

CONGENITAL DEFORMITIES OF THE KNEE JOINT IN DISLOCATION OF THE PATELLA AND ACHONDROPLASIA

By

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Dysplastic changes of the hip joint are well known, and several authors have demonstrated a gradual transition from congenital dislocation of the hip, by way of subluxation and incongruence in the hip joint to the normal hip joint (Murk Jansen, Morville and Prip Buus).

A similar analysis in regard to the knee joint has not been published, although some aspects of the dysplastic problem in the femoro-patellar joint have been studied by G. Wiberg, Fürmaier & Breit, Knutsson, Blumensaat, and Felländer.

The problem is not treated in the big textbooks of radiology, and no particular space is devoted to X-ray changes in the knee joint in dislocation of the patella (slipping patella), although the pathological changes were described as early as 1868 by Uhde after post-mortem examination of two cases.

In the present paper, the author will give a survey on the X-ray changes in a series of patients with slipping patella and a few cases of achondroplasia. An attempt will be made also to evaluate the aetiological and prognostic significance of these findings.

TECHNIQUE

In addition to the ordinary anteroposterior and lateral view, all patients had tangential views of the femoro-patellar joint. Bilateral exposures were made in the same positions, also in patients who had only unilateral complaints.

The AP views were taken directly from the front, and the patients were asked to relax the quadriceps, as its contraction may pull the

patella up by as much as 2 cm. This movement Payr has called longitudinal "Patellarspiel", and it constitutes the only independent movement of the femoro-patellar joint. The possibility of this movement is eliminated by a flexion of about 30°.

The laterals were also taken in about 30° flexion in order to avoid movements of the patella by isolated contraction of the quadriceps and in order to obtain a fixed standard of the position of the patella in relation to the femur.

Boon-Itt has given an index for the position of the patella by a geometric system. For clinical use, this method is too cumbersome, without affording a guarantee of exact values. Blumensaat's statement of the patellar level is far more simple and appears to be sufficient. This method has previously been used by Wiberg as well as by Fürmayer & Breit. In Fig. 1 the measuring line is traced on a lateral view. Its upper limit is the top of the intercondyloid fossa which presents itself as a sclerotic density in the posteroanterior direction. The posterior portion of this line forms an acute angle with the epiphyseal line, whereas its anterior portion ends about 1 cm behind the anterior limit of the condyles. If the patella is in a normal position, its apex intersects a prolongation of this line, when the knee is in 150° flexion.

The last exposure is the tangential view of the femoro-patellar joint, using Jaroschy's technique with a flexion angle of 110° in the knee joint. The patient was in the prone position, and the beam horizontal caudo-cranial, the plate resting on the quadriceps tendon. Later, this technique was modified by Knutsson who made the exposure with an angle varying from 130° to 150° and with a reverse direction of the beam.

In the present series, the author used a somewhat greater flexion in view of the fact that in many cases of dislocation the patella is in a higher position than normal, so that the articulation between the patella and the condyles does not reach a maximum until at a somewhat greater flexion. Assessment of the femoro-patellar joint is of the utmost importance in dislocation of the patella, but the tibio-femoral joint has to be examined as well. The knee joint must be regarded as a whole, if the examination is to give an overall impression of the changes which characterize the disease.

The changes of the femoro-patellar joint emphasized by the above-mentioned authors may be classified as shown below. After anatomical and radiological studies, Wiberg found that normally the patella could be grouped into three types:

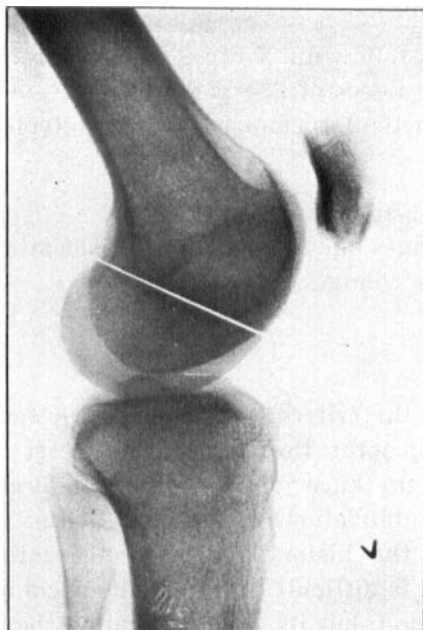


Fig. 1.

Measuring line for upper contour of the intercondyloid fossa. Pronounced patella alta with slightly kidney-shaped patella.

- I. Ridge situated in the centre of the patella.
- II. Ridge somewhat medially displaced, and
- III. Medial patellar facet very small.

On the basis of 13 cases with dislocation or subluxation Wiberg made a classification of the femoro-patellar joint. Type I is total leveling-off of the articular surfaces of both the femur and the patella. Type II is maldevelopment of the lateral femoral condyle with or without flattening of the articular surface of the patella, and Type III shows no pathological changes. Folke Knutsson assessed the degree of dysplasia on the basis of the developmental stage of the patellar groove, as he found the distal end of the femur to be entirely cylindrical in the foetal stage.

In all cases of subluxation Fürmaier & Breit found patellar changes and incongruence in the femoro-patellar joint due to aplasia of the lateral condyle, genu valgum, and increased external rotation of the distal end of the femur.

Present Investigations.

On the basis of follow-up X-rays, the author classified the X-ray appearances of the knees of 284 patients.

The bony and articular changes may be divided into three main groups:

- (1) Primary dysplastic changes.
- (2) Bony changes due directly to the dislocation.
- (3) Secondary changes.

Primary Changes.

In analogy with the criteria set up by Murk Jansen for congenital dysplasia of the hip joint, the author tried to set up criteria for dysplastic changes of the knee joint as seen in lateral dislocation of the patella, in lateral subluxation, and in patella alta.

In 4 instances, the history indicated dislocation, but the X-ray changes did not. It is difficult to find radiological and clinical criteria for medial dislocation, but its existence cannot be entirely denied, although some authors do (Thompson and Bosworth).

The present series did not contain any case of torsion dislocation or inversion dislocation.

The following sections deal with the primary bony and articular changes found in the patients.

Furthermore, they include an evaluation of the valgus position in the knees of these patients. To afford a basis of comparison, the author secured measurements of 100 subjects with no evidence of knee disease.

Changes in Patellar Shape.

According to the tangential views, the changes in shape may be divided into three types, viz.

- (1) Total flattening of the articular surface, the patella becoming almost hemispherical.
- (2) Comma-shaped, i.e. the lateral portion of the articular surface is greatly excavated and occupies about two-thirds of the entire posterior surface, while the medial portion becomes convex. In these cases the patellar ridge is in the medial portion.
- (3) A patella of normal appearance.

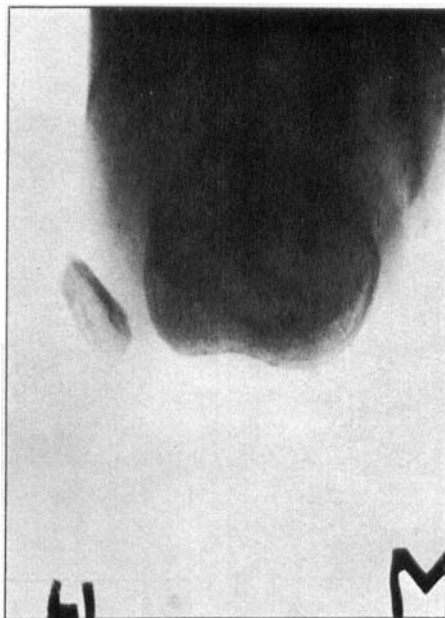


Fig. 2.

Tangential view showing total flattening of the patella. Marked changes of the femoral condyles.

Total flattening of the articular surface was seen in 22 patients, 12 of whom had permanent dislocation. Fig. 2 shows examples of the totally flattened articular surface, in permanent dislocation. The right patella is totally dislocated. Its articular surface is completely flat, without a ridge, and the shape of the entire patella has changed: it is narrower, but longer from side to side than the normal patella of the left knee.

Such total flattening of the articular surface may also be observed in intermittent dislocation. The transition from total flattening by way of comma shape to the normal patella is gradual, so the grouping may give rise to difficulties.

Type 2 manifests itself as a comma shape of the entire patella whose articular surface has undergone these changes. This phenomenon was encountered in 119 patients, in 86 of whom it was bilateral.

Fig. 3 a and b gives a typical example of comma shape with the marked excavation of the lateral articular surface and abolished articulation between the medial femoral condyle and the convex, shortened

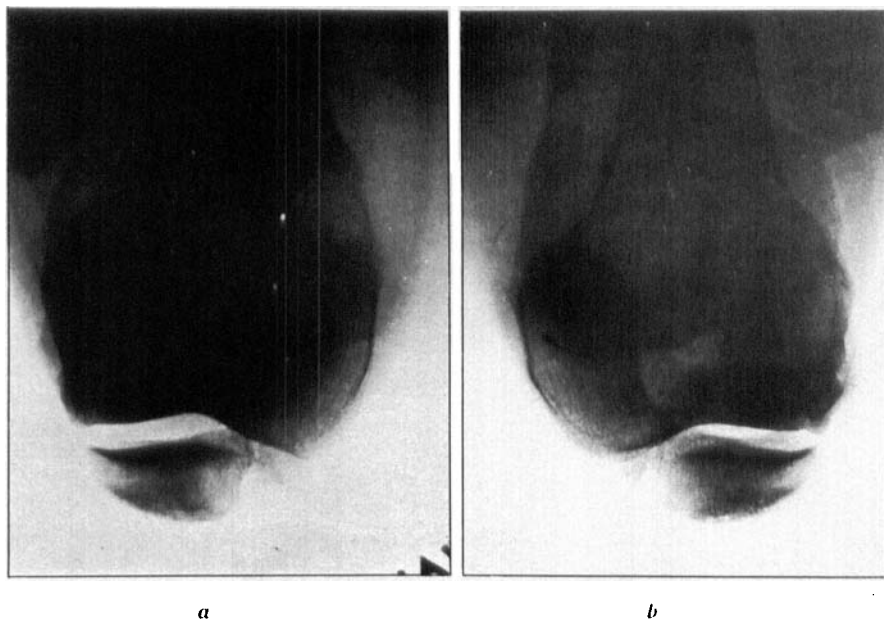


Fig. 3 a and b.

Both patellae of pronounced comma shape, medially with irregular contours.

patellar surface. In this case, the excavation is accentuated by a tendency to bipartition.

There are marked variations within this type. In Fig. 4, for instance, the patellar ridge is completely obliterated and the patella is triangular. Fürmaier & Breit consider this type an important sign in subluxation of the patella, but it seems more reasonable to interpret it as a variant of the hemispherical patella, i.e. a sign of the most pronounced forms of dislocation, whereas only minor changes are observed in subluxation.

Out of the 142 patients who exhibited changes in patellar shape as the only dysplastic sign or co-existing with dysplastic changes in the femur or tibia—11 had acquired dislocation. All had a history of a violent initial trauma followed by acute articular symptoms except one patient whose dislocation was a sequel of poliomyelitis involving paresis of the quadriceps femoris.

Patella Alta.

As already mentioned, the level of the patella was estimated on the basis of Blumensaat's criteria. Out of 286 patients no less than 207 had

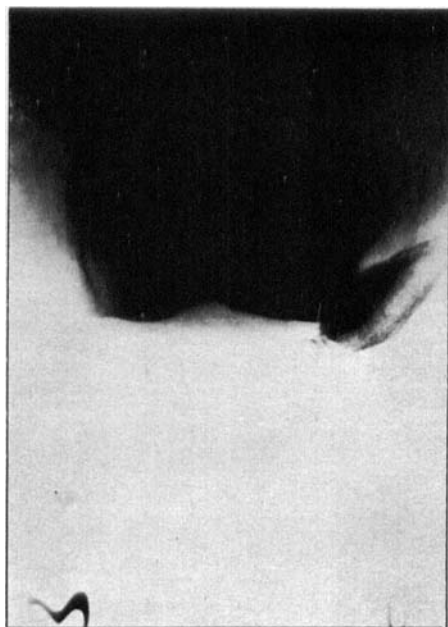


Fig. 4.

Triangular patella with a greatly flattened patellar ridge.

this abnormality. Patella alta may also co-exist with other diseases: osteomyelitis of the femur, fractures involving shortening, poliomyelitis, Schlatter's disease, and spasticity of the lower limbs. The present series did not contain any example of these diseases or of other diseases which might have explained the high position of the patella.

Like Fürmeier & Breit, the the author can see no reason to divide the condition into congenital, true, and false patella alta. The incongruence in the femoro-patellar joint is the same whether there is a question of real or relative elongation of the ligament.

Isolated patella alta without actual dislocation occurred in only one case. This patient had periodical instability, a sign which Pitzen found to be a typical sequela of the high position.

Patella alta entails a disturbance in the equilibrium between the quadriceps and the ligament and consequently leads to instability.

Patella alta may at times be accompanied by an alteration in shape, illustrated in Figs. 5 and 6 a and b. The patella may be almost semi-lunar or kidney-shaped, there being a marked excavation of the central part of the articular surface. In a few instances osteophytes may extend from the apex patellae, presumably due to traction periostitis.

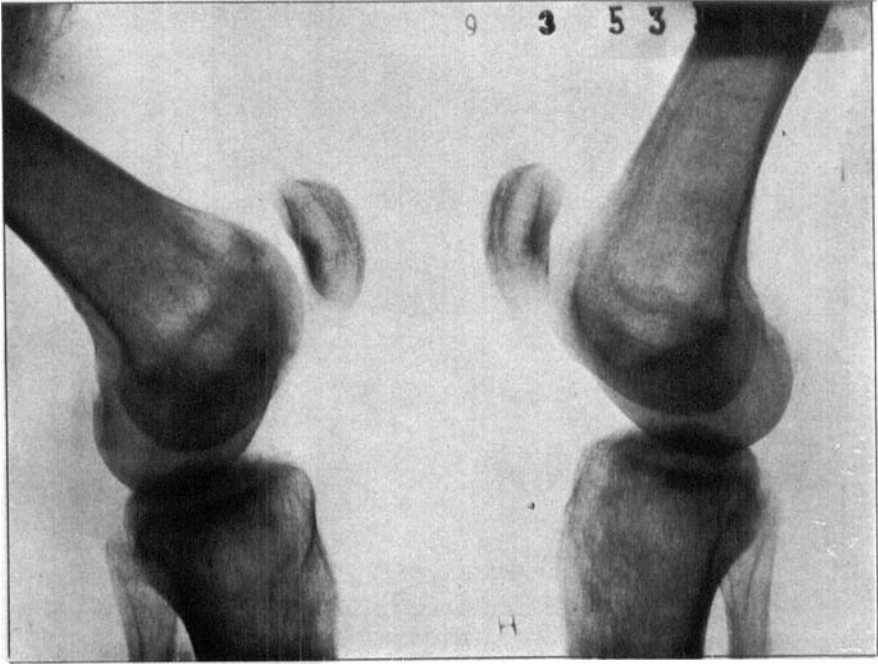


Fig. 5.

Patella alta with slight excavation of the joint surface.

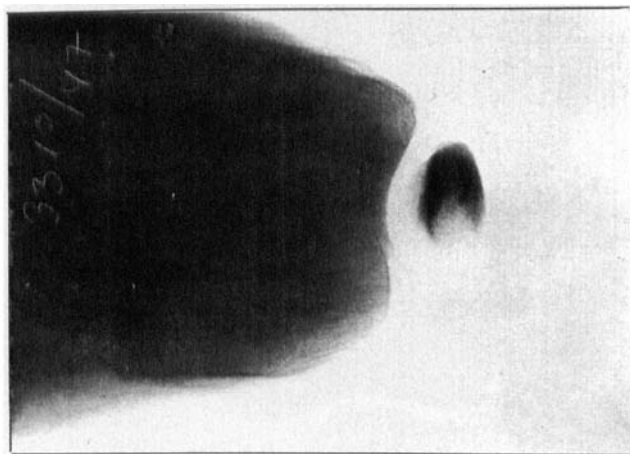
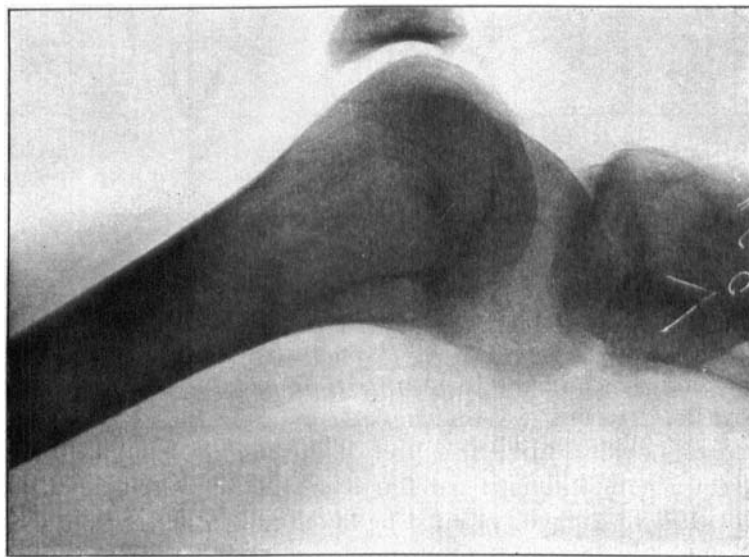
The cause of this alteration is no doubt related to the altered articulation between the patella and the patellar surface of the femur, there being increased loading on the central part. This alteration in shape leads to incongruence in the lateral plane, as a rule combined with a similar incongruence in the frontal plane. These alterations must be interpreted as the pathological cause of the clinical instability.

The significance of patella alta has been emphasized by various authors. Pitzen states that it is the most common cause of habitual dislocation, while Kapel, Ober, Karl, and Friedländer have found it as a possible aetiological factor among a number of others.

In my series patella alta was observed in about 75 % of all those who were X-rayed. In other words, it is a very common dysplastic abnormality. It was striking that in the great majority of cases patella alta was bilateral, being unilateral in only 12 cases.

Just like the above-mentioned patellar changes, patella alta may co-exist with other dysplastic changes in the knee joint.

In most instances patellar dysplasia is associated with other bony



a *b*
Fig. 6 a and b.
Pronounced excavation of the patella with complete flattening in the tangential view.

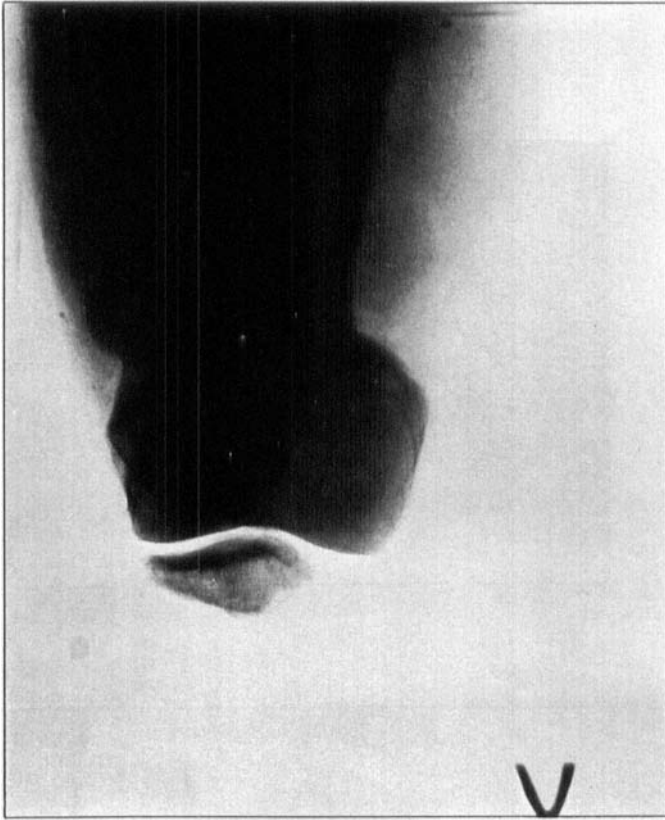


Fig. 7.

Aplasia of the lateral femoral condyle. Patella comma-shaped with irregular medial contour.

changes in shape and position. Isolated congenital patellar dysplasia was found in a total of 56 patients, in 5 of whom it was unilateral.

The sequelae of patellar dysplasia manifest themselves in X-ray signs of incongruence in the femoro-patellar joint. Clinically, this may result in instability in the joint, and it may alter the direction of the pull of muscles on the anterior aspect of the thigh.

This great accumulation of patellar dysplasia in a series of patients with dislocation of the patella must be taken as a proof that congenital maldevelopment of the joints predisposes to permanent or intermittent malposition of the joint.

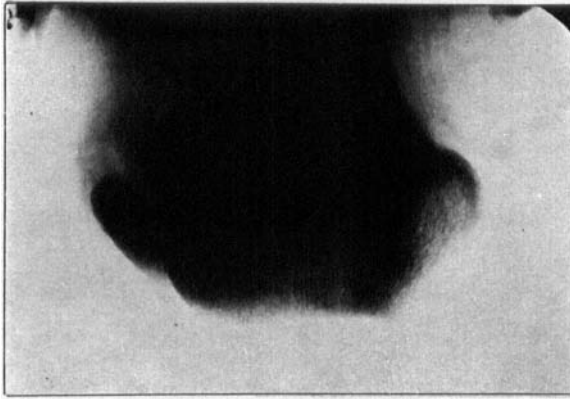


Fig. 8.

Total aplasia of the femoral condyles in a case of total dislocation.

Changes of the Femoral Condyles.

Dislocation of the patella has been attributed to primary developmental anomaly by many authors (Steindler, Bogen, and Finsterer). Quite particularly, several workers (Stokes, Servier, Canton, Appel, Herlyn, Bunts, Kapel, Ober, Wiemuth, and Moreira) point out deficient development of the lateral femoral condyle.

On the other hand, Friedland and Fründ believe that aplasia of the lateral femoral condyle is secundar to permanent pressure. The aetiological theories are numerous (foetal rickets, intrauterine trauma, disturbances of central innervation, deficient blood supply to the lateral condyle).

In practice, the theory that a flattening of the lateral femoral condyle is a cause of lateral dislocation of the patella has resulted in Albee's operation.

The author assessed not only the appearance and shape of the lateral femoral condyle, but also paid regard to the shape and depth of the patellar groove. This may be distinctly illustrated by two examples. Fig. 7 shows unmistakable aplasia of the lateral condyle, whereas the groove is of a medial position. The articulation between the patella and the femoral condyle shows only moderate incongruence, due essentially to the flat lateral condyle. In Fig. 8 the patellar groove is entirely obliterated. Both condyles are flatter than normal, but the lateral condyle projects a little in relation to the medial one. At the same time, there is a pronounced patellar dysplasia.

These cases are doubtless variants of the same form of dysplasia,

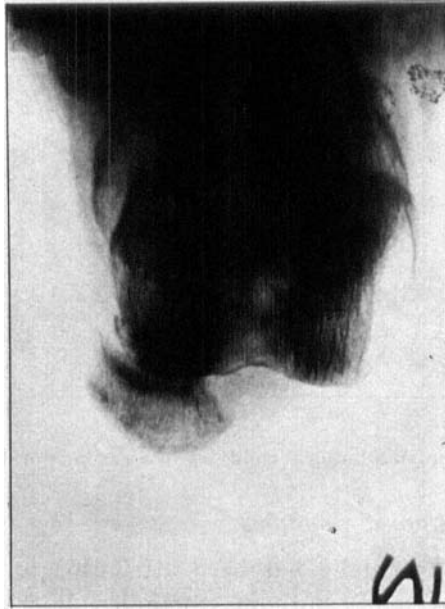


Fig. 9.

Permanent subluxation with aplasia of the lateral femoral condyle. Severe femoro-patellar osteoarthritis.

there being gradual transitions from total flattening to very mild forms of diminished height of the lateral condyle. A total of 154 patients had variations in the height of the lateral compared with the medial femoral condyle. In 10 there was a history of well-marked initial trauma. Of them, 8 had mild abnormalities, whereas 2 showed marked flattening of the patellar groove co-existing with flattening of the lateral condyle and total lateral dislocation of the patella. The former patient had permanent dislocation following transplantation of the biceps to the lateral part of the extensors.

Flattening of the patellar groove was observed in 108 cases, the same cases which showed dysplastic changes of the lateral femoral condyle. Fig. 8 is an example of marked flattening. In this case the condylar region is almost cylindrical in shape, resembling the foetal form. The most marked changes in the shape of the condylar regions were seen in permanent dislocations. Out of the 108 patients 6 had a well-marked initial trauma at the time of the first dislocation. The abnormalities in these cases are slight, but on the other hand distinct enough to belong to this group.

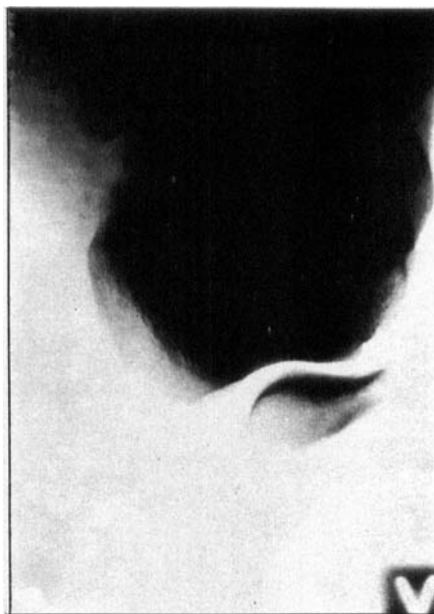


Fig. 10.

Lateral subluxation of the patella with aplasia of the lateral femoral condyle and comma-shaped patella.

The patellar and condylar changes as well as the variations in the femoro-patellar articulation make up a special type of femoro-patellar dysplasia. Dysplasia of the lateral condyle and patellar groove were found isolated, like the changes in patellar shape, in the group of patients who had had the most severe initial trauma. These are the cases with slight congenital changes, the condition being predominated by the trauma. In these cases it is justified to speak of condylar dysplasia as a cause of the intermittent malposition of the patella.

The variations in articulation consisted in all cases of lateral division of the patella.

Total dislocation, the patella resting on the external aspect of the lateral condyle, occurred in 19 cases. Fig. 12 a and b shows total dislocation of the patella co-existing with other dysplastic changes, such as total flattening of the patella, aplasia of the lateral condyle, and a flat patellar groove, i.e. the appearance of typical femoro-patellar dysplasia. For comparison, the figure shows the left femoro-patellar joint which has the same dysplastic changes, but no lateral malposition. Transitional varieties may be seen in a case shown in Fig. 9 in which

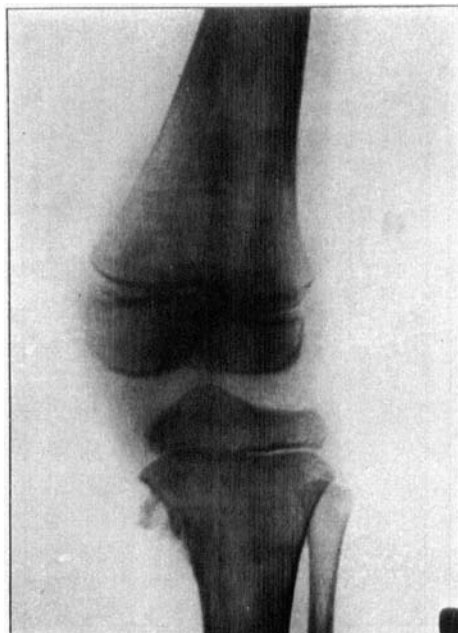


Fig. 11.

the patella is greatly displaced to the lateral aspect, but still in contact with the articular surface of the lateral condyle. Mild articulation changes were observed in a total of 116 patients. Fig. 10 shows slight incongruence in the femoro-patellar joint with about 1 cm lateral displacement of the patella. The articulation takes place essentially between the lateral, excavated articular facet of the patella and the lateral femoral condyle.

Just as in the other groups of dysplastic changes, there are dislocations with well-marked initial trauma—represented in 4 cases. In all but one of these cases the changes were slight. As apparent from what has been stated above, patients with predominating initial trauma show only mild, and generally isolated, dysplastic changes. In these cases there is only a slight predisposition to dislocation which has to be elicited by an adequate trauma.

The predominant majority of patients among those who have congenital predisposition to dislocation had either patellar dysplasia or femoro-patellar dysplasia with incongruence of the joint. In view of this marked accumulation of dysplasia, it seems justified to state that incongruence in the femoro-patellar joint—like that in the hip joint—

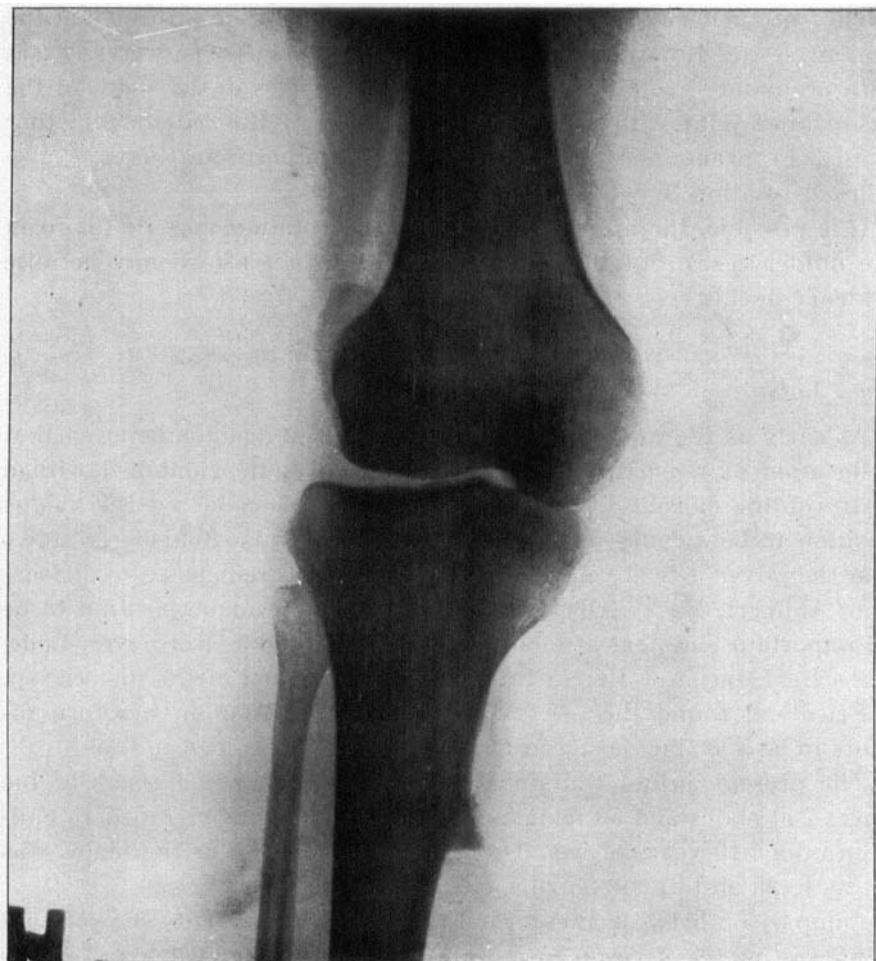


Fig. 12.

Figs. 11 and 12.

Moderately severe tibio-femoral incongruence. Both patients had permanent dislocation of the patella.

is an important cause of intermittent dislocation and permanent malposition of the patella.

Changes in the Tibio-femoral Joint.

Hohlbaum, Hübscher and Strube do not consider the aplasia of the lateral femoral condyle to be real, but believe that it is due to increased external rotation of the femur.

The author tried to form an estimate of the rotation positions in the present series. Rotation was external in all cases. There were 7 cases with pronounced rotation. All had marked changes in the shape of the entire knee joint with permanent dislocation of the patella. In other words, in pronounced cases of patellar malposition there is also marked rotation between the tibia and femur.

It is possible, therefore, that less marked rotation may be found in the milder cases, but the X-rays at hand do not afford any definite evidence in this respect.

Genu Valgum.

As early as the middle of the past century, Malgaigne believed that dislocation of the patella was due to genu valgum combined with a laxity of the capsule. Numerous authors have considered the valgus position to be a cause of patellar dislocation. Thus, Rohlederer states that the physiological valgus position in women predisposes to dislocation. Aldibert, Macey, Ober, and Bunts consider valgus position to be an important aetiological factor, whereas Hoffmann, Isermayer, Bade, Hübscher, Marion & Barcat interpret it as a sequel of the dislocation.

Friedland found the physiological valgus position in newborn infants to be $5^{\circ}.3$, increasing in men to $7^{\circ}.3$ and in women to $8^{\circ}.0$.

The present author examined 100 subjects without diseases of the knees (50 males and 50 females). This normal series included 10 children under 10 years of age. The average angulation in the males was $4^{\circ}.20$ – $4^{\circ}.25$ and in the females $6^{\circ}.55$ to $7^{\circ}.15$.

Comparison between the normal series and the patients showed that while the normal series is grouped around an average value and shows conformity between the two angulations in the same individual, the patients show numerous, more or less marked valgus positions. It is of interest to ascertain whether there is a difference between the valgus position of the two limbs in the normal series and in the patients. While the two angulations in the same person differed by more than 5° in only about 10 % of the normal series, 20 % to 45 % of the patients showed marked differences. In unilateral dislocations, this is particularly apparent, the valgus position being on the whole more marked on the side of the dislocation.

On the basis of these findings it may be stated that a pathological valgus position often co-exists with dislocation or permanent malposition of the patella.

Rotation and valgus positions must be considered the cause of radiologically demonstrable incongruence between the tibia and femur. Considered as one, these three factors make up the third dysplastic type in patellar dislocation, i.e. the tibio-femoral type.

This type was encountered in 41 patients. Figs. 11 and 12 show moderate degrees of these changes. In both instances the femoral condyles are a little medially displaced in relation to the tibia. In 39 of these cases the dislocations were congenital.

Multiple Articular Dysplasias.

The series included two patients with pronounced dysplastic changes of nearly all joints of the limbs.

CASE REPORTS

Rec. 1395/29. A male, born April 19, 1909.

History: The patient had been awarded a disablement pension owing to achondroplasia, as his disease was so severe that he was considered completely unfit for treatment or training. Since the age of 2 it had been noticed that both patellae were on the outside of the knees. There had been no acute dislocations or episodes of "locking". From early childhood the patient has suffered from pain in both knees and increasing difficulty in walking. In addition, he has bilateral congenital dislocation of the hips. During the past 3 or 4 years the patient has had constant pain in both knees, both during weight-bearing and resting. He also complains of marked restriction of motion which has also become accentuated during the past few years. Pronounced difficulty is found in starting and pain when climbing stairs. Never had swelling of the knees. Complains of a marked feeling of insecurity and always wears a "testudo" bandage around his knees.

Family history: Negative.

Objective examination:

Left knee: Contours greatly altered, characterized by the totally dislocated patella which is situated on the outside of the knee, leaving an empty space on the anterior aspect. On the medial aspect there is a marked prominence of the medial femoral condyle. Valgus position is 40°. The lower leg is 30° externally rotated in relation to the thigh. Furthermore, there is a 10° flexion contracture in the knee. Pronounced varus curvature of the upper part of the lower leg. Femur straight. No serous or purulent effusion. Circumference 34 cm. No tenderness, moderate swelling of the capsule. Movements are 170/90 with loud cracking and grating. Contraction of the quadriceps only moves the patella a little and pulls it further to the lateral aspect. The ligament, which is also displaced, is very short and strong. The patella is on the outside of the lateral femoral condyle and is irreducible. Upon each flexion it moves further laterally. No tenderness. There is very little mobility of the patella.

Right knee: On this side too the outlines are characterized by the totally dislo-



Fig. 13 a.

cated patella. Medially, the medial femoral condyle projects. 35° valgus position exists in the knee. The lower leg is in about 30° external rotation, and there is a flexion contracture of 10° in the knee. Circumference of knee is 34 cm. Movements are 170/90 with loud cracking and grating. Just as on the left, the patella is laterally dislocated. There is a pronounced grating of the patella, and upon each flexion it moves further to the lateral aspect. The lateral mobility is restricted. Contraction of the quadriceps moves the patella to the lateral aspect. The ligament, which is short, is also laterally displaced.

The gait is very unstable, marked by the excessive valgus position of both knees, which knock against each other at every step, and by the congenital dislocation of the hips. In the erect position there is a distinct bayonet position of both knees.

Indoors the patient can manage without a stick, but he always uses one stick out of doors.

X-rays: Enormous articular incongruence with marked varus curvature of the up-



Fig. 13 b.

per part of the lower leg and pronounced valgus position of both knees. Marked prominences of the medial condyles, and both patellae rest on the lateral aspects of the knees. The joint spaces of both knees are greatly narrowed. Halisteresis of the bones and moderate osteophytes along all edges. The tangential views show total lateral dislocation of the patella. Nearthroses on the outside of both knees with pronounced marginal sclerosis. Severe aplasia of both lateral femoral condyles.

Rec. 3422/36. Female, born May 2, 1936.

History: From birth the patient had had deformity of both knees in the form of permanent dislocation of the left patella to the lateral aspect of the knee as well as dislocation of the right patella upon flexion of the knee. Moreover, she had been treated for pronounced valgus position of both knees by night splints, flatfoot boots, and redressing plaster cast.

When seen on May 27, 1947, the patient's left hip was in 150° flexion contracture

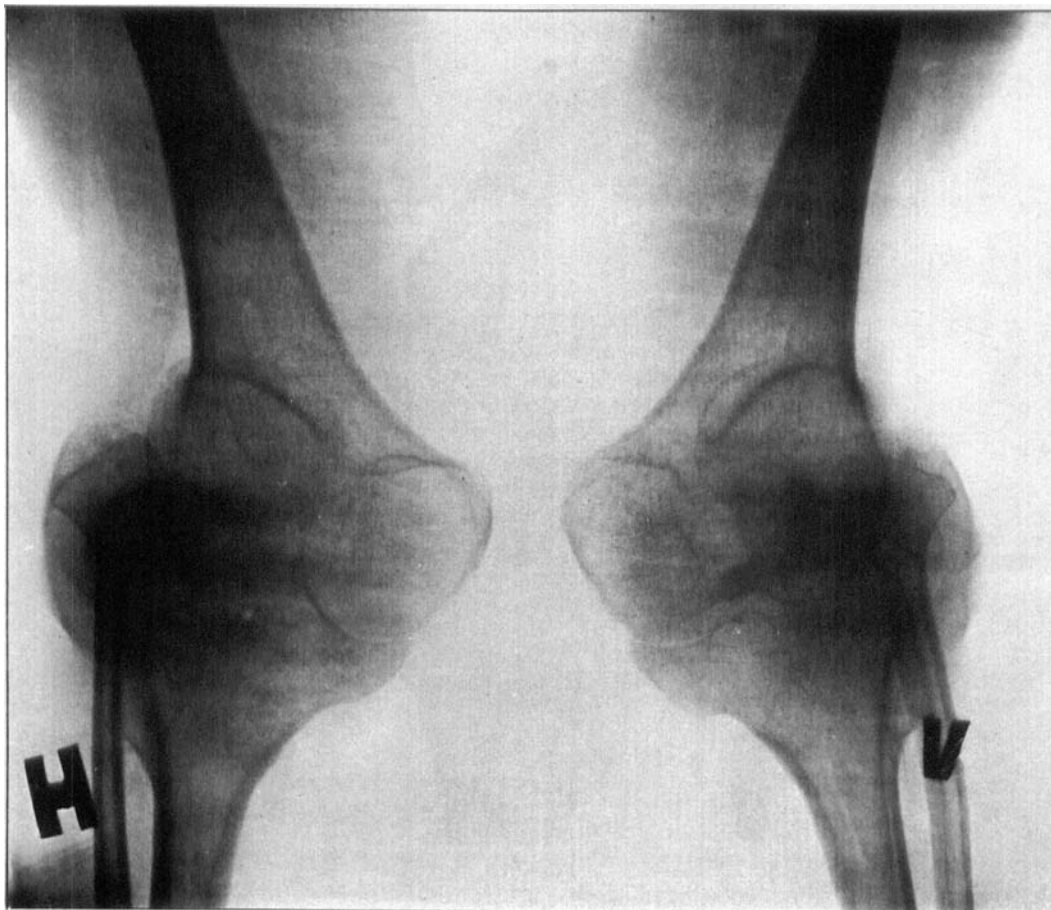


Fig. 13 c.

Fig. 13 a, b and c.

Pronounced dysplasia of the knee joint in an achondroplastic patient with total dislocation of the patella.

and 20° adduction. It could be abducted 25° from the mean position, however, but it could not be extended to 180°. Rotation free. The left knee was in 40° flexion contracture and could not be extended from this position. At the same time, there was a 20° valgus position of the knee. The left foot was in 100° equinus. 2½ cm shortening of the left lower limb. Free mobility of the right foot, knee, and hip joint. The left patella was on the outside of the knee. The femoral condyles were normal to palpation. In 1949 the patient had subastragalar arthrodesis on the right because of the pronounced pes plano-valgus. At the same time, traction was applied to the left lower limb to straighten it out, and redressement of the contracture of the left knee was performed. She was after-treated with a walking cast for 2 months.

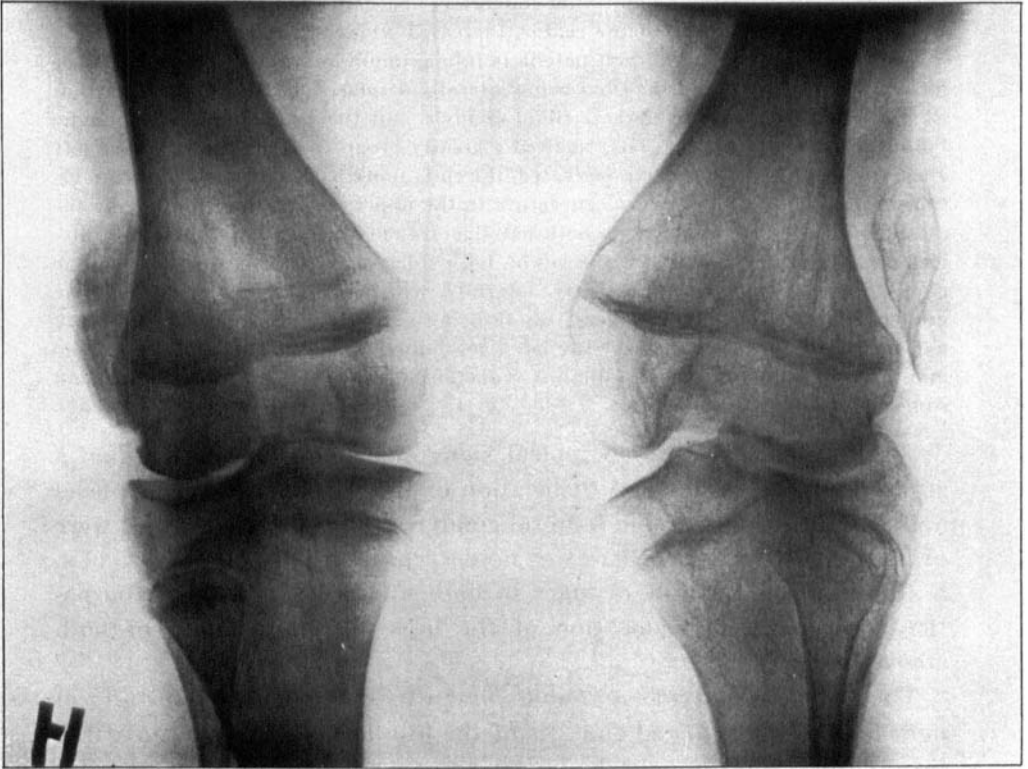


Fig. 14.

Pronounced dysplasia of the knee joint and total dislocation of the patella in a patient with multiple changes of all joints.

Obj. signs: R. knee in 20° valgus. No effusion, capsular swelling, or tenderness. The right knee can move 170/60° with loud cracking and grating. The patella is standing on edge, its lateral margin directed backward and the medial one forward, riding on the lateral femoral condyle. Upon each flexion, the patella moves to the lateral aspect of the condyle and slides back into its subluxation during extension. It is definitely more fixed than normal, small, and high-seated.

Extension strength in the knee is satisfactory.

Left knee is in 15° valgus position and 20° flexion. Contours of the knee are obliterated and characterized by the great deformity. No effusion or swelling of the capsule. Movements 155/50° with loud cracking and grating. Left patella is totally laterally dislocated, lying on the outside of the lateral condyle from which position it cannot be budged. The ligament is lax and also laterally displaced. There is pronounced atrophy of the quadriceps on both sides.

Elbow joints: Flexion-extension movement is free with some grating on the right, pronation free, supination restricted on both sides. The patient's height is normal for her age.

X-rays of elbow joints: Capitulum humeri is absent on both sides. Subluxation and deformity of the head of the radius. Increased width of the epiphyses.

X-rays of knees: (Fig. 14). Left patella is in maximum lateral dislocation. Distinct incongruence of the joint, the tibia being laterally displaced, so that the articulation is essentially between the lateral tibial condyle and the lateral femoral condyle. Follow-up X-rays 3½ years later showed a greatly progressing deformity of the left knee, the valgus position being increased, the tibia more backward displaced in relation to the femur, and the varus curvature in the upper part of the tibia having increased. In the tangential views, both patellae are small, flat, totally laterally dislocated with unmistakable nearthroses on both sides. No trace exists of the patellar ridge. Femoral condyles are greatly deformed with only a trace of the patellar groove. Right patella is "in layers", there being a frontal fissure between its two parts. Incipient osteoarthritis of the left knee joint. Epiphyses are wider than normal. X-rays of the hips showed distinct reduction in the height of the epiphyses and some increase in their width.

The former case showed typical signs of achondroplasia. He had a severe bilateral permanent dislocation of the patella with pronounced deformity of the tibial and femoral condyles. The epiphyseal lines were of increased width, but there was no decrease in their height. Fig. 14 a, b and c shows multiple changes in both knees. Furthermore, the patient had bilateral dislocation of the hips and contracture of both elbow joints.

The latter patient was a young woman with congenital deformity of both knees and acquired changes of the hip and elbow joints. At first, this patient was thought to be an achondroplastic dwarf, but after puberty she grew beyond dwarf height, and the proportions between her limbs and trunk are not characteristic of this condition.

X-rays showed changes of the knees, hips, and elbows (Figs. 14 a, b, c, d, and e), i.e. diminution of the epiphyses, an increase in their width, and total dislocation of both patellas with frontal bipartition of the right one.

According to these changes, the patient must be classified as a transitional variety to achondroplasia which has manifested itself solely by multiple dysplastic changes.

On the basis of these findings it may be established that dislocation of the patella is in the majority of cases due to congenital articular changes, changes which manifest themselves as varying degrees of dysplasia affecting the structures of the knee joint.

These two patients represent the most pronounced form of condro-epiphyseal dysplasias with deformities of several joints and anomalies of growth. It is striking that the changes present in isolated dysplasia of the knee exhibit the same X-ray signs as found in these two patients.

If these anomalies of growth are to be interpreted as being of the same aetiology, it must be investigated whether transitional varieties exist—i.e. cases in which more than one joint is abnormal and whether there is any question of regular hereditary transmission.

In one-third of all the patellar dislocations of the present series, the condition was bilateral. More than half the patients had pronounced dysplastic changes of both knee joints. In these cases the dislocation is interpretable merely as a symptomatic manifestation of congenital changes of the knee joint.

Dominant inheritance was found in 64 cases. These do not include familial cases of congenital dislocation of the hip, varus feet, and other defects of the lower limbs, but these conditions were found in 2 % of all the subjects.

Osteochondritis dissecans was not demonstrated in the severe varieties of dysplasia. In a case of osteochondritis dissecans in association with dwarfism recently published by John White, no mention is made of dysplasia, although it is beautifully illustrated in a number of X-ray films. The osteochondritis has no doubt been caused by incongruence in the joints, not as a primary lesion associated with dwarfism.

SUMMARY

The dysplastic changes of the knee joint in the presence of dislocation of the patella and achondroplasia are described. These changes manifest themselves as alterations in patellar shape, variation in the articulation between the patella and femur and between the tibia and femur. Moreover, variation in the position of the patella (*patella alta*), alterations in the contours of the patellar groove and lateral femoral condyle are present.

These changes exist in more than three-quarters of all patients with dislocation of the patella.

There were gradual transitions from dysplastic changes in one joint by way of bilateral to multiple articular changes as seen in achondroplasia.

RESUME

Les modifications dysplastiques de l'articulation du genou dans les cas de dislocation de la rotule et de l'achondroplasie sont décrites. Ces modifications se manifestent comme des altérations de l'ombre patellaire, d'une variation dans l'articulation entre la rotule et le fémur et entre le tibia et le fémur.

Il y a de plus une variation dans la position de la rotule (patella alta), une altération dans les contours de la concavité patellaire et du condyle fémoral latéral.

Ces modifications existent chez plus de trois quarts des malades souffrant d'une dislocation de la rotule.

Il y avait des transitions graduelles allant de modifications dysplastiques dans une articulation, aux modifications articulaires bilatérales ou multiples, comme on les voit dans l'achondroplasie.

ZUSAMMENFASSUNG

Die dysplastischen Veränderungen des Kniegelenkes bei Vorhandensein von Patellarluxation und Achondroplasie werden beschrieben. Diese Veränderungen äussern sich in Veränderungen der Gestalt der Patella, Variationen in der Artikulation zwischen Patella und Femur und zwischen der Tibia und dem Femur, fernerhin in Variationen in der Stellung der Patella (patella alta), Veränderungen in der Kontur der patellaren Furche und des lateralen Femurkondyles.

Diese Veränderungen sind in mehr als drei Vierteln aller Patienten mit Patellarluxation vorhanden.

Man fand stufenweise Übergänge von dysplastischen Veränderungen in einem Gelenk bis zu bilateralen und multiplen Gelenkveränderungen wie sie bei der Achondroplasie gesehen werden.

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