the National Parks Board based on the “Specification for playground equipment for public use”<sup>(1)</sup>. Despite these guidelines, studies done mainly in Caucasian populations have shown a significant number of injuries being related to the use of playgrounds<sup>(3-9)</sup>. These will be referred to in detail when discussing our results. What remains glaring is despite a fast developing region with increasing numbers of playgrounds there have been no studies reflecting the pattern of these injuries in the South East/East Asia region.

This study was ideally carried out in our hospital as it handled a majority of injuries from the paediatric population defined as those 17 years and below and as such provided a good extrapolation of the pattern of playground equipment related injuries in the country. We found that out of all extremity fractures seen, close to 20% were related to playground injuries. This compares well to the 29% that was reported by Farnsworth et al in San Diego<sup>(5)</sup>. Also, a study done by Purvis et al in the United States (US) reported recently showed that 75.8% of emergency room-treated injuries occurred on public playground equipment<sup>(6)</sup>. In our study we found that the male to female ratio in all groups of age was approximately 2:1 (Fig. 1). This differed from the study in Caucasian populations which revealed similar rates of injuries in both male and females<sup>(4,5,9)</sup>. This could be contributed by the arguably perceived notion of boys being more boisterous in Asian populations. The racial differences matched the racial proportions of the population. The average age of seven concurred with most studies on playground injuries<sup>(3-9)</sup>.

When the mode of injuries was looked at, monkey bars produced the majority of the injuries (66%) as shown in Fig. 2. This was in concurrence with most studies<sup>(3-9)</sup>. When stratified to age, the largest number of injuries was shown to be related to monkey bars in the five through 12 years age group (Fig. 4). This is interesting as the “Specification for playground equipment for public use” states that: “The maximum height of upper body devices for use for two- through five-year-old shall be no greater than 1,500 mm, measured from the centre of the grasping device to the top of the protective surfacing below. The maximum height of upper body devices for use by five- through 12-year-olds shall be no greater than 2,100 mm”<sup>(1)</sup>. It appears that the higher height limit tended to produce the most injuries.

Chalmers and colleagues from New Zealand clearly showed that the risk of injury was significantly increased at heights of over or 1,500 mm<sup>(11)</sup>. This was further confirmed by Mott et al at the Royal Infirmary in Cardiff<sup>(7)</sup>. This may be due to older children holding on to the false notion that they were better able to avoid injuries falling from higher heights. Poor absorbing surface was thought also to contribute to these injuries<sup>(12-14)</sup>. However it was shown by E Petridon et al that although the absorbing potential of the playground was important for head injuries it did so to a much lesser extent when it came to extremity fractures sustained from a fall<sup>(3)</sup>. This was also implied by the study by Chalmer<sup>(11)</sup>. It is not difficult to understand how the

presence of adults did not influence the occurrence of these fractures as shown by Waltzman et al<sup>(4)</sup>. The role that playground equipment-related injury is further emphasised by Mott et al who concluded that successes in injury prevention have resulted from making the environment safer rather than just educating children<sup>(15)</sup>.

We then looked at supracondylar fractures alone as it was the most common fracture requiring hospitalisation in our hospital. A total of 476 supracondylar fractures were seen in the study period and 156 out of these (33.0%) were related to playground equipment. Out of these 102 (65.4%) were related to monkey bars alone. Again this compared well with the 61% derived in the study done by Farnsworth et al in San Diego<sup>(5)</sup>. The male to female ratio of 2:1 differed from most other studies which did not show any difference in fracture incidence with respect to gender<sup>(5)</sup>. The age group ranged from two to 14 with the average and median being at seven years old. This compared well with the San Diego study<sup>(5)</sup>. The pattern of supracondylar fractures in the different age group once again showed that the five- to 12-year-old were worst affected with most falling off monkey bars (Fig. 5).

It is not surprising that since supracondylar fractures formed the biggest proportion, the overall fractures distribution when stratified for age and mode (Fig. 4) were very similar to that of supracondylar fractures alone (Fig. 5). It was also found that 60.9% of the supracondylar fracture was on the left arm. This was thought to be due to the fact that a fall from a height usually occurred on the non-dominant arm since the dominant arm is used to hang on to the rung of the monkey bar.

Thus from the above the most likely scenario of a playground injury is of a seven-year-old boy falling from a monkey bar with a maximum height of 2,100 mm onto his non dominant arm sustaining a supracondylar fracture. The question that needs to be answered is, what is it in this scenario that can be changed to reduce these equipment related fractures. It is unwise to remove playgrounds completely as they are important in the overall development of a child. It is also not possible to impose different age limits to different playground equipment as it would be almost impossible to enforce. Parent supervision and trying to educate a seven-year-old child on the oxymoron of how to play has great limitations. The limitation of playground surface in reducing extremity fractures from a height has already been alluded to above<sup>(3)</sup>.

What remains is the design and the content of the playground which can be varied to ensure

maximum safety for a seven-year-old child. Thus it would be wise to exclude monkey bars or hanging equipment from playground completely. If this is not possible, then the height limit should be reduced to a maximum of 1,500 mm or less.

This study, being retrospective, has the limitation of accuracy of data as all retrospective studies do. In addition data regarding details of injury and treatment of injury was not obtained as this could determine the clinical "cost" of these injuries in more detail.

Now that we have studied the injury pattern, it would be interesting to study the playgrounds themselves. This can be done prospectively by visiting and investigating every aspect of the playground and equipment that had produced an extremity fracture. Other valuable information such the rate of injury of a particular playground or equipment can be studied by observing the number of children visiting a particular playground in a day. Factors that might contribute to these fractures such as presence of a supervising adult can also be studied. As an extension of the above findings, we will be embarking on a prospective study to determine the actual dimensions of playground equipment to ascertain its safety in our playgrounds.

## CONCLUSION

Although some injury is inevitable and can be expected during play, the finding that 20% to 30% of extremity fractures occurring as a result of playground equipment is rather high. Based on our findings, monkey bars or "upper body devices", which can be up to a height of 2,100 mm, are the biggest culprit. They affect the primary school-going child who is most commonly injured, with a supracondylar fracture which is the fracture that most likely will require hospitalisation and surgery.

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