Epiphysiodesis of the greater trochanter in Legg-Calvé-Perthes disease : The importance of timing

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Patients with Legg-Calvé-Perthes disease (LCP) often exhibit relative overgrowth of the greater trochanter and shortening of the femoral neck. Biomechanically, this corresponds to a shorter lever arm and a decreased muscle tension which may result in a Trendelenburg gait and pelvic instability. This is a retrospective study of 31 patients (32 hips) with LCP disease and relative overgrowth of the greater trochanter who were treated with an epiphyseodesis. The average age at operation was 10 years and 6 months. We evaluated the patients clinically with the Trendelenburg sign and analysed on radiographs the growth of the greater trochanter and the neck-shaft angle of the normal hip and the pre- and postoperative growth and angle of the involved hip. We did not find any significant differences between the pre- and postoperative values. After a mean follow-up of 4 years and 2 months, however, 27 patients presented with a negative Trendelenburg sign (versus 14 patients preoperatively).

Keywords : Legg-Calvé-Perthes disease ; greater trochanter overgrowth ; epiphysiodesis.

INTRODUCTION

Relative overgrowth of the greater trochanter is a late complication of various conditions. The most common are LCP disease and avascular necrosis in developmental dysplasia of the hip, but it can also be seen in septic arthritis, trauma and other conditions such as myelomeningocoele, arthrogryposis and epiphyseal dysplasia (*5, 16*). In LCP, physeal

arrest results in a short femoral neck corresponding biomechanically to a short lever arm of the hip abductor muscles (*15*). In addition, the high-riding greater trochanter decreases their tension. This muscular insufficiency results in pelvic instability (Trendelenburg sign) and limping. Sometimes there is limitation of abduction caused by trochanteric impingement. Some patients also suffer from abnormal fatigue of their hip abductors. The aim of this retrospective study is to evaluate the effect of epiphyseodesis of the greater trochanter on this clinical deterioration.

MATERIALS AND METHODS

Between 1990 and 2002, 38 patients (39 hips) with LCP presenting with relative overgrowth of the greater trochanter were treated in the Orthopaedic Department of the University Hospitals. Five patients could not be evaluated because of lack of radiological follow-up. Two patients already had an osteotomy of the femur before the epiphyseodesis.

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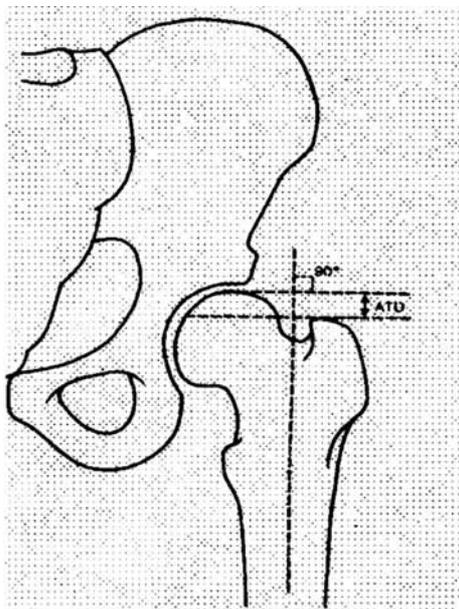
Fig. 1. — The ATD (articulo-trochanteric distance) is measured as the distance in millimeters between two parallel lines perpendicular to the axis of the shaft of the femur, one at the level of the tip of the greater trochanter and the other at the highest part of the ossified femoral head. The distance is recorded as positive if the tip of the greater trochanter is caudal to the highest part of the femoral head and negative if the tip of the trochanter is proximal to the femoral head (*8*).

Fig. 2. — The NSA (neck-shaft angle) on the AP radiograph (*8*).

The medical and radiological records from more than one year before the operation were available in 26 patients. Five patients were seen only one month before operation. All 31 patients (32 hips) had postoperative clinical and radiological follow-up. There were 7 girls and 24 boys. The left hip was affected in 23 patients, the right hip in 7 patients and in one patient both hips were involved.

The mean age at operation was 10 years and 6 months, ranging from 7 years and 11 months to 12 years and 1 month. The mean follow-up time was 4 years and 2 months (range : 7 months to 7 years and 9 months).

Indications for epiphyseodesis were a positive Trendelenburg sign with overgrowth of the greater trochanter or an increase in relative overgrowth during follow-up.

In 24 cases, a shelf acetabuloplasty was performed at the same time. In 5 cases, only an epiphyseodesis of the greater trochanter was done, and on two occasions the epiphyseodesis was done a few months after a shelf acetabuloplasty.

The Phemister technique for epiphyseodesis as described by Langenskiöld and Salenius (*12*) was used (*21*).

The growth of the greater trochanter was evaluated, using the articulo-trochanteric distance (ATD) (fig 1). The neck-shaft angle (NSA) was also measured (fig 2). Both measurements were done pre- and postoperatively, both on the affected hip and the normal hip (*8, 17*). The clinical Trendelenburg sign was evaluated (*2, 6*) and compared with the ATD and the NSA of the involved hip.

The results were analysed using statistical analysis software (SAS) (*18*). The age dependence of the ATD and NSA and the difference between boys en girls and between different procedures were analysed using regression analysis. The differences between pre-and postoperative observations were evaluated by analysis of covariance. The evaluation of the clinical situation was calculated with the SIGN test

RESULTS

First the NSA and ATD of the normal hip were evaluated. The average distance and angle for every patient during one year (for example from the 7th to the 8th birthday) were calculated. Regression analysis produced curves, showing the evolution of ATD and NSA in the normal hips according to age
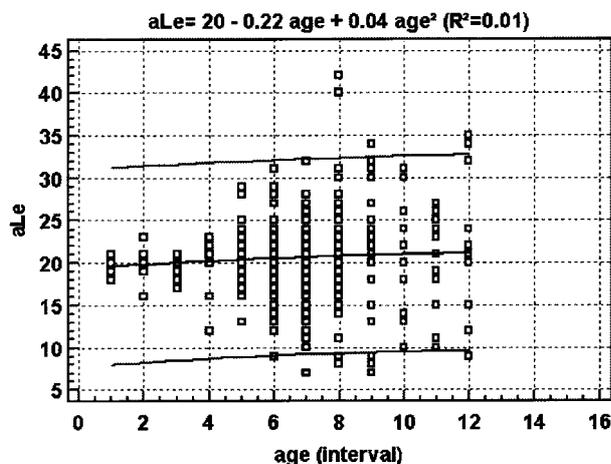
Fig. 3. — Evolution of the ATD of the normal hip in patients with LCP. Age interval : 1 : 4-5 ; 2 : 5-6 ; 3 : 6-7 ; ……. ; 12 : 15-16 years (Le values in millimetres).
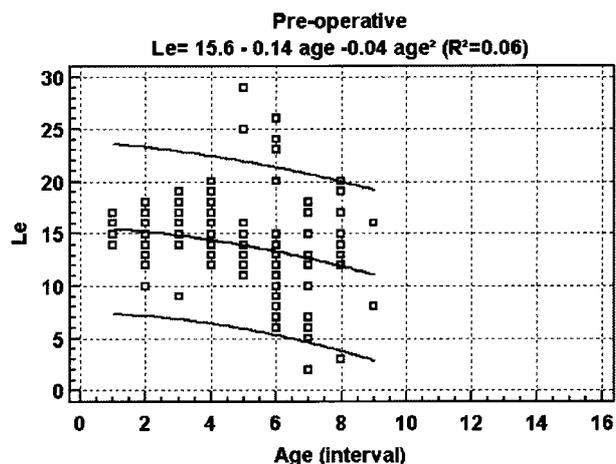
Fig. 5. — Evolution of the ATD of the involved hip in patients with LCP pre-operatively.
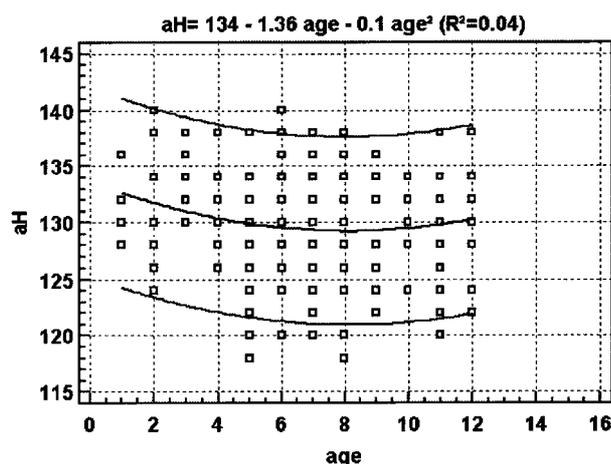
Fig. 4. — Evolution of the NSA of the normal hip in patients with LCP (H values in degrees).
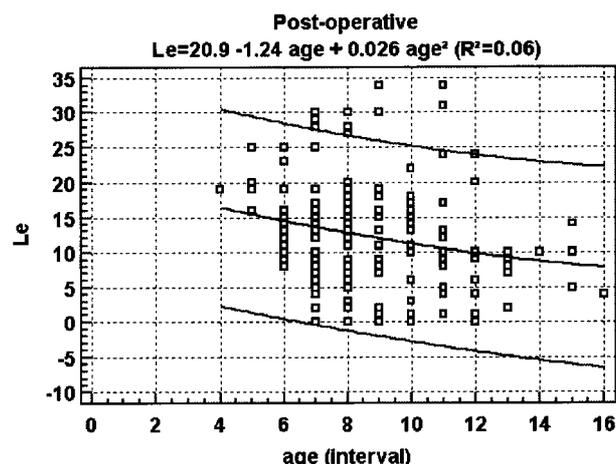
Fig. 6. — Evolution of the ATD of the involved hip in patients with LCP post-operatively.

intervals (figs 3 and 4). The same measurements were performed for the involved hip pre- and post-operatively (figs 5, 6, 7, 8). Figure 5 clearly shows a decrease in ATD over the years preoperatively. Postoperatively, however, the decrease continues. There was no significant difference between both results. Also concerning the NSA no significant difference was found. There was no difference in results according to age or gender. There was no difference between the three types of procedures.

At the time of operation 18 patients had a positive Trendelenburg sign. After follow-up only two remained positive (p = 0.001). From the 14 patients with a negative Trendelenburg sign pre-operatively, 11 remained negative and 3 became positive (p = 0.029). No ATD value could be defined where the Trendelenburg sign becomes positive. In the patients who became positive postoperatively no clear change in the ATD and NSA was seen. They all had a shelf-acetabuloplasty at the same time.
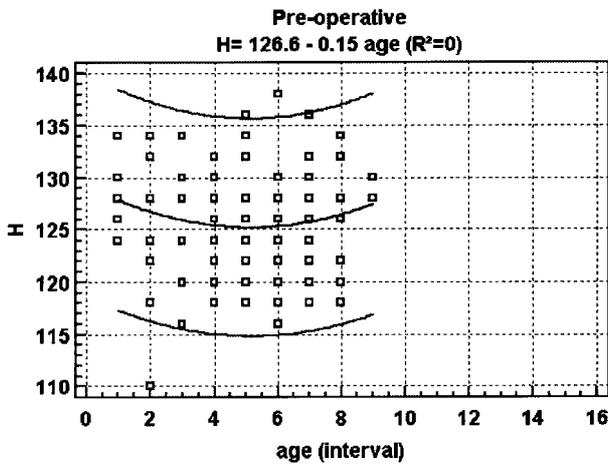
Pre-operative
H= 126.6 - 0.15 age (R²=0)

Fig. 7. — Evolution of the NSA of the involved hip in patients with LCP pre-operatively.

Post-operative
H=122.3 + 0.83 age - 0.04 age² (R²=0)
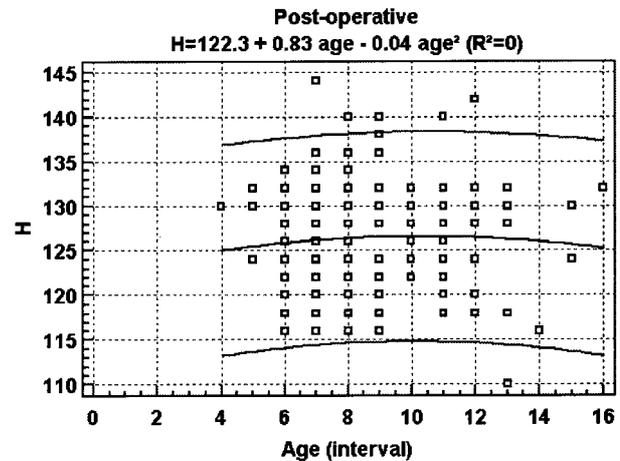
Fig. 8. — Evolution of the NSA of the involved hip in patients with LCP post-operatively.

DISCUSSION

The three major problems that may occur in LCP are : 1) a femoral length discrepancy that progresses with growth because of damage to the proximal capital physis, 2) *coxa magna* and loss of sphericity with subluxation and secondary coxarthrosis and 3) *coxa brevis* and relative overgrowth of the greater trochanter.

Several other methods of surgical treatment for high standing greater trochanter have been reported, such as lateral displacement osteotomy (*14*), distal transfer of the greater trochanter (*16, 22*), femoral neck lengthening osteotomy (*7*), greater trochanteric advancement (*4*) or combinations thereof (*9, 14, 17*).

However , the least invasive operation is epiphyseodesis, which aims at obtaining a growth arrest (*5, 14*).

This procedure was already proposed in 1940 (*3*) and the first study was done by Langenskiöld and Salenius (*12*). They showed in studies using tetracycline fluorescence that epiphyseodesis of the trochanteric growth plate can be expected to prevent only about half of trochanteric overgrowth, because the remaining half results from appositional bone growth in the cephalic portion of the trochanter.

Most authors reported that the operation should be done before the age of 8 years (*5, 11, 12, 14, 17*).

Katz (*10*) stated that the growth in length of the femoral neck was most pronounced after the age of 9 years. The distance between the greater trochanter and the top of the femur does not change markedly after 8 years of age in a normal hip (*8*). The relative overgrowth is caused by the growth arrest of the capital epiphysis (*1*). Moreover, patients with LCP often present with a retardation of skeletal maturation (*19*). It was therefore supposed that the operation could also have its effect at an older age.

In this study the average age at operation was 10 years and 6 months. We did not see a significant difference in the monthly change of the distance before and after the operation. Probably the indication for operation was made too late.

But the question might be raised why so many patients did well after the operation. The hip abductors in adults have to work at full capacity to prevent pelvic instability (*20*). Maybe when the child grows, the muscles adapt to this specific situation of relative overgrowth. We did not find any literature describing the maximum capacity of the muscles in childhood and whether children also must have a full capacity of muscle strength.

In our investigation there were no patients with an articulo-trochanteric distance that became negative. Other authors state that patients with an ATD of less than 5 mm almost always have a positive

Trendelenburg sign (*13*), but there was no follow-up until adulthood. Probably an articulo-trochanteric distance of 5 mm or less is too difficult to properly adapt to, making an operative treatment necessary.

It was already pointed out by Gage and Cary (*5*) that epiphyseodesis of the greater trochanter does not affect the evolution of the neck-shaft angle, which was confirmed in this study.

CONCLUSION

Epiphyseodesis of the greater trochanter is a small operation to prevent relative trochanter overgrowth. It should be done before the age of 8, and only to prevent the articulo-trochanteric distance to become negative. After the age of 8 years, the epiphyseodesis can no longer reduce the relative overgrowth. Only when the articulo-trochanteric distance is negative, can an operative treatment to correct overgrowth be indicated. Otherwise we propose to wait until adulthood because a number of clinical problems will resolve during maturation.

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