

CORRECTION WITH GROWTH FOLLOWING DIAPHYSEAL FOREARM FRACTURE

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In 25 children with fracture of the shafts of the forearm an average angulation deformity of 20° was recorded when the fracture had healed. At follow-up, which took place after the cessation of growth, the angulation deformity was reduced by half; there was, however, a large individual variation. Both severe and less severe deformities were found to be corrected. Correction was more likely in younger children than in older children, though again there were exceptions to this rule. The most common dysfunction recorded was a decreased pronation-supination. This was not very closely correlated with angular deformity.

Key words: forearm; fracture; deformity; diaphysis; growth

Accepted 16.1.76

Unlike adults, children are supposed to be able to achieve correction of post-fracture angulation deformity of the forearm (Aitken 1935, Blount et al. 1942 and others). In the Department of Orthopaedic Surgery in Malmö the policy has been to reduce diaphyseal fractures of the forearm in children to an anatomically correct position. Nevertheless in some instances the treatment has not been successful.

The purpose of this investigation was to evaluate the late results in incompletely reduced forearm fractures in children and to study the relationship to age and degree of deformity.

MATERIAL AND METHODS

All shaft fractures of the forearm in children treated in Malmö since 1950 were available for the study. From almost 200 treated cases, 25 were selected in whom there had been a discernible angular deformity at the time of the termination of treatment. From the films of these cases it was found that only a malpositioning amounting to 10° or more could be recognized. The 25 patients therefore had an *early residual angulation* of at least 10° measured as the maximum angulation in either the AP or the lateral film of the forearm after the fracture had healed. In many instances the position of the fragments had been anatomically correct after the reduction but had deteriorated later on. The 25 cases also fulfilled the criterion that they, at the time of follow-up, should have obtained the maximum correction possible at the cessation of growth. The age of the children varied between 2 and 15 years at the time of the fracture.

The follow-up examination included radiograms of both forearms. Maximum angulation of the radius or the ulna was measured on AP

Financial support was obtained from the Swedish Medical Research Council (project no. B 75-17X-2737-07C).

and lateral films and a comparison was made between the injured and the uninjured forearm. Although the angulation in most instances was rounded and did not have a sudden transition it was possible by comparing the two sides to evaluate the differences. Deviation from the shape of the normal side was recorded and is referred to as *late residual angulation*.

Finally the pronation-supination range was measured by asking the patient to turn a handle with his elbow locked.

Standard statistical procedures were applied. Probability levels better than 95 per cent are referred to as significant.

RESULTS

It could be demonstrated that at follow-up the children had achieved reduction of their early residual angulation by an average of 10° or about 50 per cent (Table 1). The pronation and supination range was decreased by an average of 25° which is about one fifth of the normal range of movement (Table 1). The late residual angulation did not depend on the localization of the fracture; however, most of the fractures were in the middle third of the diaphysis and the number

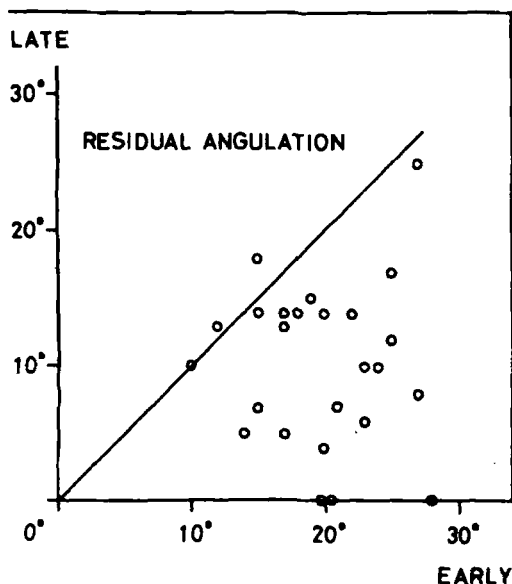


Figure 1. The relationship between early and late residual angulations.

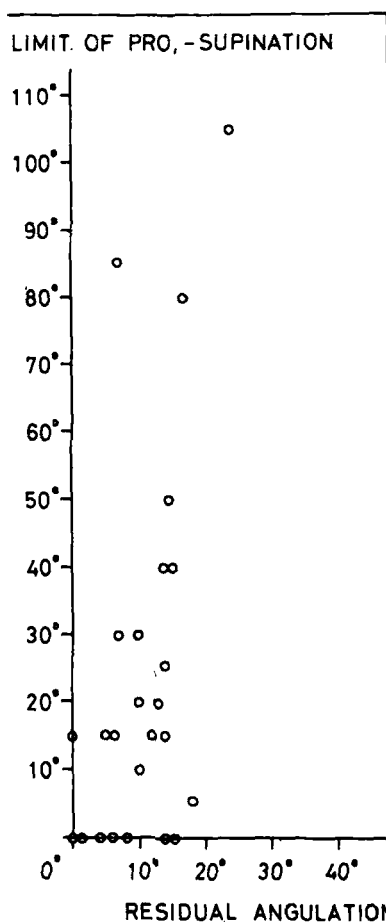


Figure 2. The relationship between late residual angulation and the limitation of pronation-supination.

Table 1. Age and variables of deformity.

Number	25
Age at fracture	8.4 ± 3.1 (2-15)
Residual angulation (late)	10.2 ± 6.1
Residual angulation (early)	19.8 ± 5.0
Limitation of pronation, supination	24.6 ± 28.6

does not permit positive conclusions. Fractures in the distal third of the shafts of the radius and the ulna had rarely been left with any discernible early residual angulation. There was no difference between cases in whom the early

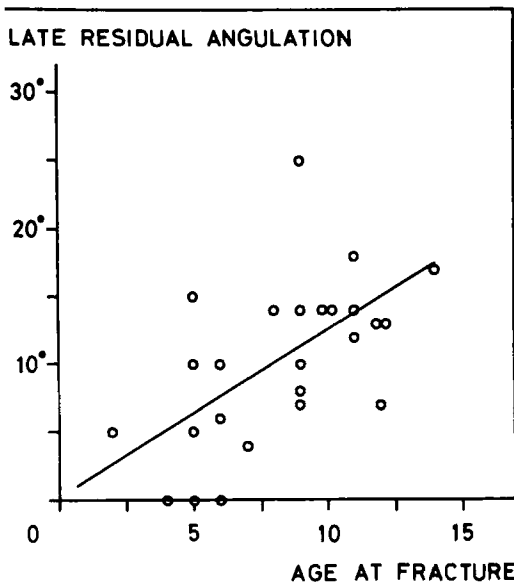


Figure 3. The relationship between the age at the time of fracture and late residual angulation.

residual angulation had been greater in the radius or the ulna and there was no significant correlation between early residual angulation and late residual angulation. Obviously a child with a severe deformity has, on average, the same chance to achieve correction of the angulation spontaneously as a child with a less severe angulation (Figure 1). In spite of the large variation there was a significant correlation between the late residual angulation and the limitation of pronation and supination (Figure 2). The age at the time of the fracture was correlated positively with late residual angulation, older children being less able to compensate for the fracture deformity (Figure 3). Also, there was a slight but significant correlation between the age at fracture and the reduction of residual angulation which had taken place between the time of the termination of the treatment and the time of follow-up (Figure 4).

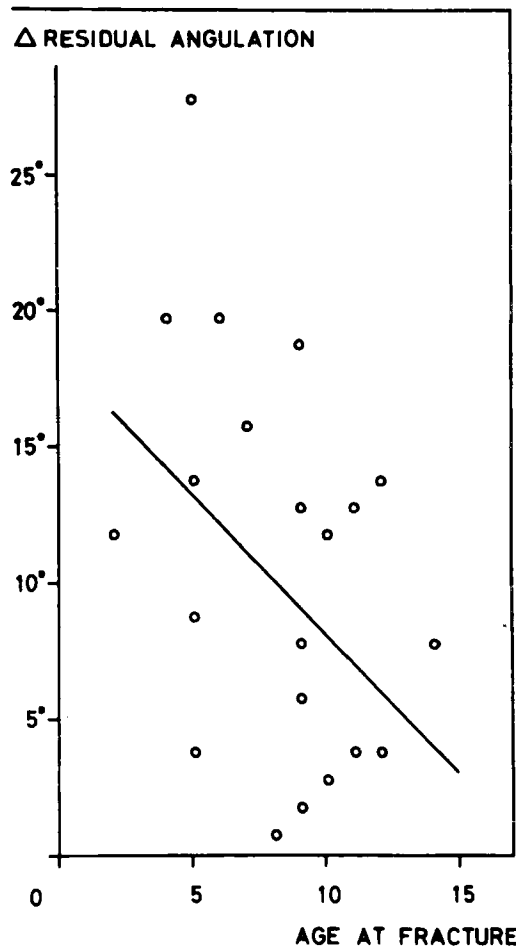


Figure 4. The relationship between the age at the time of fracture and the reduction in the residual angulation.

DISCUSSION

The capacity for spontaneous correction of deformity has been demonstrated to be greatest in the distal metaphyseal part of the radius and the ulna (Blount 1954, Hughstone 1962, Lindholm et al. 1972, Koncz 1973). Moreover, Hughstone (1962) claims that in diaphyseal fractures "growth will not correct angulation deformity as it does in metaphyseal fractures" and on the whole opinions as to whether or not diaphyseal fracture deformity can spontaneously achieve correction differ a great deal (Gandhi et

al. 1962). Koncz (1973) observed that a spontaneous correction could occur in the distal third of the diaphyses whereas the curvature remained if the fracture was located more proximally.

It should be emphasized that in the present study only the angular deformity was recorded. This may explain, to some extent, the large residual variance of the data. In the past, some authors have suggested that an angular deformity of 10° or even 20° may be left untreated in children (Steinart 1966, Ehalt 1961). This statement cannot be verified from our findings in that we have seen deformities of that magnitude which have not corrected with growth. In fact, the degree of deformity seems to be unrelated to the final result; small angulation deformities may remain and large deformities may achieve correction. Moesner & Östergaard (1966) suggest that children under 9 years of age are able to achieve correction of 90 per cent. of the deformity. So far, in our study, only children under 10 have been able to produce large corrections with growth. However, in our series one patient who sustained a fracture at the age of 9 still had, at the age of 19, a 25° deformity and a locked pronation and supination. Therefore this '9 years' rule is probably not valid in all instances and large angulation deformities can probably be left untreated only in very young children. Nevertheless, it is possible to demonstrate a significant relationship between age and the ability to correct deformity as has been suggested previously by Blount (1954), Buck et al. (1966) and Moesner & Östergaard (1966), but the residual variance involved in this relationship is so large that conclusions and predictions cannot easily be made for the individual case.

Locked or very limited pronation and supination was seen in a few cases. A 19-year-old woman with very poor range of pronation and supination motion suf-

fered more from the cosmetic deformity of the forearm than from the limited range of movement, and some patients with a limitation of 60° or less in the range of pronation and supination seemed to be unaware of their incapacity.

The conclusion from our findings must be that all deformities exceeding 10° should be corrected (at least those in the middle third of the shafts of the radius and the ulna) if one wants to ensure a final result with a correct anatomical position. Even if a young child has a good chance of achieving correction of an angular deformity the ability to correct is not possible to predict in the individual case. Smaller or greater angulations, within limits, have the same chance of returning to normal. The correlation between the final angulation deformity and the range of pronation and supination motion is rather weak; probably this type of movement is influenced by other factors as well.

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