EARLY DIAGNOSIS OF CONGENITAL DYSPLASIA AND CONGENITAL DISLOCATION OF THE HIP
VALUE OF THE ABDUCTION TEST
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The purpose of this communication is to present our experience in the early diagnosis of congenital dysplasia and dislocation of the hip. Inclusion of the abduction test in the routine physical examination of the newborn and older infant, with roentgenographic studies of those infants exhibiting a positive result with the test, has enabled us to reduce materially the age at which the diagnosis of congenital disease of the hip is made. There has seemed to be a universal appeal for early diagnosis of the condition, with agreement that early diagnosis and early treatment are the sine qua non of optimum results.

We became interested in the early diagnosis of congenital dysplasia of the hip when we were privileged to hear and talk with Dr. Hart,1 who was enthusiastic about the possibilities of early diagnosis. We had the opportunity to examine all newborn infants in a community and then follow them in well-child clinics. We hoped that inclusion of the abduction test as part of the routine examination of the

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To appraise the accuracy and possible limitations of the (high) abduction test in the diagnosis of congenital hip joint abnormalities the test was specifically used in examining 11,010 infants. All infants were examined during their first day of life, again on the fifth day, and (90% of them) at regular intervals for six years. In children routinely examined the average age at the time of diagnosis was 4 months, with no dislocations being undiscovered prior to the weight-bearing age, in children not routinely examined the average age was 14 months. In most infants full 90-degree abduction is unusual after the neonatal period; during the second through the eighth or ninth month abduction is frequently in the range of 60 to 70 degrees. With dysplasia and dislocation, abduction is usually limited to 45 to 50 degrees. Abduction limited to 60 degrees or less should warrant roentgenographic examination.
newborn infant would make possible the diagnosis of all dysplasias and dislocations of the hip at birth. Therefore, beginning Jan. 1, 1949, the abduction test was included and the results recorded in the neonatal examinations. All infants were examined

**Abduction Test as a Screening Method in the Diagnosis of Congenital Dysplasia of the Hip: Periods of Observation and Results**

<table>
<thead>
<tr>
<th>Period</th>
<th>Observation and Results</th>
<th>Av. Age at Diagnosis, Mo.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 1, 1945 to Dec. 31, 1948</td>
<td>5,929 newborn infants examined (and 90% examined periodically in well-child clinics); 2 evidenced dislocated hips after weight-bearing age</td>
<td>14</td>
</tr>
<tr>
<td>Jan. 1, 1949 to Sept. 30, 1950</td>
<td>Abduction test made part of routine examination of newborn infants; one infant with normal abduction at birth later found to have dislocated hip (September, 1950)</td>
<td>14</td>
</tr>
<tr>
<td>Oct. 1, 1950 to Dec. 31, 1955</td>
<td>Abduction test emphasized as part of monthly examination in well-child clinics; no dislocations undiscovered by time of weight-bearing age</td>
<td></td>
</tr>
<tr>
<td>Jan. 1, 1949 to Dec. 31, 1955</td>
<td>11,010 infants examined (and 90% followed in well-child clinics)</td>
<td></td>
</tr>
<tr>
<td>Jan. 1, 1949 to Dec. 31, 1955</td>
<td>32 with congenital dysplasia of the hip and fluctuation</td>
<td>4</td>
</tr>
<tr>
<td>Jan. 1, 1949 to Dec. 31, 1955</td>
<td>30 with probable congenital dysplasia</td>
<td>2.9</td>
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within the first 24 hours of life and again on the 5th day. More than 90% of these infants were then seen at regular intervals in the well-child clinics.

In order to detect infants who might have dysplasia and who had been born prior to Jan. 1, 1949, physicians examining infants in the well-child clinics were encouraged to include the abduction test as part of the routine examination at all ages up to one year. Within the first year it became evident that (1) a normal result with the abduction test at birth did not exclude the possibility that dysplasia or dislocation might become evident later and (2) the test should be part of the examination of all infants at monthly intervals through at least 12 months of age.

The effectiveness of the routine use of the abduction test as a screening method for detection of acetabular dysplasia and dislocation of the hip is manifested by the data in the table. In 5,929 patients first examined as newborn infants, with 90% of them being examined regularly in the well-child clinics from Jan. 1, 1945, through Dec. 31, 1948, the diagnosis of congenital disease of the hip was not made prior to the weight-bearing age, the average age at diagnosis being 14 months. After institution of the abduction test as part of the routine neonatal examination of 11,010 infants born in the period Jan. 1, 1949, through Dec. 31, 1955, the diagnosis of congenital dislocation of the hip was made in two newborn infants and that of probable congenital dysplasia of the hip without dislocation in three newborn infants. All other infants gave negative results with the abduction test during the neonatal period.

Although encouragement was given to use the abduction test as part of the physical examination of all infants less than 1 year of age, the point was not stressed until one of the infants whose abduction test gave a negative result at birth dislocated one of his hips at the time of weight-bearing. After this experience, use of the test in the routine examinations at the well-child clinics was strongly emphasized, and since that time (October, 1950) all dislocations have been detected prior to the weight-bearing age. By the use of the abduction test and roentgenographic examination, the average age at diagnosis was reduced from 14 months to 4 months for dysplasia with dislocation.

**The Abduction Test**

The abduction test (fig. 1) is simple to perform but requires intelligent application. We have had no difficulty in interpreting the test in the neonatal period when abduction of 80 to 90 degrees is found without undue pressure or without special effort to achieve "optimum conditions." When the results of the abduction test have been positive, they have been quite definitely so, with abduction difficult beyond 45 to 50 degrees.

Interpretation of the results of the test at the subsequent age levels requires more experience. In most infants, full 90-degree abduction is unusual after the neonatal period, and during the 2nd through the 8th or 9th month abduction is frequently in the range of 60 to 70 degrees. With dysplasia and dislocation, abduction is usually limited to 45 to 50 degrees. Abduction limited to 60 degrees or less should warrant roentgenographic examination.

![Fig. 1.—Abduction test. Top (left), normal at birth to 1 month of age, (right) often normal, 1 to 9 months of age. Bottom (left), suspected significant limitation, (right) definite limitation.](https://jamanetwork.com/)

Abduction may be limited because of other conditions, such as arthrogryposis multiplex, moderate to severe spasticity, and coxa plana, and may be unexplained in some instances. However, we believe that the test offers a valuable, simple screen-
The exact mechanism of limitation of abduction in such disease is not fully understood. The limitation that is present in actual dislocation is not difficult to understand, but the limitation that is present when dislocation cannot be demonstrated is of more obscure etiology. Several theories have been suggested but definite evidence to support these theories is lacking.

In our well-child clinics, our experience has been that about two thirds of the infants who had limitation of abduction of a degree considered by the examining physician to warrant roentgenographic examination have had "roentgenographically normal" hips. The infants were examined by pediatricians and pediatric fellows, with varying degrees of experience, in interpretation of the results of the test. The tendency of the less experienced has been to take roentgenograms even when minimal limitation of abduction was shown.

The tendency for greater awareness of the possibility of early diagnosis of congenital dysplasia of the hip by use of the abduction test has led to some confusion. A physician examining an infant may detect what he interprets as limitation of abduction of one or both hips. The infant is referred for roentgenographic examination. Unfortunately, accurate interpretation of the roentgenograms during the neonatal and early-infancy period may be difficult, if not impossible. There has been a surprising lack of knowledge of the normal variations as well as the limitations of the criteria commonly used to diagnose congenital disease of the hip. This was aptly pointed out by Caffey and co-workers.

Undoubtedly, many infants are being treated unnecessarily for questionable or nonexistent "congenital disease of the hip." However, it is also evident that in many instances the diagnosis should be made early but is not, because of failure of detection by clinical examination or because of difficulty in interpretation, or misinterpretation, of the roentgenograms. Children with frank dislocation of the hip which is not discovered until they are 1½ to 2½ years of age are still being referred to the clinic for orthopedic care. All of the infants in our study are now at least 3½ years of age, and in no infant whose progress has been followed with regular examinations has dislocation become evidence after weight-bearing age. It would therefore seem that no child with dysplasia and dislocation lacked the clinical signs to permit early diagnosis.

Other Clinical Signs

The other clinical signs that are mentioned in relation to the early diagnosis of congenital dysplasia of the hip are Ortolani's sign (jerk), unequal thigh creases, unequal gluteal creases, unequal length of the legs, external rotation of one leg, and a "clicking" sound on abduction of the hips. Limp is a late sign of congenital dysplasia of the hip.

We have not found Ortolani's sign (jerk of entry and jerk of exit, or either) to be a consistently dependable diagnostic sign. Hart stated that this sign is pathognomonic of dysplasia. We have not infrequently observed infants in whom both the "jerk of entry" and the "jerk of exit" were present within the first 24 hours after birth and then absent in many by the 5th day of life. The progress of these newborn infants has been followed and in none has evidence of dysplasia of the hip developed subsequently. Many of these infants represented breech presentations. We have not felt that the presence of Ortolani's sign alone in the newborn infant warrants roentgenographic examination, the diagnosis of dysplasia, or treatment.

We have found inequality of thigh creases both as to number and as to depth to be of little value in the early detection of congenital dysplasia of the hip with luxation. The same may be said for the gluteal creases and the length of the legs. Furthermore, these signs may not be present in an infant with bilateral dislocation, and certainly the

Fig. 2.—Drawing to illustrate Hilgenreiner's measurements. Lines drawn: YY, line drawn through Y cartilages to touch visible tips of isilia; BB, line drawn tangentially to visible acetabular face and through medial and lateral bony edges of acetabular face—difficult to draw accurately in newborn infant because of insufficient roentgenographic definition at this age; CC, line drawn from most cephalic point of femoral diaphysis and perpendicular to YY line. (Note: YY, BB, and CC lines designated as such by present authors for descriptive purposes.) Hilgenreiner's measurements are—angle between BB line and YY line, known as acetabular angle; d, distance between point of transection of YY line by BB line and point of transection of YY line by CC line, generally referred to as d line of Hilgenreiner; h, distance between most cephalic point of femoral diaphysis and point where CC line transects YY line. (Reproduced with permission from Harris, L. E., Lipscomb, P. H., and Hodgson, J. R.: Hilgenreiner Measurements of Hip Roentgenograms in 247 Normal Infants 6 and 7 Months of Age: Follow-up of Deviations From "Normal", J. Pediat. 56:478-484 [April] 1960.)
Roentgenographic Criteria

As previously noted, this report is concerned primarily with the use of the abduction test as a screening technique for detection of congenital disease of the hip. Detailed roentgenographic data will be given in a future report. However, the criteria we have used will be briefly noted.

Congenital Dysplasia of Hip with Luxation.—We have chosen to limit the diagnosis of congenital dysplasia of the hip to those infants who showed roentgenographic evidence of luxation. Hilgenreiner’s measurements have been used as described in figure 2. The characteristics of the group designated as having “congenital dysplasia of the hip” include the Putti triad of upward displacement of the upper end of the femur, sloping acetabular roof (that is, increased acetabular index), and poorly developed epiphysial nucleus. In addition, all these infants except those in whom dysplasia was discovered in the newborn period have shown an iliac stress line (fig. 3). Figure 4 represents a typical example of this group. We have used the term “luxation” to mean displacement, complete or incomplete.

Probable Congenital Dysplasia of Hip.—The infants with probable congenital dysplasia of the hip were those who had a positive result with the abduction test, increased measurable acetabular angles, and subsequently also a delay in appearance of the ossification of the capital femoral epiphysis but did not show displacement of the head of the femur. Figure 5 represents an example of this category.
Comment

The fact that older children with frank dislocations of the hip continue to be seen seems to emphasize the need for continuous and adequate physical examinations during the first year of life, if congenital dislocation of the hip is to be diagnosed early. It is well recognized that most infants do not have regular examinations during the first year; they receive their medical care through the overworked and harassed general practitioner who simply does not have the time available for regular monthly examinations of the infants under his care. Perhaps an effort to educate mothers in the application of the abduction test would be justifiable.

It is a simple test to perform; indeed, in areas of Italy 4 where there is a high incidence of congenital disease of the hip the mothers have been indoctrinated in the signs that may indicate dislocation. At present, in addition to constant education of physicians in the methods of early diagnosis, public education would seem to offer a great opportunity for early recognition. Such methods would undoubtedly lead to a great deal of confusion for some time but they might be worth it.

We have not discussed methods or results of treatment. The problem of diagnosis is the responsibility of all physicians dealing with children, while the problem of treatment should be in the hands of the orthopedic surgeon. Although results of treatment will be presented in detail in a future report, it may be stated without hesitation that early diagnosis and treatment have greatly improved the final outcome of congenital dysplasia of the hip with luxation.

Does the abduction test always give a positive result in congenital dysplasia of the hip with luxation and in congenital dysplasia of the hip before luxation? In our experience, the result has always been positive when there is luxation, as shown by the fact that, apparently, the diagnosis has not been overlooked in about 9,000 infants, the youngest of whom is now more than 3½ years of age. Our experience also suggests that the abduction test may not give a positive result in many infants in the predislocation phase. We arrived at this opinion because all the infants having dysplasia and luxation were examined at monthly intervals and they did not have a definitely positive result of this test prior to the time of diagnosis (average age, 4 months). If one might assume that at least some of the infants in the category of those having "probable dysplasia" would have experienced luxation at a later age and that the abduction test always gave a positive result in the predislocation phase, then the group with eventual luxation should have been discovered at an earlier age than the average of 4 months. The abduction test may not be successful in diagnosing dislocation in the retarded and extremely hypotonic infant, the infant with severe spasticity, or the infant with myelodysplasia and flaccid paralysis of the legs. No doubt, some infants with dysplasia and dislocation do not demonstrate a positive result with the abduction test, but we have not seen such an infant who was otherwise normal.

Our study included those infants born from Jan. 1, 1949, through Dec. 31, 1955. At the time of this report (July, 1959), still no infants examined within 24 hours of birth and cared for by pediatricians in the well-child clinics have shown dislocation of the hip at the weight-bearing age. The average age at diagnosis of those with congenital dysplasia of the hip and luxation has remained essentially unchanged (4 months).

Summary and Conclusions

The search for a simple effective means for the early diagnosis of congenital disease of the hip continues. At present, the abduction test seems to be the most easily applied test to accomplish this end. It is simple to perform and requires a minimal degree of experience for adequate interpretation.

This report presents the results of use of this test as a screening procedure in 11,010 newborn infants, about 90% of whom were subsequently examined regularly in well-child clinics. With this test, the average age at diagnosis of congenital dysplasia with dislocation was reduced from 14 to 4 months, with no dislocations being undiscovered prior to the weight-bearing age.

A negative result of the abduction test at birth does not rule out potential dislocation of the hip. The test should be done regularly during the first 12 months of life.

While of limited value, other clinical signs suggestive of congenital dislocation of the hip should not be ignored. These signs may be of little value in infants with bilateral dislocation.

On the basis of roentgenographic findings the infants were classified as (1) those with congenital dysplasia of the hip with luxation and (2) those with probable congenital dysplasia.

References