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ROENTGEN APPEARANCE OF COXARTHROSIS

Relation between the Anatomy, Pathologic Changes, and Roentgen Appearance

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Though it is known that osteophytes are reactive changes secondary to cartilaginous degeneration, roentgenographically demonstrable osteophytes in the hip joint sometimes persist unchanged for a long time without any associated clear differences in the joint space, i.e. without cartilaginous changes. A frequent moot point is whether such lesions should be regarded as manifestations of aging or of arthrosis.

As soon as subchondral changes supervene, however, the condition must undoubtedly be diagnosed as coxarthrosis. In such cases the joint cartilage is, as a rule, more or less destroyed by local relative overloading of the degenerated cartilage.

The destruction usually involves the proximal part of the femoral head and the corresponding part of the acetabulum.

The distribution of the load on the hip thus plays an important role in coxarthrosis. As in a previous investigation (Hermodsson 1947) the anatomy of the joint was therefore judged from the size of the CE angle, which allows a good conception of the distribution of the load on the hip.

The subchondral changes, formerly widely regarded as a manifestation of ischaemic necrosis, have long been known to pathologists. The modern consensus of opinion, however, recognises two phases, *viz.* a productive and a destructive one.

The Productive Phase

In this phase the subchondral bone becomes hyperaemic and hyper-

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vascular in response to a stimulus from the degenerating joint cartilage in the so-called pressure area of the proximal articular surface of the femoral head. New bone forms round the vessel walls in the weight-bearing segment of the head with consequent bone sclerosis. The hyperaemic reaction, however, reduces the resistance because the bony architecture gradually becomes rarefied and weakened.

The Destructive Phase

In this phase the excessive pressure on the proximal part of the femoral head results in total local destruction of the cartilage, and the repair processes in the joint cartilage and the subchondral bone fail to revitalize (regenerate) the tissue. The result is necrosis, so-called cyst formation, collapse of a varying-sized part of the bone with flattening of the overlying surface and upward-lateral displacement of the femoral head. The displacement results in medial widening of the joint space. This is accompanied by the development of osteophytes in the joint cartilage on the medial articular surface of the femoral head, i.e. in the non-pressure area. Marginal osteophytes develop on the head, neck, and acetabulum during both of these phases.

Recent descriptions of the pathologic anatomy of advanced coxarthrosis agree well with the roentgen appearance of the type of changes here called proximal arthrosis.

ROENTGEN APPEARANCE OF COXARTHROSIS

A. *Signs of Degeneration and Destruction of the Cartilage*

Since the only direct sign of degeneration of the cartilage in the roentgenogram is a decrease in the volume of the joint cartilage, which is reflected mainly in a narrowing of the joint space, it is understandable that mild degeneration of the cartilage is not demonstrable roentgenegraphically. Moreover, no joint space will be seen in the medial part of the hip joint. (The thickness of the basal calcified zone of the joint cartilage may deviate from normal. The occurrence and significance of such a deviation will not be discussed here.)

It should, however, be recollected that a decrease in the width of part of a joint space implies a displacement of the corresponding part of femoral head towards the caetabulum. Since the hip joint is a ball-and-socket joint (enarthrosis), such displacement is usually accompanied by an increase in the width of other parts of the joint space.

Cartilaginous destruction may also be manifest as a change in the floor distance (see "D. Displacement of femoral head").

B. *Osteophytes*

According to modern pathologists, secondary bone formations, osteophytes, are less important than previously supposed. It should also be borne in mind that in degeneration of the cartilage osteophytes constitute only a local reaction and not a referred reaction. In this conjunction it might not be out of place to mention Harrison & Trueta's (1953) remark: "The osteophyte is the result of an attempt to revitalise degenerating cartilage, and mark the site of a biological response to a tissue sick from underwork".

Osteophytes are, however, the most characteristic and striking roentgenologic changes of arthrosis. It is therefore natural that they have received such wide attention in the roentgenological diagnosis and literature.

Osteophytes on the femoral head and neck fall into four types: marginal, perifoveal, "buttress" (Wiberg 1939) in the dorso-medial part of the femoral neck, and "capital drop".

The term "capital drop", coined by Waldenström & Wiberg, is hardly adequate because the bone formations in question manifest themselves not only as drop-shaped marginal osteophytes but usually also extend far up onto the medial articular surface of the femoral head, "the non-pressure area", in the form of a deep-seated layer in the uncalcified part of the articular cartilage. The blood vessels responsible for these bone formations spring from marginal vessels and from newly formed vessels coming from the subchondral bone and piercing the otherwise largely preserved, basal calcified zone of the articular cartilage.

The outline of this calcified zone represents the roentgenologic outline of the head and it appears in the same, unchanged position irrespective of any osteophytes in the uncalcified articular cartilage. The appearance of the roentgenogram often conveys the impression of a double joint surface. This phenomenon and the underlying pathological changes were described as early as 1934 by Hermodsson in an investigation of dislocations of the shoulder joint.

Five types of osteophytes can be recognized on the acetabulum: (A) on the upper lateral border, (B) on the lower border of the posterior horn, (C) along the anterior border of the posterior horn, (D) "double acetabular floor", and (E) along the lateral border of the os ileum, outside and above the upper-lateral margin of the acetabulum in some

cases of proximal arthrosis with marked displacement of the head. They seem to lengthen the roof of the acetabulum laterally and are therefore here referred to as "eaves". (They correspond largely to what is generally called "Vordach" in the German literature.)

C. *Structural Changes*

These radiologic changes, which are most marked in the femoral head, occur mainly in the second stage, the destructive phase, of the bone changes. The pathologic-anatomic picture is clearly reflected in the roentgenogram.

In the productive phase the structure as well as the calcium of the spongy bone may appear somewhat irregular. Rarefied areas alternate with denser areas leaving the impression of sclerosis. These changes are most common near the articular surface and are confined to areas beneath roentgenologically demonstrable destruction of the cartilage.

In the destructive phase the structure of the spongy bone appears more or less indistinct. Cystic formations, sometimes with dense margins, may be seen.

In advanced arthrosis with widespread structural changes large parts of the femoral head as well as corresponding parts of the acetabulum successively collapse and become flattened. The consequent deformation of the head can be readily differentiated from the deformation by osteophytes by examination of the basal calcified zone in the articular cartilage. This zone is more or less well preserved in cases with capital drop and is always situated at its original site. But in cases of collapse and flattening the roentgenogram shows no zone of calcium within the flattened part.

The structural changes described above are seen mainly in proximal arthrosis. Therefore, and in agreement with descriptions by pathologists, it is mainly in the upper proximal part of the hip joint that such features are seen in the roentgenogram.

D. *Displacement of Femoral Head*

1. Cartilaginous destruction implies, as pointed out above, a displacement of the femoral head and this displacement may be manifest by a decrease or an increase of part of the roentgenologically visible joint space. Consequently, an increase does not necessarily mean a true increase in the thickness of the articular cartilage. Misinterpretations in this respect are not rare.

2. In the medial part of the hip joint there is no roentgenologically demonstrable joint space, but other signs of cartilaginous destruction can be seen. The author coined the term "floor distance" to denote the shortest distance between the original surface of the femoral head and the outer limb of the so-called U-figure or tear-figure. The original surface of the femoral head is to be understood here as the outline of the basal calcified zone of the articular cartilage.

As described previously (Hermodsson 1947) the floor distance in non-arthritic joints is usually 7–12 mm. This range of variation may appear wide (but hardly when compared with the variation of the thickness of the articular cartilage), but in proximal arthrosis the floor distance is often substantially increased, not infrequently two or more times the maximum normal distance. On the other hand, in medial arthrosis the distance may be abnormally short. Such shortening is best seen on comparison between roentgenograms obtained in successive stages of arthrosis in individual cases.

3. In many cases of proximal arthrosis Shenton's (Ménard's) line is broken because the head is displaced in a proximal direction. On the other hand, in severe medial arthrosis there is sometimes a slight displacement of the head in a distal direction.

4. Double acetabular floor and capital drop are signs of a displacement of the head. They occur only in proximal arthrosis and may be regarded as a sort of vacuum phenomenon.

5. Eaves (see above).

6. In certain advanced cases of medial arthrosis with severe widening of the lateral part of the joint space owing to medial displacement of the head, osteophytes may be seen on the lateral part of the acetabulum, on the lateral circumference of the neck, and on the lateral articular surface of the head. The last-mentioned ones correspond to the osteophytes on the medial surface of the joint in capital drop in proximal arthrosis.

7. The actual collapse, flattening of a fairly substantial part of the head and acetabulum, as is often found in proximal arthrosis, implies a displacement of the head. In advanced cases this displacement is much larger than that caused by changes of the joint space.

8. A secondary acetabular protrusion may sometimes be seen in advanced medial arthrosis.

E. *Registration of the Roentgenological Changes*

CE angle is given in degrees.

p: arthrosis of proximal type.
m: arthrosis of medial type.
d: floor distance (in mm).
cd: cartilaginous destruction.
o: marginal osteophytes.
bu: buttress.
dr: capital drop.
ea: eaves.
str: structural changes.
cy: isolated cysts.
irr: anatomical irregularities in the roof of joints with CE angles of normal size.
pro: secondary acetabular protrusion.
cv: coxa vara
ep: inveterate epiphyseal slipping.

If the *degree* of cartilage destruction is to be recorded, the symbols cd^{+}, cd^{++}, or cd^{+++} may be used. A case of proximal arthrosis may be expressed e.g., as follows: 12°, p (cd+o+str+db), d = 24; A medial arthrosis, e.g., 35°, m (o+cd), d = 4; irr, cv 115°.

PROXIMAL ARTHROSIS

The earliest sign of proximal arthrosis is usually a narrowing of part of the joint space as seen in the roentgenogram proximally in the joint, thus in the region of the roof, as an expression of destruction of the cartilage there. This destruction is usually most severe laterally, in the region of E, but in some cases with only mild dysplasia the decrease in the width of the joint space is more distinct further medially (see below).

Small marginal osteophytes appear relatively soon.

The roentgenographic signs produced by these changes represent a mild form, stage I, of proximal arthrosis.

When destruction of the proximal cartilage advances and the destruction is more or less complete in a varying sized area, structural changes arise in the corresponding part of the femoral head and acetabulum. Isolated cysts, often with dense margins, are common, particularly in the roof. The floor distance is usually increased. The neck often shows a buttress, most marked on the dorso-medial circumference.

When structural changes are clearly demonstrable in the roentgeno-

gram, the condition may be interpreted as moderate arthrosis, stage II.

As the arthrosis advances, it produces roentgenographic signs of collapse, flattening of the head and acetabulum. The collapse of the roof is usually most pronounced laterally. In the femoral head it is most pronounced in the antero-superolateral part (importance of lateral views). It is of interest to compare this collapse of the head with the localization and development of double acetabular floor and capital drop.

Collapse of frequently considerable parts often causes substantial displacment of the head. The most important roentgenological signs of this displacement are: large increase of the floor distance, double acetabular floor, and capital drop. Cases with these signs of proximal arthrosis may be labelled as severe, stage III.

CE Angle

In proximal arthrosis the CE angle is always subnormal (with 26° as the lower limit of the normal range).

It is, however, often difficult or impossible to assess the size of the CE angle in moderate and severe proximal arthrosis. This had led to much confusion and many misinterpretations in the literature.

When the head is displaced, the displacement is usually craniolateral, i.e., towards the upper lateral border of the acetabulum. The centre of the head, C, thus shifts towards E. If C follows the line CE exactly, no true changes of the CE angle will occur. But if the displacement occurs in a more sagittal direction, thus steeper than the line CE, the CE angle will tend to increase. In the same way the CE angle will decrease if the direction of displacement of the head is less steep than the line CE. The latter type of displacement is by far the more common.

Evaluation of the true, original CE angle in a given case of proximal arthrosis thus has several inherent sources of error.

Point E is defined by Wiberg as follows: "the point where the curving of the acetabular border latero-superiorly begins, i.e. where the bony support may be considered to end. The part of the acetabular roof which gives a dense shadow in the roentgen picture ends there".

The true point E can, however, be blurred or effaced by the following changes.

1. The density of the marginal zone lateral to E may be increased even in the mildest of the three stages of proximal arthrosis. The distinct border between the true dense acetabular outline and the outline of the bone lateral thereto thereby disappears.

2. "The point where the curving of the acetabular border laterosuperiorly begins" is displaced further laterally owing to a slight flattening of the bone contour in this region in association with the increase of density. (It should be observed that in many joints with a dysplastic acetabulum point E is situated far medially to the lateral border of the ileum.

Thus, in the presence of arthrotic changes one might be misled to imagine that E is situated further laterally, i.e. nearer the border of the ileum, than it really is. This results in over-estimation of the CE angle and the joint may be erroneously regarded as normal. Several examples of such misinterpretations are on record.

3. Because of collapse, flattening of the bone above the acetabulum, the visible outline of the roof may be situated further proximally than it was originally, especially the lateral part. Stirctly speaking, point E then no longer exists. (Shenton's line is broken in such cases.)

4. Eaves often elongate the outline of the roof laterally in such a way as to leave the impression that point E is situated much further laterally than it really is.

A group of cases deserving special mention are joints with a CE angle 21–25°, corresponding to Wiberg's "uncertain" group. These "borderline cases" often show a characteristic feature in the development of arthrosis which is due to the anatomic conditions.

The slope of the acetabular roof in such cases is usually only slight and the radius of its curvature differs only slightly from normal. The joint space is, however, narrowest medially (before arthrosis) as it usually is in dysplasia. Destruction of the cartilage is usually not so preponderantly lateral as in pronouncedly dysplastic joints but more evenly distributed over the major part of the roof. This is due to the difference in the distribution of the pressure. The head is therefore displaced in a more cranial direction than in severe dysplastic joints.

In mild proximal arthrosis the decrease in the roentgenographic width of the joint space may sometimes be most distinct in the medial part of the roof because of the above-mentioned incongruence between the head and the acetabulum even if it is evenly distributed over the entire roof.

This may be misleading and result in a diagnosis of medial arthrosis. Proper analysis and evaluation of certain cases of this type is only possible if the development of the arthrosis has been followed, preferably from the very beginning.

The risk of misinterpretating such a case as mild arthritis is still

greater. A search of the literature failed to reveal any systematic analysis of the roentgenological differential diagnosis between arthritis and arthrosis of the hip. This point is receiving attention by the author. A detailed discussion of this differential diagnosis lies beyond the scope of this paper.

CASES OF PROXIMAL ARTHROSIS

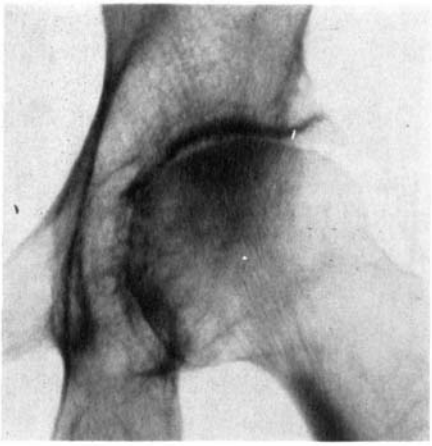

Figure 1. E. L., female, 1965.

Figure 2. Same patient, 1967.

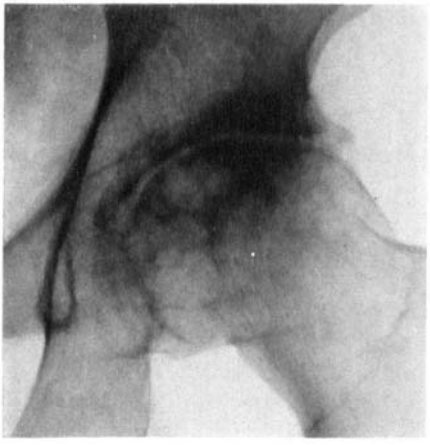

Figure 3. Same patient, 1969.

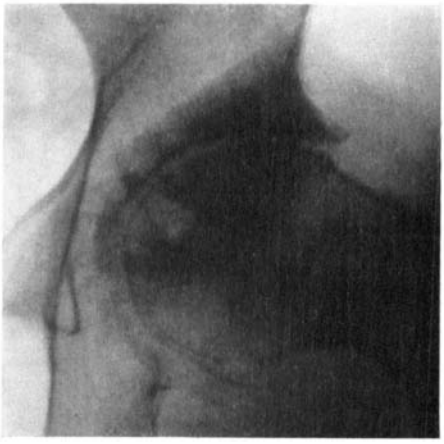

Figure 4. Same patient, 1969. Lauenstein's position.

CASES OF PROXIMAL ARTHROSIS

Figure 5. B. B., female, 1962.

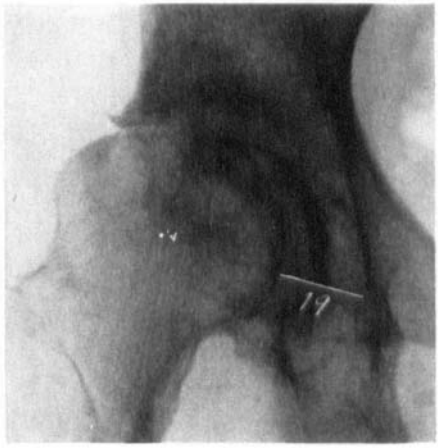

Figure 6. Same patient, 1967.

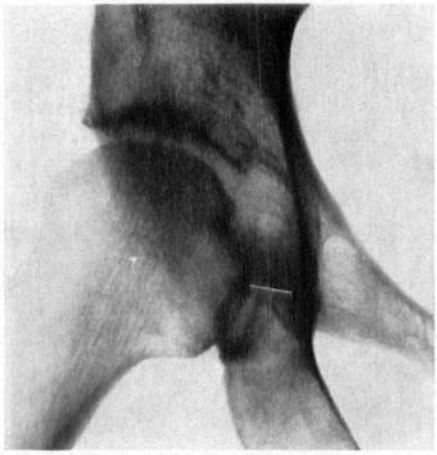

Figure 7. L. W., female, 1959. Right hip joint.

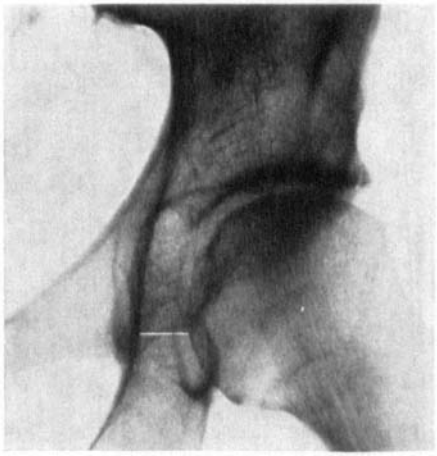

Figure 8. Same patient, 1959. Left hip joint.

CASES OF PROXIMAL ARTHROSIS

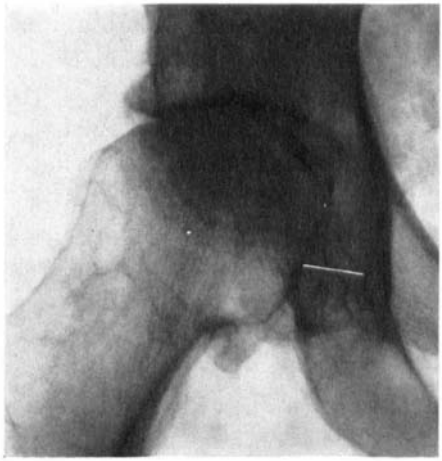

Figure 9. Same patient, 1968.
Right hip joint.

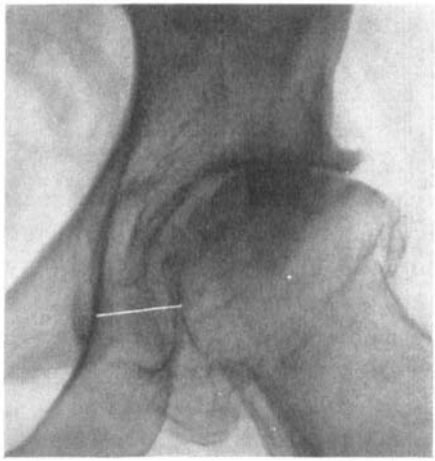

Figure 10. Same patient, 1968.
Left hip joint.

MEDIAL ARTHROSIS

The roentgenogram of medial arthrosis differs strikingly from that of proximal arthrosis, not only because of differences in type of roentgenographic details but also, and perhaps mainly, because of differences in the severity of the changes, the lesions usually being more or less marked in proximal arthrosis but relatively few and mild in most cases of medial arthrosis.

1. Judging from personal experience, the first roentgenologic sign of medial arthrosis is small marginal osteophytes on the border between the femoral head and the neck, on the border of the fovea, on the upper-lateral border of the acetabulum, and on the posterior horn of the lunate surface.

Pathological studies have shown that the osteophytes are manifestations of a local, reactive phenomenon seen in degeneration of the cartilage. Such degeneration must therefore be present also in joints with roentgenographically demonstrable osteophytes but without any distinct narrowing of the joint space or shortening of the floor distance.

2. However, roentgenologic signs of the usually mild destruction of the cartilage in the medial part of the joint can be discerned with time.

The decrease in the volume of the cartilage owing to destruction there reduces the floor distance. This decrease, which is often very small, is best readily seen in those cases where the progression of the arthrosis can be followed.

Owing to the anatomy (ball-and-socket joint), a decrease in the thickness of the cartilage medially with consequent, though only slight, displacement of the femoral head in medial direction must also cause a slight decrease in the width of the most medial part of the joint space adjacent to the acetabular fossa. Otherwise no medial displacement can occur unless the head is simultaneously displaced somewhat in distal direction, as it occasionally is.

The last-mentioned phenomenon with displacement of the head medially-inferiorly with demonstrable increase in width of the joint space in the entire region of the roof is here called a "paradoxical" increase in width because it is not a sign of an increase in the volume of the cartilage but of a decrease of the joint cartilage (thus a remote symptom).

Owing to the anatomy of the joint even the above slight decrease in the width of the medial part of the joint space produces a more or less distinct, though slight, increase in the width of the lateral part of the roentgenologic joint space. These changes result in asymmetry of the joint space which is sometimes the most distinct radiologic sign of mild destruction of the medial cartilage. It is, of course, *not* a sign of an increase in the volume of the cartilage laterally by new formation of cartilaginous tissue.

3. *Structural changes* in the medial lower part of the head and the region of the fovea are sometimes seen in cases of medial arthrosis with a relatively marked decrease of the floor distance, but they are rarely of any significance compared with the often extensive changes in proximal arthrosis. A slight flattening of the changed area has occasionally been observed.

4. Acetabular protrusion is often described as an aetiological factor of coxarthrosis.

Primary protrusion and Otto Chrobak's pelvis must, however, be distinguished from secondary protrusion.

In the secondary, but not in the primary, form the floor of the acetabulum is thickened by secondary bone formation.

In some cases of medial arthrosis the author has had the opportunity

of following the development of a typical secondary protrusion after the onset of arthrosis. It would appear justified to regard the medial arthrosis as an aetiological factor of the protrusion and not the other way around. The author has never seen any case of proximal arthrosis with the development of protrusion during the course of arthrosis.

It seems probable that osteoporosis (or some form of osteomalacia) must be assumed as a further aetiological factor. This appears to be strengthened by the observations by the author in rheumatoid arthritis (whether treated with cortisone or not).

Illusrated cases of arthrosis cum protrusion in the literature also appear to be of the medial type and to be associated with a thickening of the floor of the acetabulum. It would therefore appear meaningless to calculate the frequency of protrusion in proportion to all cases of arthrosis. Such a frequency should instead be calculated only relative to the number of cases of medial arthrosis. Protrusion should not be regarded as an aetiological factor but as a secondary phenomenon in such cases.

Anatomic Details of the Joints in Medial Arthrosis

In joints with medial arthrosis the CE angle is of normal size. Occasionally it may be of borderline value, i.e. 24–25°. It should, however, be recollected that an irregularity in the configuration of the acetabulum can result in the measure of the CE angle differing slightly with the slope of the pelvis (Hermodsson 1947).

Even if the CE angle is of normal size, the following irregularities, i.e., deviations from normal anatomy, may be seen.

1. *Medial flattening of the roof of the acetabulum.* This results in narrowing of the medial part of the joint space already before development of arthrosis. This narrowing constitutes a source of error in the evaluation of destruction, if any, of the cartilage, and is probably also a predisposing factor for arthrosis.

2. *Accentuated curvature in the lateral part of the roof adjacent to E.* This may readily lead to a false diagnosis of destruction of the cartilage.

3. *Very deep acetabulum in joints with large CE angle.* Here the roof is flatter than expected from the configuration of the head with consequent incongruence. The joint space is wider laterally. The incongruence probably predisposes to development of medial arthrosis of the joint.

4. *Coxa vara.* Here the term "coxa vara" refers solely to the size of the angle of the femoral neck. The present investigation is not concerned with coxarthrosis secondary to other diseases, thus not after epiphyseal slipping, for example. It should, however, be stressed that deformation due to epiphyseal slipping is often difficult to diagnose (both in the absence and particularly in the presence of secondary arthrosis). In such cases the diagnosis requires careful roentgen examination and experience on the part of the examiner (cf. Jerre's (1950) thesis on slipped upper femoral epiphysis).

The abnormally small angle of the neck in coxa vara (irrespective of the cause) implies a disturbance of the normal distribution of the load on the hip and thereby predisposes to medial arthrosis.

Coxa vara appears often to be associated with a deep acetabulum with a thin floor (possibly primary acetabular protrusion).

PRIMARY AND SECONDARY COXARTHROSIS. PROGNOSIS

According to modern pathologists, the changes in coxarthrosis can, under certain favourable circumstances, regress. According to Trueta: "The osteoarthritis is a reversible condition, which can be made quiescent by measures to restore the chances of survival or revival, of the joint cartilage".

Judging from the literature and personal experience, structural changes, e.g. cyst formation, can regress, *inter alia* if the joints are rested long enough. It is more difficult to understand regeneration of joint cartilage. Harrison et al. (1953) and Trueta (1964), however, state: "Where the fibrous marrow comes to the surface at the pressure area it differentiates into a fibrocartilage which is usually degenerated, but at times is almost hyaline in nature. Especially in patients whose hip joints have been placed at rest or when mechanical conditions have been changed, these cartilaginous outgrowths become confluent and may resurface the previously naked and eburnated bone". (It appears from the literature that pathologists support their claims on examination of cases of proximal arthrosis (cf. Fig. 3!).)

Pathologists support their conclusions mainly on cases of arthrosis which have been operated, especially by osteotomy. Also some orthopaedists share the opinion of the pathologists and generally support their conclusions on cases that have been subjected to osteotomy.

From a roentgenological point of view, it should, however, be ob-

served that an increase in the width of the joint space is, as mentioned, by no means always a sign of regeneration or increase in volume of the articular cartilage.

Arthrosis of dysplastic joints (proximal arthrosis) is regarded by certain authors as "primary arthrosis". It would, however, be more correct to label it "secondary". Strictly speaking, also the medial arthrosis of the joints with a normal CE angle should be regarded as secondary if there are such deviations from the normal anatomy, which must be regarded as predisposing to arthrosis.

Primary arthrosis then is relatively uncommon and its prognosis is good compared with that of secondary arthrosis and particularly with that of proximal arthrosis.

SUMMARY

In hip joints with a normal CE angle the coxarthrosis assumes a medial type. The proximal type is to be found only in joints with subnormal angle. The size of the floor distance is of great importance to the roentgenologic diagnostics of the progression of the arthrosis.

The prognosis of the medial type of arthrosis is by far the best.

CASES OF MEDIAL ARTHROSIS

Figure 11. S. S., male, 1957.

Figure 12. Same patient, 1967.

CASES OF MEDIAL ARTHROSIS

Figure 13. R. W., male, 1954.

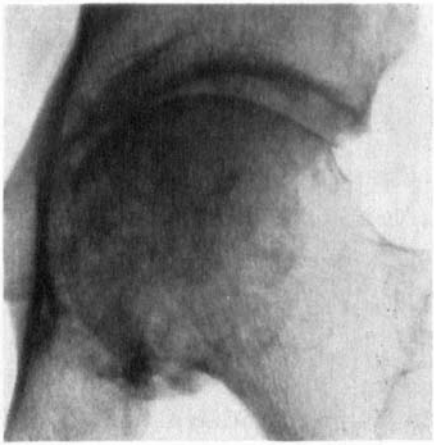

Figure 14. Same patient, 1962.

Figure 16. Same patient, 1969.

Figure 15. Same patient, 1969. Lauenstein's position.

CASES OF MEDIAL ARTHROSIS

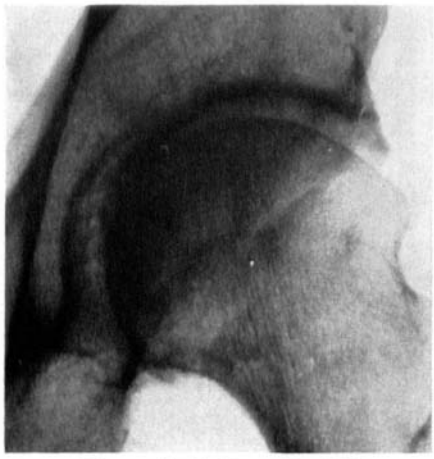

Figure 17. E. T., male, 1969.

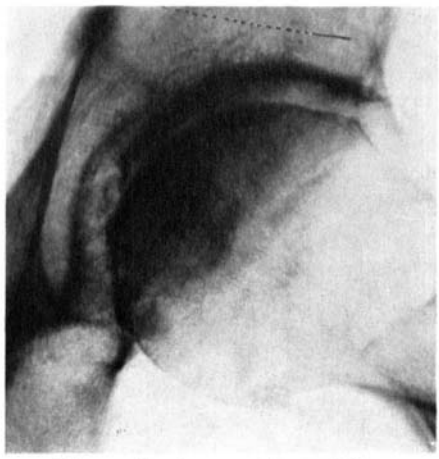

Figure 18. Same patient, 1969. Lauenstein's position.

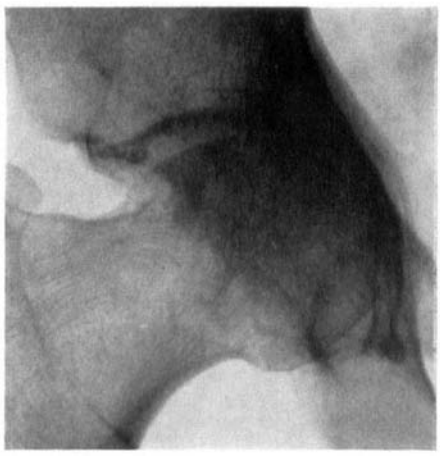

Figure 19. F. F., male, 1959. Right hip joint.

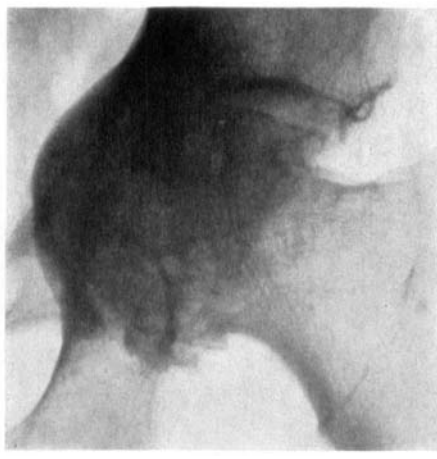

Figure 20. Same patient, 1959. Left hip joint.

CASES OF MEDIAL ARTHROSIS

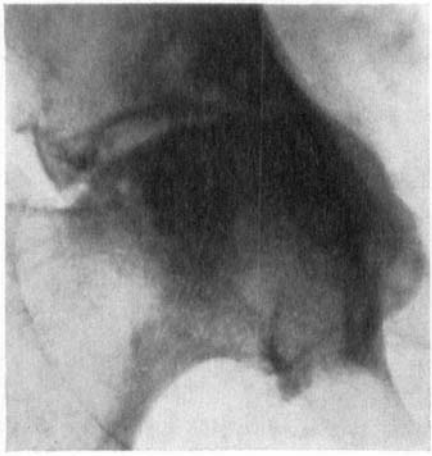

Figure 21. Same patient, 1967. Right hip joint.

Figure 22. Same patient, 1967. Right hip, Lauenstein.

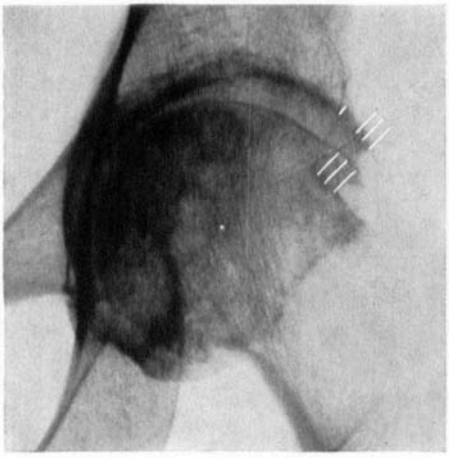

Figure 23. K. B., female, 1969. Left hip joint.

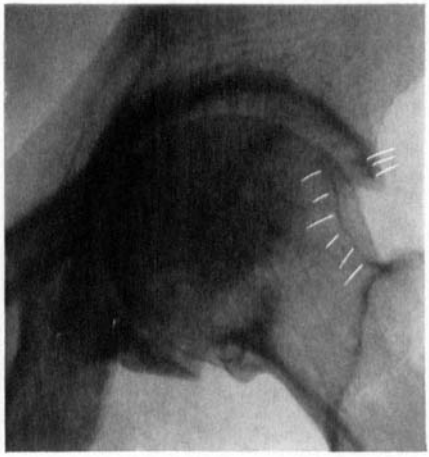

Figure 24. Same patient, 1969. Left hip joint. Lauenstein.

Notes to the figures.
Films of the entire pelvis were used in the examination of all hip joints. Frontal views and views in Lauensteins position were taken in all cases. For explanation of symbols in this Table, see page 174.

Patients Name, sex, year of birth	Rtg.	Rtg. symbols	Fig. no.	Remarks
E. L., female	1965	22°, p(o+cd+db), d=11	1	Joint space
b. 1896	1967	22°, p(o+cd+str+bu+db), d=13	3	clearly wider in
	1969	19°, p(o+cd+str+bu+db+dr), d=14	3, 4	1967
B. B.,female	1962	20°, p(cd+o+str+db), d=12	5	hip op. 1968
b. 1896	1967	15°?, p(cd+o+str+db+bu+dr), d=19	6	
L. W., female	1959	24°, o, d=10	7	
b. 1901	1959	23°, p(o+cd), d=10	8	
	1968	20°?, p(o+cd+str+bu+db+dr), d=13	9	
	1968	28°?, p(o+cd+str+bu+db+dr+ea), d=18	10	
S. S., male	1957	33°, m(o+cd), d=8	11	
b. 1908	1967	37°, m(o+cd), d=7	12	
R. W., male	1954	45°, m(o+cd), d=4	13	1969: beginning
1890	1962	45°, m(o+cd+str), d=3	14	of a protrusio.
	1969	45°, m(o+cd+str), d=0	15, 16	Bone formations laterally
E. T., male	1969	40°, m(o+cd), d=8	17, 18	
b. 1904				
F. F., male	1959	45°, m(o+cd), d=1. Coxa vara (112°)	19	No other joint
b. 1896	1959	45°, m(o+cd+str), pro, c. vara (105°)	20	diseases. No
	1967	45°, m(o+cd+str), pro!, c. vara (112°)	21, 22	steroid therapy
K. B., female	1969	45°, m(o+sd+str), d=2, pro.	23, 24	Bone formations laterally on the
b. 1909				head, neck, and acetabulum

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