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THE EPIPHYSEAL ANGLE IN COXA VARA INFANTUM AND ITS RELATION TO RESULTS

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Though the primary cause of coxa vara infantum is still obscure, its roentgenological appearance is fairly well defined.

There is general agreement that adequate therapy consists of various types of correction osteotomies.

The purpose of the operation is above all to re-establish pelvic stability and though a certain discrepancy has been described between functional and roentgenological results (*Johanning* 1951, *Magnusson* 1954) attempts are always made to obtain a correct roentgenological result. *Pylkkänen* (1960) found that a good roentgenological result invariably meant a good clinical result as well.

As known, the pathologic anatomy is believed to consist of a disorder of the enchondral ossification of the epiphysis of the femoral head which owing to decreased strength of the juxta-epiphyseal bone of the neck results in a statically induced coxa vara and sometimes even in loss of continuity in the collum.

It would therefore appear that purely mechanical and dynamic factors play an important role, both in the development of the deformities and in the end-results of operation.

In 1935 *Pauwels* published his first work on the effect of the slope of the fracture and thereby of the ratio between the shearing force and the force of compression on the prognosis of collum femoris fractures. —It is tempting to assume that in coxa vara infantum similar mechanical factors are at work and that the angle between the pathological growth zone and the horizontal plane, the epiphyseal angle, may thus be of importance in the development of the secondary varus.

Since 1932 as many as 59 growing hips with coxa vara infantum

have been treated with sub- or intertrochanteric osteotomy at the orthopaedic department in Härnösand. In 50 of these hips the roentgen films allowed measurement of the angle achieved by operation between the epiphyseal line in the caput femoris and the horizontal plane through the Y-cartilage:—the epiphyseal angle. This measurement (previously used by *Johanning* 1952, *Jerre* 1956, *Pylkkänen* 1960) was made in roentgenograms taken with the patient supine on the table with the lower extremities extended in neutral position. The collum-diaphyseal angle was also measured in films taken at the last roentgen follow-up. This angle was measured according to *Müller* (1957).

The results of these measurements are given in Table 1.

At the time of the operation these patients were on the average 8.6 years old. The mean period of observation was 5 years.—There were 26 female and 24 male hips.

It is clear from Table 1 that all the hips with an epiphyseal angle of less than 30° at the post-operative roentgen examination showed a collum-diaphyseal angle lying within the normal range at the last roentgen follow-up.

Pauwels (1935, 1965) showed that when a fracture line in the femoral neck forms an angle of more than 25° with the horizontal plane, the shearing force begins to make itself felt, while when the angle is smaller, the force of functional compression is predominant. The hips in Table 1 with a smaller epiphyseal angle than 30° would thus correspond to Pauwels' group 1.

Of the hips which postoperatively showed an epiphyseal angle between 30° and 50° and thus corresponded to Pauwels' group 2, 10 showed a normal diaphyseal angle at the last roentgen control, while 7 showed coxa vara (Table 1).

Table 1. Coxa vara infantum. 50 hips treated by sub- or intertrochanteric osteotomy Roentgenological findings.

Post operative epiphyseal angle*	Collum-diaphyseal (C–d)-angle at review Number of hips	
	C–d angle normal (115–140°)	Coxa vara (C–d angle < 115°)
< 30°	11	
30–50°	10	7
> 50°		22

* Angle between epiphyseal line and horizontal plane.

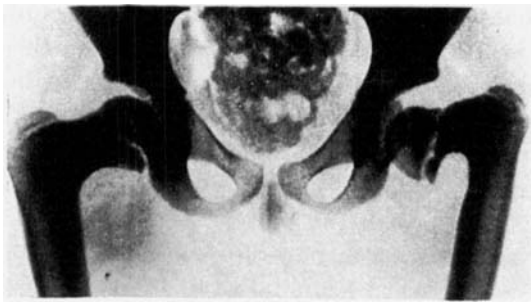

Figure 1. Case 27. ♂ Age 5 years.

Finally, all the hips with a postoperative epiphyseal angle of more than 50° and thus corresponding to Pauwels' group 3, showed coxa vara at the last follow-up (Table 1).

In Pauwels' groups 2 and 3 the functional shearing force increases and becomes more and more predominant as the angle increases (*Pauwels* 1935, 1965).

Besides the operated cases there were 5 conservatively treated growing hips with coxa vara infantum. 4 were male, 1 was female. These patients' ages ranged from 2 to 6 years at the time of the first examination. They were followed up for 8.1 years, on the average.

At the first examination 4 of these hips had an epiphyseal angle of 30–35°. These angles did not increase between subsequent examinations and at the last follow-up all showed a normal collum-diaphyseal angle.

In the 5th of these hips the epiphyseal angle was 50° at the time of the first examination. The patient's relatives refused to allow operation. At the last examination the varus deformity of this hip was increased.

Figure 1 shows bilateral coxa vara infantum in a 5-year old boy. The roentgenological collum-diaphyseal angle is 56° on the left side and 97° on the right. There is thus a considerable decrease of the otherwise fairly large collum-diaphyseal angle at this age (about 140°, *Lanz & Wachsmuth* 1938). The epiphyseal angle in this patient is 75° on the left side and 35° on the right.

Figure 2 shows the same patient 3 years later. In the left hip the varus deformity has increased, the collum-diaphyseal angle is now 50°, the epiphyseal angle 85°. The right hip has, on the other hand, normalized spontaneously, the collum-diaphyseal angle here is 118° and the epiphyseal angle 30°.

Figure 2. Case 27. ♂ Age 8 years.

Figure 3. Case 27. ♂ Age 12 years.

Figure 3 shows the same patient 4 years later (7 years after first examination). The right collum-diaphyseal angle is 127° and the epiphyseal angle 20°, *i.e.* both normal.—Intertrochanteric osteotomy had been done 4 years previously on the left side. Here the collum-diaphyseal angle is 88°, thus coxa vara. The postoperative epiphyseal angle of this hip was 65°.

In view of the advancing physiological varization of the collum-diaphyseal angle, which occurs during the entire period of growth, the amount of spontaneous valgization shown in Figures 1 and 2 was in reality larger than what is suggested by the illustrations.

Spontaneous normalization of coxa vara infantum has been reported earlier, but judging from the literature it is rare. *Lindemann* (1949) reported 2 hips with normalization of the collum-diaphyseal angle after conservative treatment. *Jerre* (1956) and *Rütt* (1957) described 1 hip each with practically complete restitution without treatment. *Pylkkänen* (1960) reported 4 untreated hips with complete spontaneous recovery.

The investigation appears to justify the conclusion that in coxa vara infantum one should not accept a postoperative epiphyseal angle of

more than 30°. This conclusion is in agreement with the findings of previous workers in this field (*Johanning* 1951). Though early osteotomy is the standard therapeutic measure, a certain expectative attitude might be adopted in those cases (possibly with attempted valgization by great trochanter epiphyseodesis (*Laurent* 1959, *Pylkkänen* 1960, *Chigot & Labbe* 1962)) where the epiphyseal angle does not exceed 30° and the roentgenologic juxta-epiphyseal pathologic changes are moderate.

SUMMARY

In a series consisting of 50 growing hips with coxa vara infantum the relation was studied between the postoperative epiphyseal angle and the collum-diaphyseal angle at the last roentgen follow-up.

All the hips that showed an epiphyseal angle of less than 30° after the operation had a normal collum-diaphyseal angle at the last re-examination. The larger the postoperative epiphyseal angle the greater the tendency to coxa vara as an end-result.

All the hips with a postoperative epiphyseal angle of more than 50° had a collum-diaphyseal angle of less than 115° at the last re-examination.

The material also included 5 conservatively treated hips. 4 of them showed an epiphyseal angle of about 30°, all became normal spontaneously. The 5th with an epiphyseal angle of 50°, showed an increased varus-deformity at the last examination.

RESUME

Dans une série d'observations comprenant 50 hanches avec coxa vara infantum en croissance, la relation entre l'angle épiphysaire post-opératoire et l'angle colonne-diaphyse au dernier examen radiographique a été étudiée.

Toutes les hanches dans lesquelles l'angle épiphysaire était inférieur à 30° après l'opération avaient un angle colonne-diaphyse normal au dernier examen. Plus l'angle épiphysaire post-opératoire est grand, plus il en résulte une tendance au coxa vara.

Toutes les hanches ayant un angle épiphysaire post-opératoire de plus de 50° avaient un angle colonne-diaphyse de moins de 115° au dernier examen.

Les observations comprenaient aussi 5 hanches soumises à un traitement conservateur. Chez 4 d'entre elles, l'angle épiphysaire était d'environ 30°. Toutes devinrent normales spontanément. Dans le 5ème cas

où l'angle épiphysaire était de 50°, on a constaté au dernier examen une déformité varus plus prononcée.

ZUSAMMENFASSUNG

In einer Reihe von 50 Hüften im Wachstumsalter mit Coxa vara infantum wurde die Beziehung zwischen dem postoperativen Epiphysenwinkel und dem Collum-Diaphysenwinkel bei der letzten Röntgennachuntersuchung studiert.

Alle Hüften, die einen Epiphysenwinkel von weniger als 30° nach der Operation zeigten, hatten einen normalen Collum-Diaphysenwinkel bei der letzten Nachuntersuchung. Je grösser der postoperative Epiphysenwinkel war, desto grösser war die Neigung zur Coxa vara als ein Endergebnis.

Alle Hüften mit einem postoperativen Epiphysenwinkel von mehr als 50° hatten einem Collum-Diaphysenwinkel von weniger als 115° bei der letzten Nachuntersuchung.

Im Material waren auch 5 konservativ behandelte Hüften inbegriffen. 4 derselben zeigten einen Epiphysenwinkel von ungefähr 30°, alle wurden von selbst normal. Die fünfte mit einem Epiphysenwinkel von 50° zeigte eine zunehmende Varusdeformitet bei der letzten Untersuchung.

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