

Predilection for Supracondylar Fractures in Children with Cubital Recurvatum

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Abstract

It has been a common observation that children with supracondylar fracture of the humerus tend to demonstrate hyperextensibility of their elbow joints. In this study, we measured and compared the degree of hyperextension of the uninjured elbow of children less than sixteen years old who sustained either a supracondylar or a distal radial fracture.

We concluded that children with higher degree of hyperextension in the elbow are more likely to sustain a supracondylar fracture than a distal radius fracture during a fall on the outstretched hand.

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Introduction

Children tend to protect themselves with their outstretched arms when they fall, resulting in high incidence of upper limb fractures and accounting for 65% to 75% of all long bone fractures in children.¹⁻⁴ Fractures about the elbow alone account for 7%, out of which supracondylar fracture is the commonest. In a study of fractures in 8682 children by Landin,⁴ supracondylar fracture was 10th in frequency of occurrence.

Supracondylar fracture is therefore commonly encountered by the orthopaedic surgeon during his daily practice. Despite its prevalence, this fracture still remains as one of the fractures that poses some difficulty in its management. For instance, during the acute stage of the injury, the child is often not agreeable to a proper examination. Diagnosis is usually made after an appropriate radiograph has been taken. In addition, many clinicians and parents have been perturbed by the occasional unfavourable outcome of cubital varus deformity which can be difficult to predict during the early stages of management.⁵

This is in contrast to distal radius fracture which is the commonest fracture sustained among children,¹ often caused by a similar mechanism of injury as a supracondylar fracture i.e. a fall on the outstretched hand. The former, usually results in less deformity in children as it remodels well. Moreover, neurovascular complications are also less common compared to supracondylar fracture.

It is of interest to find out what factors predispose a child's arm to a supracondylar fracture rather than a distal radius fracture during a fall on the outstretched arm. We conducted a retrospective study in an attempt to find a correlation between the degree of cubital recurvatum and its predilection for supracondylar fracture during a fall on an outstretched hand using distal radial fracture as comparison.

Materials and Methods

Our sample population was obtained from the attendance of children aged 16 and below at the outpatient clinic of our hospital. They were previously seen at the accident and emergency department where the diagnosis of fracture was first made.

We surveyed a total of 58 children in 1995, of which 25 had supracondylar fractures and 33 had distal radius fractures. All of them were seen at least once by a qualified specialist to confirm the diagnosis.

The parent of each child was given a survey form similar to that depicted in Appendix 1. Only cases where the fracture was sustained from a fall on the outstretched hand were included in the study.

In this study, we made the assumption that the degree of cubital recurvatum of the two elbows was probably similar prior to the injury. This assumption is supported by Boone and Azen's⁶ study of 109 subjects. They found that there was no significant difference in the degree of extension between the right and left arms of healthy

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APPENDIX 1: SURVEY FORM FOR PARENTS OF PATIENTS

Predilection for Supracondylar Fracture in Patient with Cubital Recurvatum

1. Age (at time of injury)
2. Sex (M/F)
3. Date of injury
4. Mechanism of fall (on outstretched arm? Yes/No)
5. Previous injury to contralateral elbow? (Yes/No)
6. Arm injured? (Right/Left)
7. Dominant arm? (Right/Left)
8. Treatment requiring operative procedure? (Yes/No)

Examination of upper limbs:

- Degree of extension of elbow on uninjured arm:
- Degree of extension of elbow on injured arm:
- Degree of cubital valgus on uninjured arm:
- Degree of cubital valgus on injured arm:

subjects. Thus, by measuring the uninjured elbow, we could obtain a fair reflection of the degree of hyperextension of the injured limb prior to the injury.

Those who had sustained injury to the contralateral elbow at any time were excluded from the study as the measurements of the contralateral elbow may not reflect the true degree of recurvatum.

Each child was brought into the examination room with the examiners being blinded as to the region of the injury. The examiners were only shown the uninjured arm and measurements of the cubital recurvatum were made. The first 10 children in our study had their measurements repeated by another examiner to exclude inter-observer error. Thereafter, we also measured the cubital angle of both elbows of those children with supracondylar fractures.

All measurements were made using a standard goniometer. The degree of cubital recurvatum was measured by first placing the arm on a horizontal block and allowing the forearm to extend fully over the edge of the block. The humerus and radius were palpated and the limbs of the goniometer were aligned parallel to the bones. The axis of the goniometer was made directly over the axis of the elbow extension movement.

In measuring the cubital angles, the elbow was placed in full extension. The limbs of the goniometer were aligned parallel to the midline of arm and forearm with the axis of rotation at the midpoint of the elbow flexure crease. All examiners followed the same method of measurement.

The results were collated, tabulated and analysed using the standard statistical methods commonly used in daily practice namely, the student's *t*-test, correlation coefficient, confidence interval and the chi-square test.

Results

A total of 58 children were surveyed in this study. Twenty-five children had supracondylar fractures and the remaining 33 had distal radial fractures. One child

had a previous injury to the contralateral elbow and was excluded from the study.

Out of the 57 children, 46 sustained their injuries while breaking their fall on outstretched arms, while the remaining injuries were caused by various other mechanisms or the parents were unable to ascertain the mechanism of injury. The measurements of this group of 46 children who shared the same mechanism of injury were used for analysis.

Thirty-three out of the 46 children who sustained fractures on the outstretched arms were males. Using the chi-square test, it was found that there was no significant difference in the proportion of fracture type observed between the gender ($\chi^2 = 0.16$; $P = 0.69$).

Seventeen out of the 46 children broke their fall and sustained a fracture on their right hand ($\chi^2 = 0.06$; $P = 0.81$). A total of 13 children fell on their dominant hand while the remaining 33 fell on their non-dominant hand ($\chi^2 = 1.26$; $P = 0.26$). There was no significant difference in the proportion of fracture types observed between the right and left arms and between the dominant and non-dominant arms.

Three out of the 26 children who sustained a distal radial fracture required an operative intervention while only 1 out of the 20 children who sustained a supracondylar fracture required an operative procedure.

When measuring the amount of angular deformity to the elbow of those who sustained a supracondylar fracture, it was noted that only 3 out of the 20 children had no deformity, 9 had an angular deformity of less than 5° , 5 had 6° to 15° of angular deformity and 3 had more than 15° of angular deformity.

In the analysis for inter-observer error, the measurements on the degree of cubital recurvatum of 2 independent examiners were compared and analysed and were found to have a high correlation coefficient value of 0.976.

The 95% confidence interval for the mean of the degree of recurvatum in the distal radius fracture group was $10.346 \pm 2.045^\circ$, and that for the supracondylar fracture group was $16.8 \pm 2.107^\circ$. This difference was found to be statistically significant ($P < 0.05$) using the two-sample student's *t*-test.

There was a significant difference in the degree of cubital recurvatum comparing those who sustained a supracondylar fracture to those who sustained distal radius fracture. We also found that our simple clinical method of measurement yielded values that correlated well between different observers.

Discussion

In a study of 1579 cases of elbow injuries by Henrikson,⁵ it was noted that children who sustained supracondylar fracture were more likely to have hyperextension of

their normal elbows than those children who had sustained other types of elbow injuries. In addition, he also found that children with hyperextension of the elbow were more susceptible to repeated supracondylar fractures than the general paediatric population.

Minkowitz and Busch⁷ explained the mechanism of the supracondylar fracture by the bending moment of the olecranon on the isthmus of the lower humerus. The bending moment is generated by the presence of the collateral ligaments and soft tissue which restrict hyperextension and converts the floor reaction force on impact to a bending force.

Using the same model, we can attempt to postulate that there is a difference in the breaking force between elbows of different degree of extension even when the resultant force on impact is the same. Referring to Figure 1, the amount of moment about the breaking point is calculated by the product of the resultant force and the perpendicular distance, d . Using exaggerated illustration in Figures 2a and 2b, it can be shown that the perpendicular distance increases with the degree of hyperextension permitted and thus increases the moment or bending force at the breaking point. It was this theoretical finding, together with the experience from Henrikson's study, that formed the basis of our hypothesis for this study.

In our study, we could not exclude the possibility of age being a confounding factor due to the limitation of a small study population. A larger study population that allows age-stratified analysis will probably enable us to eliminate age as a possible confounding factor.

Conclusion

The results of our study of 46 children who sustained fractures on the outstretched arm showed that there was a significant difference in the degree of cubital recurvatum of those who sustained a supracondylar fracture compared to those who sustained a distal radius fracture. It was also noted that our clinical method of measurement yields values that correlated well between different observers.

In our study, majority of the patients were male (71.7%) as was also reported by Landin and Danielsson.³ Contrary to the usual belief, more fractures were sustained in the non-dominant hand (71.7%). Angular deformity of the elbow was observed to be a common complication after a supracondylar fracture. Out of the 20 children who had their cubital angles measured, only 3 demonstrated no difference in the angle between the injured and uninjured elbows.

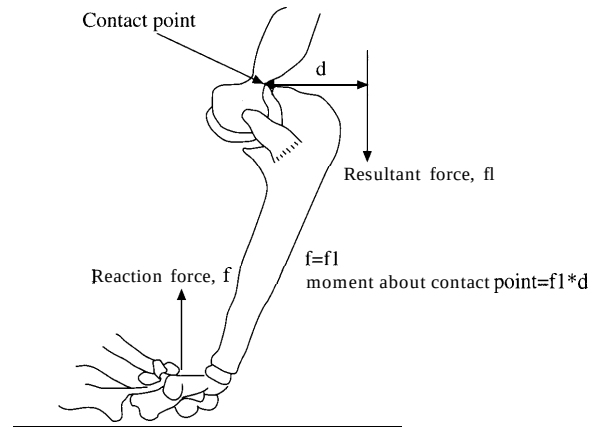


Fig. 1. Postulated mechanism for supracondylar fracture during fall on outstretched arm.

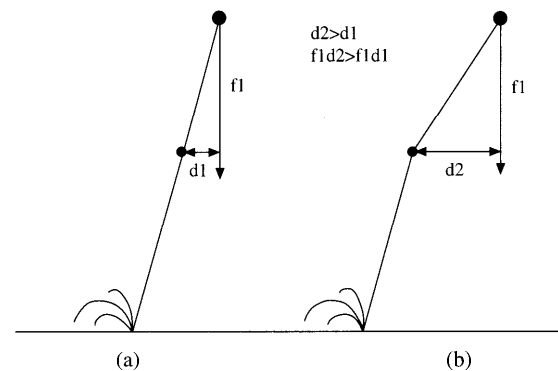


Fig. 2a. Illustration of a fall on an outstretched arm with a lesser degree of elbow hyperextension.

Fig. 2b. Illustration of a fall on an outstretched arm with a greater degree of elbow hyperextension.

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