The development of the tibiofemoral angle in children

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ing the acromion by replacing it after osteotomy is desirable because of the ease and rapidity of closure, the good cosmetic result, and the biomechanical advantage of preserving the acromion as the origin of the deltoid muscle. This method also allows excellent exposure of the entire rotator cuff area. In the presence of an inadequate repair of the rotator cuff, the method is predicated on the idea that the biceps can be utilized functionally as a substitute for the rotator cuff. One can readily visualize the effect of the transplanted tendon to depress the humeral head. Inferomedial pressure will tuck the proximal end of the humerus into the glenoid socket.

The results in this small series of fourteen patients were satisfactory — 78 per cent of the patients had good or excellent results. It should be emphasized that the fourteen patients had very severe damage to the shoulder capsule, and the results therefore are to be rated with this selectivity in mind.

References

The Development of the Tibiofemoral Angle in Children

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The development of the tibiofemoral angle in children at different ages has been of extensive interest for many years. As far as we know there are no published series in which the development itself was followed longitudinally during growth. In most reports only examples of different tibiofemoral angles have been reported, and in some cases the angle was expressed as the distance between knees or medial malleoli. In some reports the proportional number of varus or valgus knees at different ages has been expressed in per cent. Very few roentgenographic investigations have been published. As it is an important question in clinical orthopaedic surgery whether to correct extreme varus or valgus knees by osteotomy, we collected the present series in order to determine the tibiofemoral angle in children of various ages.

Material and Methods

This series includes 979 patients from the Paediatric Clinic of the University of Helsinki. These patients were in the hospital for a variety of reasons and the knees and legs were roentgenographically examined for reasons unrelated to their illness. The series also includes 300 patients from the Orthopaedic Hospital of the Invalid Foundation, Helsinki. Of these patients, fifty-nine were examined roentgenographically twice and fifty-two were examined three or more times, at intervals of six months. The entire series thus comprised 1,480 examinations of the tibiofemoral angle done roentgenographically and clinically. In the examination, the extremity was positioned with the patellae straight ahead. If there was torsion or bowing of the tibia, a longitudinal axis was estimated between the patella and the mid-point of the ankle joint. If there was a divergence between the angles in both legs, their mean was taken as the representative figure. The results were processed by computer. As the results of the clinical examinations correlated directly with those of the roentgenographic examinations, only the latter were used for analysis. The material was divided into groups according to age, each group containing an average of forty patients, with six-month intervals from birth to sixteen years. The largest group was that between the ages of zero and six months, containing ninety-four patients. The oldest group was the smallest and contained only nine patients. The tibiofemoral angle was measured on the roentgenogram by drawing a longitudinal axis midway between the femoral and tibial diaphyseal cortices. The angle between these two longitudinal lines was measured in degrees. In the case of newborn infants drawing the lines was difficult because their femora are not straight; therefore, the femoral line drawn represented our best estimate of the longitudinal axis of the femur. In the case of the older children the drawing of the longitudinal lines presented no difficulty. The results were processed by computer and the output gave the mean of the angle in every age group and the correlation between the age of the patients and the tibiofemoral angle.
The development of the tibiofemoral angle in children during growth. The results are based on 1,480 measurements of the tibiofemoral angle of children at different ages. The mean of the measurements is in the middle and on both sides of this is the error of the mean, which was an average of ± 4.4 degrees. The standard deviation was ± 8 degrees.

Results

The main results obtained are shown graphically in Figure 1. The tibiofemoral angle in the newborn infants and in children less than one year old was in pronounced varus which then decreased with growth. At the age of about one and one-half years the knees tended to straighten. During the second and third years the angle changed to a marked valgus position. The valgus position corrected itself in the following years. The development of the tibiofemoral angle was similar in boys and girls (Figs. 2 and 3). On the graphs three lines are shown (mean ± error of the mean) supplemented by a smoothed curve of the tibiofemoral angles drawn by hand. The standard deviation of the entire series was ± 8 degrees and the standard deviations were greater for boys and for younger children. In the series of boys the standard deviation was ± 10 degrees and in girls, ± 7 degrees. The error of the mean in the entire series was ± 4.4 degrees, 4.8 degrees in boys and 4 degrees in girls. The development of the tibiofemoral angle in a representative patient is shown in Figures 4-A through 4-D.

Discussion

In clinical practice it has sometimes been noted that the development of the tibiofemoral angle in children follows a certain pattern, in which there is first a pronounced varus in newborn infants and infants and subsequently an extreme
valgus position. Prior to the present study this had not been proved statistically. Our material includes 1,480 examinations of 1,279 patients whose tibiofemoral angles were measured and expressed in degrees. It was shown that before the age of one year there is pronounced varus position, which changes into valgus when a child is between eighteen months and three years old. The valgus can sometimes be extreme. It corrects spontaneously to about 5 to 6 degrees, where it remains until the age of six to seven years.

Children, when they learn to walk, tend to hold their feet wide apart to increase stability. This may be why a pressure on the outer side of the knees exists and the medial part of the epiphyseal plate grows faster, resulting in the valgus position of the tibia. Whatever the reason for the development of the normal tibiofemoral angle in children during growth might be, it is obvious from this investigation that an operative procedure to correct the angle in normal children is seldom indicated.

References