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THE TREATMENT OF CONGENITAL DISLOCATION AND SUBLUXATION OF THE HIP IN THE OLDER CHILD

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In the difficult process of choosing among the means available for completing the treatment of a congenital hip dislocation *after the age of walking*, it occurred to us that two major concerns were paramount: prevention of post-reduction avascular necrosis, and prevention of residual coxo-femoral dysplasia at the stage of stabilization of the reduction. During the past 10 years, the emphasis has been on choosing and perfecting the techniques that appeared to be the best solutions to the problems raised in trying to meet these two goals. Our study was based on 72 congenital dislocations, 20 congenital dysplasias and subluxations, and 50 residual dislocations and subluxations which were sequelae of previously treated malformations. In each of these categories, this study tries to review the problems, to examine some of the recently proposed solutions, to present our personal experience and finally to formulate more reliable indications.

DISLOCATION AFTER THE AGE OF WALKING

A. *Reduction of dislocation and prevention of avascular necrosis*

The severe failures in the treatment of congenital dislocation of the hip are related to avascular necrosis. In fact, avascular necrosis may cause deformity of the femoral head and sometimes hopelessly compromises the results. Epiphyseal alterations have occurred as a consequence of reduction. Many a study on this topic show the importance of circulatory disturbances of the epiphysis after traction on the posterior circumflex artery and after excessive pressure on the femoral head. It seems obvious to us now that any reduction should be attempted only after *preparation by continuous traction* of the relevant lower limb. Progressively lowering the femoral head helps the circulatory system to adapt to the new position of the femur and loosens

the hip muscles. These precautions, although efficient, still need improvement, since statistics continue to show a variable but sometimes significant percentage of avascular necrosis. It occurred to us that the preparation technique might be able to be improved on. We have to remember at this point what we learned from Somerville. In November 1957, he reported a series of 50 dislocations, all of which had been reduced without causing any subsequent avascular necrosis. The 50 cases had been prepared for the reduction on a Scott frame, i.e. by progressive traction and abduction. These results increased interest in *progressive abduction.* In Paris, Petit quickly adopted this new procedure. Prior to his visit to Oxford in 1957, continuous traction alone had reduced the rate of avascular necrosis in his patients to 15 per cent. After his visit to Somerville, the use of traction abduction and internal rotation allowed him to improve his results drastically. At the Paris SICOT Meeting in 1966, he reported about 0.5 per cent avascular necrosis after reduction.

Within the past decade we have used progressive traction with abduction and internal rotation on all dislocations in older children, with extremely good results. Of 72 dislocations, 17 of which were in children more than 4 years old, we have had only one avascular necrosis, and that was in an 8-year-old girl after a difficult open reduction. One may therefore assert that post reduction avascular necrosis can be prevented by slow progressive preparation, with traction abduction and internal rotation. This preparation seems to help the hip, and its vessels and muscles, adapt to the position needed for reduction.

We go beyond this and use it to achieve a truly *atraumatic progressive spontaneous reduction.* Our concern is to set the hip in such a position that it later allows the spontaneous penetration of the head into the acetabulum. This ideal position is situated on an axis called "*the reduction axis*" (Figure 1 a, b, c), which passes through the midpoints of both teardrops on the A. P. film. In order to place the head on that axis one has to use:

a) traction, in order to position the head in front of the acetabulum,
b) abduction, in order to horizontalize the femoral neck, and
c) internal rotation equal to the anteversion angle.

When the hip is perfectly oriented on the axis, traction is abandoned and the position is held in a bilateral spica cast. Definite reduction occurs by itself in the cast. *This is the phenomenon of head penetration*

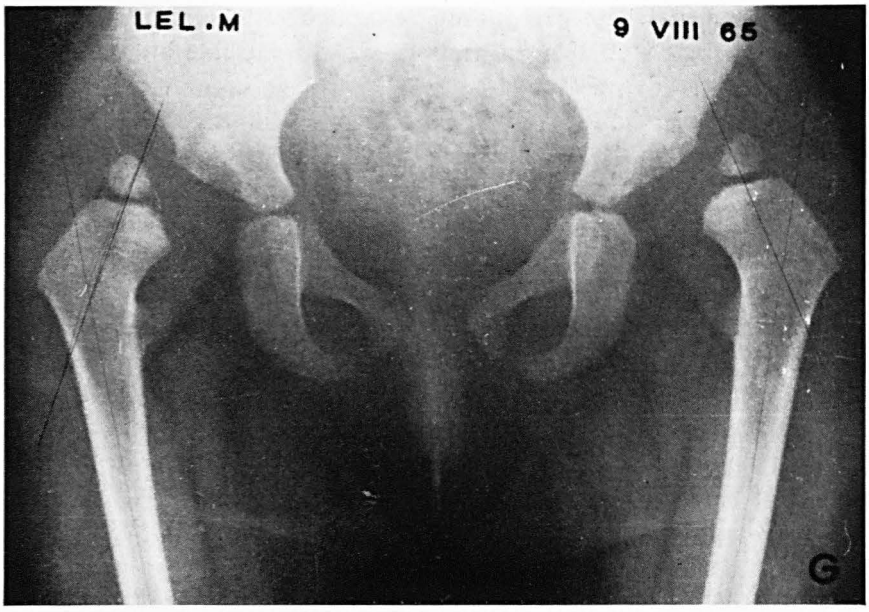


Figure 1 a. Bilateral congenital dislocation in a girl aged 2 years 4 months.

in the cast (Figure 2 a, b, c) described by Severin and later by Petit. Our experience showed *that progressive spontaneous penetration occurs in most cases when the orientation of the femoral head is kept in the spica.* Of 72 dislocations (Table 1), 56 (77 per cent) of the cases were reduced in this way. What are the advantages of this technique? 1) It is an atraumatic closed reduction. Its safety is obvious, since out of 56 reductions we have not had one single case of avascular necrosis. 2) It is efficient, since out of 72 dislocations it allowed a closed reduction in 56 cases, 13 of which were in children more than 4 years of age. 3) It permits distinguishing between hips which will respond to closed reduction and those which need an open procedure. The criterion is the *absence of penetration of the head* after adequate immobilization in the spica. In those cases arthrography almost always shows a narrow pinhead-like isthmus. There is no way the head can go through it, so open reduction is mandatory. However, in order to be efficient, this technique has to be *very precise.* Adhesive skin traction is applied on both lower limbs and is carefully padded with bandages. In order to keep the limbs under enough tension, the bandages are rerolled every second day. While one person removes the traction weights and maintains the limb in position by applying slight traction,

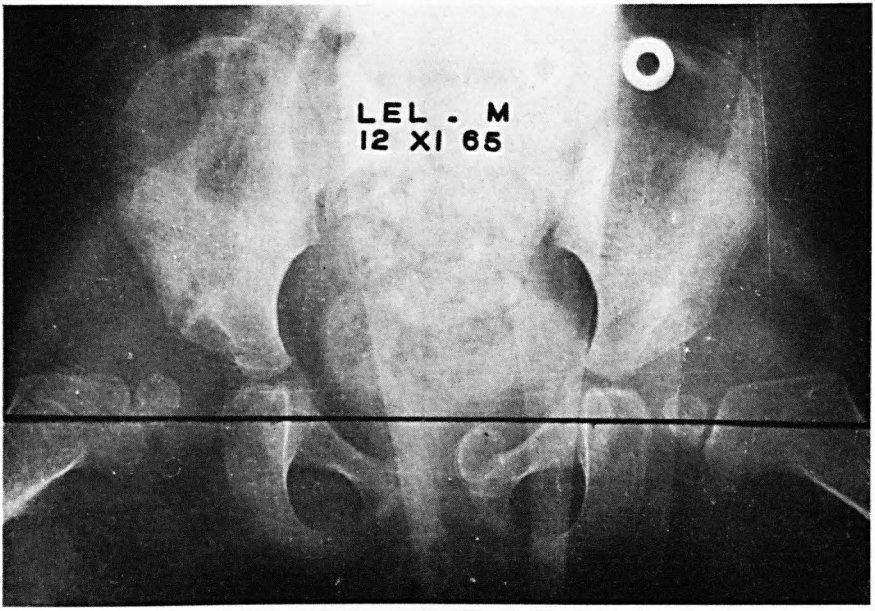


Figure 1 b. Setting of the femoral heads on "the reduction axis".

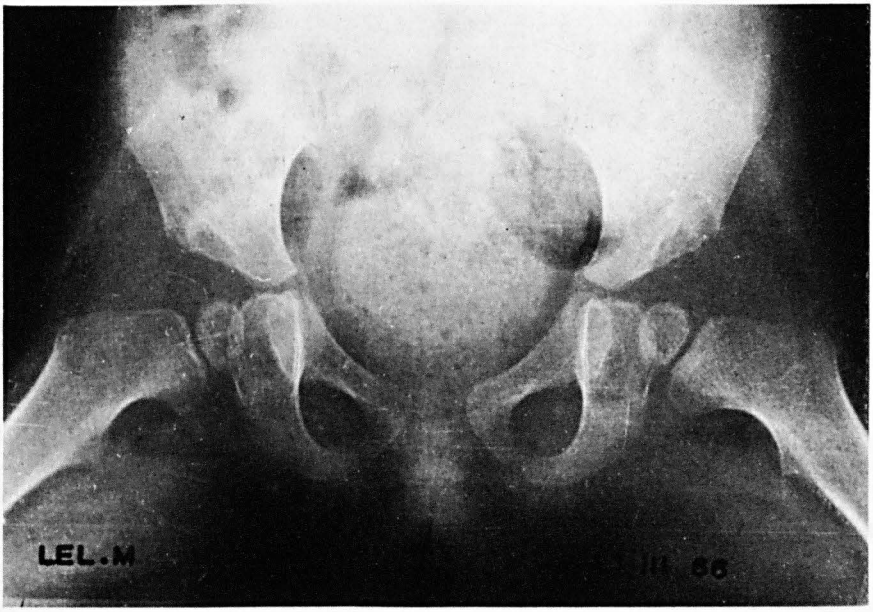


Figure 1 c. Bilateral reduction occurred by itself in the cast.

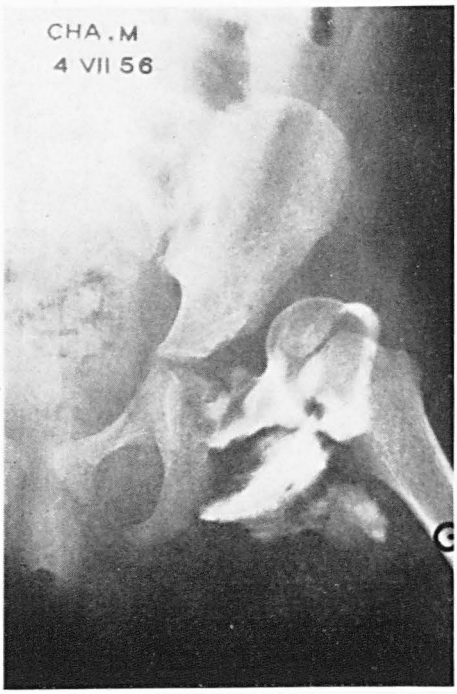


Figure 2 a, b, c.
The phenomenon of head penetration studied by arthrography.

Figure 2 a. Girl, aged 3 years.

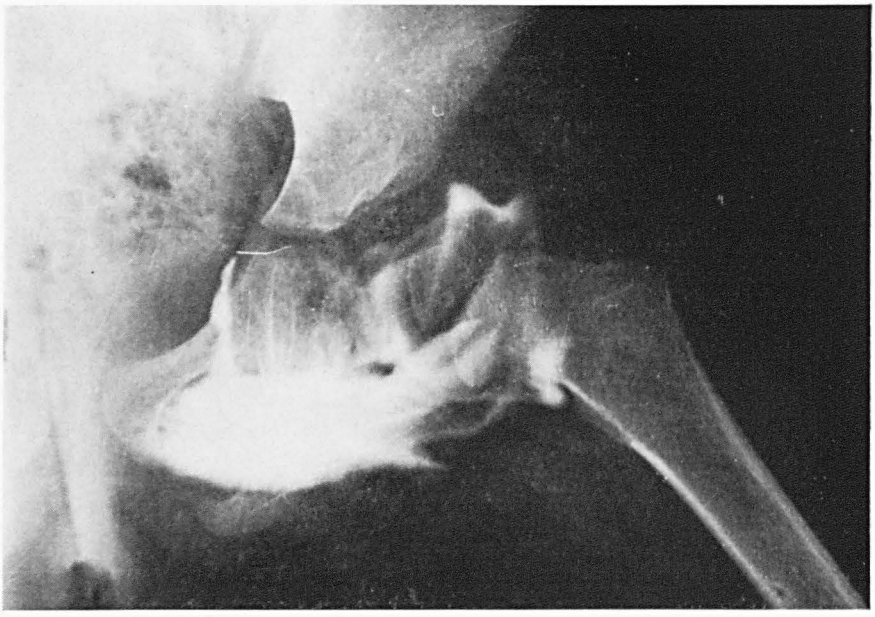
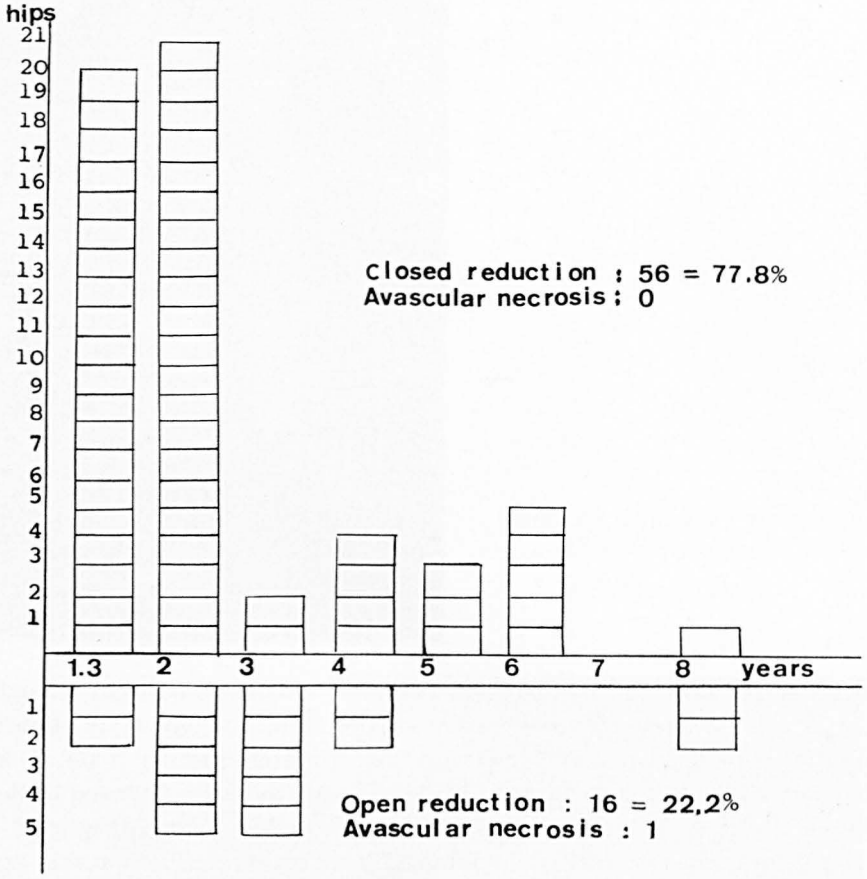


Figure 2 b. At the stage of immobilization in the cast.

Figure 2 c. 2 months later.

another person rolls the bandage. The bandage has to be tight enough to prevent slipping of the adhesive on the skin, but obviously should not be so tight as to hamper circulation. Counter-traction is obtained by immobilizing the chest of the child in a canvas brace fastened to the bed and elevating the bottom part of the reduction frame (Figure 3). The three stages in setting the femoral head on the reduction axis are as follows: a) *lowering* is performed by longitudinal traction with progressively heavier weights. X-rays are taken once a week to check the progression of the head. Traction force varies and has been adapted to each particular case. For a 1½-year-old child, one starts with 0.5 kg and progressively reaches 3 to 4kg by the end of the third week. In older children, weights reach 4, 6, 8 and sometimes 12 kg. The lowering phase may last more than 1 month. It is therefore a quite *forceful traction, but it is progressive.* It is stopped when the head is in front of the acetabulum. b) *Abduction.* This is performed by lateral displacement of the traction pulleys on the curvilinear edge of the reduction frame. An abduction of 45° to 50° is achieved within 10 days. When 25°–30° of abduction are obtained, the straps of internal rotation are set in place. They are only supposed to counteract the external rotation

Table 1. Congenital dislocations : 72.



in the beginning and later to induce some internal rotation. c) *Internal rotation.* This is performed by use of a folded strap (Figure 4) applied at the root of the thigh and fastened with a safety pin to the postero-lateral aspect of the bandages. One of the heads of the folded strap turns around the thigh and must be anchored to the bed in order to fix the rotation and the limb. The other head, the most superficial one, supports the weights and allows progressive internal rotation. This latter becomes easier when longitudinal traction decreases. It is therefore necessary to decrease the traction as needed for the rotation. Abduction remains unchanged at this stage. Internal rotation reaches progressively the anteversion angle, and will therefore be different for each case. One starts with 0.100 kg and reaches progressively 0.500 kg,

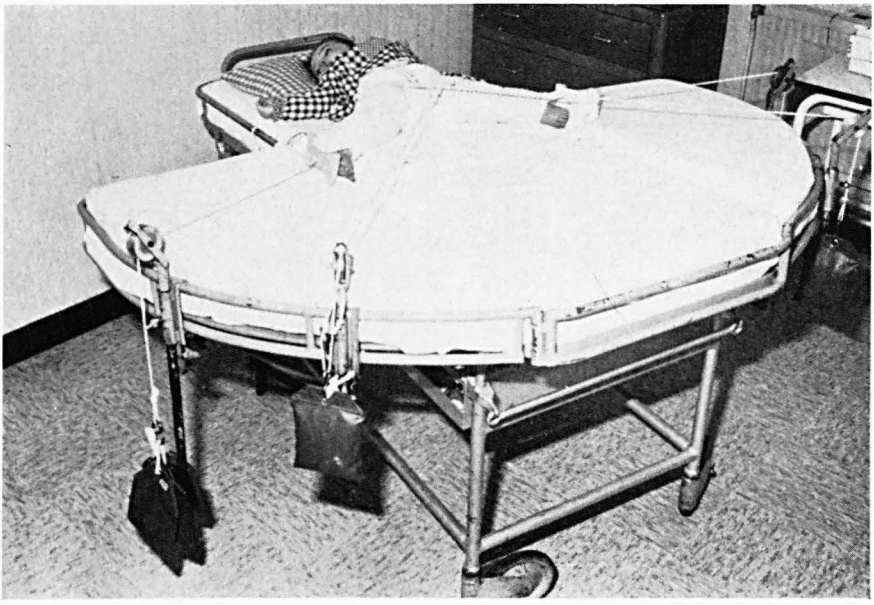


Figure 3. The reduction frame.

0.750 kg up to 1 kg. It is essential that the three stages are adapted to the child's reactions. No pain should be felt. If the child complains in his sleep or during the day, the sequences are too fast. One then must stop for a day or two, or one may go backwards and decrease the weights or the abduction if necessary. The most difficult part of the treatment is the internal rotation and should be performed very gently. This progressive setting of the head and neck of the femur on the reduction axis is checked on X-rays once a week. The minimum time for this phase is 5–6 weeks. In older children or in difficult cases, it may take 2 months. When the positioning of the hip is good, it is then time to maintain the position in a bilateral spica cast without any reduction manœuvre. Making the spica is not particularly difficult and is done on a reduction frame in order to prevent any movement. The child is not usually anesthetized but is always sedated. Several assistants are necessary in order to hold the position obtained after traction (Figure 5). *It is essential to keep the femoral heads in the right direction in the cast,* if one expects them to penetrate into the acetabulum. Usually we have kept the patients immobilized for a couple of months before checking the reduction. Recently we have actually noticed on tomograms made through the cast that penetration

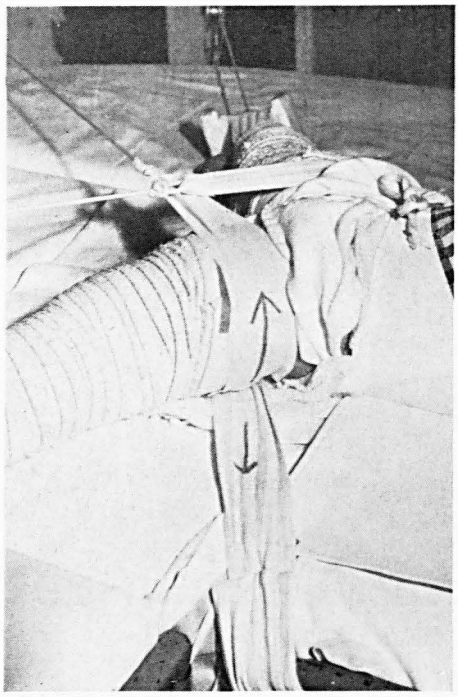


Figure 4. Internal rotation: the two heads of the folded strap.

may occur more rapidly. This has allowed us to shorten the immobilization in the cast and go directly to the next step, which is surgical stabilization of the reduction.

B. *Stabilization of the reduction and prevention of residual hip dysplasia*

After the age of walking, the reduction of the dislocation is unstable and in most cases requires surgery. In order to accomplish this in the best way, one has to consider the future of the hip, the risk of osteoarthritis later, and the *prevention of residual hip dysplasia.* As a matter of fact, long term follow-up shows that this dysplasia remains quite frequent after classical treatment, i.e. after femoral osteotomy as advised by Somerville and Pauwels. *The improvement of congruity obtained by varisation derotation osteotomy is unable in most cases to allow normal development of the acetabulum.* This latter remains insufficient and cannot prevent the onset and worsening of late subluxating coxa valga, which compromises the end results of the treatment (Figure 6).

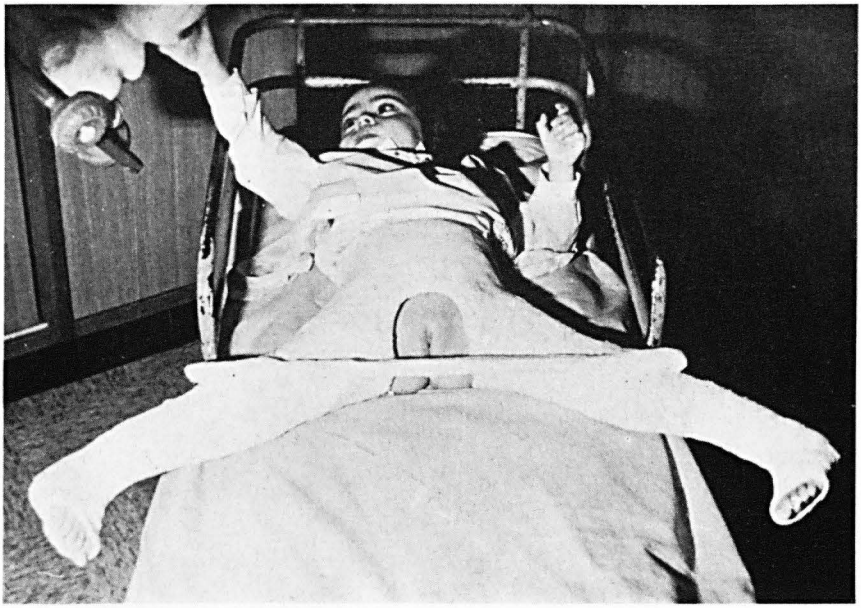


Figure 5. The bilateral spica used for closed reduction.

We have therefore considered very carefully the works of those who suggested *direct correction of residual acetabular insufficiency.* Pemberton reported a technique of pericapsular osteotomy of the ilium which would allow better covering of the head and stabilization of the reduction and subsequently better development of the acetabulum. We have no experience with that kind of operation, which appears to be a sophisticated acetabuloplasty. Theoretically its disadvantage might be to modify the shape and capacity of the acetabulum. In practice, it does not seem to be an easy operation. Salter, on the other hand, has designed an operation to correct the maldirection of the acetabulum without altering its integrity. Technically this operation is easier and its efficiency has been proven in a large number of cases.

Within the past 10 years we have used *the innominate osteotomy of Salter* to stabilize reductions in dislocations in older children. The following will show how we have incorporated this procedure into our therapeutic protocol. One has to separate closed reductions from the cases which require an open reduction.

a) *Closed reduction.* When the X-ray film shows that the head has penetrated the acetabulum, the spica cast is removed under general anesthesia. The position of the hip is then checked with a new A. P.

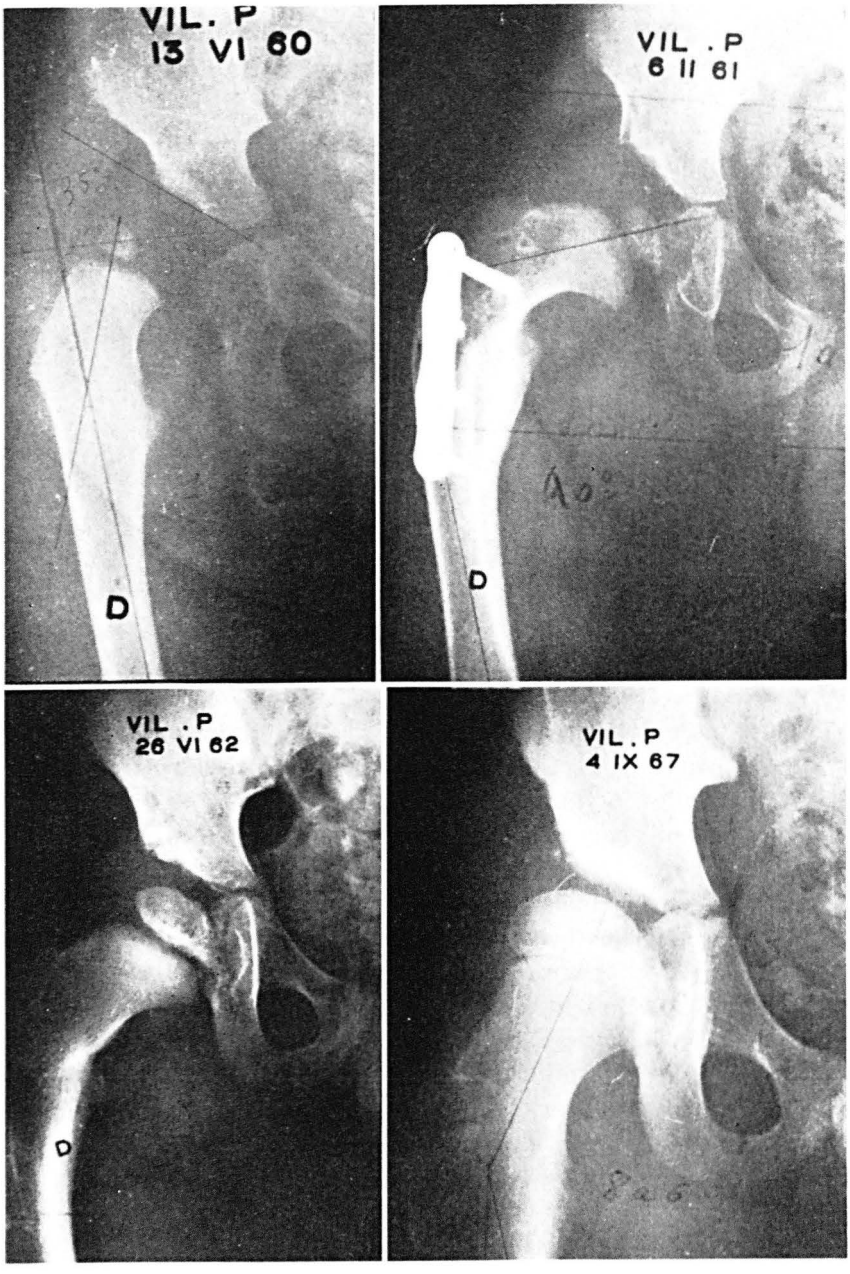


Figure 6. Boy aged 15 months. Open reduction and varisation derotation femoral osteotomy. Failure of normal acetabular development and residual subluxation.

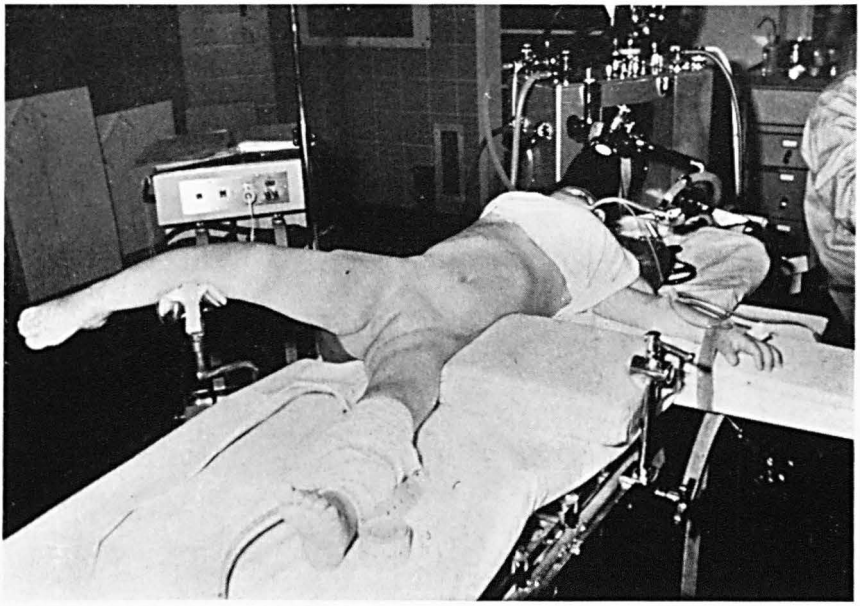


Figure 7. Positioning of the child on the operating table.

film. Without modifying abduction one takes an A. P. film in a free position and then another one in internal rotation equaling the anteversion angle. There is no movement of the joint, but the purpose of this is to determine before innominate osteotomy which cases will need a *combined femoral derotation osteotomy*. As our experience has shown that excessive anteversions can lead to redislocations, we tend to correct those over 55–60°. In the operative theatre the patient is positioned partly on his side, with the lower limb in *abduction internal rotation* (Figure 7) in order to maintain congruity. At this stage, on the basis of the preoperative X-ray one decides whether to use simple innominate osteotomy or to combine it with a derotation osteotomy. In both cases, since reduction has been obtained, the whole operation will remain extra-articular, so there is never any direct action on the joint itself and its different elements. Therefore one may say that from the beginning of traction until the end of the surgical stabilization, the treatment remains atraumatic (Figure 8 a, b, c, d, e and Figure 9 a, b, c, d). From the technical viewpoint, innominate osteotomy was performed as described by Salter but with slight modifications: 1) The operative positioning is slightly different. 2) There is no arthrotomy since the dislocation is reduced. 3) There is no adductor or iliopsoas

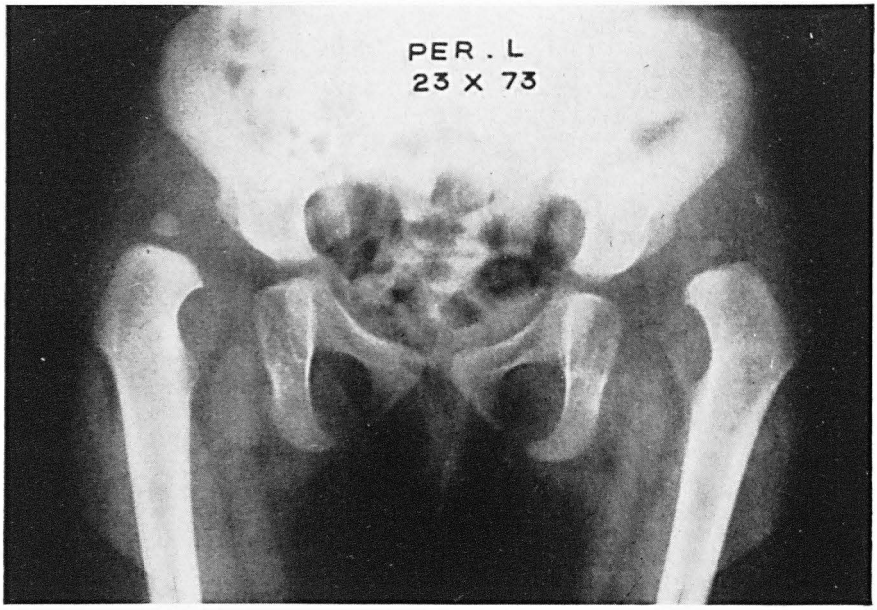


Figure 8 a. Bilateral congenital dislocation in a girl of 17 months.

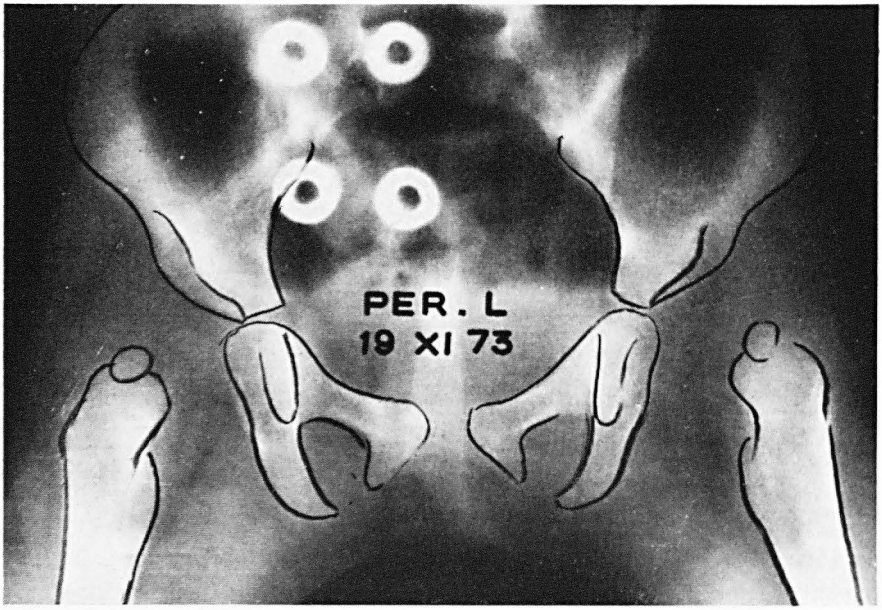


Figure 8 b. Lowering of the heads by longitudinal traction.

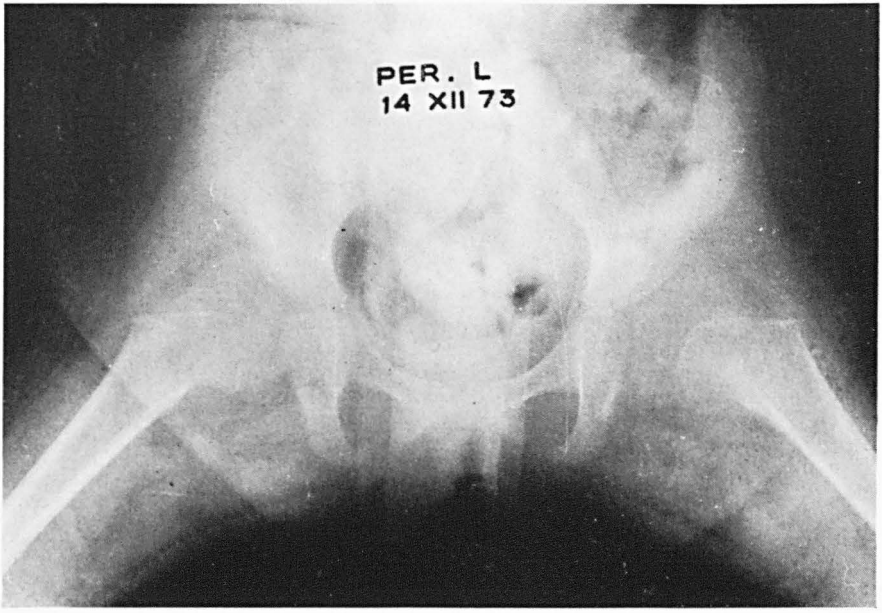


Figure 8 c. Setting of the femoral heads on the reduction axis.

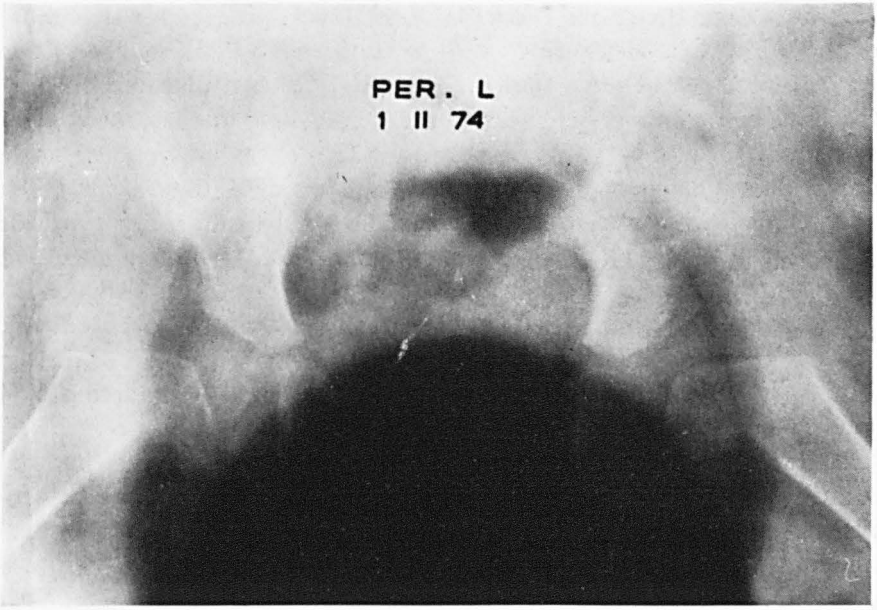


Figure 8 d. Bilateral reduction in the cast (tomogram).

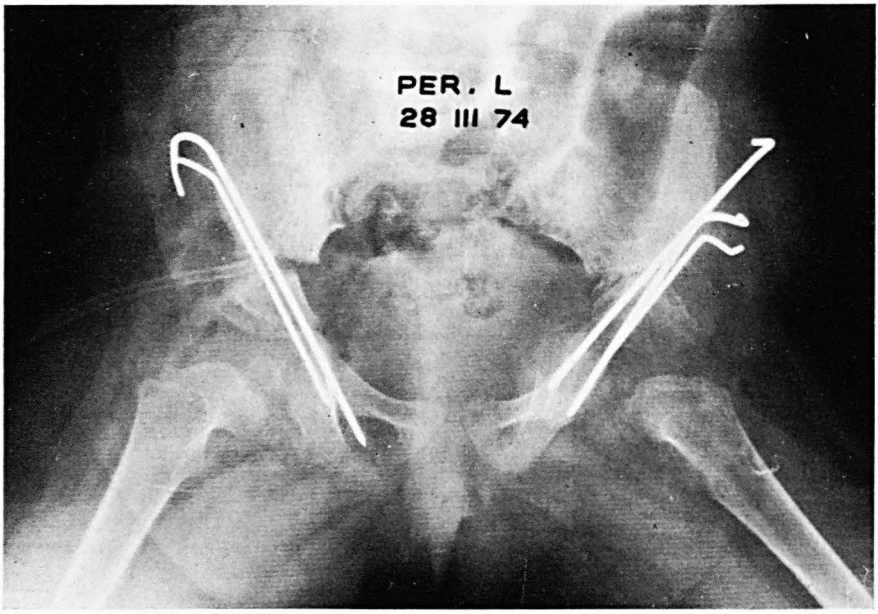


Figure 8 e. Stabilization of the reduction by innominate osteotomy on the left on February 14, 1974 and on the right on March 28, 1974.

tenotomy since the closed reduction has allowed progressive stretching of these muscles. 4) There was no capsulorrhaphy. Subsequently, we think that it might have improved the stabilization of three hip dislocations which recurred after operation. When femoral derotation osteotomy is necessary, we perform the two operations on the same day. Femoral osteotomy is performed first through a lateral approach over the subtrochanteric area, then innominate osteotomy proceeds through the usual approach. After surgery, the child is immobilized in a bilateral spica after the best positioning of the lower limbs has been ascertained by X-rays. A couple of months later the wires are removed, but the lower limbs remain immobilized for one more month in plaster splints which allow flexion extension with 30° of abduction and moderate internal rotation.

b) *Open reduction.* If 2 months of being in a plaster cast has not allowed the head to penetrate the acetabulum, we proceed with arthrography in order to check the interposition and the nature of the intra-articular obstacle. We perform the open reduction first; *it is very important that the head be perfectly reduced before stabilization.* This step is performed with innominate osteotomy, either during the same

stage or in a second stage. The approaches have to be adapted to the different problems presenting together. There are three of them:

1) If the head has been lowered and is well directed, if the anteversion is not excessive, we proceed then with Salter's operation. Reduction through an anterior approach and stabilization by innominate osteotomy (Figure 10 a, b, c, d).

2) If the head is low enough and the anteversion angle exceeds 55 to 60°, reduction is then performed through a Watson-Jones approach allowing also a derotation osteotomy. Innominate osteotomy is performed through a second approach either immediately or after 4–6 weeks of plaster immobilization.

3) If the head has not been lowered enough in older children or after previous treatments elsewhere, the main concern is the reduction. If this latter was performed forcefully, the risk of avascular necrosis would be quite high. Our only case of avascular necrosis was in an 8-year-old girl whose reduction had been difficult. The solution to this problem has been given by Klisic. After referring to Ombredanne's works he showed by his operative successes that the best way to reduce the dislocations, *without dangerous pressure* on the femoral head, was to perform a *shortening of the shaft of the femur.* We have had experience using his technique for, e.g. arthrogryposis, cerebral palsy and osteomyelitis sequelae, which have a worse reputation than congenital dislocations. The results obtained allow us to state that his technique is, at present, the best solution we found to this problem. From the technical viewpoint we perform a Watson-Jones approach with femoral osteotomy under the lesser trochanter. As Klisic advises, the psoas tendon is divided and the joint approached on its inferior aspect after reversing the proximal fragment into abduction. When the joint has been cleared, reduction of the head into the acetabulum is performed and does not appear to be impeded by the glutei muscles. On the contrary, the long muscles of the thigh are overstretched and induce a dangerous pressure on the reduced head. The only way to prevent this is to shorten the shaft as needed. When femoral osteosynthesis is completed, stabilization of the reduction is started at once or is performed as a second-stage procedure after plaster immobilization in the most stable position. Klisic stabilizes his reduction with a Chiari osteotomy. Up to now we have always used the innominate osteotomy.

For these difficult cases it occurred to us that we could widen the spectrum of indications by using Steel's "trick". This author obtains

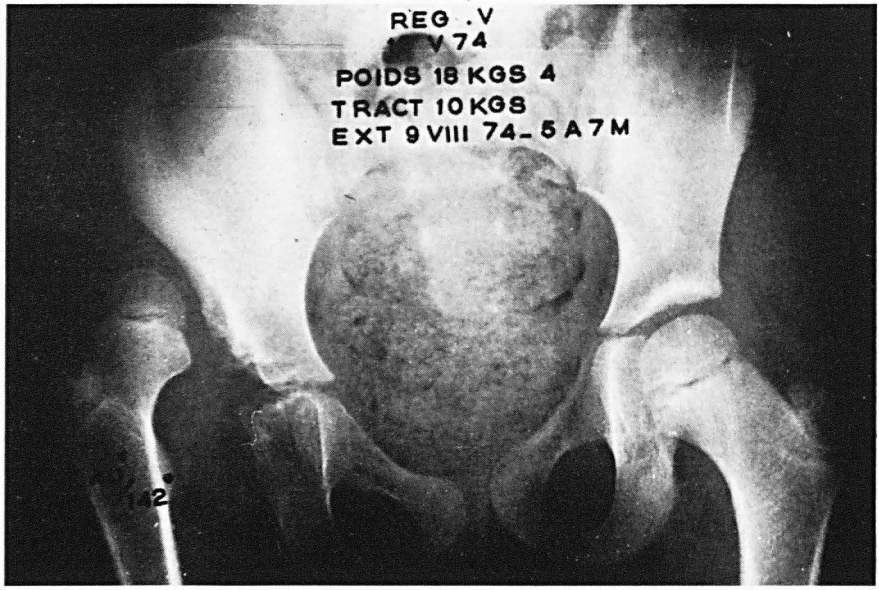


Figure 9 a. Congenital dislocation of right hip in girl aged 5 years 7 months and weighing 18 kg. Beginning the skin traction on August 9, 1974. Weights reached 10 kg.

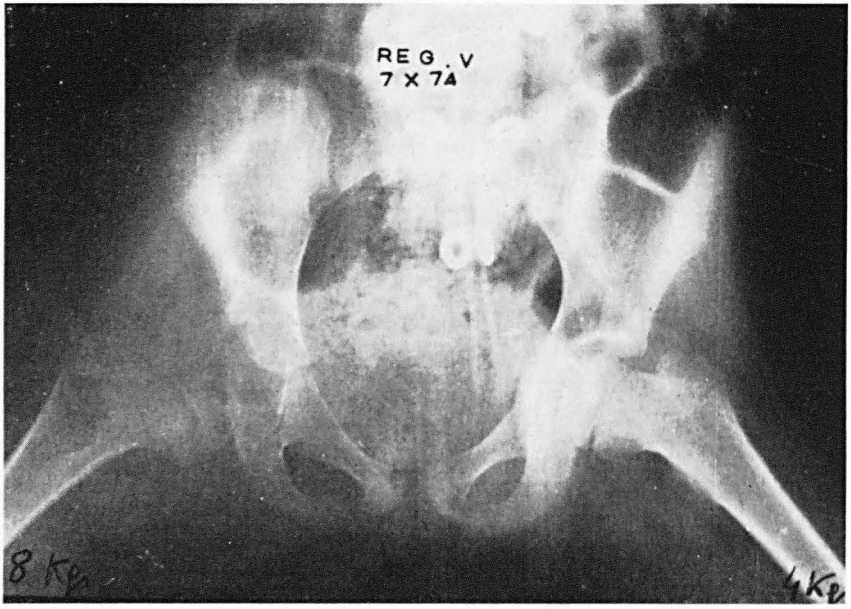


Figure 9 b. Setting of the femoral head on the reduction axis.

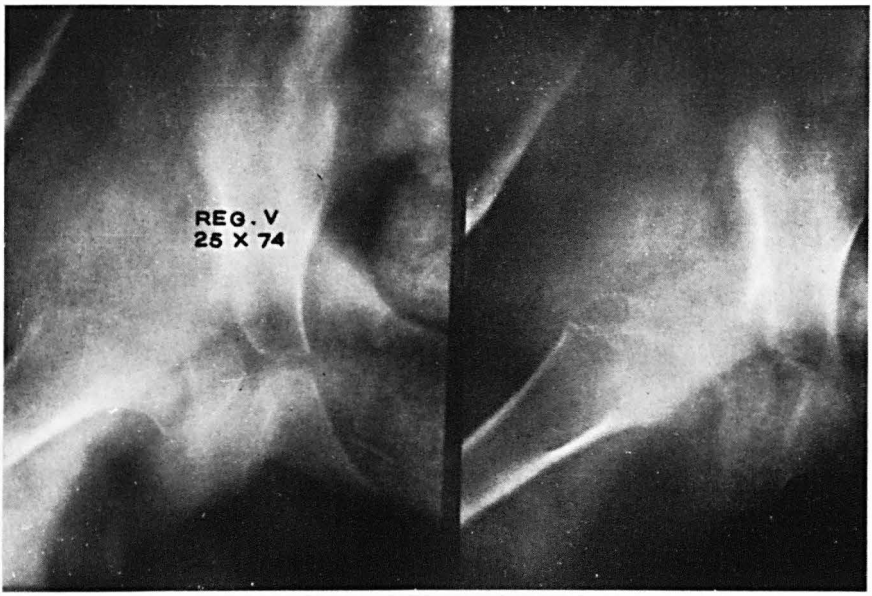


Figure 9 c. Reduction in the cast (tomogram).

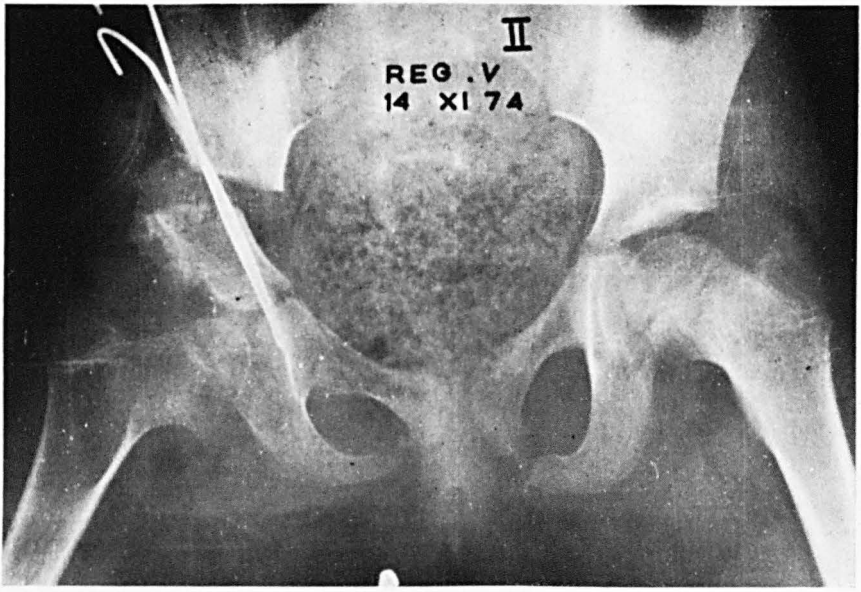


Figure 9 d. Stabilization of the reduction by innominate osteotomy.

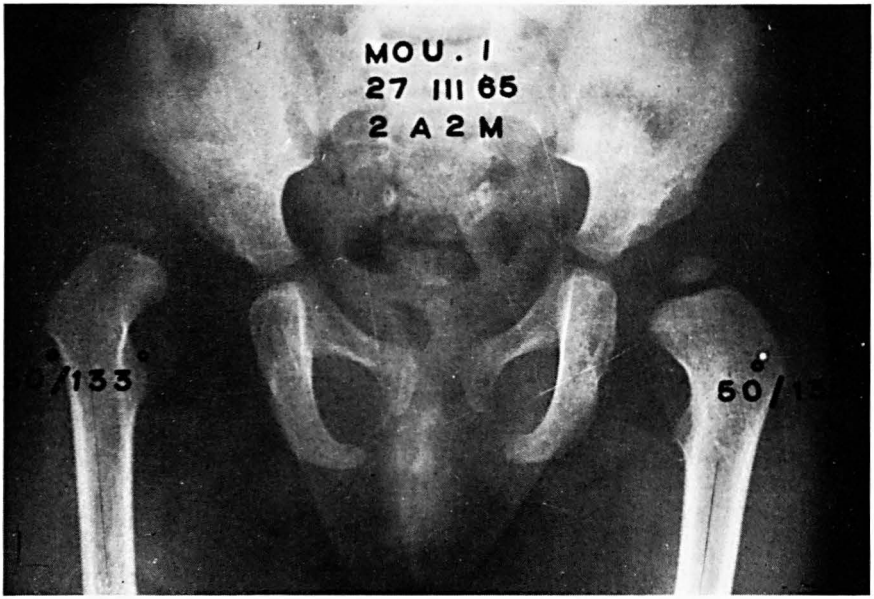


Figure 10 a. Congenital dislocation of the right hip and subluxation of the left hip in girl aged 2 years 2 months.

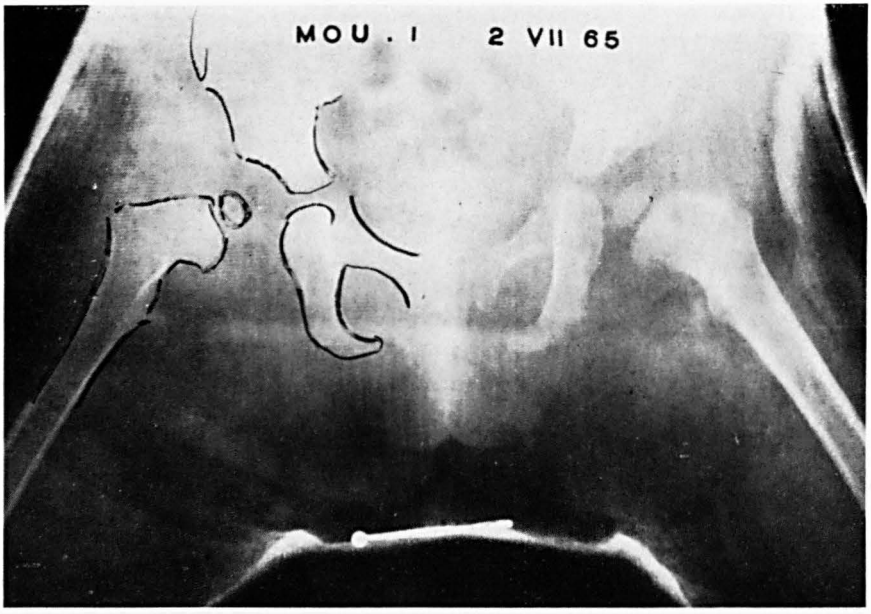


Figure 10 b. Absence of penetration of the head on the right after immobilization in the spica.

Figure 10 c. Arthrography shows a narrow pinhead-like isthmus.

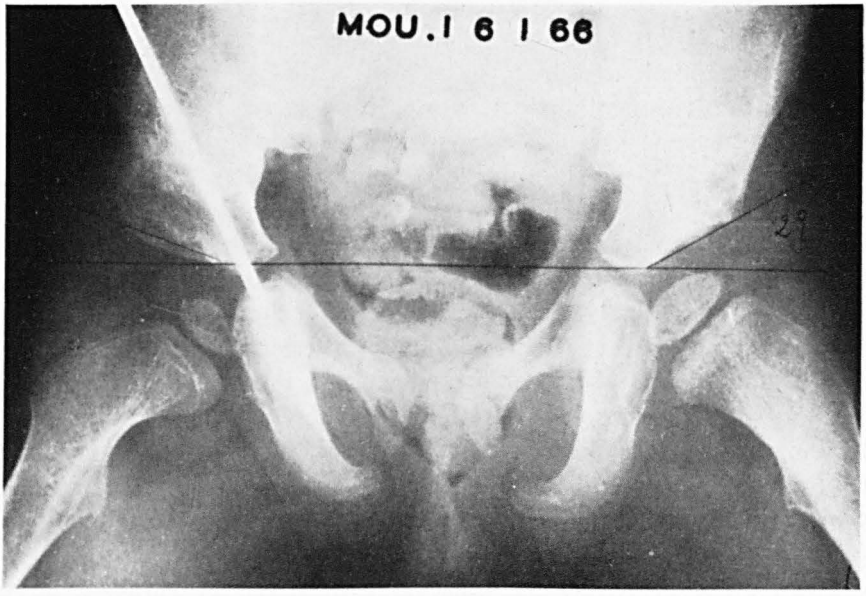


Figure 10 d. Treatment by Salter's operation.

an easier and more efficient distal fragment tilt by dividing the iliopubic and ischiopubic rami. We have used it once and were very pleased with its efficiency.

The solutions that we have proposed appear to answer the wide spectrum of possibilities. Incoercible and incongruous hips are not indications for Colonna arthroplasty. One knows by now that its later results are mediocre or poor, and it pleases us to solve these problems with a different solution.

RESULTS OF CONGENITAL DISLOCATION TREATMENT

These are the results of 72 dislocations. The youngest child was 15 months of age, the oldest cases were 8 years old. Minimum follow-up was 1 year, maximum was 10 years. Fifty-two per cent of the cases have been followed- up for at least 5 years. Fifty-six dislocations were reduced by closed methods, 16 by open methods. All cases were made stable by Salter's innominate osteotomy. Additional derotation osteotomy was performed in 15 cases, of which nine were one-stage operations and six were two-stage procedures. Additional varisation derotation osteotomies were done in eight cases, four prior to innominate osteotomy and four subsequently.

From the clinical viewpoint one may stress *that closed reductions did not lead to any limitation of the range of motion of the hips,* but some open reductions did.

From the roentgenological viewpoint the results were assessed according to Severin's classification as described by Salter. In type I, the hip is perfect, with a normal CE angle, and this is considered an excellent result. In type II, there may be some deformity of the femoral head but a normal CE angle, and this is considered a good result. In type II special, there is moderate deformity of the femoral head but a normal CE angle. In type III, there is residual dysplasia of the hip but no subluxation; however, the CE angle is less than normal. Type II special and type III together are considered fair results. In type IV, there is some degree of subluxation with the CE angle near zero, and this is considered a poor result. In type V, the subluxation is more severe or there is a "wandered acetabulum". In type VI, there is complete dislocation. Both type V and type VI are considered complete failures.

Results are presented in Table 2. The group of children under 4 years of age (Figures 11 and 12) with 55 dislocations had excellent

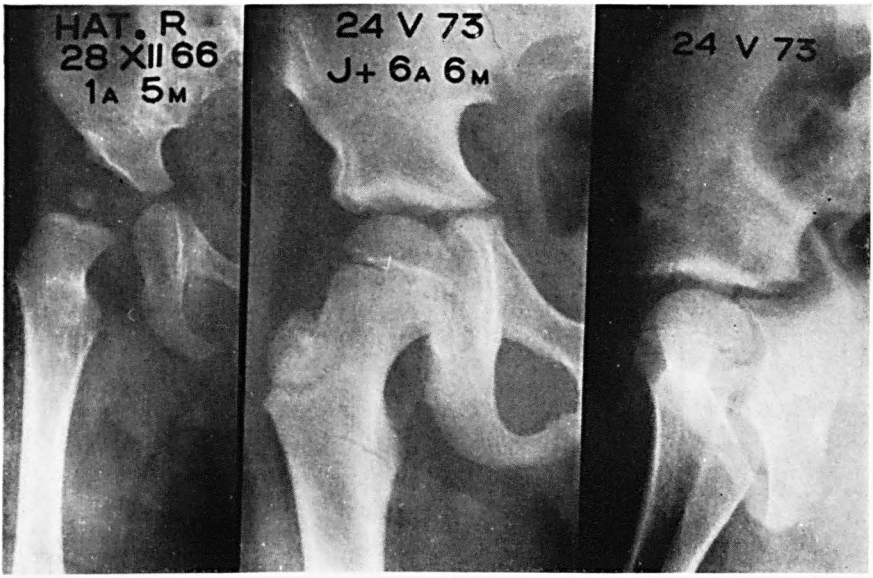


Figure 11. Congenital dislocation of the right hip in boy aged 1 year 5 months. Six and a half years after closed reduction and innominate osteotomy.

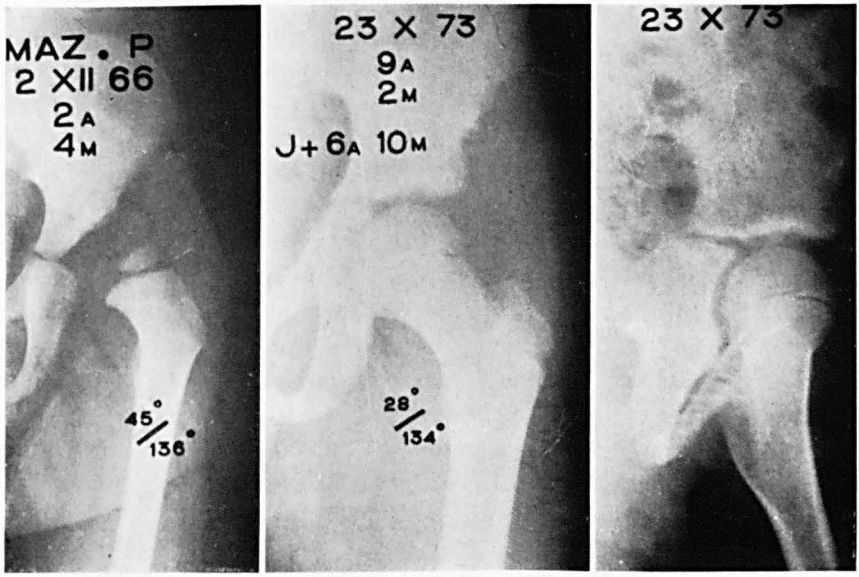


Figure 12. Congenital dislocation of the left hip in a boy aged 2 years 4 months. Six years ten months after closed reduction and innominate osteotomy (the anteversion angle decreased).

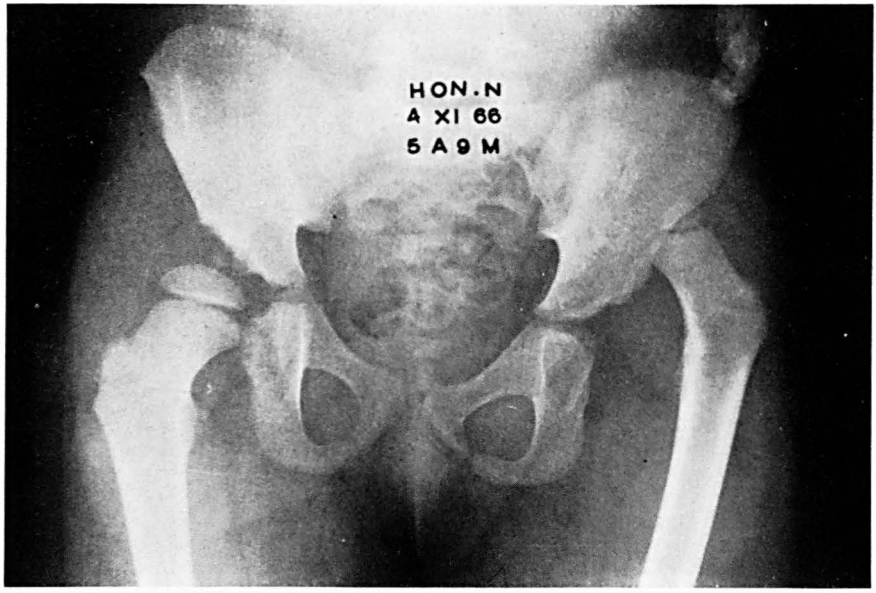


Figure 13 a. Congenital dislocation of the left hip and subluxation of the right hip in girl aged 5 years 9 months.

and good results in 85.4 per cent of the cases. There was only one poor result. In the 17 hips in children between 4 and 8 years of age (Figures 13 and 14) 58.8 per cent had excellent and good results. There was one poor result and one complete failure.

The complications observed during the treatment of these 72 dislocations are as follows.

One case of avascular necrosis in an 8-year-old girl with an untreated dislocation. Open reduction was performed and the head was reduced forcefully without the required shaft shortening.

Seven cases of redislocations, distributed as follows: One case by muscle retraction, set back into place by an iterative open reduction; this was the patient with avascular necrosis. One case by technical failure of the innominate osteotomy; the hip was set back into place by closed reduction and made stable by a repeated innominate osteotomy.

Four cases were due to exessive anteversion: after repeated closed reduction for three and open procedure for one, anteversion was corrected by derotation osteotomy; results were all good except for one case which progressively subluxed.

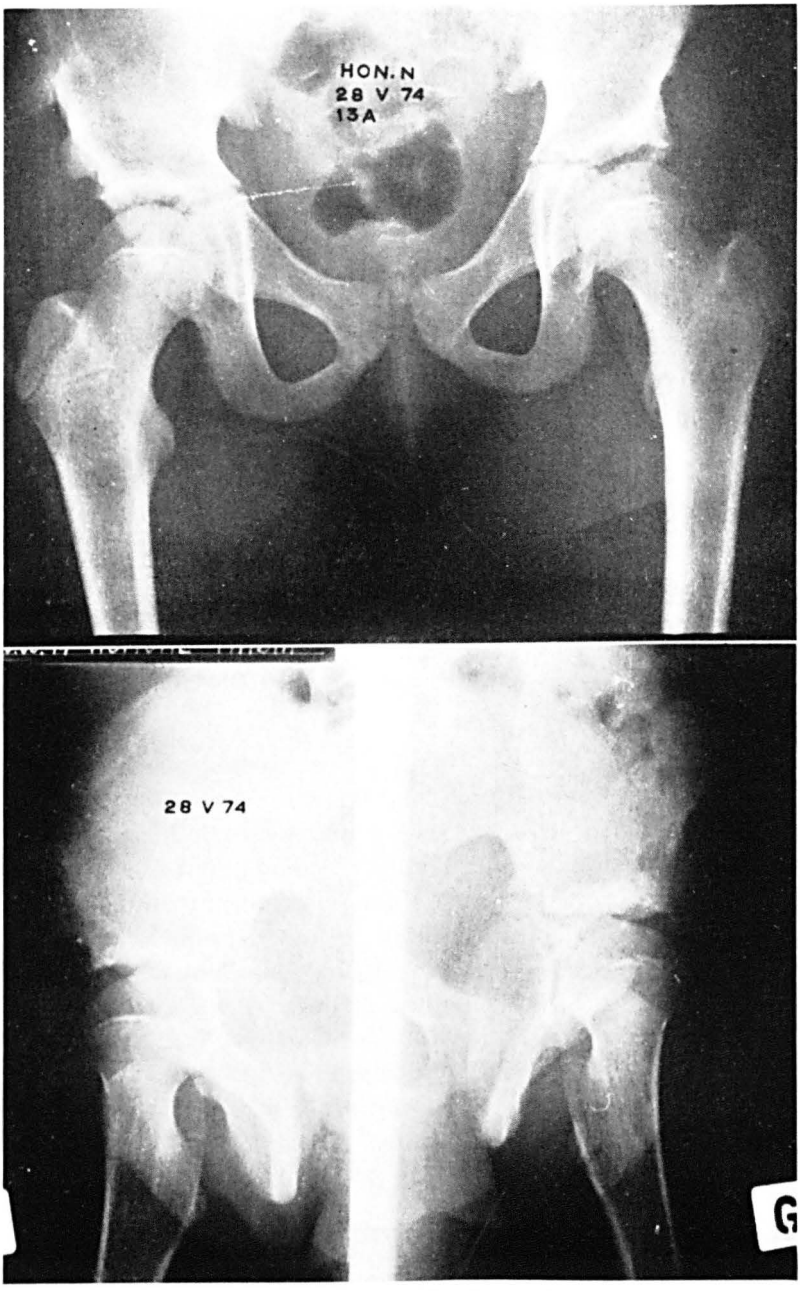
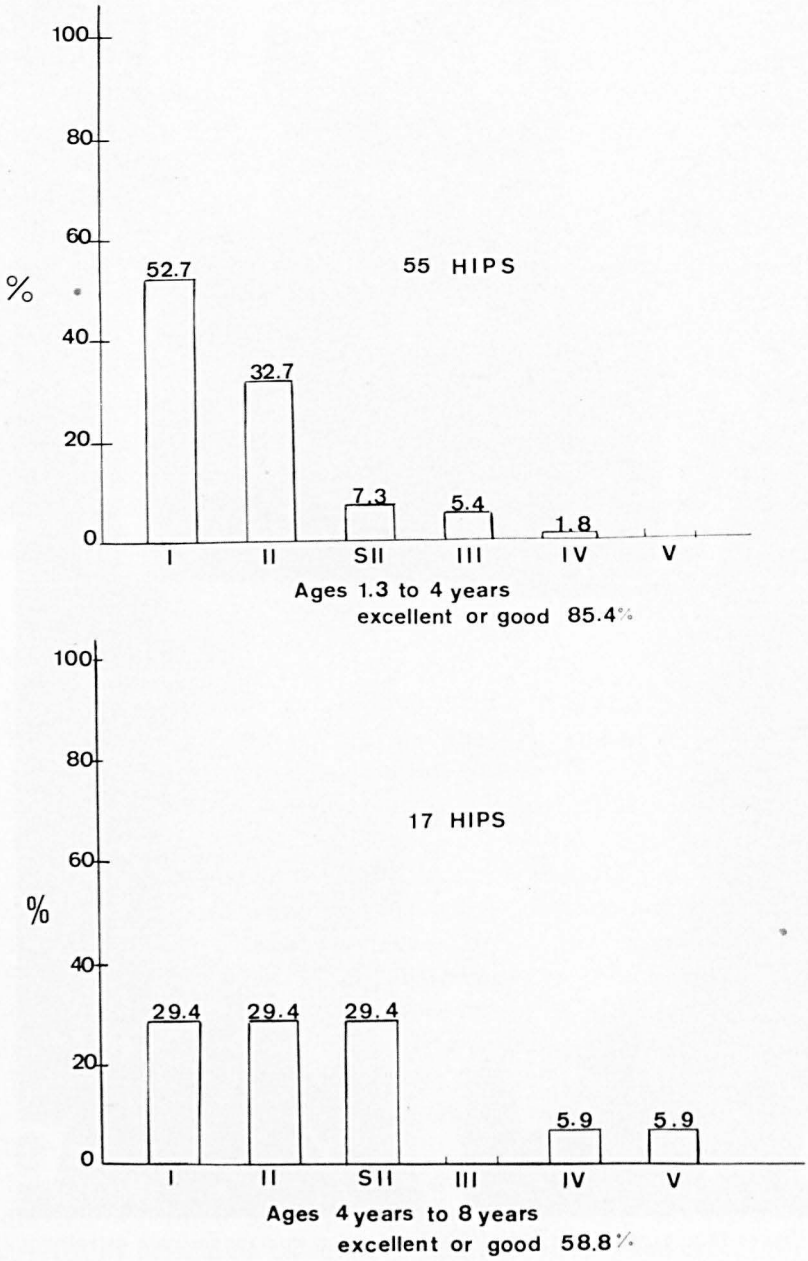


Figure 13 b. Seven years after closed reduction and innominate osteotomy.

Table 2. Radiographic results of primary treatment for dislocation based on Severin classification.



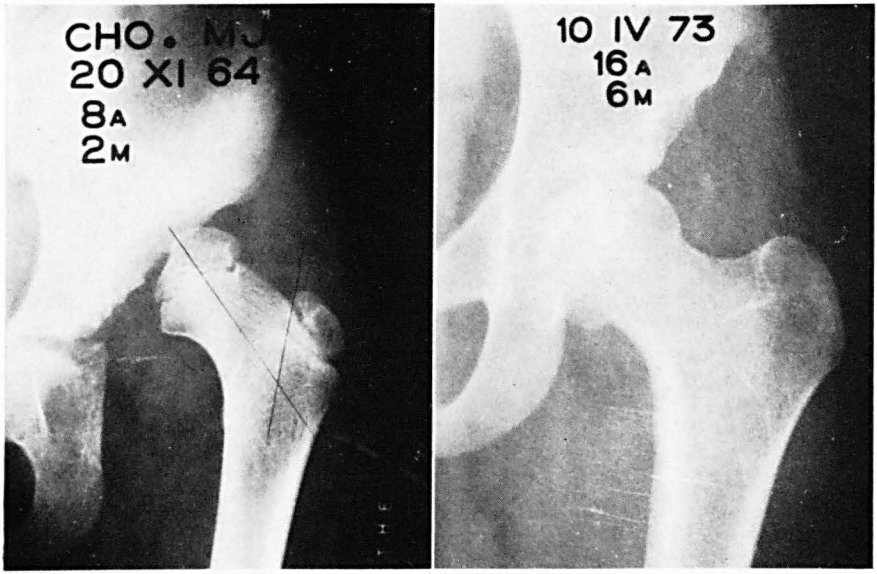


Figure 14. Girl aged 8 years 2 months. Congenital dislocation of the left hip; open reduction after failure of closed reduction, followed by innominate osteotomy 8 months later. Normal CE angle at the end of growth (16½ years).

One case of capsular laxity was a good result in the end after open reduction and capsulorrhaphy.

Two cases of secondary displacement of the innominate osteotomy by insufficient fixation; one case was reoperated with good result, the other was a poor anatomical result but the family refused iterative surgery owing to a good functional result.

Four cases of skin perforation by the Kirschner wires.

Seven cases of *transitory* stiffness after cast immobilization, four of which seem to have reasonable explanations: two cases were open reductions and in the two others the wires had penetrated into the joint spaces. The seven cases improved with "unloading" skin traction.

In one case, undisplaced supracondylar femoral fracture occurred during removal of the spica.

DYSPLASIAS AND SUBLUXATIONS

Treatment of congenital dysplasias and congenital subluxations is easier than in the case of dislocations, since the prerequisite of reduction is already obtained. In this case the head has not left its

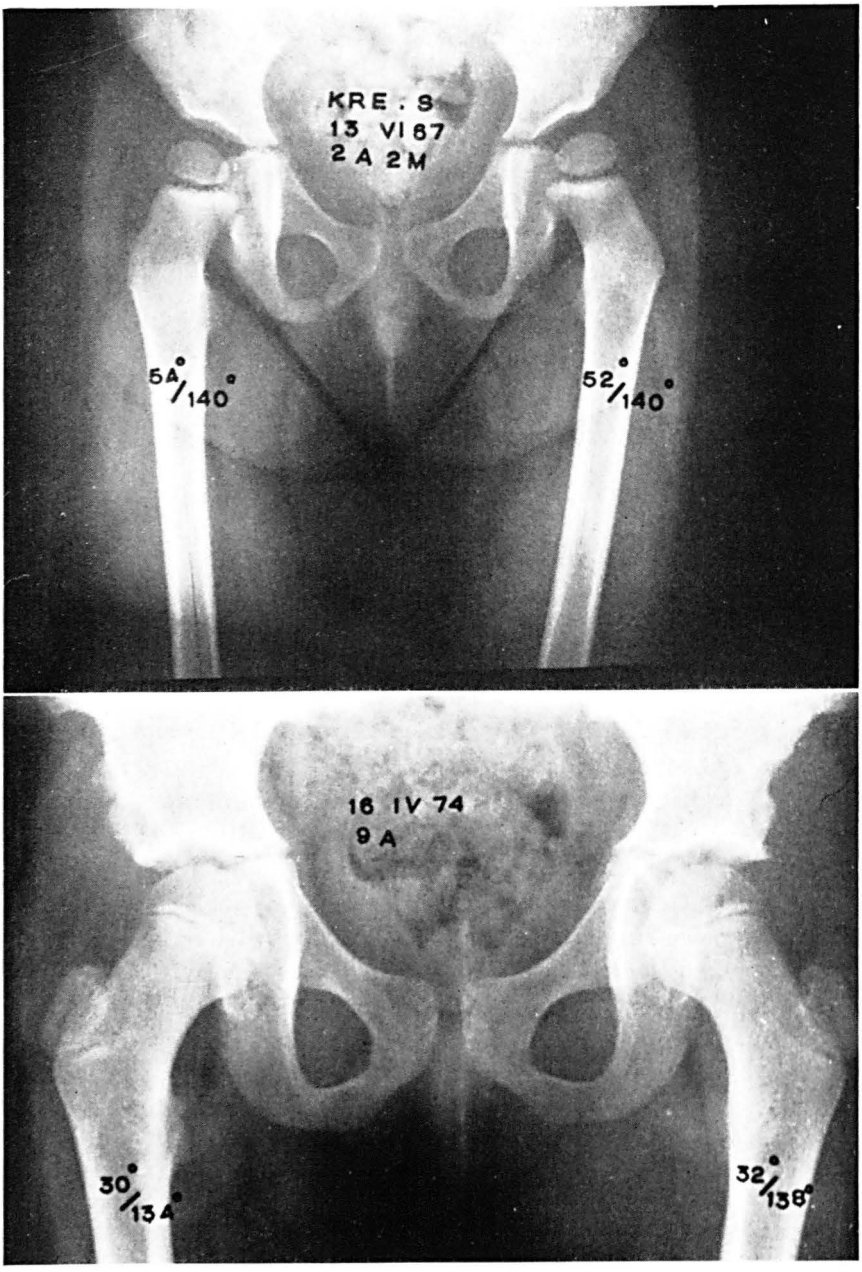


Figure 15. Bilateral congenital subluxation in a girl aged 2 years 2 months. Innominate osteotomy on both sides. Result 7 years later (the anteversion of the femoral neck decreased).

acetabulum and, if concentricity is not good enough, it remains easy in most cases to replace the head in the bottom of the acetabulum since there is no interposition in a subluxation. However, in older patients good centering of the head sometimes requires preparation by slow progressive skin traction. It is used in all cases associated with a contralateral dislocation, since both hips are then subjected to traction. When the congruity is good, treatment of the dysplasia may then be undertaken. It is logical nowadays to correct directly the maldirection of the acetabulum, since it is the most essential factor of the dysplasia. Among pelvic osteotomies the best choice appears to be Salter's innominate osteotomy. As a matter of fact, Salter's results (Salter & Dubos 1974) are so remarkable that it seems impossible to obtain better results with any other technique: *100 per cent are good results before age 4* and 91.6 per cent after that age.

We have personally used the same technique in 20 cases: 8 cases of contralateral dysplasias or subluxations and 12 cases of isolated dysplasias or subluxations. Six cases were considered to require combined derotation varisation osteotomy during the same procedure as the

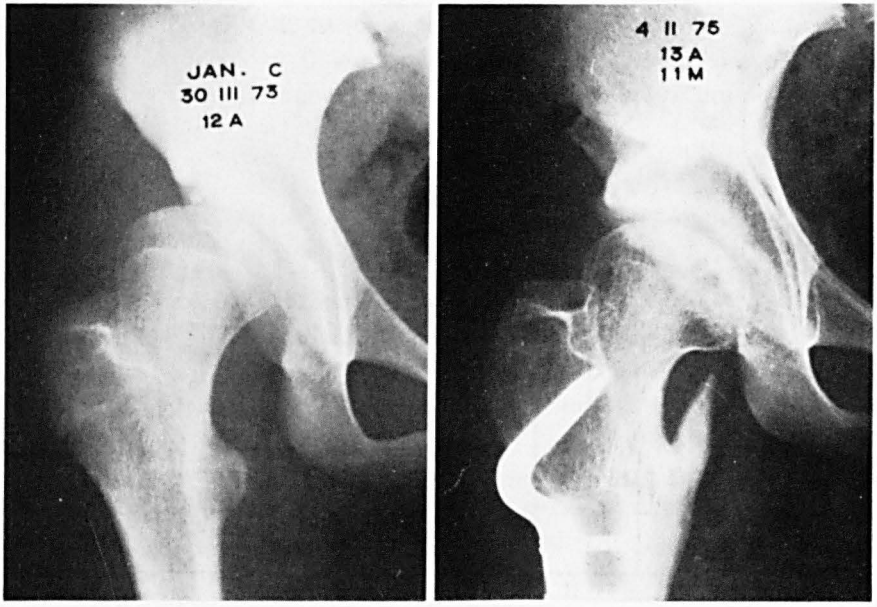
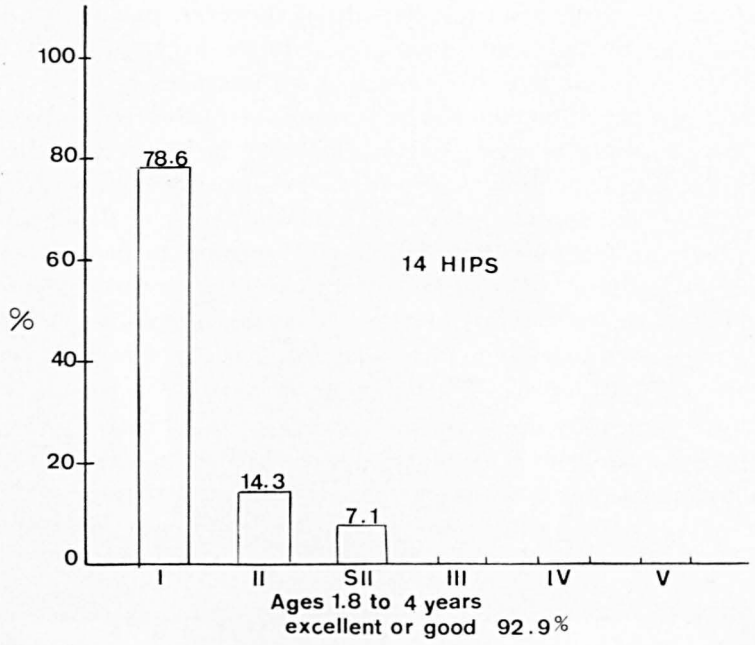
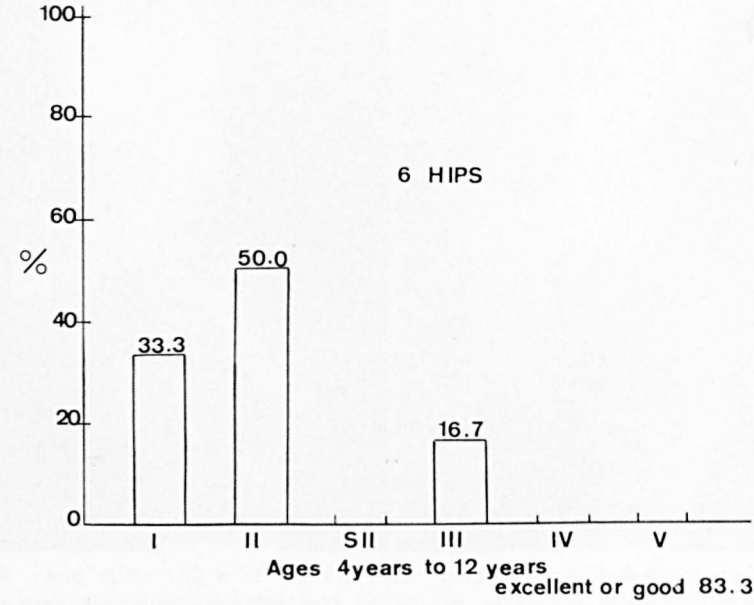


Figure 16. Untreated subluxation of the right hip in a girl of 12 years. Result 2 years later after varisation derotation femoral osteotomy and innominate osteotomy.

Table 3. Radiographic results of primary treatment for subluxation based on Severin classification.



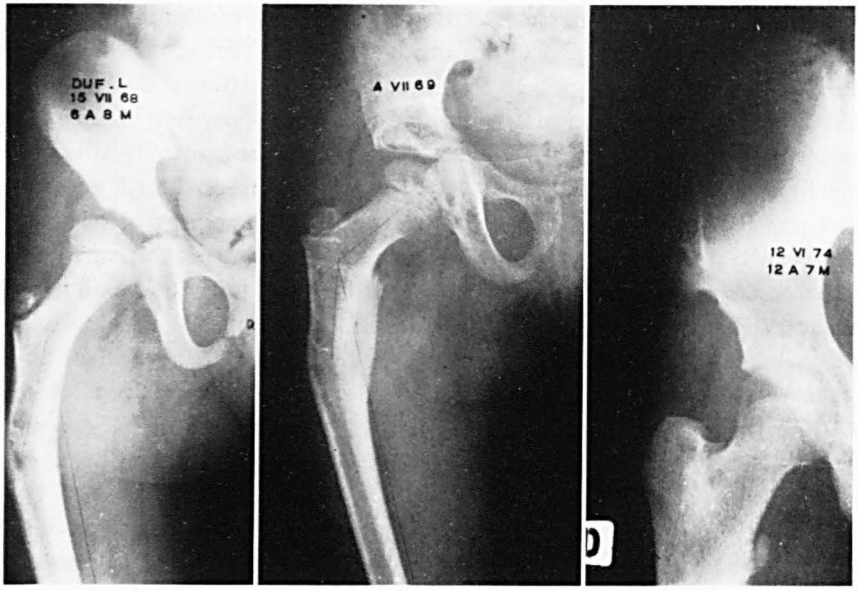


pelvic osteotomy. In two cases femoral osteotomy was undertaken as a second-stage procedure. The minimum follow-up period was 1½ years, the maximum follow-up was 9 years. In nine patients the follow-up lasted 5 years. The graphs of our results are shown in Table 3. In patients under 4 years of age, 92.9 per cent of our results were excellent or good. One case was fair. In patients more than 4 years old, 83.3 per cent gave excellent or good results and one was considered a fair result. After reviewing our cases we think that combined femoral osteotomy is not necessary in young children (Figure 15). As a matter of fact, the percentage of excellent results is higher in the group which did not have femoral osteotomy. We have noticed in several of these cases a spontaneous improvement of the femoral dysplasia, particularly of the anteversion. Consequently, in the future we shall choose combined femoral and innominate osteotomy only in older children with severe subluxation (Figure 16).

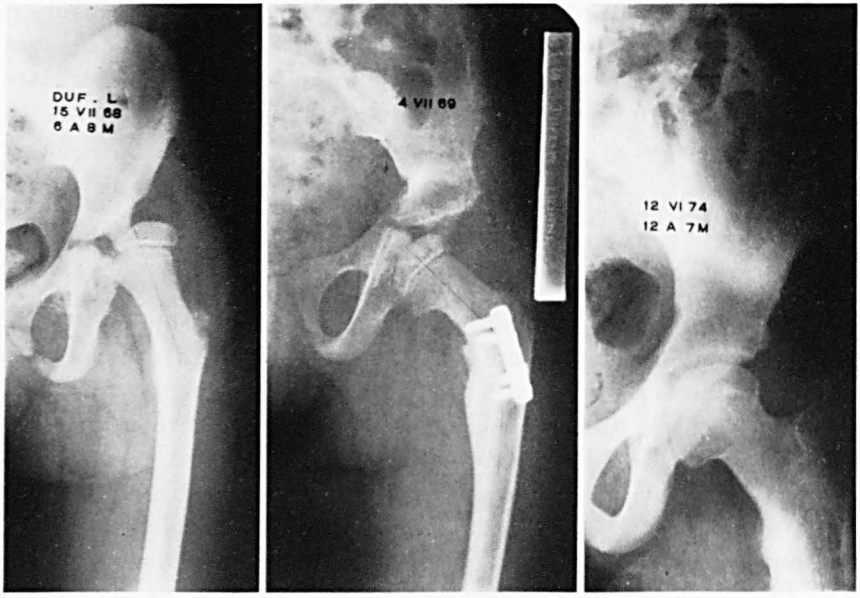
The complications in this group are as follows: one moderate avascular necrosis in a 2½-year-old boy who underwent a combined femoral and pelvic osteotomy. This child had not had any traction prior to the operation. As advised by Salter, we should have tenotomized the adductor and the psoas in order to reduce the pressure on the femoral head. One technical failure of innominate osteotomy reoperated at 3 weeks postoperatively in a 10½-year-old girl. One healing delay in an 8-year-old girl. Two cases of superficial sepsis.

RESIDUAL SUBLUXATIONS AND DISLOCATIONS AS SEQUELAE OF PREVIOUSLY TREATED MALFORMATIONS

Coxo-femoral dysplasias sometimes remain moderate but most often are important. When encountered, during growth, after a previous treatment, they raise difficult problems which up to now have been solved by femoral osteotomies, which sometimes had to be repeated, shelf operations, and Colonna's arthroplasty. Nowadays, pelvic osteotomies allow a new approach and result in a progressive shift to new indications. Two techniques have been specially developed: Salter's osteotomy and Chiari's osteotomy. From the mechanical viewpoint, these two operations give an analogous result: it improves the covering of the head and makes the hip stable. However, from the physiological viewpoint, the result is quite different. In the first case, the head is covered by the cartilaginous portion of the acetabulum and the normal



a = right hip.



b = left hip.

Figure 17 a, b. Bilateral residual subluxation in a girl aged 6 years 8 months, and results 6 years after combined varus femoral osteotomy and innominate osteotomy.

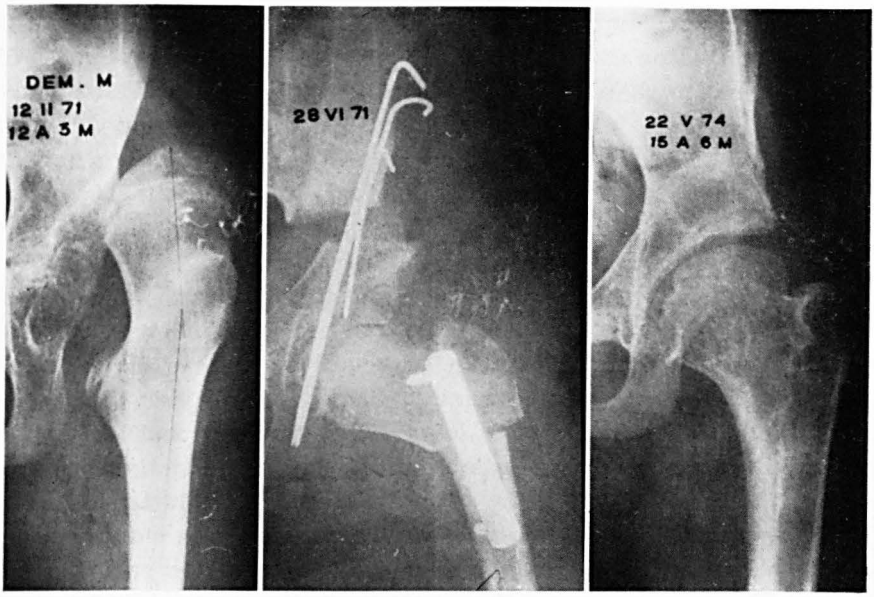


Figure 18. Girl aged 12 years 3 months. Residual dislocation after open reduction of the left hip. Open reduction by Klisic's technique and stabilization by innominate osteotomy in the same session. Result 3 years later.

conditions of a joint are restored. In the second case, the head is covered by the bony slice of the proximal fragment and is separated from it only by capsular interposition. These conditions actually create an arthroplasty. This difference is significant indeed, and as far as we are concerned it gives the preference to innominate osteotomy in children as long as their growth potential remains noticeable. Nevertheless, to be successful this operation has to comply with prerequisites which are not met in all cases. It is first necessary for the head to be centered and reduced in the true acetabulum; without this, innominate osteotomy should not be done. X-ray films prior to the operation are therefore necessary to determine whether simple innominate osteotomy or a combination of femoral and innominate osteotomy should be performed. Our experience has shown that major coxo-femoral dysplasias were better treated by combined osteotomies (Figure 17). However, varisation should not be overdone, since hypercorrection of the neck-shaft angle might remain when growth is completed. If the concentricity is not acceptable, which happens particularly in fixed dislocations and subluxations, one may still build up a new hip by combining open reduction and innominate osteotomy. Open reduction

will be performed through a Watson-Jones approach with the required femoral shortening as described by Klisic. Innominate osteotomy will then be done through the usual approach, in the same operative stage whenever possible. Before starting such a difficult treatment a second requisite will be to determine the possibility of achieving good joint reconstruction. Our experience has made us aware that the potential of head remodelling remains for a long time. On the condition that a normal articulation relationship has been restored within the joint, one may expect good results up to 12 years of age (Figure 18). The sometimes astonishing results obtained have made us completely abandon Colonna's arthroplasty. When the prerequisites are not all met, our indication is then a Chiari osteotomy. The author suggests this operation for children more than 4½–5 years old. We think that the growth potential remains so important at that age that an innominate osteotomy is the better choice if the concentricity of the reduction is good. We reserve the Chiari ostotomy for *fixed subluxations in older children at the end of growth.* It seems to be the best indication in such circumstances. However, our experience is not very extensive and we have not included in this work the only case that we treated in such a way.

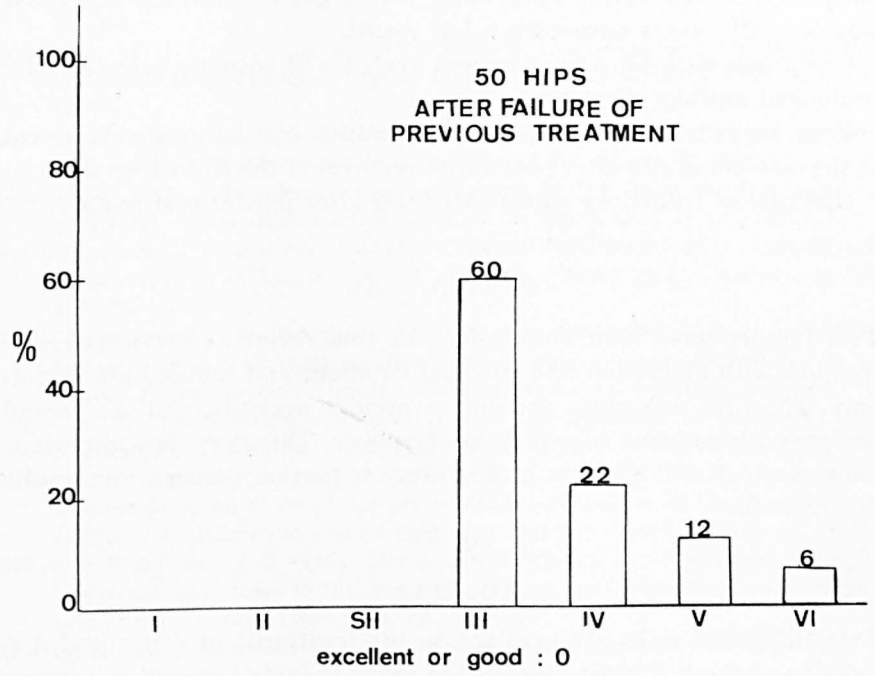
Table 4 gives the results of 50 residual subluxations or dislocations after previous treatment. Thirty-two cases were treated by simple innominate osteotomy, 13 cases by femoral + innominate osteotomy, and 5 cases underwent open reduction prior to innominate osteotomy. When femoral osteotomy was performed, it was done at the same time as innominate osteotomy in all but three cases: twice it was done before, and once after. Femoral corrections were mainly: varisations in 10 cases, derotation twice, and combined varisation-derotation once. Twenty-nine cases were followed-up for 5 years or more. The maximum follow-up was 10 years. The minimum follow-up was 1 year. The two graphs in Table 4 show the state of those 50 hips prior to and after treatment. Whatever the difficulties of the treatment, 54 per cent of the cases had excellent and good results.

The complications observed are as follows.

One case of avascular necrosis in a 15-year-old girl. After a 6-week period of progressive skin traction reaching 9 kg, the surgical phase required a 25° varisation femoral osteotomy + innominate osteotomy. The tilt of the distal fragment was difficult and we were wrong not to do the usual tenotomies prior to it.

One technical failure of the innominate osteotomy in the first case of the series in 1964.

Table 4.


50 HIPS
AFTER FAILURE OF
PREVIOUS TREATMENT
100
80
60
40
20
0
%
60
22
12
6
I
II
SII
III
IV
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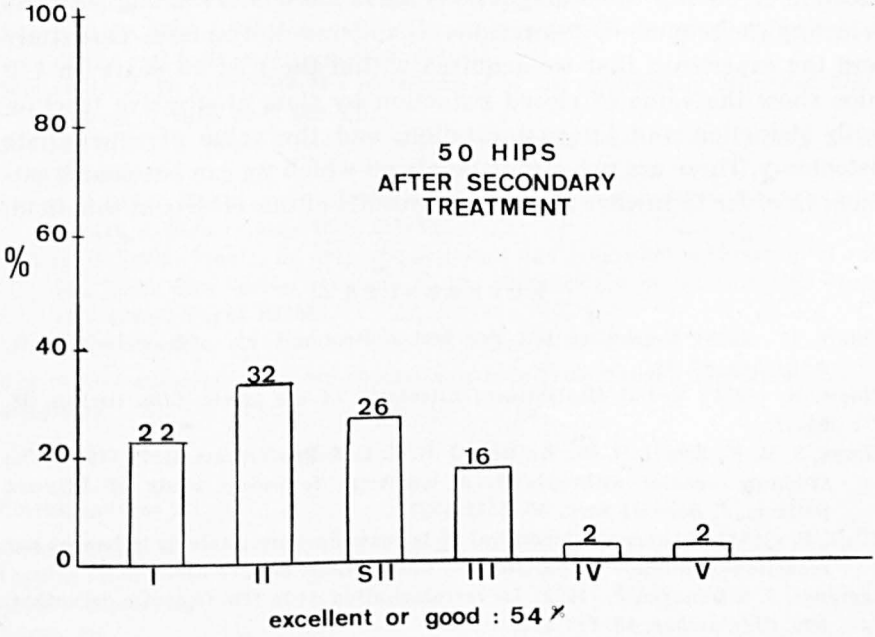
VI
excellent or good : 0


50 HIPS
AFTER SECONDARY
TREATMENT
100
80
60
40
20
0
%
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32
26
16
2
2
I
II
SII
III
IV
V
excellent or good : 54 %

Three insufficient fixations with post-operative displacement. Two patients were reoperated upon early with a good result, the third case was done 2½ years later with a fair result.

One sepsis with joint involvement healed well without sequelae after prolonged antibiocytherapy.

Four superficial sepsis cases, among which two led to displacement at the osteotomy site after premature removal of the Kirschner wires.

One case of transitory painful stiffness after plaster cast removal.

CONCLUSION

Two factors have been emphasized in this review: slow progressive traction with abduction and internal rotation, and innominate osteotomy. The first procedure prevents avascular necrosis, and the second one prevents residual coxo-femoral dysplasia. These are two important notions which will allow us in the future to further improve our results in this field.

SUMMARY

Two additional risks are involved in the treatment of congenital dislocation of the hip when diagnosis is made too late: avascular necrosis folowing the reduction, and residual coxo-femoral dysplasia. Our study and the experience that we acquired within the past 10 years on 142 hips show the value of closed reduction by slow progressive traction with abduction and internal rotation, and the value of innominate osteotomy. These are two strong points on which we can base our treatment in order to further improve the results of our efforts in this field.

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Key words: avascular necrosis; spontaneous reduction; Salter's innominate osteotomy

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