Arch Orthop Traumat Surg 97, 117–133 (1980)

Archives of Orthopaedic and Traumatic Surgery

The Diagnosis of Congenital Hip-Joint Dislocation by the Ultrasonic Combound Treatment

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Summary. Due to poor penetration of bone, ultrasonic techniques have not been popular in orthopedic procedures. Since they are non-invasive and are not associated with a radiation hazard, their application in the diagnosis of congenital hip-joint dislocations merits investigation. Methods are presented in Part I which should enable the experienced investigator to make the diagnosis and avoid falsh interpretations. In Part II, the practical results of these techniques over an 18 month period are presented and discussed. The small size of the object under examination and the, in general, poor resolving power of ultrasonoscopes constitute the major difficulties encountered when using ultrasonic diagnostic devices. The fact that these methods are harmless to the patient, economical, simple to perform, and noninvasive, make them attractive diagnostic tools for screening infant hip-joints congenital luxations.

Zusammenfassung. Das Ultraschallverfahren wurde in der Orthopädie wegen seiner schlechten Knochendurchdringung noch wenig eingesetzt. Da keine Strahlenbelastung vorliegt, bietet es sich jedoch besonders bei Säuglingen und Kindern als nichtinvasives Diagnoseverfahren an.

In der Orthopädie ist die Diagnose der congenitalen Hüftluxation mit dem Ultraschall anzustreben.

Wegen der Kleinheit des Objektes und der relativ geringen Auflösung stößt die Methode jedoch auf Schwierigkeiten.

Es wird daher in der vorliegenden Arbeit im theoretisch-experimentellen I. Teil eine Abtasttechnik erarbeitet, mit deren Hilfe es unserer 2jährigen Erfahrung nach dem mit der Methode vertrauten und geübten Untersucher möglich ist, eine Diagnose zu stellen. Röntgenuntersuchungen könnten auf Zweifelsfälle und besonders ungünstige Fälle beschränkt werden.

Im II. Teil werden erstmals praktische Ergebnisse aus den letzten 1½ Jahren gezeigt und erläutert.

Auf die Schwierigkeiten der Interpretation möchten wir besonders hinweisen. Es muß aber festgestellt werden, daß die vorliegenden Abbildungen bereits Reproduktionen sind. Die Bildqualität am Bildschirm ist erheblich besser, das Format größer. Wir sind überzeugt, daß es jedem Orthopäden nach relativ kurzer Zeit möglich ist, die vorgestellte Methode anzuwenden.

Ein allgemeines Screening der Säuglingshüften liegt im Bereich der Möglichkeit.

Part I: Theory and Experimental Investigation

Nowadays ultrasonic diagnosis has an important meaning in many medical fields.

The ultrasonic method is especially favorable to investigate soft tissue. It brought about new understandings and diagnostic possibilities in obstetrics (fetal position, deformities, twins etc.), in internal medicine (liver, gall bladder, heart diagnosis), and in ophthalmology—to mention only a few examples.

Especially in obstetrics the ultrasonic method cannot be missed anymore since there is no exposure to harmful radiation. This advantage is also interesting in orthopaedics to diagnose the infant congenital luxation of the hip, which normally causes a considerable even dangerous exposure to radiation.

A screening of infants could verify the luxated hips, if the ultrasonic technique could be used to distinguish between normal and luxated joints, and the dangerous exposure of infants and children to radiation could be decreased considerably.

However, in orthopaedics we need very often three dimensional pictures which we cannot produce with ultrasonic methods. The pictures in two planes are difficult to read. Another disadvantage is the fact, that

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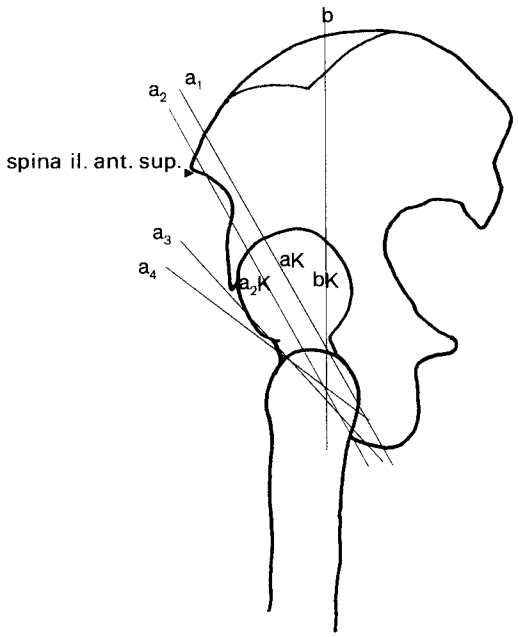


Sketch A. Normal left hip, lateral view schematically: a_1; intersecting line analogous to AE 1 at the ilium. a_K: continuation of a_1 to the femoral head; a_2: intersecting line analogous to AE_2; a_2k: continuation of a_2 to the femoral head; a_3/a_4: tangential sections, not usable

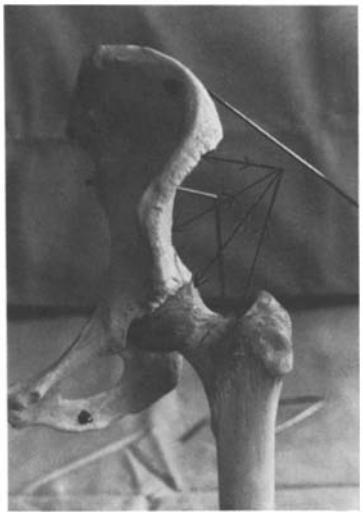


Fig. 1. Left hip preparation, frontal view. The direction of the ultrasonic beam schematically marked by arrows

Fig. 2. Left hip preparation, frontal view: AE = anterior standard plane of the lateral sector

ultrasonic will hardly or not at all penetrate the bone and only give an impression of the contours. Therefore we have to develop a standardized classification of these contours in order to interpret them correctly.

Basically a picture will be optimal if the ultrasonic is reflected totally, in other words if its direction to the object of examination is as perpendicular as possible.

The investigation of the infant hip and the diagnosis of the congenital luxation of the hip has to be based on specially standardized intersecting planes, which can be reproduced any time. The ultrasonic beam has to be directed perpendicularly to the femoral head, the socket and the ilium.

The Theory of the Intersecting Planes of the Hip Joint

A. The Normal Hip

According to the optimal conditions for the ultrasonic beam, the perpendicular direction to the object, the upper part of the femoral neck and head, of the acetabular rim and the ilium has to be aimed at in perpendicular direction (Fig. 1). Several intersecting planes are available to aim at the hip joint frontally (Sketch A).

a) Spine – trochanter – tuberosity (Lenschow)*. Represented by line a1 in Sketch A; Fig. 2 shows the intersecting plane and the plane of the picture (AE 1) in three dimensions.

b) Line a2: the anterosuperior spine and the most anterior part of the femoral head is barely visible → AE 2 (Fig. 3).

c) Line b: (Fig. 4) the upper point of the iliac crest – femoral head – major trochanter → AE 3.

Theoretically not each plane is equally favorable. They are the source of potential mistakes interpreting the result, especially since a femoral head in a stable position is well covered by the acetabulum.

The single planes are discussed in the following:

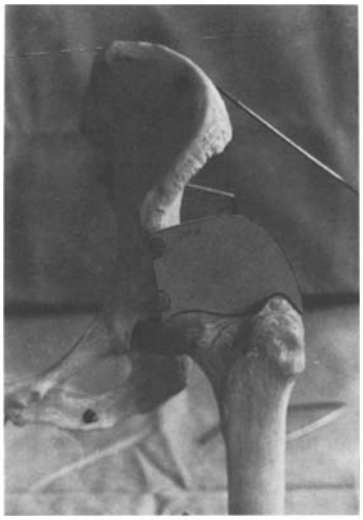


Fig. 3. Left hip preparation, frontal view: AE_2 = most anterior plane (not usable)

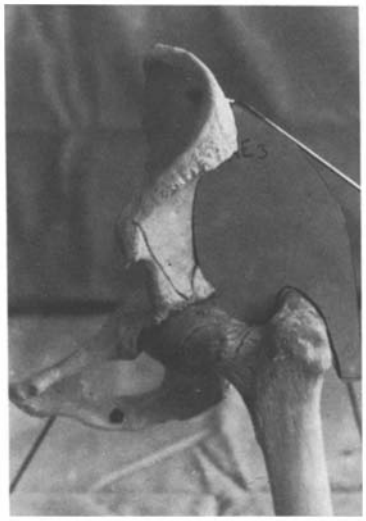


Fig. 4. Left hip preparation, frontal view: AE_3 = posterior standard plane of the lateral standard sector

AE 2 (Anterior Plane). Fig. 3: three dimensionally, Fig. 5 middle: section schematically with intersecting plane and contour: This plane cannot be used at all, because there is no correct relationship between femoral neck – head – iliac contour.

AE 1. Fig. 2: three dimensionally, Fig. 5 left: graph of the contours lines. This plane, described above by Lenschow, is called the anterior standard plane: It points out a good relationship between the trochanter, femoral head and ilium (protuberance). It is possible to achieve initially good pictures, since the degree of antetorsion can be taken into consideration in a lateral position. However, it is not sufficient to estimate a congenital luxation only in one plane, which will be discussed later.

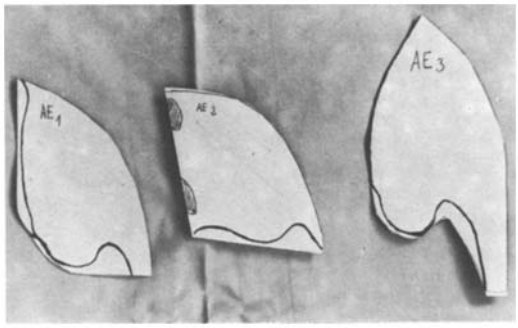


Fig. 5. Intersecting planes with bony contours within the left lateral standard sector (normal)

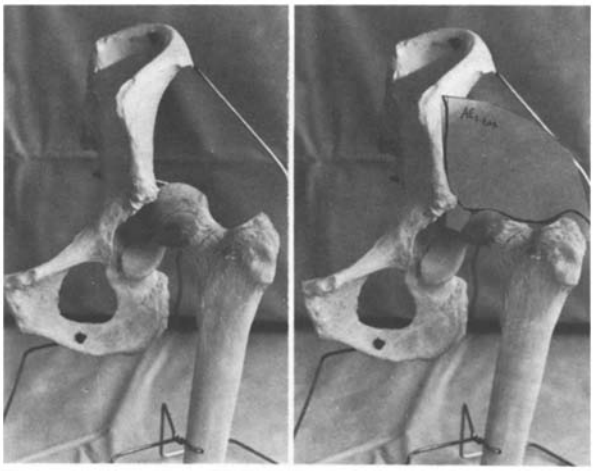


Fig. 6. Luxation. AE 1 lux = AE_1 with luxated femoral head

AE 3 (Posterior Standard Plane). Fig. 4: three dimensionally, Fig. 5 right: schematic, Sketch A: line b-bk.

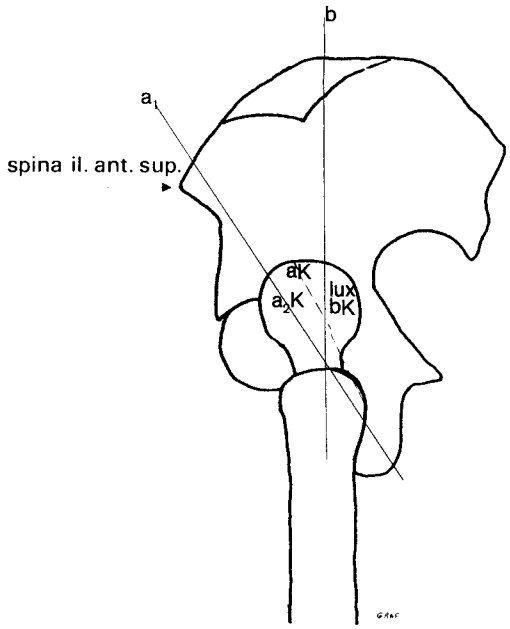
This view also offers a favorable diagnostic position in case of a normal hip. The position of the femoral head covered by the acetabular roof is well visible. In cases of an increased antetorsion only the posterior part of the head can be seen and does not allow a complete judgement of a hip luxation.

Figure 5 demonstrates all intersecting planes.

B. A Survey of the Standard Views AE 2, AE 1, AE 3 as Mentioned Above to Estimate a Congenital Luxation of the Hip

Provided that the femoral head will luxate backward and upward we find the following situation:

AE 1 (Fig. 6, Sketch B). The iliac contour remaines unchanged; the femoral head and neck is luxated backward and upward and only partly visible in its



Sketch B. Left hip, luxated, lateral view schematically: a_1 continuing into line a_2k instead of a_K, b continuing into b_b lux

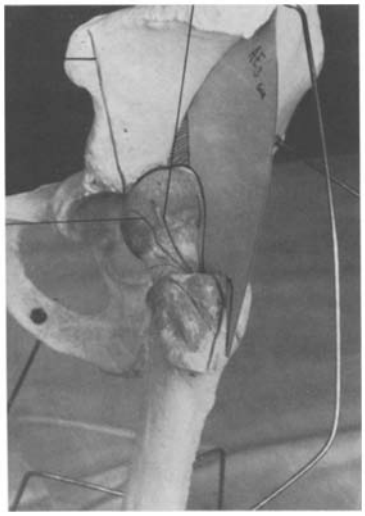


Fig. 7. Left hip preparation, lateral view: *a* = intersecting line analogous to the anterior standard plane at the ilium. a_k = continuation of *a* to the head in normal position; a_{2k} = continuation of a_2 to the head in normal position

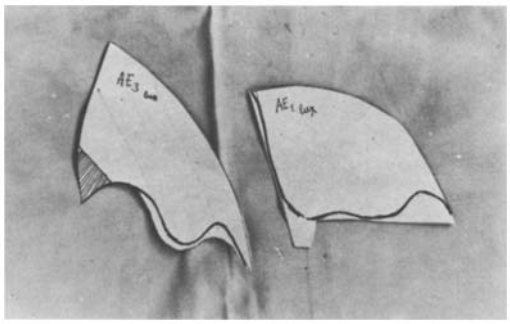


Fig. 8. Intersecting planes with bony structures within the left lateral standard sector (luxated hip)

Fig. 9. Left hip preparation, frontal view: luxation: AE_3 lux = posterior standard plane with luxated head

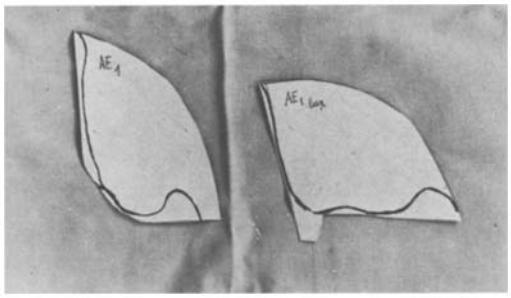


Fig. 10. Intersecting planes with bony contours in comparison. Left: AE_1 = anterior standard plane, normal position; right: AE_1lux = anterior standard plane, luxated

anterior portion. The outline simulates a tight position of the head within the acetabulum, although the luxated head is arching behind the intersecting plane (Fig. 7). Sketch B: Line "*a*" does not procceed into line "*ak*", but a proceeds into "a2k", which is not useful. In Fig. 8 the contour only simulates a correct position.

AE 2. The iliac contour is bending significantly into the direction of the head. The contour of the elevated head is well visible. (Fig.8 The left contour is called AE 3 lux.)

According to our experiences this plane is very useful for a diagnosis. However, in the case of a severe torsion of the femoral head, only a small portion will be visible. This view should not be used as the only proof of a correct or a luxated position of the femoral head. Fig. 10 demonstrates the direct comparison between

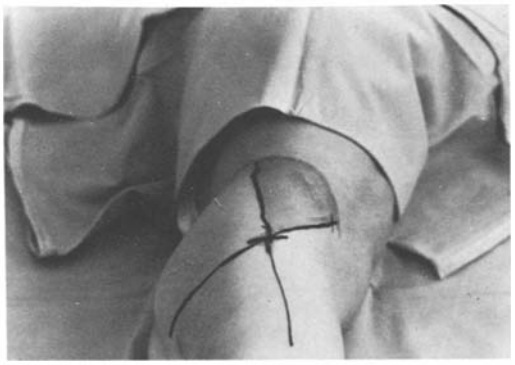
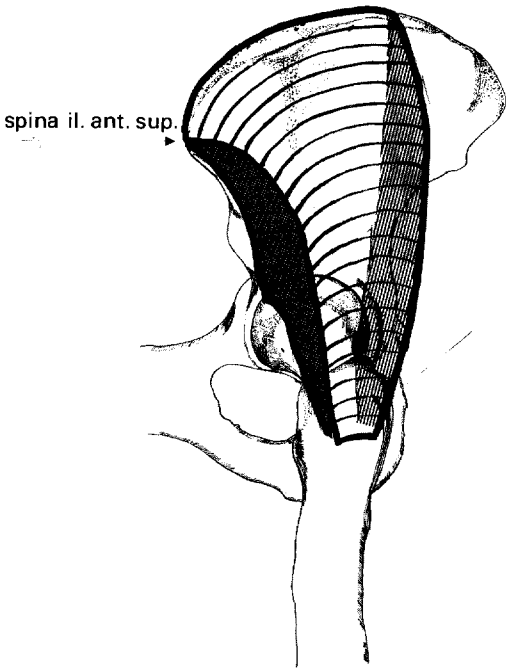
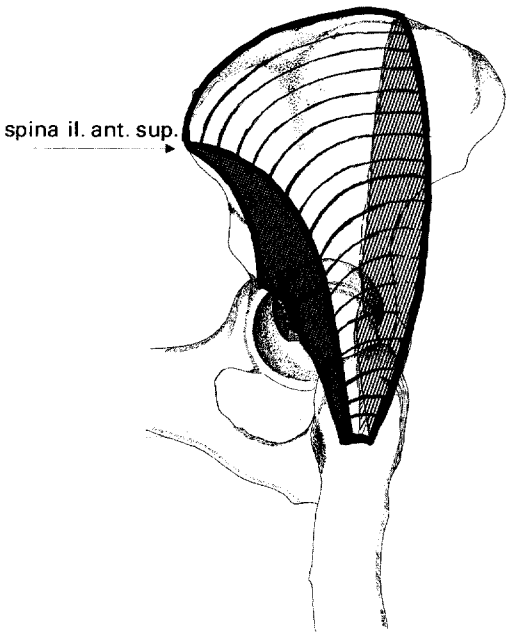


Fig. 11. Left lateral position: right hip with dark lateral standard sector



Sketch C. Left hip, lateral view, normal, lateral standard sector. ▨ anterior standard plane AE 1; ▩ posterior standard plane AE 3



Sketch D. Left hip, lateral view, lateral standard sector, luxated hip. ▨ anterior standard plane AE 1 luxated; ▩ posterior standard plane AE 3 luxated

plane AE 1 and the plane AE 1 Lux of the luxated head: These intersecting planes resemble each other to such an extend that a correct diagnosis of the hip joint only in one of the planes is not possible.

Conclusions

False interpretations of the picture will be caused by planes which do not go through the center of the femoral head. The palpation points on the surface of the skin are the anterosuperior iliac spine, the highest point of the iliac spine, and the major trochanter. The femoral head is located deep inside this three dimensional sector in unknown position. In order to find the correct planes we have to locate the head between the palpation points mentioned above. Stating a diagnosis we ought to talk about a *lateral standard sector* instead of lateral standard planes (Fig. 11, Sketch C and D).

Each cross section through the center of a sphere is a complete circle not only on oval section. A cross section within the standard sectors through the center of the femoral head consequently provides a correct diagnosis. Practically most of the hip joints to be examined have a small nucleus, which can be assumed as the center of the entire femoral head. Even if there is no radiographic evidence of such a nucleus, the ultrasonic picture already shows a nuclear density, which supports the diagnostic procedure. The practical importance of this phenomenon will be discussed in part II.

The Possibilities of the Lateral Position

1. For the Lateral Standard Sector

a) Strictly Lateral with Extended Leg (Fig. 11). With regard to the antetorsion correct planes can only be achieved close to the anterior standard plane AE 1.

b) Lateral Position. The hip joint is slightly flexed, the leg is attached to the supporting table with the knee joint in flexion, creating a slight inward rotation of the hip joint. The antetorsion seems to be corrected and the intersecting planes, more favorable for diagnostic

purposes, are closer to the posterior standard plane AE 3.

Incidental Remark

The most correct and quickest diagnostic possibility within the standard sector is provided by a plane exactly through the center of the femoral head. In most of the cases the natural anatomical structures are helpful for the evaluation: the dense nucleus of the femoral head and each intersecting plane of the lateral sector, which goes through the iliac contour, the nucleus of the head and the caetabular roof.

In very young infants the nuclear density of the femoral head is not always visible with ultrasonic methods. The contour of the femoral neck has to be explored in another plane.

At first it seems to be promising to choose a position analogous to the position for a radiograph in axial direction (Lorenz-position). This method, which should reveal an empty socket projected by two perpendicular planes, will fail because of practically and technically reasons:

Practically. The ultrasonic head has to be led along the adductor tendons. However, around the hip joint they project very strongly underneath the skin leaving indentations above and underneath the area of the hip joint. The ultrasonic head gliding on a contact gelly cannot be held in a close enough contact along the narrow tendons. Especially in agitated children it is hardly possible to handle the ultrasonic head.

Technically. The contour to be evaluated by the ultrasonic method is formed by the concave Adam's bow, which continues into a concave empty acetabulum only visible in luxated hips but not usable for orientation at the ilium in normal hips. This results into unfavorable reflexions and errors which interfer with an exact location of the critical area of femoral head and socket.

The following theory will explain the possibility to a achieve a correct projection:

In case of a congenital luxation of the hip the femoral head is located somewhat behind and above the original socket. We choose the plane (AE) from behind, i.e. in belly position with laterally extended leg, in order to achieve a straight plane of reflexion. It is possible to palpate along the line: trochanter–femoral neck–head and posterior acetabular rim. An interruption of this continuing line, resp. a femoral head is visible, which is not totally covered by the marked posterior acetabular rim appearing as a step-like contour.

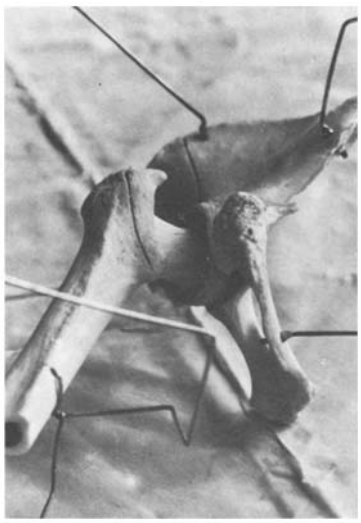


Fig. 12a. Left hip preparation in belly position, normal position

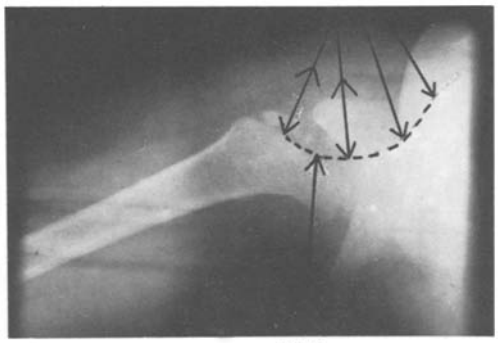


Fig. 12b. Radiograph in position analogous to Fig. 12a. Ultrasonic beam marked by arrows, SHD-line: femoral neck–ilium line

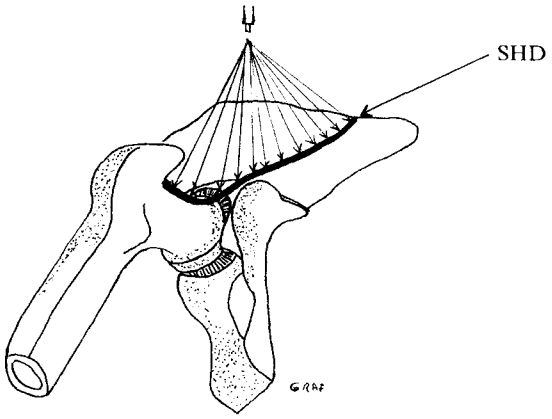


Fig. 12c. Sketch to Fig. 12a/b: left hip, belly position. Ultrasonic plane marked by arrows. Normal femoral head–ilium line (SHD)

Even this plane does not exclude the risk of an excentric circular section. Never a diagnosis should only be based on one plane, but the entire posterior

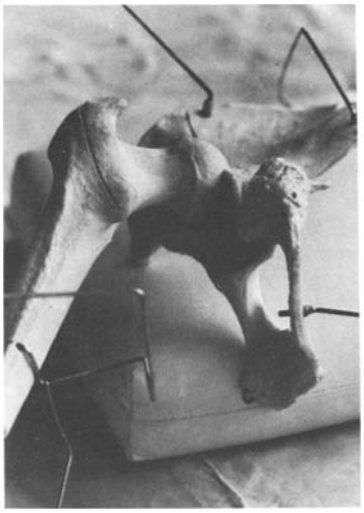


Fig. 13a. Left hip preparation in belly position, luxated

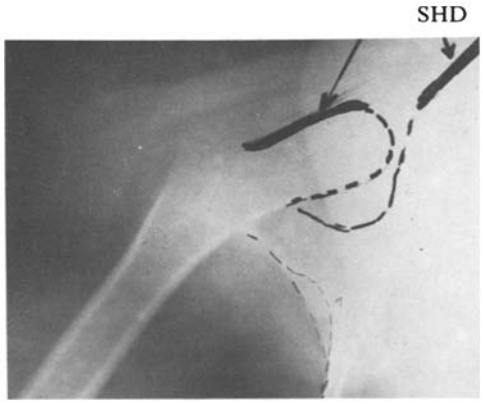


Fig. 13b. Radiograph of the left hip, position as in Fig. 13a. Distinctly interrupted SHD-line

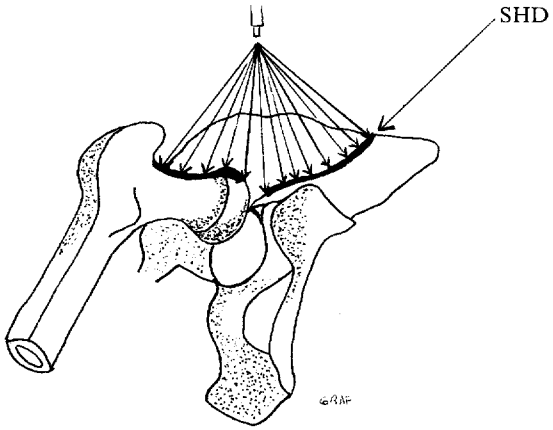


Fig. 13c. Sketch to Fig. 13a/b left hip luxated, belly position. Ultrasonic plane marked by arrows. Distinctly interrupted femoral head–ilium line (SHD)

standard sector should be evaluated (exception explained below).

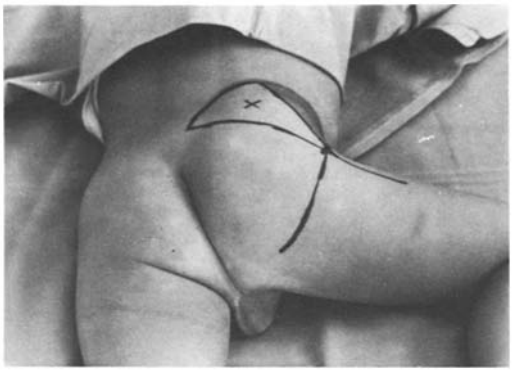


Fig. 14a. 1. Possible position for the posterior standard sector (×)

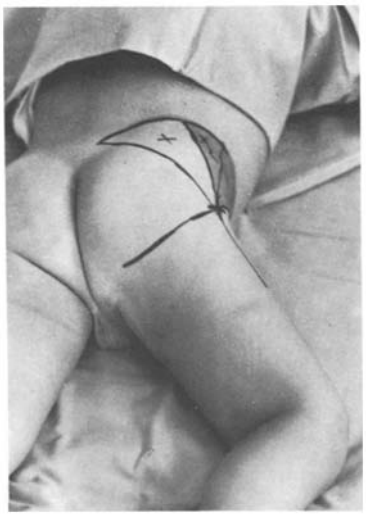


Fig. 14b. 2. Possible position for the posterior standard sector (×)

Posterior Standard Sector (Fig. 14a, b, sector X). Belly position: highest point of the iliac crest–major trochanter posterosuperior iliac spine.

The position (a or b) is not important, since the femoral head is the constant center of rotation in both positions. Only the position of the femoral neck and the major trochanter is variable, which always will be explored by probing the described sector. The position "a" is less comfortable, however, the femoral head will be luxated more backward by pressing the knee tightly on the supporting table.

Preliminary Summary

A basic change of thought process is necessary in reading penetration- or projection pictures in contrary to pictures in intersecting planes (reflexion). The evaluation of the bone is limited on contours with exception of a few special cases. One plane only is not sufficient enough to establish a diagnosis, since the possibility of an erroneous interpretation is too likely (Exception described below).

Correct Diagnosis

1. Lateral Standard Sector. At least two interecting planes within the sector: one plane within the anterior and one within the posterior lateral sector is sufficient for the diagnosis and documentation.

2. Posterior Standard Sector. The same criteria as described above.

Exception, as mentioned above:

Each intersecting plane directly through the nucleus of the femoral head within the lateral or posterior standard sector is immediately usable for diagnostic purposes.

Part II: Practical Use and Documentation

The investigations were carried out with an ultrasonic Sonograph EDP 1000 (Unirad) using the Combound-scan method with a 3.5 MHZ, 6 mm, 1–3 cm transducer.

Method

The child is in a lateral position held by the mother or an assistant. The lateral standard sector is explored. Two intersecting planes, representative for a diagnosis, will be choosen and stored. Afterwards the child will be moved into belly position. The posterior standard sector will be explored, and 2 planes will be choosen again.

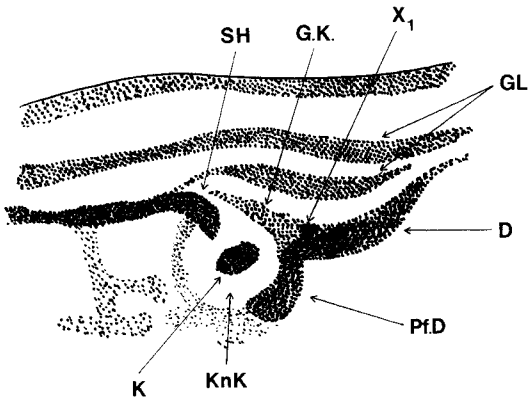
Now we have 4 important pictures of the hip which can be called off together and documented. The 2 upper pictures originate from the lateral and the 2 lower pictures originate from the posterior standard sector, and 1 hip will be documented on one picture.

An immediate documentation was done with a polaroid camera or a picture was taken directly from the screen with a normal single lens reflex camera using a teleobjective on a tripoid and a 21 DIN-black and white film. The pictures with a normal camera are cheaper and can be reproduced from the negative as often as necessary.

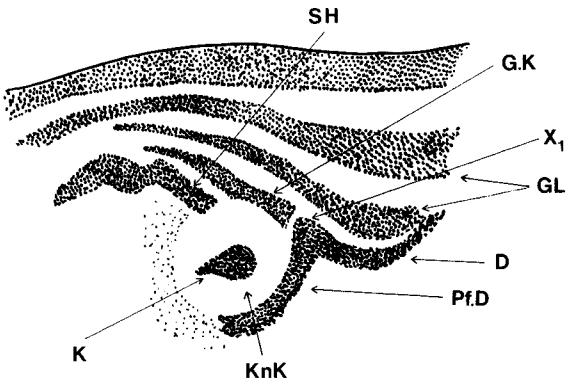
At the first femoral neck and the ilium will be explored in order to achieve an informative survey. Usually only a slight turn of the ultrasonic head will be necessary to find the diagnostically important nucleus in the center of the femoral head.

Now the resulting picture has to be interpreted correctly.

At first it is difficult to evaluate ultrasonic pictures in intersecting planes instead of radiographic (penetrating) pictures, which we are used to do daily in a



Sketch A to Fig. 1 Left picture (above) left hip, lateral standard sector. SH = femoral neck; GK = joint capsule; X_1 = acetabular rim; GL = gluteal muscle; D = ilium; Pf.D. = acetabular roof; KnK = cartilaginous head; K = dense nucleus



Sketch B to Fig. 1 Right picture (above) left hip, lateral standard sector. SH = femoral neck; GK = joint capsule; X_1 = acetabular rim; GL = gluteal muscle; D = ilium; Pf.D. = acetabular roof; KnK = cartilaginous head; K = dense nucleus

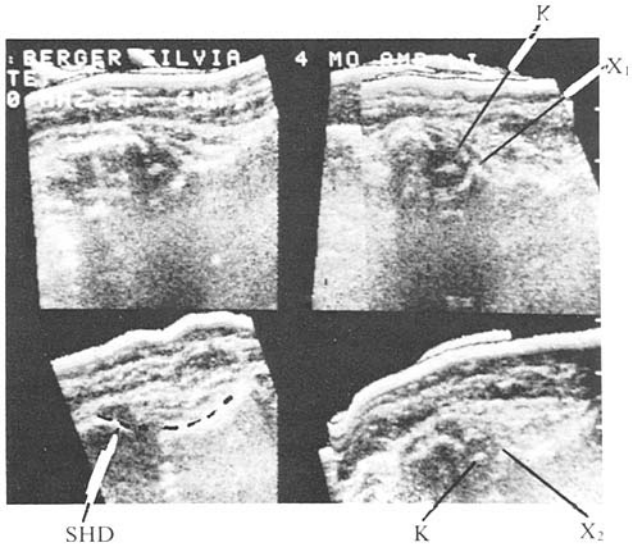
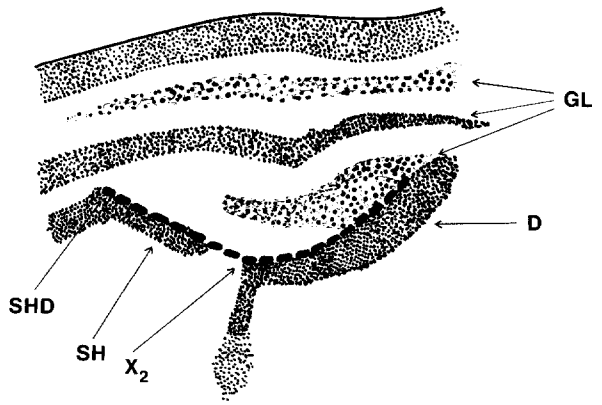
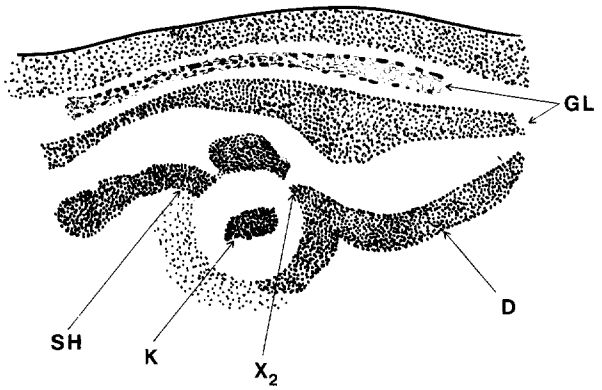


Fig. 1. B.S. 4 months, left hip lateral position, pictures from the lateral standard sector. K = nucleus of the femoral head; X_2 = posterior acetabular rim; SHD = femoral head–ilium line; X_1 = acetabular rim



Sketch C to Fig. 1 picture below, left hip, posterior standard sector. GL = gluteal muscle; D = ilium; SHD = femoral neck–ilium line; SH = femoral neck; X_2 = posterior acetabular rim



Sketch D to Fig. 1 Right picture (below) left hip, posterior standard sector. GL = gluteal muscle; D = ilium; SHD = femoral neck–ilium line; SH = femoral neck; X_2 = posterior acetabular rim

great number. Additionally the ultrasonic pictures seem to be less clear and "scintillating" compared to radiographs. We certainly create a considerable risk of erroneous interpretation if we look at an ultrasonic picture more like an unsatisfactory radiograph. Several months are necessary to achieve the ability to take ultrasonic pictures and to read them correctly. It also takes some time to become familiar with the ultrasonic device, and with the anatomical details of the pelvic area and to develop an imagination in three dimensions. On the opposite to a radiograph with the patient in upright position the ultrasonic picture shows the patient in lateral or belly position, which changes the three dimensional relations.

The routinely documentation consisted of pictures from 2 planes within the lateral sector (above) and 2 pictures within the posterior sector (below).

The sketches A–D, related to Fig. 1, help to become familiar with the ultrasonic result.

SHD-line: contour line femoral neck–acetabular rim–ilium.

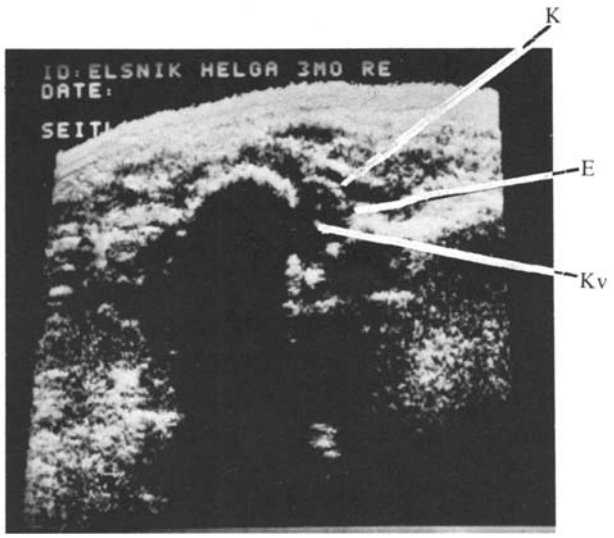


Fig. 2a. E.H. 3 months, right hip, plane within the lateral standard sector. K = femoral head; E = acetabular rim; Kv = nuclear density

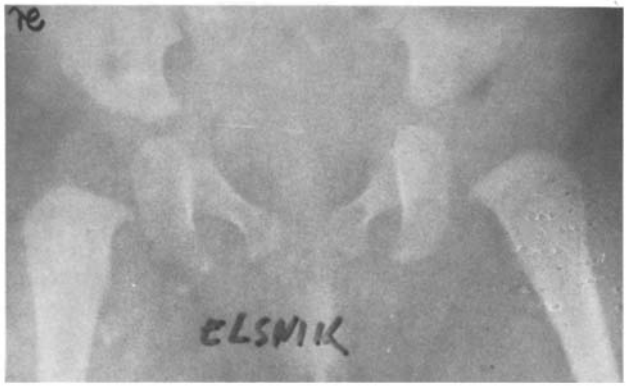


Fig. 2b. Radiograph to Fig. 2a in comparison, lateral position

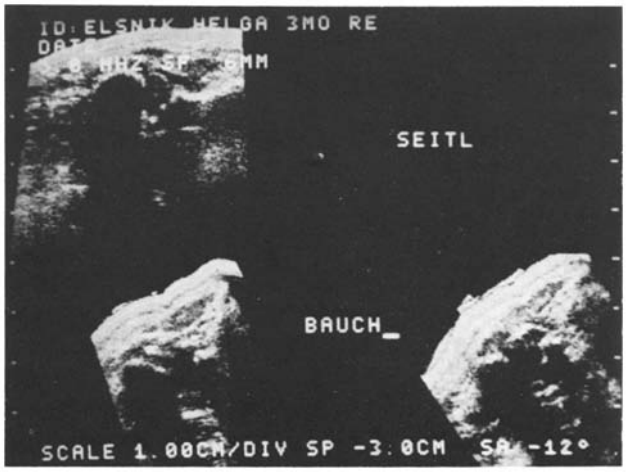


Fig. 2c. The same patient as in Fig. 2a picture sequence below, planes within the posterior standard sector

Fig. 3. Radiograph to **3a, 3b** and **3c**

Fig. 3a. Right hip, lateral standard sector

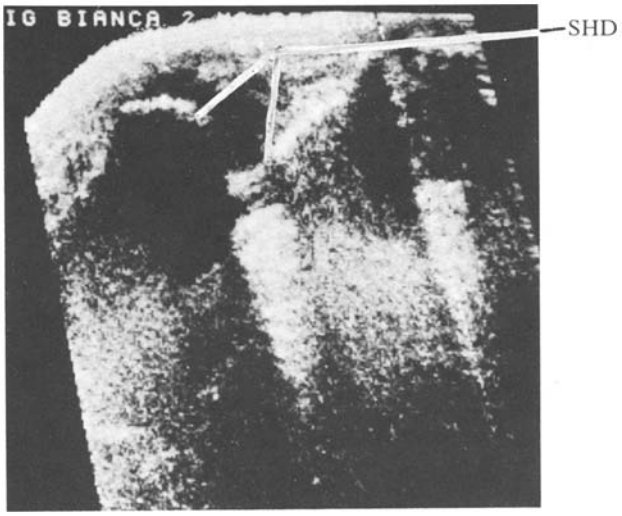


Fig. 3b. Right hip, posterior standard sector, 1. plane: SHD interruption

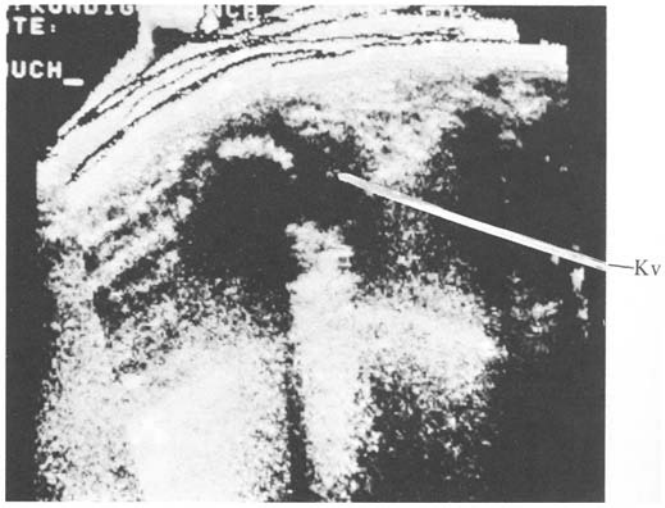


Fig. 3c. Right hip: posterior standard sector, 2. plane: Kv = nuclear density

The identification is listed below ID on the left upper edge: Name, outpatient/hospitalized, right/left hip.

Fig. 1: Sketch A–D: central density of the femoral head visible, head completely covered by the acetabular roof: normal hip. Posterior sector (pictures below): right: good coverage of the central nucleus, left: excentric plane but physiologic line femoral neck–ilium (SHD).

Fig. 2a: Distinct density of the femoral head, at the same time no analogous density on the radiograph (Fig. 2b). Good coverage by the acetabular roof, the cartilagineous head is well separated from the surrounding structures. Normal development of the hip, diagnosis proved by the position of the head (center) in the acetabulum.

Fig. 2c: Left fig. (below) physiological curvature of the line femoral head–ilium (SHD-line).

Example of a Luxated Hip

Patient K.B. 3 months: luxation of the right hip, left hip normal.

Fig. 3: Radiograph to Fig. 3a–3c luxated hip, Fig. 4a/b normal hip.

Fig. 3a: The luxated femoral head is clearly visible in relation to the acetabular roof. The diagnosis can be proved by intersecting planes within the posterior sector.

Fig. 3b: 1. plane, posterior sector, right hip: significant interruption of the SHD-line, the shadow of the femoral head is "backward–upward".

Fig. 3c: 2. plane, posterior standard sector: Significant interruption of the SHD-line; the slight density of the femoral head does not appear underneath the acetabular roof.

Fig. 4a: Lateral standard sector: well developed acetabulum, physiologic SHD-contour line, central density and cartilaginous portion of the femoral head entirely visible. Correct position. Diagnosis: normal position of the hip joint.

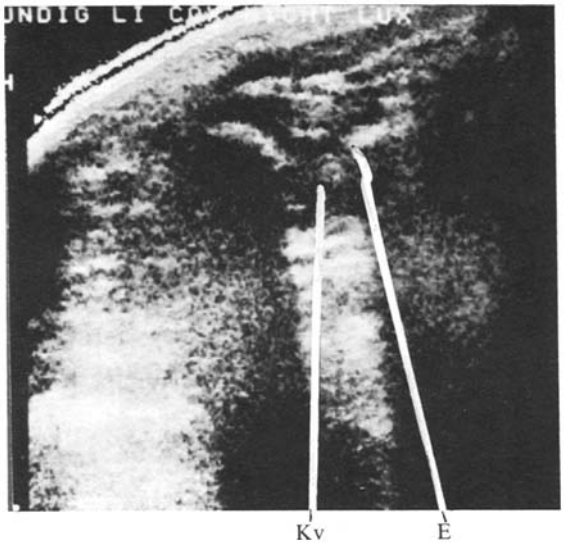


Fig. 4a. Left hip: lateral standard sector: E: acetabular rim; Kv: nuclear density

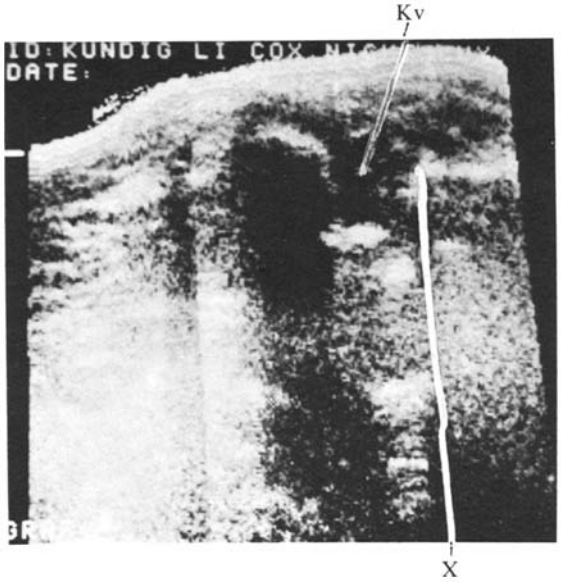
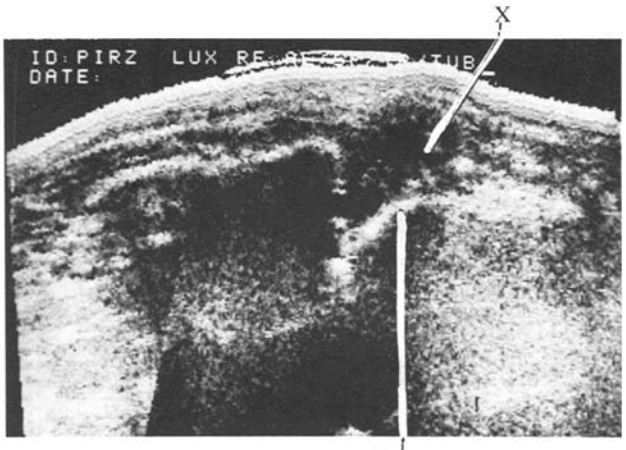
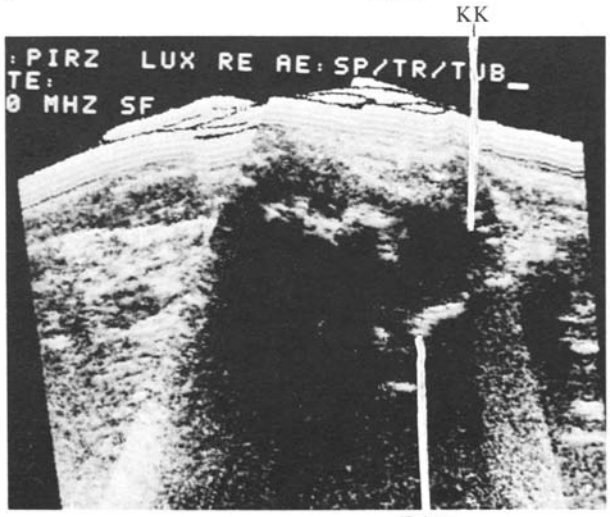


Fig. 4b. Left hip: posterior standard sector: x = posterior acetabular rim; Kv = nuclear density



a



b

Fig. 5a, b. Right hip, lateral standard sector, luxated. x = elevated ligamentous apparatus; KK = contour of the femoral head

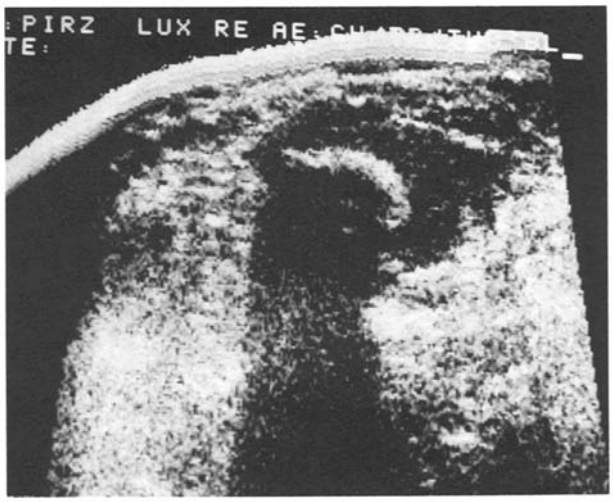


Fig. 5c. Right hip, same patient (5a/b), belly position, plane within the posterior standard sector

Fig. 5d. Radiograph to Fig. 5a–c

Fig. 4b: Posterior standard sector: regular SHD-line, central density of the femoral head covered by the posterior part of the acetabular roof.

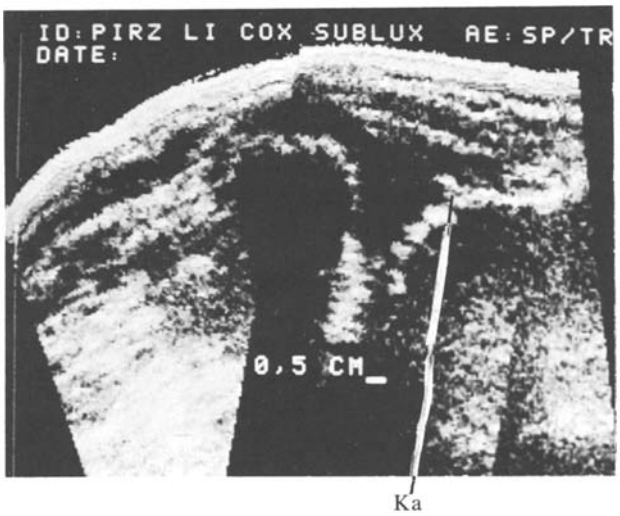


Fig. 6a. Left hip: lateral standard sector. Ka = capsular insertion

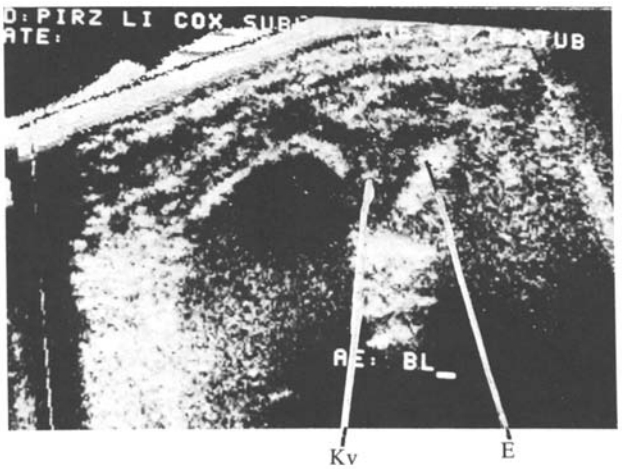


Fig. 6b. Left hip: posterior standard sector. Kv = nuclear density; E = acetabular rim

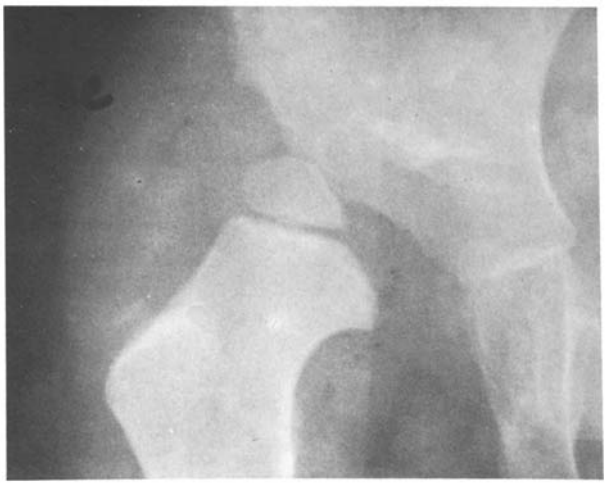


Fig. 7. Radiograph to **7a–d**

Fig. 7a. Right hip, lateral standard sector, 1. plane

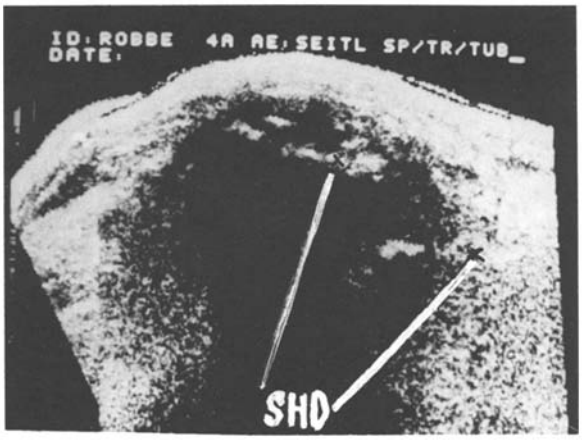


Fig. 7b. Right hip, lateral standard sector, 2. plane, significant interruption of SHD

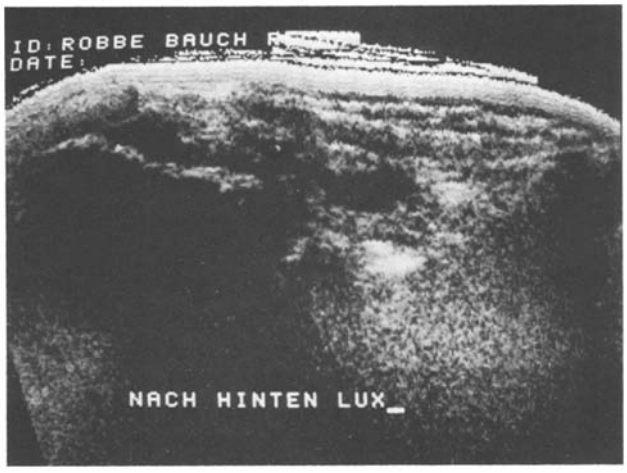


Fig. 7c. Right hip, belly position, posterior standard sector

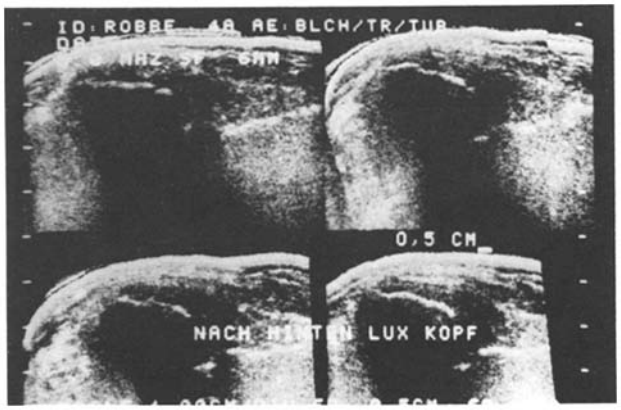


Fig. 7d. Right hip, belly position, posterior standard sector, 4 different intersecting planes

Luxated Hip: P.M. 3 months: Fig. 5a–c luxated hip (right), Fig. 6a/b normal hip (left)

Fig. 5a/b: Significant interruption of the SHD-line visible on 2 planes within the lateral standard sector of the right hip. The contour of the femoral head in elevated and laterally shifted position is visible.

Fig. 5c: Right hip: belly position. AE within the posterior standard sector: no coverage by the acetabular roof, interrupted SHD.

Fig. 5d: Radiograph to 5a–c confirming the diagnosis.

Comparison to the Left Side

Fig. 6a: Left hip: lateral standard sector; acetabular rim and insertion of the capsule, central density not visible on an excentric circular plane. SHD-line seems to be interrupted-subluxation?

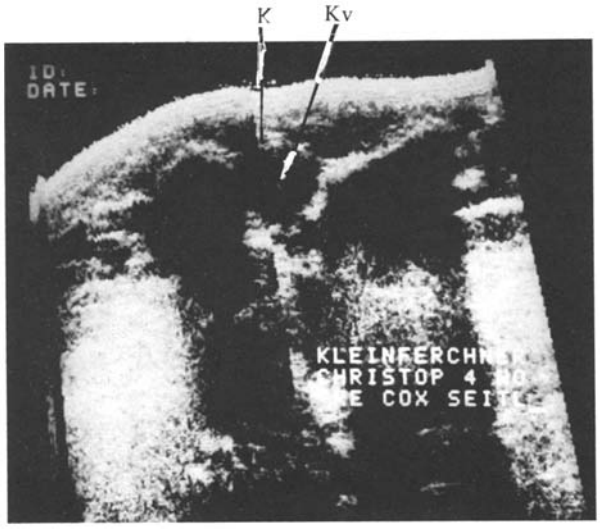


Fig. 8a. Right hip: lateral standard sector. Kv = nuclear density; K = femoral head

Fig. 8c. Right hip: lateral standard sector, 3 intersecting planes

Fig. 8b. Right hip: posterior standard sector

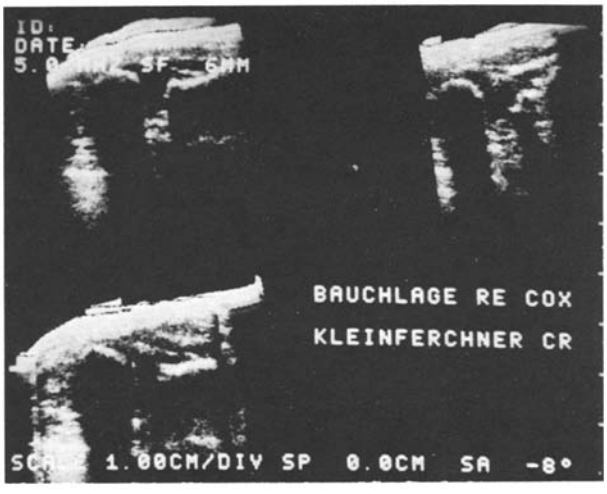


Fig. 8d. Right hip, posterior standard sector, belly position, 3 intersecting planes

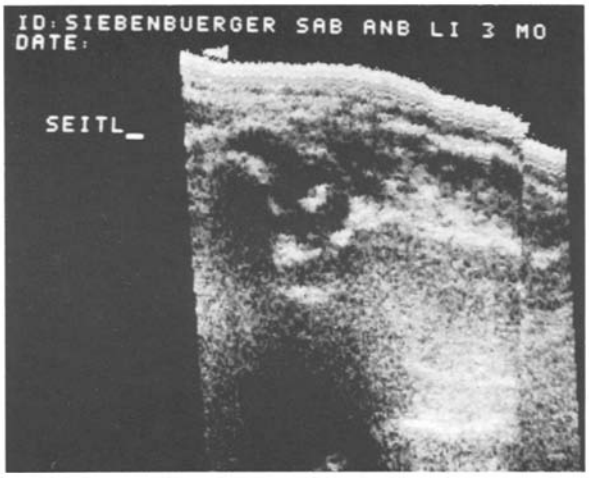


Fig. 9a. S.S. 3 months, left hip lateral standard sector

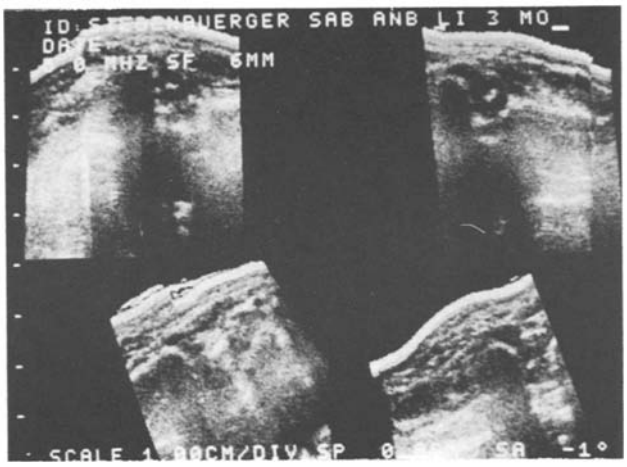


Fig. 9c. S.S. documentation: left hip

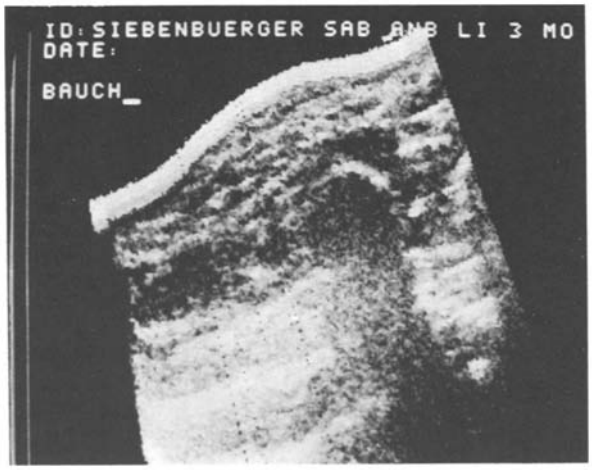


Fig. 9b. S.S. left hip, posterior standard sector

Fig. 6b: Final diagnosis achieved by exploration of the posterior standard sector (analogous to a Lorenz-position): central density of the femoral head visible underneath the acetabular rim.

R.A. 4 years

Fig. 7: Radiograph in comparison to Fig. 7a–d, luxation of the right hip.
Fig. 7a/b: Pictures from the lateral standard sector: significant interruption of SHD, head elevated behind the acetabular roof.
Fig. 7c: Posterior standard sector: excentric circular plane: only a slight interruption of SHD, misinterpretation possible using only 1 plane.
Fig. 7d: Documentation of the entire posterior sector: the entire posterior standard sector has been evaluated like a tomogram. Significant interruption of SHD, no acetabular coverage. Diagnosis: luxation of the right hip.

Kl.Ch. 4 weeks, right hip (Fig. 8a–d)

The luxation of the hip in a 4 week old infant could be excluded without any doubt: Fig. 8a/b are pointed out for a better orientation.
Fig. 8a: Lateral standard sector: right hip. Femoral head clearly visible with a slight density in the center.
Fig. 8b: Posterior standard sector: Regular line femoral neck–ilium (SHD)
Fig. 8c: 3 intersecting planes within the lateral standard sector: central density of the head sufficient covered, femoral head well visible.
Fig. 8d: The diagnosis can be achieved by these intersecting planes. However, there is no central density to be identified, and there is no interruption of the SHD-line.

S.S. 3 Months, Left Hip (Fig. 9a–c)

Fig. 9a: Central density entirely covered, contour of the femoral head and the acetabular rim clearly visible.
Fig. 9b: Central nuclear density well covered.
Fig. 9c: Documentation of the left hip: the pictures above are within the lateral sector the pictures below within the posterior sector.

L.S. 4 Months, Right Hip (Fig. 10a–c)

Fig. 10a: Plane within the lateral standard sector: regular SHD-line, distinct central density of the femoral head, sufficient coverage.

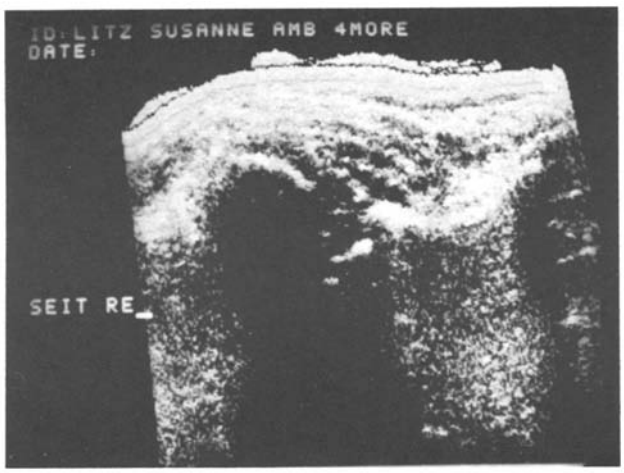


Fig. 10a. L.S. 4 months, right hip, lateral standard sector

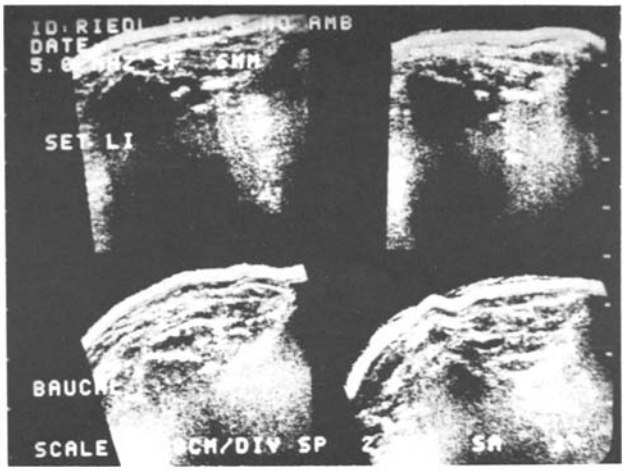


Fig. 11. R.E. 10 months, documentation left hip

Fig. 10b. L.S. 4 months, right hip, posterior standard sector

Fig. 12. S.M. 9 months, documentation right hip

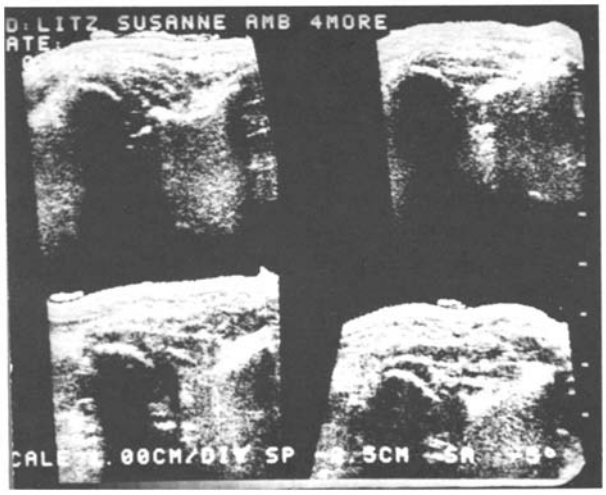


Fig. 10c. L.S. right hip documentation

Fig. 13. T.M. 3 months, documentation left hip

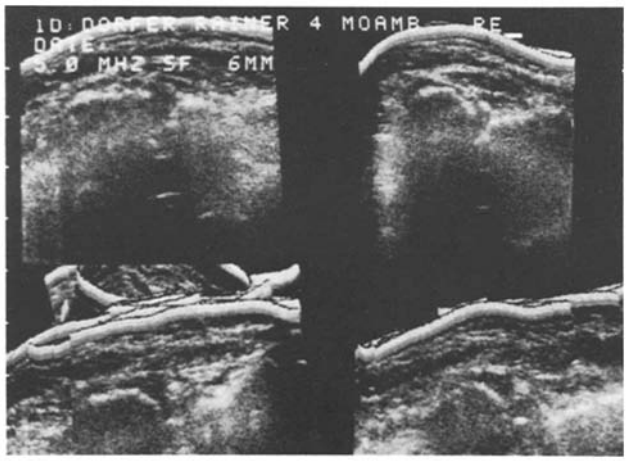


Fig. 14. D.R. 4 months, documentation right hip

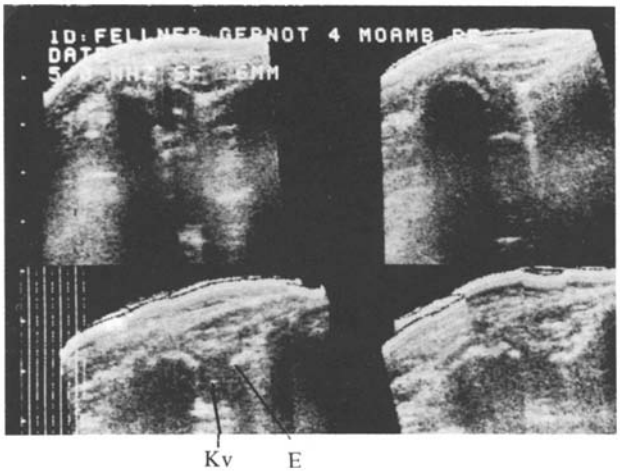


Fig. 15. F.G. 4 months, documentation right hip. Kv = nuclear density; E = acetabular rim

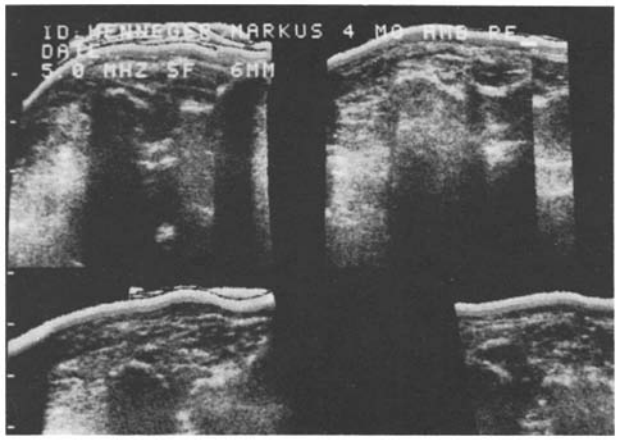


Fig. 16. W.M. 4 months, documentation right hip

Fig. 10b: Plane within the posterior standard sector: regular SHD and good coverage.
Fig. 10c: Documentation with 2 intersecting planes within the anterior sector (above) and 2 planes within the posterior sector.

Routine Documentation

R.E. 10 Months

Fig. 11: Sufficient coverage of the central density in lateral and belly position: no luxation.

S.M. 9 Months

Fig. 12: Sufficient coverage of the central density within the lateral standard sector. In belly position (posterior standard sector): Regular SHD in all intersecting planes, normally developed hip.

T.M. 3 Months

Fig. 13: Identification of the central density not sure, however, a luxation of the hip can be excluded because of a regular SHD-line appearing on all planes of the lateral and posterior standard sector.

D.R. 4 Months

Fig. 14: Regular SHD on the plane within the lateral standard sector: Good coverage of the central density in belly position: no luxation of the hip

F.G. 4 Months

Fig. 15: Left picture above (lateral standard sector) and picture below (posterior standard sector) with distinct coverage of the central density, no luxation of the hip.

W.M. 4 Months

Fig. 16: Regular SHD on all intersecting planes, on the right picture (below, 2. picture from the posterior standard sector). No luxation of the hip.

Our clinical examples demonstrate the possibility to achieve a correct diagnosis of a luxated hip in infants and to avoid false interpretations, if a standardized technique is used to explore the sectores.

There is no age limit for the diagnosis according to the clinical experience in the case of a 4 week old infant.

The problem of dysplastic hips in infants cannot be discussed in this paper, since further special examinations would be necessary.

According to our experiences within 2 years using ultrasonic diagnosis in infant hips we believe that this method is safe enough if the diagnosis can be based on the appearance of a nuclear density i the center of the femoral head. A diagnosis without this density is possible, however, only a great amount of experience is necessary to examine these cases, as we already pointed out in the theoretical part.

Incorrect diagnoses cannot be excluded entirely, and in doubtful cases a radiographic examination is recommended. However the advantage of the ultrasonic method is the possibility to screen all infant hips without the considerable risk of a too frequent to radiation. During the past 1.5 years we explored 150 infant hips and documented 52 of them. Four luxated hips could be verified on the ultrasonic B picture. An examination of both hip joints takes 4 min on an average. The costs for the documentation with a polaroid picture are presently Sch 20[1]. The costs per patient can be reduced to Sch 8 if a normal single lens reflex camera is used to take a direct picture from the screen. (The result will be dictated and the picture will be developed and added to the report some days later.)

1 Sch = Austrian Schillings

The ultrasonic method seems to be a possibility to reduce the exposure to radiation and the costs per patient.

We greatly appreciate Dr. E. Lenschow's detailed and stimulating informations to Prof. Dr. H. Buchner.

References

Kramps HA, Lenschow E (1978) Neues von Picker. Zur Anwendung der Ultraschallcomboundmethode zur Weichteildiagnostizierung und Konturendarstellung in der Orthopädie. Bulletin US 1/78

Received January 15, 1980